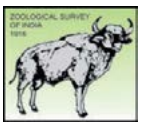
ISSN (Online) : 2581-8686
ISSN (Print) : 0375-1511

Rec. zool. Surv. India: Vol. 123(i2S)/363-378, 2023
DOI: 10.26515/rzsi/v123/i2S/2023/172530



Diversity of Mollusca (Gastropoda) Along Intertidal Rocky Shores of Thiruvananthapuram District, Kerala Coast

Preetha Karnaver[1*]., Ajin Madhavan [2]., Ravinesh R [3]., Reshmi, R [4].
Biju Kumar. A [5] and Hari Kumar., B[6]

[1]Department of Zoology, Christian College,Chengannur, Alappuzha 689122, Kerala, India
**Email-: karnaver1@gmail.com*
[2]Department of Marine Biology, Microbiology and Biochemistry, School of Marine Sciences, Cochin University of Science and Technology, Cochin – 682016, Kerala, India.
[3]Centre for Marine Living Resources and Ecology, Ministry of Earth Sciences, Atal Bhavan, LNG Road, Puthuvypu, Ochanthuruthu P.O, Kochi-682508
[4]Department of Zoology, NSS College, Pandalam, Pathanamthitta 689501, Kerala, India
[5]Department of Aquatic Biology & Fisheries, University of Kerala, Thiruvananthapuram 695581, Kerala,
[6] KNM NSS ayurveda hospital, Vallamkulam, Pathanamthitta, Kerala, India

Abstract

An assessment of intertidal rocky shore biodiversity of gastropods along Mulloor, Kovalam and Vizhinjam sites of Thiruvananthapuram district Kerala coast is done during three different seasons during 2020- 2022, and identified 108 species across 6 subclasses, 9 orders, 20 super families, 27 families and 61 genera. Neogastropoda was the most species- rich order (50 species) followed by orders Littoriimorpha (30 species), Trochida (7 species), Cycloneritida (7 species), Lepettellida (5 species), Patellogastropoa (2 species), Cephalaspidea (2 species) and Seguenziida (1 species). Family Muricidae was having maximum species diversity (18 species) followed by family Conidae (17 species). Among the 108 species observed in the study, 50 were commonly occurring, whereas 22 were uncommon and 36 were rare. *Littorara undulata* was the most abundant species observed during the study. A site - wise comparison of the three study sites revealed that Vizhinjam (84 species) was having maximum species diversity followed by Mulloor (82 species) and Kovalam (61 species). An assessment of diversity indices such as Shannon-Wiener index (H) Simpson Dominance Index (D), Evenness index (E) gave significant values indicating very high diversity of gastropods along the study sites. The present study provides information on the gastropod resources of the selected study area, which forms the baseline data for future ecological studies.

Keywords: Biodiversity, Mollusca, Gastropoda, Intertidal rocky, species.

Introduction

Rocky intertidal zone provides wide variety of marine species, serves as a feeding and breeding ground for many organisms, and helps to protect the coastline from erosion. (Miller 2004). Rocky shore organisms are adapted to tolerate the extreme conditions of this environment, such as desiccation, temperature changes, wave actions and tidal fluctuations, which results in a unique and harsh habitat for many marine organisms (Nair and Thampy, 1980; Smith

*Author for correspondence : diptera.zsi@gmail.com
Article Received on: 02.04.2023 Accepted on: 15.06.2023

2013; Eglantine *et al.*, 2014; Marshall *et al* 2013; Underwood and Chapman 2013). Rocky shore is highly heterogenous and genetically diverse environment (Araújo *et al.*, 2005) that offers a wide array of ecosystem services like fresh air, clean and recycled water, protection, food source, sites of recreational activities, high productivity etc. (Branch *et al.*, 2008). Apart from being rich biodiversity sites, they are ideal laboratories for studying ecological and biological processes, providing food and feeding grounds for many rare and threatened species and promoting the stabilisation of inshore sediments (Benedetti, 2001).

