



ECOLOGICAL DRIVERS AND DIVERSITY OF FRESHWATER MOLLUSCS IN THE LAKES OF THREE SELECTED DISTRICTS OF TAMIL NADU, INDIA

NIPU KUMAR DAS^{1,2,3*}, SHREYA S. NAIR¹, NEELAVAR ANANTHRAM ARAVIND^{1,4*}

¹ SM Sehgal Foundation Centre for Biodiversity and Conservation, Ashoka Trust for Research in Ecology and the Environment (ATREE), Royal Enclave, Srirampura, Jakkur PO, Bangalore 560064, India (e-mail: nipukdkcc@gmail.com); NKD  <https://orcid.org/0000-0002-3436-3104>; NAA  <https://orcid.org/0000-0002-4515-8421>

² Manipal Academy of Higher Education, Madhav Nagar, Manipal, Udupi 576104, India

³ Department of Zoology, Kamrup College, Chamata (Gauhati University), Nalbari, 781306, Assam, India

⁴ Yenepoya Research Centre, Yenepoya (Deemed to be University), University Road, Derlakatte, Mangalore 575018, India

* corresponding author

ABSTRACT: Freshwater molluscs are key components of aquatic ecosystems, contributing to ecosystem functioning. However, their diversity in southern Tamil Nadu remains poorly studied, especially in lentic ecosystems. We surveyed 41 waterbodies across the Tenkasi, Tirunelveli and Thoothukudi districts of Tamil Nadu to document species composition and water quality variables. A total of 24 species belonging to 18 genera and 12 families were recorded, accounting for 11.2% of India's freshwater malacofauna. Gastropods dominated the assemblage (83%) compared to bivalves (17%). *Gabbia travancoria* and *Idiopoma dissimilis* were the most widespread species, whereas *Pettancylus tenuis* and *Corbicula striatella* were restricted to single sites. Sundarapandipuram tank exhibited the highest richness with nine species. Physicochemical analysis revealed variation in conductivity, nutrients, and dissolved oxygen across sites, and CCA indicated that conductivity and nutrient enrichment were the primary drivers of species composition, with dissolved oxygen playing a secondary role. The frequent occurrence of pollution-tolerant and medically important taxa in human-use waterbodies highlights both ecological and public health concerns. This study provides the first regional checklist and highlights the need for long-term monitoring, habitat conservation, and integrated eco-health studies on freshwater molluscs.

KEYWORDS: gastropoda; lentic ecosystems; morphology; taxonomy; Western Ghats

INTRODUCTION

Globally, an estimated 6,979 freshwater mollusc species have been described (MOLLUSCABASE 2025), with an additional 4,000 or more potential undescribed gastropod species projected worldwide (LYDEARD et al. 2004). Within the Indian political boundary, 214 freshwater mollusc species are currently reported (TRIPATHY et al. 2024). Freshwater molluscs in India are represented by the class Gastropoda, with 150 species, and 67 bivalve species are recorded across diverse freshwater habitats, from high-altitude glacial lakes to low-elevation lentic and

lotic habitats. Historically, documentation of freshwater molluscs from different states and ecoregions of India was largely carried out by the Zoological Survey of India (ZSI). More recently, TRIPATHY et al. (2024) reported that Tamil Nadu in southern India harbours 39 species of freshwater molluscs, including 11 endemics. At a finer spatial scale, REKHA et al. (2021) documented six species from the Madurai district of Tamil Nadu, while RANJANI & MAHESWARI (2020) reported nine species from the Koothaippar wetlands of Tiruchirappalli district. In the Lower



Anicut reservoir in Thanjavur district, [SANTHIYA et al. \(2017\)](#) recorded 11 species, whereas [JOHNPAUL et al. \(2010\)](#) documented seven species in and around Chennai. Singanallur Lake in Coimbatore has been reported to host seven species ([CHANDRAN 2004](#)). Studies from Kancheepuram, Vellore and The Nilgiris regions have reported 31 species and subspecies ([SOUNDARARAJAN et al. 2018](#)).

The distribution of freshwater molluscs is determined by water quality, a key ecological factor that shapes the community structure of different taxa and their distribution in freshwater ecosystems, including freshwater molluscs ([SOWA et al. 2019](#)). Physicochemical parameters, such as total dissolved solids (TDS), dissolved oxygen (DO), salinity, electrical conductivity (EC), acidity (pH), nitrate, phosphate, and others, vary across water bodies, thereby creating distinct environmental conditions. These variations play a crucial role in determining species

distribution, abundance, and community composition ([REKHA et al. 2021](#)). Studies on the effects of physicochemical parameters on freshwater molluscs in India, in general, and in Tamil Nadu, in particular, are rather meagre ([BATH et al. 1999](#), [CHUTIA & KARDONG 2021](#), [JADHAV et al. 2023](#), [KOLHE et al. 2025](#), [SANONG et al. 2026](#)). Apart from these handful of localised studies, there are no large-scale studies comparing several wetlands in India, in general, and in Tamil Nadu in particular. Thus, this study is a compilation of fresh materials collected from three large districts in southern Peninsular India, encompassing 41 lakes of varied sizes and compare the community structure with physicochemical parameters. Also, we compare other studies on freshwater molluscs from Tamil Nadu and discuss taxonomic issues in those studies. This compilation will be useful for future studies on freshwater molluscs of the Tamil Nadu region of India.

MATERIAL AND METHODS

STUDY SITES

The study was conducted in the districts of Tenkasi, Tirunelveli, and Thoothukudi, located in the southern part of Tamil Nadu, India ([Fig. 1](#)). These districts encompass diverse geographical and ecological settings characterised by a network of large, perennial freshwater lakes. These lakes are primarily sustained by seasonal monsoon rainfall and, in some cases, by canal-fed irrigation systems.

The lake ecosystems across the study area are subject to varying degrees of anthropogenic disturbance and biological invasion. Many of the water bodies are heavily impacted by invasive aquatic plants, including *Salvinia molesta*, *Pontederia crassipes*, *Pistia stratiotes*, and *Ipomoea carnea*, as well as by invasive fish species such as *Clarias gariepinus* and *Oreochromis niloticus*. In addition, several lakes receive inputs from domestic washing activities, solid waste dumping, sewage discharge, and open defecation, further degrading water quality and habitat conditions.

Despite these pressures, many lakes support substantial native and naturalised aquatic vegetation, including lotus, water lily, *Hydrilla*, and other macrophytes, which provide important habitat and breeding grounds for a variety of aquatic fauna. The lakes are also widely used for irrigation, linking them directly to local agricultural systems and livelihoods. This combination of ecological heterogeneity, invasive species pressure, and human use makes the lakes in these districts an ideal setting for assessing freshwater biodiversity, invasion dynamics, and ecosystem health.

STUDY DESIGN

Sampling was conducted over eight days in February 2022 across 41 large lakes (lentic ecosystems) in Tenkasi, Tirunelveli and Thoothukudi districts of Tamil Nadu, South India ([Figs 1–2](#)). In each water body, three accessible sites were randomly selected, and specimens were collected using a scooping net. Although accessibility varied among water bodies, sampling efforts were kept approximately consistent by surveying an area of approximately 10 × 5 m at each selected site across the lakes, and three such sites per lake were sampled.

DATA COLLECTION

Freshwater molluscs were separated from the heterogeneous samples (decomposed vegetation, aquatic plants, mud, sand, etc.) and preserved in clean vials containing absolute ethanol for further analysis. In the laboratory, specimens were rinsed with tap water to remove mud and debris and gently brushed to eliminate algal deposits. Larger specimens were examined with the naked eye or a hand lens to assess diagnostic morphological features, while smaller specimens were examined under a stereomicroscope (Leica Stemi 508). Identification from family to species was carried out using standard references ([PRESTON 1915](#), [SUBBA RAO 1989](#), [RAMAKRISHNA 2007](#)). Taxonomic status was verified using [MOLLUSCABASE \(2025\)](#), and conservation assessments were checked against the IUCN Red List (<https://www.iucnredlist.org/>). Representative specimens were cleaned with oxalic acid, treated with

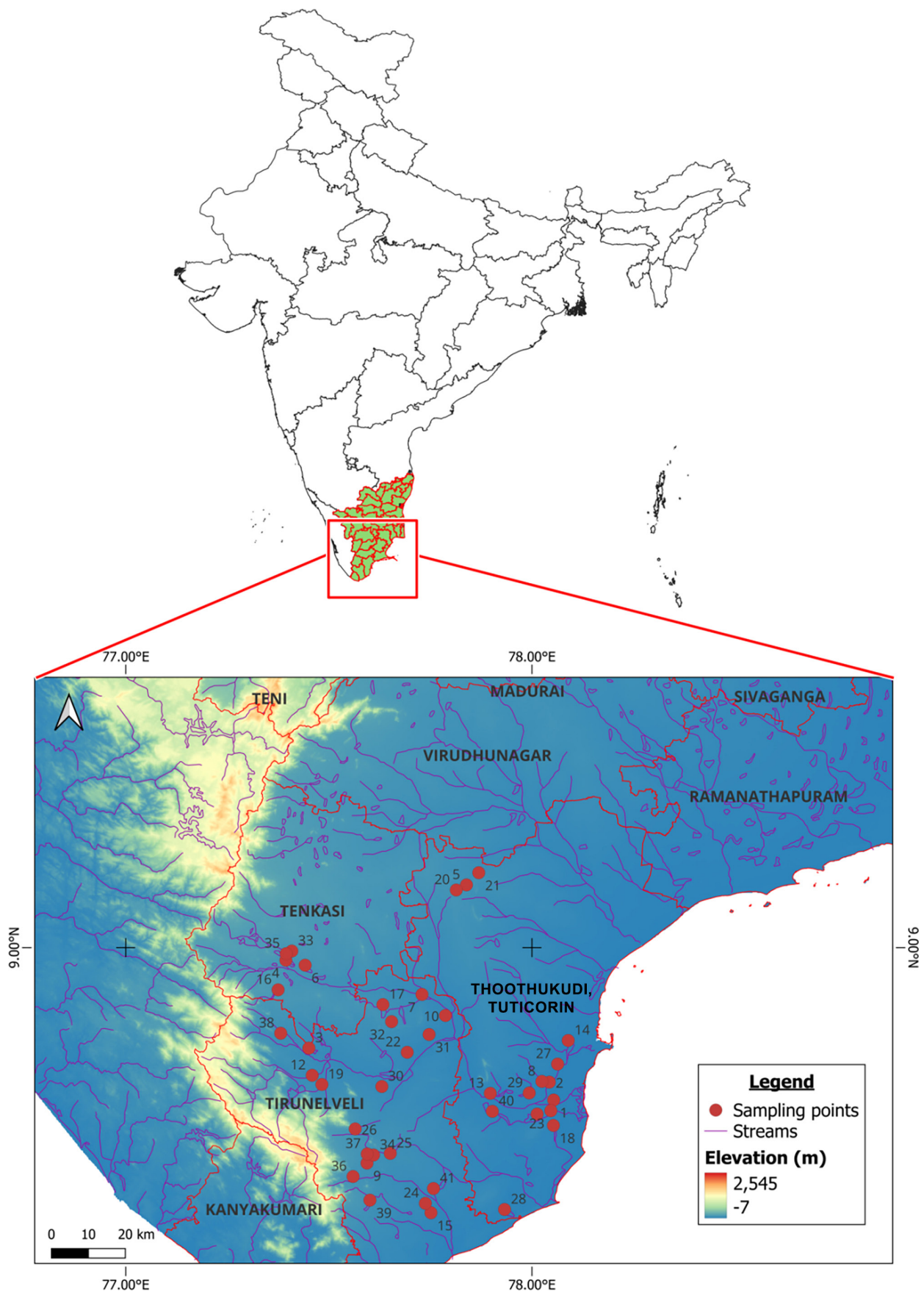


Fig. 1. Map showing the sampling locations in Tenkasi, Tirunelveli and Thoothukudi districts of Tamil Nadu. Numbers shown at each sampling point correspond to the serial numbers of the collection sites listed in Table 1



Fig. 2. Habitats of the collected freshwater mollusc species

glycerol to enhance surface gloss, and photographed using a Nikon D850 DSLR camera with Nikkor 105 mm micro-nikkor lens for larger specimens and a Leica Stemi 508 stereomicroscope for smaller specimens.

PHYSICOCHEMICAL PARAMETERS

Water samples were collected from three locations from each site to measure physicochemical variables, including pH, water temperature, electrical conductivity (EC), dissolved oxygen (DO), and total dissolved solids (TDS), using a HACH HQ40d multi-meter (USA). On the same day of collection, Nitrate (NO_3^-) and phosphate (PO_4^{3-}) concentrations were quantified with a HACH DR1900 Portable Spectrophotometer (Loveland, USA). The values obtained from three sampling points were averaged to obtain a single representative value for each site.