Rock pools form an ideal microhabitat for settling diverse flora and fauna (Tikader, 1986; Cruz *et al* 2014). Phylum Mollusca, the second largest in the animal kingdom next to Arthropoda in terms of the number of species, form one of the major and biodiverse marine invertebrate taxa (Bouchet and Strong, 2010). Gastropoda forms the most species rich and diverse class in the phylum Mollusca (Pechenik 2016). Many edible species of Gastropods are abundantly found in intertidal regions of rocky shores (Prasanna and Ramesh, 2018). Gastropods are ecologically and economically important for the coastal area and their existence influences the microecological condition of an ecosystem (Ramanibai and Govindan, 2018., Puryono and Suryanti, 2019). Rocky shore biodiversity studies from Indian coasts are very less except a few related to the ecology and distribution of individual species or on algal and invertebrate communities (Krishnaswamy, 1957, Rao and Sreeramulu, 1970, Ravinesh and Bijukumar 2013, Baiju *et al.*, 2023). The recent diversity study associated with gastropod communities along Kerala coast include those of Sary *et al.*, (2013, 2014), Ravinesh and Biju Kumar (2013), Anu *et al.*, (2017), Ravinesh *et al.*, (2022) and Baiju *et al.*, (2023). The objective of the present study is to identify the marine gastropods along intertidal rocky shores of the Thiruvananthapuram district and to determine the composition of the gastropod community based on most represented family. The study also aims at comparing the diversity indices of gastropods along the study area.

Material and Methods

The intertidal rocky patches of three closely located regions of Thiruvananthapuram district – Mulloor (8°29'30.9"N 76°53'55.5"E), Kovalam (8°24'02.0"N 76°58'18.1"E) and Vizhinjam (8°22'34.4"N 76°59'37.0"E) **(Figure: 1)** were chosen as the study sites. Monthly regular collections were taken during 2021- 2022 by direct hand picking and Snorkelling (with the help of professional divers). Photographs were taken using Olympus TG-5 and Nikkon D90 digital cameras. The identification of the shells up to species level was done following revision papers, manuals and publications (Röckel et al, 1995; Rao, 2003; Apte, 1998, 2012, 2014; Robin, 2008; Rao, 2003; Franklin and Laladhas, 2014; Edward *et al*, 2022) and online databases.

The identified shells were carefully placed in separate bottles with labels indicating the name of species, family, order, location, date of collection and name of the collector. The numbers of shells of each species obtained from each site were also recorded for calculating the diversity indices. Diversity indices such as Shannon-Wiener index (H) Simpson Dominance Index (D), Evenness index (E) were calculated using the software Paleontological Statistics Software Package for Education and Data (PAST) version 3.2.1 (Hammer *et al.*, 2001). The scheme of classification followed was that of Bouchet *et al.* (2017).

Results and Discussion

Rocky shores are the most dynamic, productive and harshest ecosystems (Worm and Lotze, 2006; Tomanek and Helmuth, 2002) and of late artificial sea walls are also reported to support biodiversity (Biju Kumar and Ravinesh, 2011). The present study revealed the presence of a total of 108 species of gastropods belonging to 6 Subclasses, 8 orders, 20 super families, 27 families and 61 genera (Table I, Figure: 2)

Order Neogastropoda harboured the highest number of species (50) categorised under nine families and twenty five genera; almost 46 % of the species collected was from this species-rich order. Neogastropods are carnivorous and prefer diversity in dietary and eating behaviours compared to other classes of Gastropoda (Taufik *et al.*, 2017). The availability of preferred food sources depending on the type of molluscs is an important factor that influences the density of a particular species (Islami 2012). Order Littorinimorpha stood next in species diversity represented by thirty species coming under six families and seventeen genera contributing to 28% of the total diversity. Orders Trochida (6%) was represented by seven species belonging to four families and four genera. Order Cycloneritida (6%) was also represented by a single genus with seven species coming under a single family, while order Lepetellida (5%) was represented by two families comprising of five genera and five species. Order Caenogastropoda(4%) harboured four species coming under three families and four genera. Order Patellogastropoda (2%) was represented

by two species coming under two genera and two families. Order Seguenziida(1%) had the least representation with a single species under the family Chilodontidae. The order Cephalaspidea (2%) was also represented by two species each belonging to two different genera coming under a single family. An analysis of the species diversity in each family revealed that Muricidae harboured the highest number of species (18) followed by Conidae (17 species) and Cypraeidae (16). Familiy Neritidae was represented by seven species followed by families Littorinidae (5), Turbinidae (4) and Fissurellidae (4). Families Trochidae, Calyptraeidae, Cymatiidae and Columbellidae were represented by three species each whereas families Planaxidae, Bursidae, Mitridae, and Haminoeidae were represented by two species each. Eoacmaeidae, Nacellidae, Haliotidae, Chilodontidae, Cerithiidae, Epitoniidae, Zebinidae, Fasciolariidae, Raphitomidae and Acteonidae however, exhibited the least species diversity with only one species each. According to Abbot (1991), gastropod families Neritidae and Littorinidae are the most commonly found across wide ecological zones.