DATA ANALYSIS

The species-site matrix with abundance data and parameter-site matrix were used to run canonical cor-

respondence analysis (CCA), which was performed using the 'vegan' package, and the significance of the CCA model was assessed using the 'anova' function with 1000 permutations. Analysis was performed using R (R CORE TEAM 2021).

SPECIES ACRONYMS

CF – *Corbicula fluminea*, CS – *Corbicula striatella*, DP – *Digoniostoma pulchella*, FB – *Filopaludina bengalensis*, GC – *Gabbia costigera*, GCo – *Gyraulus convexiusculus*, GO – *Gabbia orcula*, GP – *Gyraulus parvus*, GS1 – *Gyraulus* sp. 1 (unidentified), GS2 – *Gyraulus* sp. 2 (unidentified), GT – *Gabbia travancorica*, HC – *Hindupisidium clarkeanum*, ID – *Idiopoma dissimilis*, IE – *Indoplanorbis exustus*, LM – *Lamellidens marginalis*, MS – *Meiniplotia scabra*, MT – *Melanoides tuberculata*, PA – *Physella acuta*, PT – *Paludomus tanschaurica*, PTT – *Pettancylus tenuis*, PV – *Pila virens*, RL – *Racesina luteola*, RR – *Radix rufescens*, VC – *Villorita cyprenoides*

RESULTS

SPECIES DIVERSITY

A total of 2,492 freshwater mollusc individuals belonging to 24 species, 18 genera and 12 families were recorded from 41 sites across the lentic ecosystems of Tenkasi, Tirunelveli and Thoothkudi districts (Figs 3–24). Site-wise species occurrence is provided in Table 1. Gastropods were the dominant group, comprising 20 species (83%), while bivalves accounted for only four species (17%). This accounts for approximately 11.21% (24/214) of India's freshwater molluscan diversity (TRIPATHY et al. 2024).

Two *Gyraulus* species could not be identified to the species level due to taxonomic confusion, and we suspect that two *Gyraulus* might be new to science and need to be studied using integrative taxonomic approaches in future studies.

The most widely distributed species was *Gabbia travancorica* (Bithyniidae), recorded at 32 localities, followed by *Idiopoma dissimilis* (Viviparidae) from 31 localities. In contrast, several species were highly restricted, being recorded from a single locality each. These included *Pettancylus tenuis* (Planorbidae), *Corbicula striatella* (Cyrenidae), *Corbicula fluminea*.

(Cyrenidae), *Villorita cyprenoides* (Cyrenidae), and two unidentified *Gyraulus* (Planorbidae) (Table 1).

Among all surveyed sites, the Sundarapandipuram tank exhibited the highest species richness with nine species: *Filopaludina bengalensis*, *Idiopoma dissimilis*, *Gabbia travancorica*, *Gabbia costigera*, *Indoplanorbis exustus*, *Mieniplotia scabra*, *Melanoides tuberculata*, *Racesina luteola*, and *Corbicula straitella* (Table 1). Only one invasive alien species (*Physella acuta*) was recorded during the study. The following section provides the detailed taxonomic information for all the species recorded in the present study. We also provide the distribution in the study region, along with the distribution in India and other regions, based on SUBBA RAO (1989) and RAMAKRISHNA (2007).

SPECIES ACCOUNTS

Phylum Mollusca

Class Gastropoda Cuvier, 1795

Order Architaenioglossa Haller, 1892

Family Viviparidae J. E. Gray, 1847

Genus *Filopaludina* T. Habe, 1964

Filopaludina bengalensis (Lamarck, 1822)

Fig. 3

Paludina bengalensis Lamarck, 1822: 174.

Paludina bengalensis var. *balteata* Benson, 1836: 745.

Paludina zonata Reeve, 1863: pl. 6, fig. 34.

Vivipara bengalensis var. *mandiensis* Kobelt, 1909: 414, pl. 77, figs 8–9.

Vivipara bengalensis – ANNANDALE 1921: 267; PRESTON 1915: 83–84.

Bellamyia bengalensis – SUBBA RAO 1989: 45; RAMAKRISHNA 2007: 78–79.

Distribution. Tamil Nadu: Sundarapandipuram tank, Brencherri lake, Vaghaikulam, Kadambakulam, Nambiiyar dam, Arunthapetti lake, Pranjeri. India: widely distributed throughout India; Bihar; Himachal Pradesh; Jammu & Kashmir; Northwestern Himalaya; Uttarakhand; West Bengal. Others: Bhutan, Bangladesh, Myanmar, Nepal.

Remarks. Occurs in lentic ecosystems such as ponds, tanks, wetlands, fields, etc. This species is extensively sold and consumed for food purposes by several communities (BAGHELE et al. 2022, JADHAV et al. 2023, ROUT et al. 2023).

Genus *Idiopoma* Pilsbry, 1901

Idiopoma dissimilis (O. F. Müller, 1774)

Fig. 4

Nerita dissimilis Müller, 1774: 184.

Paludina obtusa Troschel, 1837: 173.

Paludina remossii Philippi, 1847: 134.

Paludina ceylanica Dohrn, 1857: 123.

Paludina variata Frauenfeld, 1862: 1163.

Paludina viridis Reeve, 1862: pl. 4, fig. 20.

Paludina fulva Reeve, 1863: pl. 10, fig. 64.

Paludina praemorsa Reeve, 1863: pl. 6.

Paludina heliciformis Frauenfeld, 1865: 532, pl. 22.

Paludina dissimilis var. *decussatula* Blanford, 1869: 445.

Paludina siamensis var. *burmanica* Nevill, 1885: 26.

Vivipara henzadensis Pilsbry, 1901: 188, pl. 5, fig. 1.

Vivipara variata pseudohelicina Kobelt, 1908: 293, pl. 59, fig. 5–8.

Vivipara variata peguensis Kobelt, 1908: 378, pl. 58, figs 7–8.

Vivipara dissimilis – PRESTON 1915: 87–88.

Bellamyia dissimilis – RAMAKRISHNA 2007: 90–91.

Distribution. Tamil Nadu: Sundarapandipuram tank, Brencherri lake, Vaghaikulam, Kadambakulam, Nambiiyar dam, Pranjeri, Kasaba lake, Aarumugamangalam, Koorampallam Kulam, Perunkulam, Adaichani Periyakulam, Gongaikondan lake, Mudukkumendanpatti, Rajavallipuram lake, Dohnavur lake – Vadukachimathil, Vijayanarayanam, Manur lake, Reteikulam lake, Vellur kulam, Nainar kulam lake, Thirukurungudi, Peikulam lake, Soorangudi, Nanguneri kulam, Valliyur, Kottaikarunkulam, Chettikulam, Periya Tharuvai lake, Melapudhukudi sunai, Aaladiyur Pond, Kaladai Kuruchi, India: Northern India, Peninsular India, Pondicherry, West Bengal. Others: Nepal.

Remarks. This species occurs in both permanent and temporary waterbodies and man-made wetlands with high nutrient levels and aquatic vegetation. This species is edible and consumed by several communities across India, and Nepal (JADHAV et al. 2023).

Family Ampullariidae J. E. Gray, 1824

Genus *Pila* Röding, 1798

Pila virens (Lamarck, 1822)

Fig. 5

Ampullaria virens Lamarck, 1822: 179.

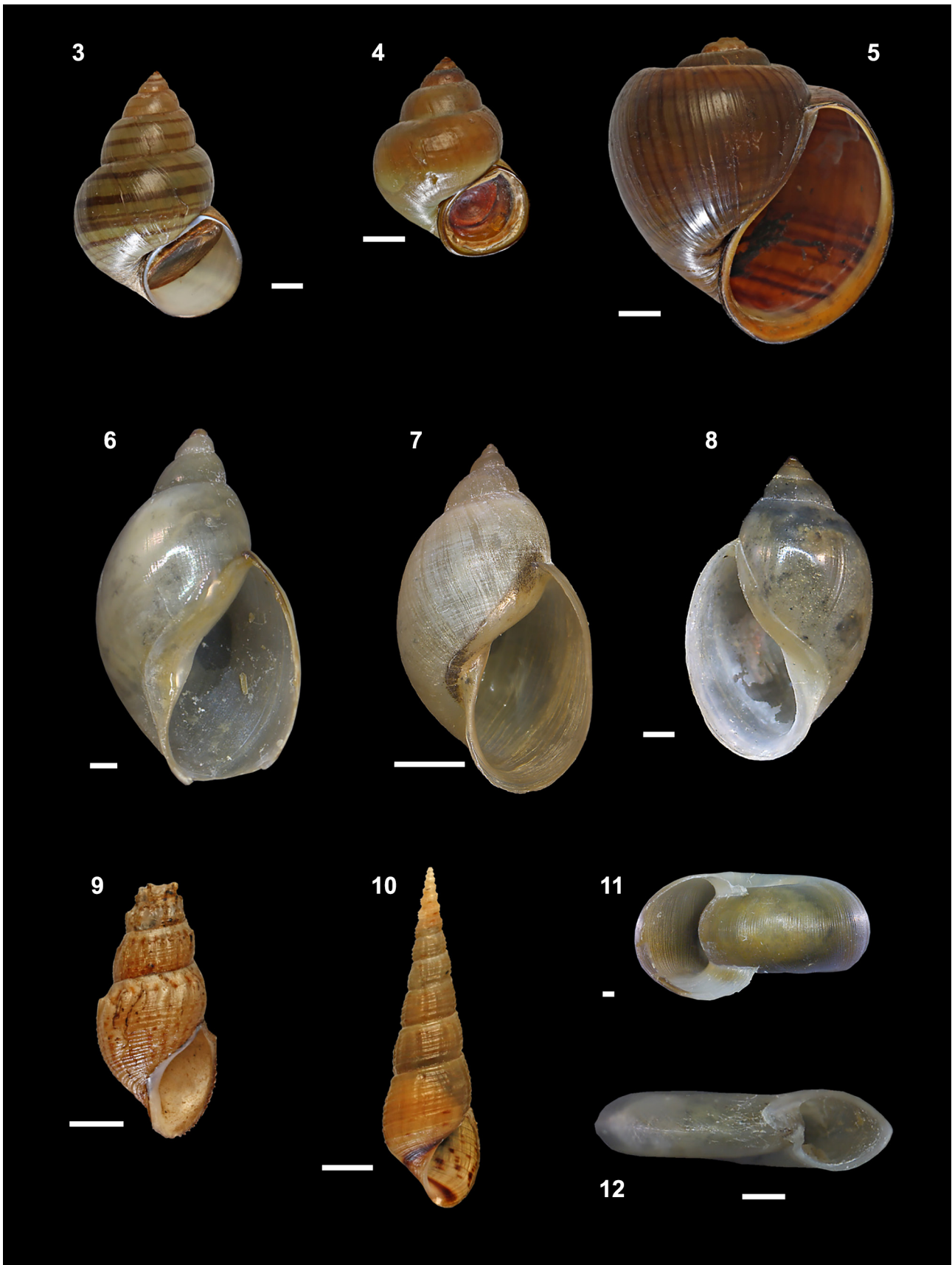
Ampullaria pallens Philippi, 1849: 17.

Ampullaria malabarica Philippi, 1852: 29, pl. 7, fig. 8.

Pila virens – SUBBA RAO 1989: 60–61, fig. 87; PRASHAD 1925: 75, pl. 14, fig. 13; RAMAKRISHNA 2007: 105–106.

Pila layardi var. *virens* – PRESTON 1915: 99.

Distribution. Tamil Nadu: Aarumugamangalam, Adaichani Periyakulam, Alampatti, Brencherri lake, Gongaikondan lake, Kaladai Kuruchi, Kasaba lake, Kottaikarunkulam, Maleermalpuram, Melapudhukudi sunai, Nainar kulam lake, Nambiiyar dam, Padmaneri, Perunkulam, Pranjeri, Rajavallipuram lake, Soorangudi, Thirukurungudi,



Figs 3–12. Freshwater molluscs reported from Tamil Nadu, India in this study: 3 – *Filopaludina bengalensis*; 4 – *Idiopoma dissimilis*; 5 – *Pila virens*; 6 – *Radix rufescens*; 7 – *Racesina luteola*; 8 – *Physella acuta*; 9 – *Mieniplotia scabra*; 10 – *Melanoides tuberculata*; 11 – *Indoplanorbis exustus*; 12 – *Gyraulus convexiusculus*. Scale bars: 5 mm (3–5, 9–10), 1 mm (6–8, 11–12).