A categorisation of species into common, rare and uncommon based on the number of specimens obtained showed that 50 species (46%) were of common occurrence, 22 species were uncommon (20.37%) and 36 species were rare (33.33%) **(Figure: 3).** *Littoraria undulata* belonging to the family Littorinidae was the most abundant species (3133) observed in the study along with *Trochus radiatus* (2959), *Anachis terpsichore* (2364), *Nerita albicilla* (1512) and *Clypidina notata* (1157). Periwinkles belonging to littorinid family; often occur at high densities along rocky shores globally (Davies and Williams, 1998). They are adapted to retreat into crevices and attach to the substrate to avoid dislodgement due to strong wave action (Katie *et al.*, 2014). A comparison of species diversity among the three study sites revealed that Vizhinjam (84 species) stood high in species diversity followed by Mulloor (82 species) and Kovalam (61 species) **(Figure 4)**.

An analysis of various diversity indices showed that Evenness Index was highest at Mulloor (41.79) followed by Vizhinjam (29.64) and Kovalam (28.57). Simpsons diversity index showed a value of 0.93 across the three sites, indicating very high diversity. Assessment of Shannon index also indicated very high diversity (3.0485) along the selected study sites.

Out of the 108 species recorded, six species were recorded for the first time from the Kerala coast and thirteen species were new records to west coast of India (Plates 1 to 3). Variations in temperature, steepness of shores, tidal range, amount of protection, wave frequency and electrical conductivity also regulate the kind and number of biotas associated with rocky habitats; (Tikader *et al.*, 1986; D'Souza *et al.*, 2022). Anthropogenic pressures due to sewage dumping, urbanization, tourism, recreational activities runoffs and shell collectors can pose a serious threat to the existing diversity of rocky habitats (Prasanna and Ramesh, 2018). Rocky shores provide a variety of food sources for marine organisms, including algae, plankton, and small invertebrates. This supports a diverse food web, with many species relying on other species for food.

Rocky shores are providing wide variety of food sources for marine organisms, including algae, plankton, and small invertebrates. This supports a diverse food web, with many species relying on other species for food. The study areas diversity of algae, sponges, crustaceans, and echinoderms and Ascidians (Ravinesh and Biju Kumar 2013, Anu *et al.*, 2017) and the overall, the combination of physical diversity, food availability, connectivity, adaptation, and environmental stability makes rocky shores a highly diverse in these regions. The rich gastropod diversity of the rocky patches along the Thiruvananthapuram coastline throws light into the potential for in- depth taxonomic studies. The varying physicochemical parameters prevailing in the ecosystem coupled with high productivity can be the reason for the highly diverse species patterns observed in the study.

Table 1—Gastropod Biodiversity associated with the intertidal rocky shores of Mulloor, Kovalam and Vizhinjam + Present; - Absent

No	Classification	Mulloor	Kovalam	Vizhinjam	Abundance	Remarks
1	Class: Gastropoda Subclass: Patellogastropoda Order Patellogastropoda Superfamily: Lottioidea Family: Eoacmaeidae ***Eoacmaea ceylanica* (E. A. Smith, 1911)**	+	+	+	**Common**	**New to west Coast of India.**
2	Super family: Patelloidea Family: Nacellidae ***Cellana radiata* (Born, 1778)**	+	+	+	**Common**	
3	Subclass: Vetigastropoda Order: Lepettellida Superfamily: Fissurelloidea Family: Fissurellidae ***Diodora singaporensis* (Reeve,1850)**	+	+	+	**Common**	
4	***Emarginula obovata* (A. Adams, 1852)**	+	-	+	**uncommon**	First record in west coast
5	***Scutus unguis* (Linnaeus, 1758)**	+	+	+	**Common**	First record to South west coast of India
6	***Clypidina notata* (Linnaeus, 1785)**	+	+	+	**Common**	
7	Superfamily: Haliotoidea Family: Haliotidae ***Haliotis varia* Linnaeus, 1758**	+	+	+	**Common**	
8	Order: Seguenziida Superfamily: Seguenzioidea Family: Chilodontidae ***Euchelus asper* (Gmelin, 1791)**	+	+	+	**Common**	
9	Order: Trochida Superfamily: Trochoidea Family: Trochidae ***Clanculus microdon* A. Adams, 1853**	+	+	+	**Common**	First record in Kerala
10	***Trochus maculatus* Linnaeus, 1758**	+	-	+	**uncommon**	
11	***Trochus radiatus* Gmelin, 1791**	+	+	+	**Common**	