Vaghaikulam, Vellur kulam, Vijayanarayanam. India: Common species in Peninsular India below the River Godavari (SIL et al. 2023).

Remarks. This species occurs in both permanent and temporary waterbodies and man-made wetlands with high nutrient levels and aquatic vegetation. Consumed as food in several communities for its rich protein content (BAGHELE et al. 2022).

Family Lymnaeidae Rafinesque, 1815

Genus Radix Montfort, 1810

Radix rufescens (J. E. Gray, 1822)

Fig. 6

Limnea rufescens Gray, 1822: 44, pl. 178, fig. 1.

Lymnaea chlamys Benson, 1836: 744.

Limnaeus amygdalum Troschel, 1837: 168.

Limnaeus patulus Troschel, 1837: 167.

Limnaeus sulcatulus Troschel, 1837: 167.

Limnaeus amygdalum var. *cycacea* Troschel, 1837: 170.

Limnaea rufescens var. *sylhetica* Hanley, 1870: 30.

Limnaea hians Sowerby II, 1872: pl. 9, fig. 57a.

Limnaea rufescens var. *attenuata* Tapparone Canefri, 1889: 311.

Limnaea mimetica Annandale, 1918: 109, pl. 10, figs 9, 9a; pl. 11, fig. 4.

Limnaea acuminata f. *malleata* Annandale et Rao, 1925: 182.

Limnaea horae Annandale et Rao, 1925: 176, fig. 2(11).

Limnaea horae f. *laticornis* Annandale et Rao, 1925: 176, fig. 2(8).

Limnaea acuminata var. *brevissima* Annandale et Rao, 1925: 182, fig. 2(1).

Limnaea biacuminata Annandale et Rao, 1925: 182, fig. 3(2).

Limnaea acuminata f. *pseudohorae* Rao, 1929: 295, fig. 8.

Limnaea decussatula Rao, 1929: 295, fig. 9.

Lymnaea rufescens var. *annandalei* Lindholm, 1929: 312.

Lymnaea (Lymnaea) acuminata var. *rufescens* – PRESTON 1915: 106–109.

Lymnaea (Pseudosuccinea) form *rufescens* – RAMAKRISHNA 2007: 205–206.

Distribution. Tamil Nadu: Moolachi. India: Throughout India, except in the high altitude cold and western Indian hot deserts. Others: Bangladesh, Indonesia, Iran, Myanmar, Nepal, Oman, Pakistan, Germany.

Remarks. Serves as an intermediate host for several parasites, including *Fasciola* spp., and *Schistosoma* spp. (SUBBA RAO 1989, SINGH et al. 2021).

Genus Racesina Vinarski et Bolotov, 2018

Racesina luteola (Lamarck, 1822)

Fig. 7

Lymnaea luteola Lamarck, 1822: 160.

Lymnaea virginiana – LAMARCK 1822: 160.

Cerasina luteola – LAMARCK 1822: 160.

Limnea ovalis Gray, 1822: 7, [178], fig. 4.

Limnea succinea Deshayes, 1833: 418, pl. 2, figs 13–14.

Limnaeus prunum Troschel, 1837: 169.

Limnaeus cerasum Troschel, 1837: 170.

Limnaeus nucleus Troschel, 1837: 171.

Limnaeus impurus Troschel, 1837: 172.

Limnaea pinguis Dohrn, 1858: 134.

Limnaea tigrina Dohrn, 1858: 134.

Limnaeus oliva Küster, 1862: 31, pl. 5, figs 25, 26.

Limnaea pinguis var. *strigata* Sowerby II, 1872: pl. 9, fig. 18b.

Limnaea luteola var. *australis* Annandale et Rao, 1925: 184, fig. 4(3).

Lymnaea (Cerasina) luteola var. *raoi* Lindholm, 1929: 311.

Lymnaea luteola (form *ovalis*) – SUBBA RAO 1989: 129.

Lymnaea (Pseudosuccinea) luteola f. *booni* – RAY 1952.

Lymnaea (Pseudosuccinea) luteola – RAMAKRISHNA 2007: 208–209.

Distribution. Tamil Nadu: Aaladiyur Pond, Alampatti, Arunthapetti lake, Brencherri lake, Dohnavur lake – Vadukachimathil, Gongaikondan lake, Kasaba lake, Kottaikarunkulam, Muppanpatti, Peikulam lake, Soorangudi, Sundarapandipuram tank, Vellur kulam, Vijayanarayanam. India: Throughout India, Andaman Is. Others: Myanmar, Nepal, Sri Lanka.

Remarks. Not a habitat-specific species, often occurs in both permanent and temporary waterbodies and man-made wetlands with high nutrient levels and aquatic vegetation. It is considered a pest of paddy and *Azolla*. Act as intermediate host for several trematodes including *Schistosoma* spp., *Fasciola* spp., *Clinostomum giganticum*, *Orientobilharzia datta*, *Echinoparyphium bugulai* (SINGH et al. 2021).

Family Physidae Fitzinger, 1833

Genus Physella Haldeman, 1842

Physella acuta (Draparnaud, 1805)

Fig. 8

Physa acuta Draparnaud, 1805: 55.

Lymnaea heterostropha Say, 1817: pl. 1, fig. 6.

Physa castanea Lamarck, 1822: 156.

Physa subopaca Lamarck, 1822: 157.

Lymnaea heterostropha – SAY 1825: 125.

Physa say Blainville, 1826: 145.

Physa borbonica Férussac, 1827: 407.

Physa striata Menke, 1828: 79.

Physa havanensis Clench, 1936: 339.

Physa nana Potiez et Michaud, 1838: 225.

Physa cubensis Pfeiffer, 1839: 354.

Physa mexicana Philippi, 1841: 5, pl. 1, figs 3–4.



- Physa solida* Philippi, 1841: 6, pl. 1, figs 5–6.
Physa fontana Haldeman, 1841.
Physa inflata Lea, 1841: 32.
Physa plicata De Kay, 1843: 78, pl. 5, fig. 85.
Physa philippii Küster, 1844: 19, pl. 3, figs 3–4.
Physa charpentieri Küster, 1850: 23, pl. 4, figs 4–6.
Physa virgata Gould, 1855: 128.
Physa grosvenorii Lea, 1864a: 114.
Physa niagarensis Lea, 1864a: 114.
Physa halei Lea, 1864a: 114.
Physa forsheyi Lea, 1864a: 114.
Physa tenuissima Lea, 1864a: 114.
Physa anatina Lea, 1864a: 115.
Physa parva Lea, 1864a: 115.
Physa striata Lea, 1864a: 115.
Physa sparsestriata Tryon, 1865: 224, pl. 23, fig. 10.
Physa distinguenda Tryon, 1865: 225, pl. 23, fig. 6.
Physa politissima Tryon, 1865: 226, pl. 23, fig. 13.
Physa lata Tryon, 1865: 227, pl. 23, fig. 7.
Physa primeana Tryon, 1865: 227, pl. 23, fig. 12.
Physa heterostropha nigricans var. *callosa* Rigacci, 1866: 31.
Physa heterostropha var. *gibbosa* Rigacci, 1866: 31.
Physa heterostropha var. *minor* Rigacci, 1866: 31.
Physa dorbigniana Lea, 1866: 166.
Limnaea compacta Pease, 1870: 6, pl. 3, fig. 4.
Limnaea ambigua Pease, 1870: 6, pl. 3, fig. 5.
Physa tenerifae var. *palmaensis* Mousson, 1872: 138, 156.
Physa tenerifae var. *gomerana* Mousson, 1872: 138–139, 156.
Physa tenerifae var. *grancanariae* Mousson, 1872: 139, 156.
Physopsis lhotellerii Bourguignat, 1879: 17.
Physopsis letourneuxi Bourguignat, 1879: 16.
Physa billingsii Heron, 1880: 62, pl. 2, fig. 5.
Physa cupreonitens Cockerell, 1889: 63.
Physa heterostropha var. *penicillata* Hemphill, 1890: 19.
Physa heterostropha var. *alba* Crandall, 1901: 29.
Physa walkeri Crandall, 1901: 57–58, pl. 2, fig. 5.
Physa rhomboidea Crandall, 1901: 44–45, pl. 2, figs 6–7.
Physa ancillaria var. *crassa* Walker, 1901: 98–99.
Physa crandalli Baker, 1906: 8.
Physa balteata Preston, 1907: 497, fig. 19.
Physa (Physa) syriaca Germain, 1911: 64.
Physa acuta var. *thermalis* Boettger, 1913: 161.
Physa oneida Baker, 1919a: 11.
Physa subopaca var. *minor* Pallary, 1920: 139.
Physa humerosa interioris Ferriss, 1920: 7.
Physa marci Baker, 1924: 15, fig. 5.
Physa michiganensi Clench, 1926: 4, pl. 1, fig. 4.
Physa humerosa interioris Pilsbry, 1932: 139.
Physa californica Coen, 1945: 13.
Physella winnipegensis Pip, 2004: 43, fig. 1.
Physa acuta – RAMAKRISHNA 2007: 227–228.
- Distribution.** Tamil Nadu: Adjacent to Sundarapandipuram tank, Moolachi. India: Jammu & Kashmir, Himachal Pradesh, Kerala, Assam, Maharashtra, Kerala, West Bengal, Manipur, Karnataka, Madhya Pradesh, Punjab. Others (Worldwide): China, South Korea, Vietnam, Thailand, Laos, Türkiye, Russia, Transcaucasia, Central Asia. Europe: Belarus, Lithuania, Czech Republic, United Kingdom, France. Africa: Morocco. Americas: United States of America (South Carolina), Cuba, Brazil, Chile.
- Remarks.** A globally invasive species native to North America; serves as host for several parasitic nematodes, including *Chaetogaster limnaei* (COLLADO & AGUAYO 2024).
- Family Thiaridae Gill, 1871**
Genus Mieniplotia Low et Tan, 2014
***Mieniplotia scabra* (O. F. Müller, 1774)**
Fig. 9
- Buccinum scabrum* Müller, 1774: 136.
Melania (Plotia) scabra Müller, 1774: 136.
Melanoides scabra – MÜLLER 1774: 136.
Plotia scabra – MÜLLER 1774: 136.
Pseudoplotia scabra – MÜLLER 1774: 136.
Thiara scabra – MÜLLER 1774: 136.
Helix aspera Gmelin, 1791: 3656.
Melania spinulosa Lamarck, 1822: 166.
Melania spinescens Lesson, 1831: 353.
Melania doreyana Lesson, 1831: 358.
Plotia elegans Benson, 1836: 782.
Melania elegans Benson, 1837: 782.
Melania (Plotia) scabra var. *elegans* Benson, 1837: 782.
Melania granum von dem Busch in Philippi, 1842: 4, pl. 1, fig. 3.
Melania pugilis Hinds, 1844: 10.
Melania scabrella Philippi, 1847: vol. 2, 172, pl. 4, fig. 13.
Melania spinulosa var. *nodosecostata* Mousson, 1849: 76, pl. 6, fig. 11.
Melania granum var. *buccinoidea* Mousson, 1849: 77, pl. 12, fig. 3, 4.
Melania acanthica Lea et Lea, 1851: 194.
Melania denticulata Lea et Lea, 1851: 195.
Melania cochlea Lea et Lea, 1851: 196.
Melania pagoda Lea et Lea, 1851: 197.
Melania datura Dohrn, 1858: 135.
Melania elegans Reeve, 1860.
Melania rugosa Brot, 1860: 257.
Melania snellemanni Schepman, 1880: 15, pl. 1, fig. 5, pl. 3, fig. 9.
Melania bockii Brot, 1881: 157, pl. 6, fig. 3.
Melania savinierei Morlet, 1884: 330–331, pl. 7 fig. 2.
Melania subcancellata Boettger, 1890.
Plotia leroyi Bourguignat, 1890: 185.