No	Classification	Mulloor	Kovalam	Vizhinjam	Abundance	Remarks
12	Family: Turbinidae ***Astralium semicostatum* (Kiener, 1850)**	+	-	+	**uncommon**	First record in west coast
13	***Turbo argyrostomus* Linnaeus, 1758**	+	-	+	**uncommon**	
14	***Turbo bruneus* (Röding, 1798)**	+	-	+	**uncommon**	
15	***Turbo intercostalis* Menke, 1846**	+	-	+	**uncommon**	
16	Subclass: Neritimorpha Order: Cycloneritida Superfamily: Neritoidea Family: Neritidae ***Nerita albicilla* Linnaeus, 1758**	+	+	+	**Common**	
17	***Nerita litterata* Gmelin, 1791**	+	+	+	**Common**	
18	***Nerita maura* Récluz, 1842**	+	+	+	**uncommon**	
19	***Nerita nigrita* Röding, 1798**	-	-	+	**uncommon**	
20	***Nerita oryzarum* Récluz, 1841**	+	+	-	**uncommon**	
21	***Nerita plicata* Linnaeus, 1758**	+	+	+	**Common**	
22	***Nerita polita* Linnaeus, 1758**	+	+	+	**Common**	
23	Subclass: Caenogastropoda Order: Caenogastropoda Superfamily: Cerithioidea Family: Cerithiidae ***Rhinoclavis sinensis* (Gmelin, 1791)**	-	+	+	**Common**	
24	Family: Planaxidae ***Planaxis sulcatus* (Born, 1778)**	+	+	+	**Common**	
25	***Supplanaxis niger* Quoy & Gaimard, 1833**	+	+	+	**Common**	
26	Superfamily: Epitonoidea Family: Epitonidae ***Acrilla acuminata* (G. B. Sowerby II, 1844)**	+	-	-	**Rare**	New to Kerala
27	Order: Littorinimorpha Superfamily: Littorinoidea Family: Littorinidae ***Echinolittorina leucosticta* (Philippi, 1847)**	+	+	+	**Common**	
28	***Echinolittorina malaccana* (Philippi, 1847)**	+	+	+	**Common**	