- Plotia bloyeti* Bourguignat, 1890: 186.
Melania pagoda var. *costulata* Schepman, 1896: 139, pl. 2, fig. 7.
Melania pinguicula Martens, 1897: 74, pl. 4, figs 17–20.
Melania varia Bullen, 1904: 110, pl. 6, figs 1, 2.
Melania (*Tarebia*) *tjemoroensis* Martin, 1905: 241, pl. 36, figs 575, 576.
Melania keiensis Preston, 1911: 229.
Melania intrepida Fulton, 1914: 163.
Melania scabroides Yokoyama, 1928: 58, pl. 5, fig. 1.
Melania sykesi Degner, 1928.
Melanoides scabra var. *elegans* Annandale et Prashad, 1919: 37.
Tiara (*Plotia*) *scabra* – PRESTON 1915: 35–36.
Thiara (*Thiara*) *scabra* – RAMAKRISHNA 2007: 153–154.
- Distribution.** Tamil Nadu: Sundarapandipuram tank. India: throughout, Andaman Islands, Western Himalaya (except Kashmir). Others: Afghanistan, Australia, Bangladesh, Comore Islands, Eastern South Africa, Greece, Indonesia, Japan, Kenya, Laos, Madagascar, Malaysia, Mauritius, Nepal, New Hebrides, Pacific Islands, Palestine, Philippines, Réunion, Seychelles, South China, Sri Lanka, Tanzania, Thailand, Taiwan, Vietnam.
- Remarks.** Typically inhabits slow to fast flowing streams but also occurs in ponds (SUBBA RAO 1989); native to India, wrongly considered an introduced species in India by AHMED et al. (2023); one of the most successful invasive species in many parts of the world (THOMPSON et al. 2009).
- Genus *Melanoides* Olivier, 1804**
- Melanoides tuberculata* O. F. Müller, 1774**
- Fig. 10
- Nerita tuberculata* Müller, 1774: 191.
Melanoides tuberculata Müller, 1774: 191.
Melania (*Melanoides*) *tuberculata* Müller, 1774.
Melania (*Striatella*) *tuberculata* Müller, 1774: 191.
Melania tuberculata Müller, 1774: 191.
Melanoides tuberculatus Müller, 1774: 191.
Striatella tuberculata Müller, 1774: 191.
Thiara tuberculata – MÜLLER 1774: 191.
Melanoides (*Melanoides*) *tuberculata* Müller, 1774: 191.
Melanoides fasciolata Olivier, 1804: 2: 40 [4th edition]. 3: 69 [8th edition]. pl. 31 fig. 7.
Turritella tuberculata Link, 1807: 138.
Turritella turricula Link, 1807: 138.
Melania trunculata Lamarck, 1822: 167.
Melania virgulata Férussac, 1827: 411.
Melania cancellata Say, 1829.
Melania mauriciae Lesson, 1831: 353.
Melania terebra Lesson, 1831: 354.
Melanoides terebra Lesson, 1831: 354.
Melania virgula Quoy et Gaimard, 1834: 3: 141, pl. 56, figs 1–4.
Melanoides pyramis Benson, 1836: 782.
Melania pyramis Benson, 1837: 782.
Melania (*Striatella*) *pyramis* Benson, 1837: 782.
Melania ornata von dem Busch in Philippi, 1842: 4.
Melania flammigera Dunker, 1844: 163.
Melania moesta Hinds, 1844: 58.
Melania tamsii Dunker, 1845: 165.
Melania rivularis Philippi, 1847: 171.
Melania suturalis Philippi, 1847: 173.
Melania tigrina Hutton, 1849: 658–659.
Melania tuberculata var. *plicifera* Mousson, 1849: 73.
Melania turriculus Lea et Lea, 1851: 190.
Melania judaica Roth, 1855: 53.
Melania (*Stenomelania*) *rustica* Mousson, 1857: 160.
Melania layardi Dohrn, 1858: 135.
Melania exusta Reeve, 1859.
Melania floricomma Reeve, 1859.
Melania punctulata Reeve, 1859.
Melania timorensis Reeve, 1859.
Melania gracilina Gould, 1859: 42.
Melania beryllina Brot, 1860: 262.
Melania zengana Morelet, 1860: 115.
Melania commersoni Morelet, 1860: 116.
Melania inhambanica Morelet, 1860: 216.
Melania rothiana Mousson, 1861: 150–151.
Melania assavaensis Mousson, 1865.
Melania tuberculata var. *assavaensis* Mousson, 1865.
Melania rubropunctata Tristram, 1865: 541.
Melania assavaensis var. *desulcata* Mousson, 1870: 213.
Melania tuberculata var. *malayana* Issel, 1874: 463.
Melania waigiensis Brot, 1874: 195.
Melania distinguenda Brot, 1874: 190.
Melania rodericensis Smith, 1876: 404.
Thiara rodericensis – SMITH 1876: 404.
Melania javanica Brot, 1877: 246.
Melania malayana Brot, 1877: 253.
Melania singularis Tapparone Canefri, 1877: 284.
Melania scalariformis Tenison Woods, 1879: 24.
Melania wilkinsonii Tenison Woods, 1879: 24.
Melania dominula Tapparone Canefri, 1883: 31.
Melania flyensis Tapparone Canefri, 1883: 41.
Melania nicobarica Tapparone Canefri, 1883: 38.
Melania pellicens Tapparone Canefri, 1883: 30.
Melania lentiginosa var. *nymphula* Westerlund, 1883: 58.
Melania (*Striatella*) *tuberculata* var. *flavida* Nevill, 1885: 244.
Melania (*Striatella*) *tuberculata* var. *luteomarginata* Nevill, 1885: 244.
Melanoides flavidus Nevill, 1885: 244.
Melanoides pyramis var. *flavida* Nevill, 1885: 244.
Melanoides pyramis var. *luteomarginata* Nevill, 1885: 244.
Melania tuberculata var. *angularis* Martens, 1897: 59.
Melania tuberculata var. *seminuda* Martens, 1897: 58.
Melania baldwini Ancey, 1899: 273.
Thiara baldwini – ANCEY 1899: 273.



Melania (Striatella) woodwardi Martin, 1905: 239.

Melania tuberculata var. *victoriae* Dautzenberg, 1908: 257.

Tiara (Striatella) tuberculata – PRESTON 1915: 15–16.

Melanoides pyramis var. *leopardina* Annandale et Prashad, 1919: 33.

Melanoides pyramis var. *puteicola* Annandale et Prashad, 1919: 33–34.

Melanoides tuberculata var. *dautzenbergi* Pilsbry et Bequaert, 1927: 257.

Melanoides tuberculata – RAMAKRISHNA 2007: 161–162.

Distribution. Tamil Nadu: Coromandel Coast, Aaladiyur Pond, Adjacent to Sundarapandipuram tank, Dohnavur lake – Vadukachimathil, Gongaikondan lake, Kadambakulam, Moolachi, Mudukkumendanpatti, Nambiiyardam, Peikulam lake, Periya Tharuvai lake, Perunkulam, Rajavallipuram lake, Sundarapandipuram tank, Tiruparremadur, Vaghaikulam, Vellur kulam. India: throughout India. Andhra Pradesh, Ganges, Himachal Pradesh, Jammu, except Kashmir. Others: Africa (North and South), Borneo, China (southern regions), Eastern Mediterranean countries, Indonesia, Japan, Nepal, New Hebrides, North Australia, Southeast Asia, various Pacific Islands.

Remarks. A common melanid inhabiting streams, rivers, irrigation canals, and stagnant ponds, often extending into brackish waters (SUBBA RAO 1989). Invasive in many tropical regions of the world, with a native range extending from East Africa, across the Middle East and to Southeast Asia (FACON et al. 2003).

Family Bulinidae P. Fischer et Crosse, 1880

Genus *Indoplanorbis* Annandale et Prashad, 1921

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

Fig. 11

Planorbis (Indoplanorbis) exustus Deshayes, 1833: 417, pl. 1, figs 11–13.

Planorbis indicus Benson, 1836: 743.

Planorbis orientalis Deshayes, 1838: 385.

Planorbis coromandelicus Dunker, 1850: 43, pl. 6, figs 14–16.

Planorbis brunneus Adams et Adams, 1855: 261.

Planorbis modicus Adams et Adams, 1855: 261.

Planorbis zebrinus Dunker, 1856: 57, pl. 6, figs 11–13.

Planorbis circumspissus Morelet, 1863: 477.

Planorbis merguensis Hanley et Theobald, 1876: 60, pl. 151, figs 5–6.

Planorbis eburneus Sowerby II, 1877: pl. 5, fig. 38.

Planorbis zonatus Clessin, 1884: 117, pl. 17, fig. 1.

Planorbis hindu Clessin, 1885: 224, pl. 33, fig. 9.

Planorbis indicus var. *zonatus* Clessin, 1886: 117, pl. 17, fig. 1.

Planorbis exustus – PRESTON 1915: 115.

Planorbis (Helisoma) pelseneeri Dupuis, 1931: 4.

Distribution. Tamil Nadu: Aaladiyur Pond, Aarumugamangalam, Alampatti, Arunthapetti lake, Brencherri lake, Dohnavur lake – Vadukachimathil, Gongaikondan lake, Kadambakulam, Kasaba lake, Koorampallam Kulam, Kottaikarunkulam, Manur lake, Mudukkumendanpatti, Nainar kulam lake, Nallur, Nambiiyar dam, Nanguneri kulam, Padmaneri, Peikulam lake, Periya Tharuvai lake, Perunkulam, Rajavallipuram lake, Reteikulam lake, Soorangudi, Sundarapandipuram tank, Thirukurungudi, Vaghaikulam, Vellur kulam, Vijayanarayanam. India: throughout the plains of India – Jammu & Kashmir, Himachal Pradesh. Others: Celebes, Indo-China, Java, Malaya, Myanmar, Nepal, Pakistan, Persia, Sri Lanka, Sumatra, Thailand.

Remarks. Usually found in permanent rivers, ponds, and lakes. Host to a wide range of parasites including *Fasciola*, *Paramphistomum*, *Schistosoma*, *Gastrodiscus*, *Plasmiorchis*, etc. (SINGH et al. 2021).

Family Planorbidae Rafinesque, 1815

Genus *Gyraulus* Charpentier, 1837

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

Fig. 12

Anisus (Gyraulus) convexiusculus Hutton, 1849.

Gyraulus chinensis convexiusculus Hutton, 1849: 657.

Planorbis convexiusculus Hutton, 1849: 657.

Planorbis stelzneri Dohrn, 1858: 134.

Planorbis saigonensis Crosse et Fischer, 1863: 362, pl. 13 fig. 7.

Planorbis turbinellus Tapparone Canefri, 1883: 248.

Planorbis (Diplodiscus) turbinellus Tapparone Canefri, 1883: 248.

Planorbis compessus Martens, 1897.

Gyraulus convexiusculus – RAMAKRISHNA 2007: 234–236.

Distribution. Tamil Nadu: Aarumugamangalam, Alampatti, Arunthapetti lake, Kaladai Kuruchi, Kasaba lake, Kottaikarunkulam, Nainar kulam lake, Nallur, Nambiiyar dam, Perunkulam, Rajavallipuram lake, Vellur kulam. India: Himachal Pradesh, Uttarakhand. Others: Afghanistan, Australia, China, Guinea, Iran, Japan, Korea, Nepal, Pakistan, Philippines, Thailand.

Remarks. A very common species in lakes, ditches, ponds, and rice fields, often associated with macrophytes; serves as host to several parasites including *Gastrothylax erumenifer*, *Paramphistomum explanatum*, *Fasciola elongatus*, etc. (SUBBA RAO 1989, KHAN 2003).

***Gyraulus parvus* (Say, 1817)**

Fig. 13

- Planorbis parvus* Say, 1817: pl. 1, fig. 5.
Planorbis (Gyraulus) parvus – SAY 1817: pl. 1, fig. 5.
Gyraulus (Torquis) parvus – SAY 1817: pl. 1, fig. 5.
Planorbis laevis Alder, 1838: 337.
Gyraulus laevis Alder, 1838: 337.
Gyraulus (Torquis) laevis Alder, 1838: 337.
Planorbis (Gyraulus) laevis Alder, 1838: 337.
Anisus (Gyraulus) laevis Alder, 1838: 337.
Gyraulus (Gyraulus) laevis Alder, 1838: 337.
Planorbis elevatus Adams, 1840: 327, pl. 3, fig. 16.
Planorbis concavus Anthony, 1843: 2.
Planorbis billingsii Lea, 1864b: 111.
Planorbis glaber var. *compressa* Lloyd, 1874.
Planorbis thermalis Westerlund, 1885: 83.
Planorbis parvus var. *walkeri* Vanatta, 1902.
Planorbis similis Baker, 1919b: 532, fig. 1.
Planorbis similis Baker, 1919b: 533, fig. 1.
Gyraulus similis Baker, 1919b: 532, fig. 1.
Gyraulus vermicularis albolineatus Henderson, 1933.
Gyraulus cyclostomus Russell, 1934: 37, figs 12–14.
Gyraulus cressmani Baker, 1942: 130–131, pl. 8, figs 17–18.
Gyraulus labiatus Leonard, 1948: 45, pl. 2, figs G, H.

Distribution. Tamil Nadu: Adaichani Periyakulam, Peikulam lake. India: Throughout the plains. Others: Central Europe, Myanmar, Netherlands, North America, Pakistan.

Remarks. Occupies a wide range of habitats, with preference for artificial and modified freshwater systems; intermediate host for avian schistosomes (BRANT & LOKER 2009); native to North America, considered a globally invasive species (GLÖER 2024).

***Gyraulus* sp. 1**

Fig. 14

Distribution. This species was collected from Muppanpatti during the present study.

Remarks. It is abundant whenever it is found.. This morphospecies is characterised by a moderately depressed shell with slightly high spire, a broad body whorl, wide umbilicus, and expanded ovate aperture. It differs from *G. convexiusculus* in its less depressed shell and broader body whorl, and from *G. parvus* in having a larger aperture and looser coiling. It differs from *Gyraulus* sp. 2 by its wider umbilicus and more inflated bodywhorl.

***Gyraulus* sp. 2**

Fig. 15

Distribution. This species was collected from Muppanpatti during the present study.

Remarks. The shell is small, compact, and tightly coiled with a narrow body whorl, reduced umbilicus, and smaller aperture. It differs from *G. convexiusculus* in lacking a strongly depressed profile, and *G. parvus* in its narrower aperture and more compact coiling. It is separable from *Gyraulus* sp. 1 by its tighter coiling and narrower umbilicus.

Genus *Pettancylus* Iredale, 1943

***Pettancylus tenuis* (Bourguignat, 1862)**

Fig. 16

- Ancylus tenuis* Bourguignat, 1862: 208.
Ferrissia tenuis – SUBBA RAO 1989: 138–139, figs 314, 316.
Ferrissia tenuis – RAMAKRISHNA 2007: 257

Distribution. Tamil Nadu: Adjacent to Sundarapandipuram tank, Brencherri lake, Thirukurugudi. India: Nilgiris and adjacent hills in South India, Maharashtra.

Remarks. Serves as host for parasites, including *Schistosoma haematobium* (SUBBA RAO 1989, SHINDE et al. 2021).

Family Bithyniidae J. E. Gray, 1857

Genus *Digoniostoma* Annandale, 1920

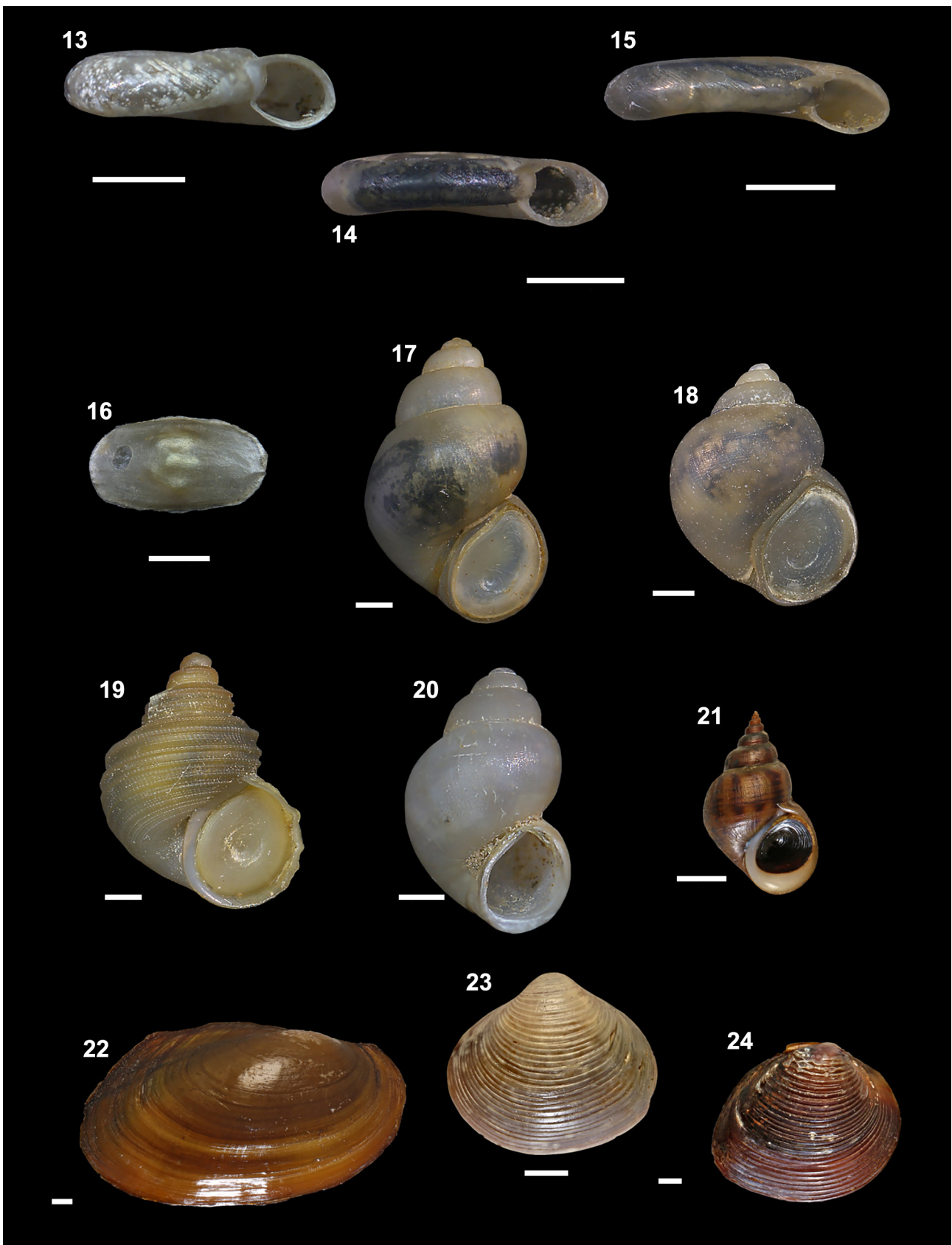
***Digoniostoma pulchella* (W. H. Benson, 1836)**

Fig. 17

- Bithynia (Digoniostoma) pulchella* Benson, 1836: 746.
Bithynia pulchella Benson, 1836: 746.
Digoniostoma pulchellum Benson, 1836: 746.
Paludina pulchella Benson, 1836: 746.
Paludina pulchella – PRESTON 1915: 73.
Digoniostoma pulchellum – SUBBA RAO 1989: 80, figs 113, 114, 119, 120.
Bithynia (Digoniostoma) pulchella – RAMAKRISHNA 2007: 120.

Distribution. Tamil Nadu: Aaladiyur Pond, Gongaikondan lake, Kasaba lake, Manur lake, Nainar kulam lake, Nambiiyar dam, Periya Tharuvai lake, Reteikulam lake, Vaghaikulam, Vellur kulam, Vijayanarayanam. India: throughout India, extending to the plains of Assam in the east and Jammu in the northwest – Uttarakhand, Uttar Pradesh, Himachal Pradesh, Jammu, Andamans. Others: Malay Archipelago, Myanmar, Pakistan, Thailand.

Remarks. Inhabits stagnant freshwater bodies and slow-moving streams (SUBBA RAO 1989); host for parasites (SANIL & JANARDANAN 2019).



Figs 13–24. Freshwater molluscs reported from from Tamil Nadu, India in this study: 13 – *Gyraulus parvus*; 14 – *Gyraulus* sp. 1; 15 – *Gyraulus* sp. 2; 16 – *Pettancyclus tenuis*; 17 – *Digoniostoma pulchella*; 18 – *Gabbia travancorica*; 19 – *Gabbia costigera*; 20 – *Gabbia orcula*; 21 – *Paludomus transchaurica*; 22 – *Lamellidens marginalis*; 23 – *Corbicula striatella*; 24 – *Villorita cyprenoides*. Scale bars: 1 mm (13–20), 5 mm (21–24)

Genus *Gabbia* Tryon, 1865***Gabbia travancorica* (W. H. Benson, 1860)**

Fig. 18

Alocinma travancorica Benson, 1860: 259.*Amnicola travancorica* Benson, 1860: 259.*Bithynia travancorica* Benson, 1860: 259.*Bithynia travancorica* Benson, 1860.*Bithynia travancorica* – PRESTON 1915: 72.*Gabbia travancorica* – RAMAKRISHNA 2007: 123, 126.

Distribution. Tamil Nadu: Aaladiyur Pond, Aarumugamangalam, Adaichani Periyakulam, Adjacent to Sundarapandipuram tank, Alampatti, Arunthapetti lake, Dohnavur lake – Vadukachimathil, Gongaikondan lake, Kadambakulam, Kasaba lake, Koorampallam Kulam, Kottaikarunkulam, Manur lake, Melapudhukudi sunai, Moolachi, Mudukkumendanpatti, Muppanpatti, Nainar kulam lake, Nallur, Nambiiyar dam, Nanguneri kulam, Padmaneri, Peikulam lake, Periya Tharuvai lake, Perunkulam, Rajavallipuram lake, Reteikulam lake, Soorangudi, Sundarapandipuram tank, Vaghaikulam, Vellur kulam, Vijayanarayanam. India: South India, especially Andhra Pradesh, Karnataka, Kerala.

Remarks. Intermediate host for parasites, *Hapladena gymnocephali* (SHEENA & JANARDANAN 2007).

***Gabbia costigera* (Küster, 1852)**

Fig. 19

Bithynia costigera Küster, 1852.*Mysorella costigera* Küster, 1852.*Paludina costigera* Küster, 1852: 33, pl. 7, figs 18–19.*Bithynia costigera* var. *curta* Nevill, 1884.*Gabbia curta* Nevill, 1884.*Mysorella costigera* – SUBBA RAO 1989: 84, fig. 124.*Mysorella costigera* – RAMAKRISHNA 2007: 127–128.

Distribution. Tamil Nadu: Madras, Aaladiyur Pond, Kaladai Kuruchi, Manur lake, Rajavallipuram lake, Sundarapandipuram tank. India: Andhra Pradesh, Karnataka, Pondicherry. Others: Sri Lanka.

***Gabbia orcula* (Frauenfeld, 1862)**

Fig. 20

Alocinma orcula Frauenfeld, 1862.*Bithynia (Gabbia) orcula* Frauenfeld, 1862.*Bithynia orcula* Frauenfeld, 1862: 1154–1155.*Gabbia orcula* – RAMAKRISHNA 2007: 123.

Distribution. Tamil Nadu: Gongaikondan lake. India: Assam, Bihar, Ganges, Maharashtra, Punjab, Rajasthan, Uttar Pradesh, West Bengal. Others: Nepal, Sri Lanka.

Remarks. Host for parasites.

Family Paludomidae Stoliczka, 1868**Genus *Paludomus* Swainson, 1840*****Paludomus tanschaurica* (Gmelin, 1791)**

Fig. 21

Helix tanschaurica Gmelin, 1791: 174, figs 1246–1247.*Paludomus spiralis* Reeve, 1847: pl. 3, fig. 15.*Melania modicella* Lea et Lea, 1851: 196.*Paludomus acutus* Reeve, 1854: 127.*Paludomus nasutus* Dohrn, 1857: 123.*Paludomus tanjoriensis* Blanford, 1863: 173, pl. 27, figs 2a–e.*Paludomus (Paludomus) tanschauricus* – SUBBA RAO 1989: 118.*Paludomus tanschauricus* – PRESTON 1915: 47.*Paludomus (Paludomus) tanschauricus* – RAMAKRISHNA 2007: 189–190.

Distribution. Tamil Nadu: Coromandel, Madras, Pulney Hills, Trichinopoly, Adjacent to Sundarapandipuram tank, Brencherii lake, Thirukurugudi. India: Andhra Pradesh, Kerala, Tamil Nadu, Maharashtra, Pondicherry. Others: Northern Sri Lanka.

Remarks. Occurs in slow-moving and temporary streams.

Family Unionidae Rafinesque, 1820**Genus *Lamellidens* C. T. Simpson, 1900*****Lamellidens marginalis* (Lamarck, 1819)**

Fig. 22

Anodonta marginalis Lamarck, 1819: 79.*Unio marginalis* Lamarck, 1819: 79.*Unio marginalis* var. *bilineata* Lea, 1831.*Symphynota bilineata* Lea, 1831: 98–99, pl. 11, fig. 19.*Unio evanescens* Mousson, 1849: 91–92, pl. 17 fig. 2.*Unio ligula* Mousson, 1849: 94–95.*Unio thwaitesii* Lea, 1859: 152.*Unio thwaitesii* Lea, 1860: 246.*Lamellidens marginalis* – PRESTON 1915: 175.*Lamellidens marginalis* – RAMAKRISHNA 2007: 288–289.

Distribution. Tamil Nadu: Aaladiyur Pond, Kadambakulam, Rajavallipuram Lake, Thirukurugudi. India: Widely distributed in India. Others: Bangladesh, Myanmar, Nepal, Pakistan, Sri Lanka.

Remarks. This species is consumed by communities across India (ARAVIND & JADHAV 2023, JADHAV et al. 2023).

**Family Cyrenidae J. E. Gray, 1840****Genus *Corbicula* Megerle von Mühlfeld, 1811*****Corbicula striatella* Deshayes, 1855****Fig. 23**

- Corbicula (Corbicula) striatella* Deshayes, 1855: 344.
Corbicula bengalensis Deshayes, 1855: 344.
Corbicula ovalis Prime, 1860: 321.
Corbicula regularis Prime, 1860.
Corbicula agrensis Prime, 1861: 128.
Corbicula parvula Prime, 1861: 127.
Corbicula subradiata Prime, 1861: 127.
Corbicula violacea Prime, 1861: 128.
Corbicula occidens Prime, 1867: 220.
Corbicula bengalica Prime, 1867: 220–221, text–figure 52.
Corbicula imperialis Prime, 1870: 299.
Corbicula striatella – RAMAKRISHNA 2007: 343–344.

Distribution. Tamil Nadu: Sundarapandipuram tank. India: The commonest Indian species occurs throughout India. Others: Afghanistan, Bangladesh, Myanmar, Nepal. Pakistan, Sri Lanka.

Remarks. Invasive in many parts of the world. This species is edible and consumed by several communities across India (ARAVIND & JADHAV 2023).

***Corbicula fluminea* (O. F. Müller, 1774)**

- Tellina fluminea* Müller, 1774: 206.
Tellina fluviatilis Müller, 1774: 206.
Cyclas chinensis Lamarck, 1806: 421.
Cyrena orientalis Lamarck, 1806: 552.
Corbicula pexata Prime, 1864: 57–58.
Corbicula pfeifferiana Prime, 1864: 417.
Corbicula insularis Prime, 1864: 414.
Corbicula andersoniana Nevill, 1877: 41.
Corbicula natalensis Clessin, 1877: 155.
Corbicula yunnanensis Nevill, 1877: 40.
Corbicula ovata Clessin, 1878: 167.
Corbicula inflata Clessin, 1878: 179.
Corbicula adunca Heude, 1880: pl. 1, fig. 3.
Corbicula aquilina Heude, 1880: pl. 2, fig. 12.
Corbicula astronomica Heude, 1880: pl. 2, fig. 7.
Corbicula aurea Heude, 1880: pl. 7, fig. 41.
Corbicula bezuariana Heude, 1880: pl. 1, fig. 5.
Corbicula bicolor Heude, 1880: pl. 2, fig. 9.
Corbicula bilineata Heude, 1880: pl. 6, fig. 33.
Corbicula cheniana Heude, 1880: pl. 5, fig. 27.
Corbicula colombeliana Heude, 1880: pl. 3, fig. 14.
Corbicula concinna Heude, 1880: pl. 4, fig. 18.
Corbicula conica Heude, 1880: pl. 3, fig. 16.
Corbicula cordieriana Heude, 1880: pl. 2, fig. 8.
Corbicula crebricostis Westerlund, 1885: 218.
Corbicula delavayana Heude, 1880: pl. 8, fig. 50.
Corbicula diminuta Heude, 1880: pl. 2, fig. 11.
Corbicula ferruginea Heude, 1880: pl. 7, fig. 38.

- Corbicula fluitans* Heude, 1880: pl. 8, fig. 47.
Corbicula foukiensis Heude, 1880: pl. 1, fig. 6.
Corbicula gentiliana Heude, 1880: pl. 1, fig. 4.
Corbicula gravis Heude, 1880: pl. 4, fig. 20.
Corbicula grilloana Heude, 1880: pl. 6, fig. 34.
Corbicula gryphaea Heude, 1880: pl. 5, fig. 28.
Corbicula ignobilis Heude, 1880: pl. 6, fig. 32.
Corbicula indigotina Heude, 1880: pl. 4, fig. 21.
Corbicula iridinea Heude, 1880: pl. 7, fig. 39.
Corbicula lapicida Heude, 1880: pl. 5, fig. 30.
Corbicula leleciana Heude, 1880: pl. 2, fig. 10.
Corbicula montana Heude, 1880: pl. 5, fig. 26.
Corbicula ingloriosa Heude, 1880: pl. 4, fig. 19.
Corbicula iodina Heude, 1880: pl. 8, fig. 46.
Corbicula obtruncata Heude, 1880: pl. 1, fig. 2.
Corbicula polychromatica Heude, 1880: pl. 5, fig. 29.
Corbicula porcellanea Heude, 1880: pl. 3, fig. 17.
Corbicula portentosa Heude, 1880: pl. 6, fig. 31.
Corbicula praeterita Heude, 1880: pl. 7, fig. 40.
Corbicula rathousiana Heude, 1880: pl. 4, fig. 22.
Corbicula scholastica Heude, 1880: pl. 5, fig. 25.
Corbicula sphaerica Heude, 1880: pl. 7, fig. 37.
Corbicula squalida Heude, 1880: pl. 8, fig. 43.
Corbicula subquadrata Heude, 1880: pl. 8, fig. 45.
Corbicula uncinulata Heude, 1880: pl. 2, fig. 13.
Corbicula variegata Heude, 1880: pl. 8, fig. 44.
Corbicula vicina Heude, 1880: pl. 3, fig. 15.
Corbicula iravadica Blanford, 1881: 221–222.
Corbicula irawadica Blanford, 1881: 221–222.
Cyrena crebricostis Westerlund, 1883: 59.
Corbicula vespertina Fischer, 1891: 240.
Corbicula subtriangularis Bullen, 1901: 223.
Corbicula fulgida Bullen, 1901: 224.
Corbicula producta E. von Martens, 1905: 66.
Corbicula clenchi Johnson, 1959: 473.

Distribution. Tamil Nadu: This species was collected from Rastha during the present study. India: Maharashtra, Assam, Others: Russia, Thailand, Cambodia, the Philippines, China, Taiwan, Korea, and Japan

Remarks. This is an invasive species reported from North America, South America, Europe, Africa, and New Zealand. It has also been reported from Thailand and Malaysia. This species is most likely widely distributed in India, but its status requires further clarification.

Genus *Villorita* J. E. Gray, 1833***Villorita cyprinoides* (J. E. Gray, 1825)****Fig. 24**

- Cyrena cyprinoides* Gray, 1825: 136.
Cyrena cyprinoides Gray, 1825: 136.
Cyrena recurvata Eydoux, 1838: 11.
Cyrena cochinchensis Hanley, 1859: 543.
Corbicula quilonica Benson, 1860: 260.

Cyrena corbiculaeformis Prime, 1860: 80.
Velorita parvula Prime, 1867: 418.
Velorita delicatula Preston, 1916: 37.
Villorita cornucopia Prashad, 1921: 118.
Villorita corbiculoides Prashad, 1927: 284.

Distribution. Tamil Nadu: This species was collected from Rastha during the present study. India: Karantaka, Kerala and Tamil Nadu. Others: not reported

Remarks. This is a brackish-water species that seldom ventures into freshwater habitats. We have included this species because it was collected from a freshwater lake with some brackish-water influence. This species is extensively harvested by coastal communities for food.

Family Sphaeriidae Deshayes, 1855

Genus *Hindupisidium* Vinarski et Bepalaya, 2023

***Hindupisidium clarkeanum* (Nevill et Nevill, 1871)**

(see NESEMANN & SHARMA 2005: pl. 2, figs 1–4)

Afropisidium clarkeanum Nevill et Nevill, 1871: 9–10, pl. 1, figs 4a–d.

Pisidium clarckeanum Nevill et Nevill, 1871: 9–10, pl. 1, figs 4a–d.

Pisidium bombayanum Theobald, 1876: 188.

Pisidium (Afropisidium) clarkeanum – SUBBA RAO 1989: 218–219, figs 615–616.

Pisidium (Afropisidium) clarkeanum dhulikhelense Nesemann et Sharma, 2005: 60.

Pisidium clarkeanum dhulikhelense – *Pisidium clarkeanum dhulikhelense* Nesemann et Sharma, 2005: 60.

Pisidium (Afropisidium) clarkeanum – RAMAKRISHNA 2007: 352–353.

Distribution. Tamil Nadu: Nilgiris, alt. 7400 ft, Mudukkumendanpatti, Soorangudi. India: Bihar, Manipur, Maharashtra, Uttar Pradesh, and West Bengal. Others: Hong Kong, Laos, Myanmar, Nepal, Thailand.

ASSOCIATION BETWEEN PHYSICO-CHEMICAL PARAMETERS AND FRESHWATER MOLLUSC ASSEMBLAGES

PHYSICO-CHEMICAL PARAMETERS

The physicochemical data were available for 34 lakes (Table 3); the remaining lakes (namely, Aaladiyur Pond, Adjacent to Sundarapandipuram tank, Brencherri lake, Kaladai Kuruchi, Maleermalpuram, Moolachi, and Rastha) were excluded from the analysis due to the unavailability of complete environmental data. The physico-chemical characteristics of the surveyed lakes showed substantial variation in water quality across sites (Table 3). pH ranged from 8.0 to 9.92, indicating predominantly alkaline conditions throughout the study area. EC varied widely (103–1996 $\mu\text{S}/\text{cm}$), reflecting considerable differences in ionic concentrations among lakes. Total dissolved solids followed a similar pattern (49–882 mg/L), suggesting that while some lakes maintain relatively low dissolved loads, others experience elevated levels likely associated with anthropogenic inputs. Dissolved oxygen concentrations ranged from critically low (0.66 mg/L) to highly oxygenated (15.26 mg/L), indicating contrasting ecological states among lakes, possibly influenced by pollution, primary productivity, and water inflows and outflows. Nutrient concentrations also varied significantly. Nitrate ranged from 0.01 to 0.22 mg/L, while phosphate concentrations were comparatively higher (1.8–14.4 mg/L). Many lakes are bordered by agricultural landscapes, and surface runoff from surrounding fields likely contributes to nutrient enrichment.

Such inputs can enhance primary productivity but may also increase the risk of eutrophication. Overall, the observed variability in physico-chemical parameters reflects varying degrees of anthropogenic influence and ecological conditions among the lakes in Tenkasi, Tirunelveli, and Thoothukudi.

CANONICAL CORRESPONDENCE ANALYSIS

The CCA analysis shows that pH, NO_3^- , and PO_4^{3-} were the primary environmental drivers structuring the freshwater mollusc community across the 34 study sites (Fig. 25). The first two canonical axes collectively explain 63.24% of the constrained variance (CCA1 = 42.92%, CCA2 = 20.32%). Sites were distributed along two dominant gradients: the pH (CCA1) and dissolved oxygen (CCA2). The ANOVA results indicate that measured physico-chemical parameters do not significantly explain the variation in the mollusc community across the sites ($F = 1.207$, $P = 0.426$). The first CCA axis is positively correlated with pH ($R^2 = 0.473$) and weakly with DO ($R^2 = 0.177$), whereas the second CCA axis is mainly correlated with NO_3^- ($R^2 = 0.372$) and PO_4^{3-} ($R^2 = 0.202$). The majority of freshwater mollusc species clustered near the origin of the ordination (Fig. 25), indicating weak relationships with the measured environmental gradients and suggesting a generalist distribution pattern. In contrast, a few



species show clearer associations with specific variables. IE (*Indoplanorbis exustus*) is positioned along the pH gradient, indicating an association with relatively alkaline conditions suggesting a high pH-tolerant species (CCA axis 1). DP (*Digoniostoma pulchella*) is aligned with NO_3^- and PO_4^{3-} vectors along CCA2, suggesting an association with nutrient-enriched conditions suggesting a preference for eutrophic conditions. The distribution of freshwater mollusc species across the studied lakes is very heterogeneous, and only certain species respond more clearly to the measured environmental variables. For example, FB (*Filopaludina bengalensis*) and PV (*Pila virens*) are weakly associated with higher EC and TDS, as well as with moderate nutrient conditions. Both the

species of GS (*Gyraulus* sp. 1 and *Gyraulus* sp. 2) are oriented in the direction of EC and TDS vectors, and weaker associations with NO_3^- and PO_4^{3-} . Several species such as GT, GC, GO, MT, PA, RL, HC, PT, LM, and CS clustered near the centre of the ordination, indicating that their distributions are close to the overall mean community composition and exhibit weak relationships with the dominant environmental gradients represented by the axes. In contrast, the wider dispersion of sampling sites across the ordination space reflects significant spatial heterogeneity in physico-chemical parameters among the studied lentic systems.

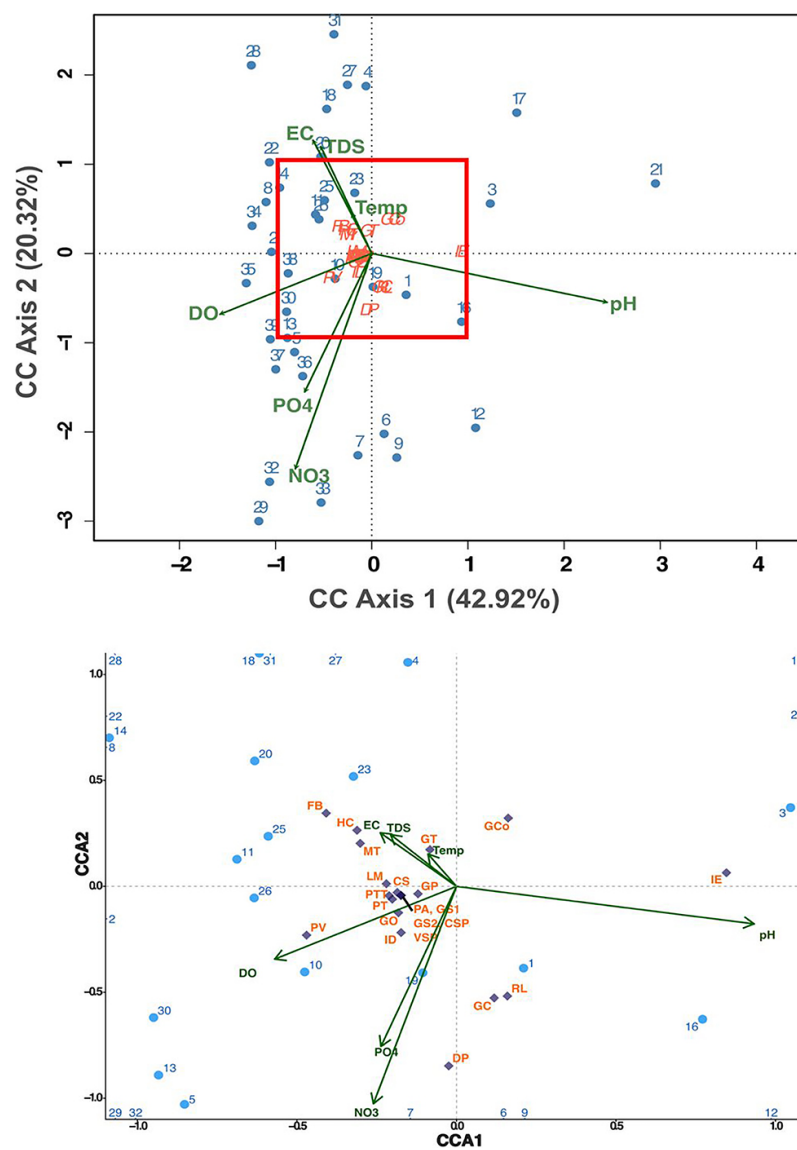


Fig. 25. CCA biplot showing the relationships among molluscan species (orange text), sampling sites (blue dots with numbers), and environmental variables (green arrows) across lentic ecosystems of Tenkasi, Tirunelveli and Thoothukudi districts, Tamil Nadu. Environmental variables include pH, dissolved oxygen (DO), electrical conductivity (EC), total dissolved solids (TDS), nitrate (NO_3^-), phosphate (PO_4^{3-}), and temperature (Temp). Species abbreviations correspond to those provided in Table 1. The lower panel shows an enlarged view of the region highlighted by the red box in the upper panel



Table 2. Comparison of freshwater mollusc species recorded in previous studies with those in the present study. “Y” indicates the presence of a species in a given study

Family	Species	Present study	AMANULLAH & HAMEED (1996)	JOHNPAUL et al. (2010)	SANTHIYA et al. (2017)	SOUNDARARAJAN et al. (2018)	RANJANI & MAHESWARI (2020)	REKHA et al. (2021)	SINDERN et al. (2022)	Remarks
1 Ampullariidae	<i>Pila globosa</i>		Y	Y	Y	Y	Y	Y		Misidentified; this species is confined to Ganges and Godavari basins (SIL et al. 2023)
2 Ampullariidae	<i>Pila virans</i>	Y	Y (in Piliidae)	Y	Y	Y (as <i>Pila virians</i>)	Y			Incorrectly cited as <i>Pila virians</i> by SOUNDARARAJAN et al. (2018)
3 Ampullariidae	<i>Pila scutata</i>						Y			
4 Bithyniidae	<i>Digonistoma pulchella</i>	Y				Y (as <i>Bithymia pulchella</i>)				
5 Bithyniidae	<i>Gabbia travancorica</i>	Y								
6 Bithyniidae	<i>Gabbia costigera</i>	Y								
7 Bithyniidae	<i>Gabbia orcula</i>	Y				Y (as <i>Gabbia orcula</i>)				Spelling error noted in SOUNDARARAJAN et al. (2018)
8 Bithyniidae	<i>Gabbia stenothyroides</i>					Y				
9 Bulinidae	<i>Indoplanorbis exustus</i>	Y	Y (in Planorbidae)	Y		Y	Y (in Planorbidae)	Y (in Planorbidae as <i>I. exustus</i>)	Y	
10 Bulinidae	<i>Indoplanorbis diffrerence</i>									Wrong identification; not traceable in MOLLUSCABASE (2025)
11 Cyrenidae	<i>Corbicula striatella</i>	Y	Y (in Corbiculidae)							



Family	Species	Present study	AMANULLAH & HAMEED (1996)	JOHNPAUL et al. (2010)	SANTHIYA et al. (2017)	SOUNDARARAJAN et al. (2018)	RANJANI & MAHESWARI (2020)	REKHA et al. (2021)	SINDERN et al. (2022)	Remarks
12 Cyrenidae	<i>Corbicula</i> sp.	Y								
13 Cyrenidae	<i>Corbicula regularis</i>		Y (in Corbiculidae)							
14 Cyrenidae	<i>Villorita</i> sp.	Y								
15 Littorinidae	<i>Cremonoconchus (Lissoconchus) carinatus</i>				Y					Currently recognized as <i>Cremonoconchus conicus</i>
16 Lymnaeidae	<i>Lymnaea ovalis</i>		Y							Not traceable in MOLLUSCA-BASE (2025)
17 Lymnaeidae	<i>Racesina luteola</i>	Y					Y (as <i>Lymnaea luteola</i>)			
18 Lymnaeidae	<i>Radix rufescens</i>	Y								
19 Lymnaeidae	<i>Radix auricularia</i>					Y				
20 Lymnaeidae	<i>Radix luteola</i>					Y				
21 Pachychilidae	<i>Sulcospira huegily</i>			Y						Accepted name is <i>Paracrostoma huegelyi</i>
22 Paludomidae	<i>Paludomas regulata</i>					Y				
23 Paludomidae	<i>Paludomas tanschaurica</i>	Y	Y (in Thiaridae as <i>P. tanschauricus</i>)	Y (as <i>P. tanschauricus</i>)		Y (as <i>P. tanschauricus</i>)		Y (as <i>P. tanschauricus</i>)	Y (as <i>P. tanschauricus</i>)	All earlier studies referred to it as <i>Paludomas tanschauricus</i>
24 Paludomidae	<i>Paludomas acuta</i>			Y						
25 Physidae	<i>Physella acuta</i>	Y								
26 Planorbidae	<i>Gyraulus convexiusculus</i>	Y				Y		Y		

Family	Species	Present study	AMANULLAH & HAMEED (1996)	JOHNPAUL et al. (2010)	SANTHIYA et al. (2017)	SOUNDARARAJAN et al. (2018)	RANJANI & MAHESWARI (2020)	REKHA et al. (2021)	SINDERN et al. (2022)	Remarks
27 Planorbidae	<i>Gyraulus parvus</i>	Y								
28 Planorbidae	<i>Gyraulus</i> sp. 1	Y								
29 Planorbidae	<i>Gyraulus</i> sp. 2	Y								
30 Planorbidae	<i>Pettancylus tenuis</i>	Y								
31 Sphaeriidae	<i>Hindupisidium clarkeanum</i>	Y								
32 Sphaeriidae	<i>Sphaerium indicum</i>				Y					
33 Stenothyridae	<i>Stenothyra blanfordiana</i>				Y	Y (as <i>M. tuberculatus</i>)		Y		
34 Thiariidae	<i>Melanoides tuberculata</i>	Y			Y	Y (as <i>Melanoides crabra</i>)			Y	Spelling error noted in SOUNDARA-RAJAN et al. (2018)
35 Thiariidae	<i>Mienplotia scabra</i>	Y	Y (as <i>Thiara (Thiara) scabra</i>)							Misidentified as <i>Tarebia ranifera</i> by SOUNDARA-RAJAN et al. (2018); accepted name is <i>Melania granifera</i>
36 Thiariidae	<i>Tarebia granifera</i>				Y	Y (as <i>Tarebia ranifera</i>)				Not traceable in MOLLUSCA-BASE (2025)
37 Thiariidae	<i>Thiara (Tarebia) lineata</i>		Y							
38 Thiariidae	<i>Thiara punctata</i>			Y						
39 Unionidae	<i>Lamellidens marginalis</i>	Y	Y		Y				Y	
40 Unionidae	<i>Lamellidens consobrinus</i>		Y		Y					



Family	Species	Present study	AMANULLAH & HAMEED (1996)	JOHNPAUL et al. (2010)	SANTHIYA et al. (2017)	SOUNDARARAJAN et al. (2018)	RANJANI & MAHESWARI (2020)	REKHA et al. (2021)	SINDERN et al. (2022)	Remarks
41 Unionidae	<i>Lamellidens corrianus</i>						Y			
42 Unionidae	<i>Parreysia favidens</i>		Y				Y			
43 Viviparidae	<i>Bellamyia crassispinialis</i>					Y				Not traceable in MOLLUSCABASE (2025)
44 Viviparidae	<i>Bellamyia b. halophilata</i>					Y				Not traceable in MOLLUSCABASE (2025); also cited incorrectly
45 Viviparidae	<i>Bellamyia b. eburnea</i>					Y				Not traceable in MOLLUSCABASE (2025)
46 Viviparidae	<i>B. bengalensis race doliaris</i>					Y				Not traceable in MOLLUSCABASE (2025)
47 Viviparidae	<i>Bellamyia bengalensis form typica</i>					Y				Not traceable in MOLLUSCABASE (2025)
48 Viviparidae	<i>Bellamyia b. anandeli</i>					Y				Not traceable in MOLLUSCABASE (2025)
49 Viviparidae	<i>Filopaludina bengalensis</i>	Y		Y (as <i>B. bengalensis</i>)	Y (as <i>B. bengalensis</i>)		Y (as <i>B. bengalensis</i>)			<i>Bellamyia bengalensis</i> f. <i>annandalei</i> is now accepted as <i>Filopaludina bengalensis</i>
50 Viviparidae	<i>Idiopoma dissimilis</i>	Y	Y (as <i>Bellamyia dissimilis</i>)			Y (as <i>Bellamyia dissimilis</i>)	Y (in Viviparoidae as <i>B. dissimilis</i>)	Y (as <i>Bellamyia dissimilis</i>)		Spelling error in REKHA et al. (2021); and all earlier studies referred to it as <i>Bellamyia dissimilis</i>

Table 3. The mean and standard deviation of different water quality parameters in different lakes studied

	Locality	pH	EC (mS/cm)	DO (mg/L)	Temp (°C)	NO ₃ ⁻ (mg/L)	PO ₄ ³⁻ (mg/L)	TDS (mg/L)
1	Aarumugamangalam	8.46 ± 0.11	560.5 ± 198.7	3.09 ± 2.14	25.75 ± 8.27	0.02 ± 0	2.6 ± 0.71	272.5 ± 98.29
2	Adaichani Periyakulam	8.35 ± 0.29	446 ± 128.69	6.04 ± 3.01	27.3 ± 1.27	0.08 ± 0.04	4.95 ± 1.2	215.2 ± 63.36
3	Alampatti	10.13 ± 0.30	477.5 ± 53.03	15.55 ± 1.63	34.65 ± 1.34	0.04 ± 0	2.8 ± 0.42	187.25 ± 16.76
4	Arunthapetti lake	8.51 ± 0.06	1099 ± 50.91	6.1 ± 0.57	29.2 ± 0.28	0.03 ± 0.01	4.55 ± 1.34	542.5 ± 26.16
5	Chettikulam	8.66 ± 0.06	288.5 ± 2.12	6.45 ± 0.77	27.3 ± 0.28	0.1 ± 0.01	8.15 ± 0.07	138 ± 1.27
6	Dohnavur lake – Vadukachimathil	8.67 ± 0.27	294 ± 2.83	7.12 ± 1.17	27.6 ± 0.42	0.05 ± 0	9.15 ± 1.77	140.8 ± 1.27
7	Gongaikondan lake	8.54 ± 0.14	900.5 ± 178.9	8.89 ± 0.83	28.85 ± 0.21	0.11 ± 0.06	12.05 ± 0.07	442.5 ± 89.8
8	Kadambakulam	8.68 ± 0.01	334.5 ± 54.45	4.81 ± 2.75	30 ± 0.28	0.04 ± 0.02	3.7 ± 0.42	159.2 ± 28.71
9	Kasaba lake	8.51 ± 0.28	346 ± 111.72	5.91 ± 4.65	29.45 ± 1.06	0.07 ± 0.05	2.7 ± 1.7	166.3 ± 54.73
10	Koorampallam Kulam	8.57 ± 0.06	882 ± 197.99	6.72 ± 1.21	30.9 ± 0.57	0.03 ± 0	2.85 ± 0.49	390 ± 93.34
11	Kottaikarunkulam	8.4 ± 0.11	602 ± 0	13.58 ± 2.38	33.6 ± 0.99	0.07 ± 0.03	7.95 ± 3.46	293 ± 0
12	Manur lake	8.93 ± 0.16	389 ± 12.73	8.86 ± 1.74	27.9 ± 0.14	0.09 ± 0	9.8 ± 0.57	181.5 ± 1.56
13	Melapudhukudi sunai	8.38 ± 0.04	395 ± 15.56	6.33 ± 0.81	30.9 ± 0.28	0.02 ± 0	3.15 ± 0.21	189.7 ± 7.21
14	Mudukkumendanpatti	8.53 ± 0.04	752.5 ± 79.9	9.56 ± 0	32.05 ± 0.49	0.02 ± 0.01	3.15 ± 0.07	337.5 ± 2.12
15	Muppanpatti	8.05 ± 0.07	1991.5 ± 6.36	3.77 ± 3.77	31.55 ± 1.06	0.28 ± 0.08	10.9 ± 4.95	884.5 ± 3.54
16	Nainar kulam lake	8.61 ± 0.33	338.5 ± 4.95	1.44 ± 1.15	29 ± 1.13	0.04 ± 0.01	5.05 ± 0.35	162.4 ± 2.4
17	Nallur	8.75 ± 0.16	425.5 ± 27.58	3.93 ± 4.62	29.45 ± 0.92	0.03 ± 0.01	2.7 ± 1.27	203.7 ± 15.98
18	Nambiyar dam	8.4 ± 0.08	774 ± 111.72	8.56 ± 0.3	30.05 ± 0.21	0.03 ± 0	4.25 ± 0.35	378.5 ± 55.86
19	Nanguneri kulam	9.14 ± 0.26	131.45 ± 0.35	8.82 ± 1.26	29.15 ± 0.78	0.02 ± 0	2.65 ± 1.77	62.2 ± 0.14
20	Padmaneri	8.31 ± 0.11	321.5 ± 0.71	8.89 ± 0.49	28.8 ± 0.42	0.05 ± 0.01	4.3 ± 0	154.2 ± 0.42
21	Peikulam lake	8.78 ± 0.31	316.67 ± 14.57	1.86 ± 0.51	30.7 ± 1.04	0.01 ± 0.01	2.63 ± 0.4	153.07 ± 8.49
22	Periya Tharuvai lake	8.36 ± 0.11	401 ± 5.66	8.66 ± 2.31	29.5 ± 0.57	0.05 ± 0.01	5.15 ± 1.2	193.15 ± 2.76
23	Perunkulam	8.4 ± 0.08	401.5 ± 4.95	7.24 ± 0.01	28.5 ± 0.28	0.05 ± 0.01	4.95 ± 1.2	193.25 ± 2.47
24	Pranjeri	8.34 ± 0.21	287 ± 19.8	7.6 ± 1.12	29.3 ± 1.56	0.06 ± 0.01	5.45 ± 5.16	138.15 ± 8.27
25	Rajavallipuram lake	8.48 ± 0.04	435.5 ± 41.72	6.64 ± 2.74	29.3 ± 0.57	0.09 ± 0.01	9.25 ± 0.07	159.75 ± 92.28
26	Reteikulam lake	8.32 ± 0.06	770.5 ± 60.1	7.73 ± 0.81	28.5 ± 0.42	0.05 ± 0	6.1 ± 0.28	376.5 ± 30.41
27	Sooragudi	8.73 ± 0.23	321 ± 45.25	12.37 ± 2.52	27.3 ± 4.1	0.01 ± 0	2.2 ± 0.85	153.95 ± 22.27
28	Sundarapandipuram tank	8.42 ± 0.01	604 ± 5.66	6.61 ± 0.01	28.75 ± 0.49	0.04 ± 0.01	3.6 ± 0.71	293.5 ± 2.12
29	Thirukurugudi	8.7 ± 0.33	120.2 ± 10.04	8.22 ± 0.91	29.85 ± 1.77	0.03 ± 0	2.4 ± 0.57	59.1 ± 1.27
30	Tiruparre madadur	8.47 ± 0.00	295 ± 0	7.85 ± 0	26.9 ± 0	0.03 ± 0	6.9 ± 0	141 ± 0
31	Vaghaikulam	8.05 ± 0.21	275 ± 5.66	2.68 ± 1.63	28.05 ± 0.07	0.04 ± 0	4.05 ± 1.48	131.3 ± 2.83
32	Valliyur	8.64 ± 0.02	104.7 ± 1.13	7.95 ± 0.01	29.6 ± 0	0.05 ± 0	3.1 ± 0.57	49.4 ± 0.57
33	Vellur Kulam	8.79 ± 0.08	330 ± 0	2.47 ± 0.84	29.8 ± 0.71	0.02 ± 0	2.75 ± 0.35	158.4 ± 0
34	Vijayanarayanam	8.94 ± 0.35	298 ± 67.88	10.26 ± 3.09	29.25 ± 1.77	0.03 ± 0.01	6.25 ± 6.15	142.75 ± 33.16



DISCUSSION

The study provided the first systematic checklist of freshwater molluscs from the lentic ecosystems of Tenkasi, Tirunelveli and Thoothukudi districts, documenting 24 species across 12 families and 18 genera. The predominance of gastropods in our collections appears to follow the general pattern observed in the Indian freshwater malacofauna, where gastropod taxa are represented by more species than bivalves (SUBBA RAO 1989, RAMAKRISHNA 2007). High species richness observed in some tanks may be due to the size, varied micro-habitats such as aquatic vegetation, clear water, structure of the tank, etc., and less pollution might be influencing. However, we have not explicitly tested this, which will be undertaken in future studies. There are several species which are restricted to a single locality, highlighting either highly specialised habitat requirements or just sampling bias, which needs to be looked at in the future.

The physicochemical gradients observed across sites, particularly variations in pH and nutrient concentrations, were reflected in the CCA (Fig. 25), which highlighted factors as the primary drivers of community composition. Such patterns are well documented in freshwater ecosystems, where nutrient enrichment and altered ionic balance restructure assemblages by favouring tolerant taxa and disfavouring sensitive ones (HEINO 2000, LEWIN 2014, THANIGAIVEL et al. 2023, KREPSKI et al. 2025). Dissolved oxygen played a secondary but important role, especially for species inhabiting oxygen-rich habitats, in line with findings from other tropical wetlands (KOLHE et al. 2025). These relationships emphasise how anthropogenic disturbances, including sewage input, cattle bathing, and invasive macrophyte growth, translate into measurable changes in both water chemistry and molluscan diversity (HORSÁK & HÁJEK 2003, JIANG et al. 2022, ŠLACHTOVÁ et al. 2023, KREPSKI et al. 2025). In this study, for example, DP, GT, GC, GO, IE, MS, MT, RL, GCo, GP, GS1, and GS2 are strongly associated with high levels of NO_3^- , PO_4^{3-} , TDS, and EC, which are indicators of pollution or pollution tolerant taxa.

The clustering of species near the ordination origin suggests that a significant portion of the community exhibits broad ecological tolerance, occurring across a wide range of sites regardless of the measured physico-chemical gradients. While the sampling sites exhibited high environmental heterogeneity, these species appear relatively unaffected by fluctuations in parameters such as pH, temperature, and NO_3^- . This pattern likely indicates two scenarios: first, that the community is dominated by generalist taxa capable of maintaining stable populations

across varying conditions; and second, that the measured physicochemical variables may not be the main drivers of niche differentiation for these species. It is also possible that unmeasured variables, such as micro-habitat structure, substrate composition (sand, clay, pebbles, litter, etc.), or the presence, absence, and abundance of macrophytes, including invasive species play an important role in influencing the distribution of freshwater molluscan assemblages.

Field observations revealed that many surveyed waterbodies were polluted with sewage, garbage, washing and construction debris, and were also heavily infested with invasive aquatic macrophytes such as *Pontederia crassipes*, *Ipomoea carnea*, *Salvinia molesta*, and *Pistia stratiotes* (Fig. 2). Additionally, activities such as vehicle washing, cattle bathing, and domestic use were common in almost all sites. These anthropogenic pressures likely influence species composition, with pollution-tolerant taxa such as *Radix*, *Racesina*, *Indoplanorbis exustus*, *Melanoides tuberculata*, and *Physella acuta* being frequently recorded in these polluted and eutrophic lakes. Such a pattern of generalist mollusc species occupying polluted habitats has been reported in other studies across the world (VAN LEEUWEN et al. 2013, VINARSKI 2017, KOLHE et al. 2025).

Notably, species such as *Indoplanorbis exustus*, *Melanoides tuberculata*, *Bithynia pulchella* and *Gyraulus convexiusculus* are of medical importance, as they serve as intermediate hosts for several parasitic nematodes, including schistosomes that infect humans and livestock (CHANDRA et al. 2017). The presence of such taxa in heavily anthropogenically used waterbodies highlights potential public health concerns and emphasises the need for integrated studies linking malacofaunal diversity, water quality, and parasite prevalence.

TAXONOMIC ISSUES

Earlier studies from the region and from Tamil Nadu were scattered and localised. Taxonomic issues persist in other studies: for example, *Pila virens* is invariably identified as *P. globosa* (SANTHIYA et al. 2017, RANJANI & MAHESWARI 2020, REKHA et al. 2021). A recent study has clearly shown that *P. globosa* is restricted to the Ganges and Godavari basins only (SIL et al. 2023). Additionally, one study has identified *Cremnoconchus carinatus* (Littorinidae) (currently recognised as *Cremnoconchus conicus* W. T. Blanford, 1870) as present in the lentic ecosystems of Tamil Nadu (SANTHIYA et al. 2017); however, this species is restricted to waterfalls in the Northern Western Ghats and is point-endemic. Also, a study

from Chennai reported three species, namely *Thiara punctata*, *Sulcospira huegily* (also a spelling error), and *Paludomus acuta* (JOHNPAUL et al. 2010). The latter two species are restricted to lotic habitats in the Western Ghats, and *Thiara punctata* is a misidentification. Studies from the Kancheepuram, Vellore, and Nilgiris regions have reported 31 species and subspe-

cies. In this study, many species were wrongly identified, such as *Indoplanorbis difference*, *Bellamya crassispinalis*, *Vivipara*, *Paludomus regulata*, *Pila globosa*, and *Pila* sp. (SOUNDARARAJAN et al. 2018; Table 2). This misidentification largely stems from inadequate and non-availability of good identification guides with images of type specimens.

CONCLUSION

The present study provides a comprehensive assessment of freshwater molluscan assemblages and their associated ecological conditions in the lentic ecosystems of the southern three districts of Tamil Nadu, India. This baseline survey highlights the considerable molluscan diversity supported by these water bodies and the environmental gradients that structure community composition. Given the increasing anthropogenic pressures on these systems, including nutrient enrichment, habitat modification, and biological invasions, targeted management interventions are essential. Effective control of invasive species, reduction of pollution inputs, and the implementation of long-term ecological monitoring programmes are particularly critical in intensively used and degraded habitats. Such measures are necessary to safeguard both common and range-restricted species, thereby ensuring the long-term stability

and conservation of freshwater molluscan biodiversity in the region.

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