No	Classification	Mulloor	Kovalam	Vizhinjam	Abundance	Remarks
29	***Echinolittorina vidua*** **(Gould, 1859)**	+	+	+	**Common**	
30	***Littoraria undulata*** **(Gray, 1839)**	+	+	+	**Common**	
31	***Littoraria intermedia*** **(Philippi, 1846)**	-	+	+	**Common**	
32	Superfamily: Rissooidea Family: Zebinidae ***Stosicia annulata*** **(Dunker, 1859)**	-	_	+	**Rare**	
33	Superfamily: Calyptraeoidea Family: Calyptraeidae ***Desmaulus edgarianus*** **(Melvill, 1898)**	+	-	+	**Common**	
34	***Desmaulus extinctorium*** **(Lamarck, 1822**	+	+	+	**Common**	
35	***Ergaea walshi*** **(Reeve, 1859)**	+	+	+	**Common**	
36	Order: Littorinimorpha Superfamily: Cypraeoidea Family: Cypraeidae ***Naria helvola*** **(Linnaeus, 1758)**	+	-	+	**Rare**	First record in west coast
37	***Naria lamarckii*** **(J. E. Gray, 1825)**	-	-	+	**Rare**	
38	***Naria ocellata*** **(Linnaeus, 1758)**	+	+	+	**Common**	
39	***Erronea caurica dracaena*** **(Born, 1778)**	+	-	-	**Rare**	First record in Kerala
40	***Erronea errones*** **(Linnaeus, 1758)**	+	-	-	**Rare**	
41	***Palmadusta asellus (Linnaeus, 1758)***	+	+	+	**Common**	
42	***Palmadusta clandestina*** **(Linnaeus, 1767)**	+	+	+	**Common**	First record in west coast
43	***Palmadusta lentiginosa*** **(J.E. Gray, 1825)**	-	+	+	**Common**	New to Kerala
44	***Lyncina carneola*** **(Linnaeus, 1758)**	-	-	+	**Rare**	
45	***Lyncina vitellus*** **(Linnaeus, 1758)**	+	+	+	**unommon**	
46	***Mauritia arabica asiatica*** **F.A. Schilder & M. Schilder, 1939**	+	+	+	**Common**	
47	***Mauritia mauritiana*** **(Linnaeus, 1758)**	_	-	+	**Rare**	First record in Kerala
48	***Monetaria annulus*** **(Linnaeus, 1758)**	+	-	+	**Uncommon**	
49	***Monetaria caputserpentis*** **(Linnaeus, 1758)**	+	-	+	**Common**	
50	***Monetaria moneta*** **(Linnaeus, 1758)**	+	+	+	**Common**	

No	Classification	Mulloor	Kovalam	Vizhinjam	Abundance	Remarks
51	***Staphylaea limacina interstincta* (W. Wood, 1828)**	-	+	-	**Rare**	
52	Superfamily: Tonnoidea Family: Bursidae ***Dulcerana granularis* (Röding, 1798)**	+	+	+	**Common**	
53	***Tutufa bubo* (Linnaeus, 1758)**	-	+	-	**Rare**	
54	Family: Cymatiidae ***Gyrineum natator* (Röding, 1798)**	+	+	+	**Common**	
55	***Lotoria Perryi (W. K Emerson and Old, 1963))***	+	+	+	**Common**	
56	***Monoplex parthenopeus* (Salis-Marschlins, 1793)**	+	-	-	**Rare**	
57	Order: Neogastropoda Super family: Buccinoidea Family: Columbellidae ***Anachis terpsichore* (G. B. Sowerby II, 1822)**	+	+	+	**Common**	
58	***Pardalinops testudinaria* (Link, 1807)**	+	+	+	**Common**	
59	***Pyrene flava* (Bruguière, 1789)**	+	+	+	**Common**	
60	Family: Pisaniidae ***Cantharus melanostoma* (Sowerby I, 1825)**	+	+	+	**Common**	
61	***Cantharus spiralis* Gray, 1839**	+	+	+	**Common**	
62	***Engina lineata* (Reeve,1846)**	+	+	+	**Common**	
63	***Engina zea* Melvill, 1893**	+	+	+	**Common**	
64	***Pollia undosa* (Linnaeus, 1758)**	+	+	+	**Common**	
65	Family: Fasciolariidae ***Filifusus ferrugineus* (Lamarck, 1822)**	+	+	+	**Common**	New to west coast of India
66	Superfamily: Muricoidea Family: Muricidae ***Chicoreus brunneus* (Link, 1807)**	-	-	+	**Rare**	
67	***Chicoreus ramosus* (Linnaeus, 1758)**	-	-	+	**Rare**	
68	***Chicoreus virgineus* (Röding, 1798)**	-	-	+	**Rare**	
69	***Haustellum langleitae* Houart, 1993**	+	+	+	**Common**	New to West Coast of India

No	Classification	Mulloor	Kovalam	Vizhinjam	Abundance	Remarks
70	***Mipus gyratus*** **(Hinds, 1844)**	+	-	+	**Uncommon**	New to West Coast of India
71	***Drupella margariticola*** **(Broderip, 1833)**	+	+	+	**Common**	
72	***Ergalatax contracta*** **(Reeve, 1846)**	+	+	+	**Common**	
73	***Lataxiena solenosteiroides*** **Houart, Fraussen & Barbier, 2013**	-	+	+	**Common**	
74	***Maculotriton serriale*** **(Deshayes in Laborde, 1833)**	+	-	+	**Uncommon**	
75	***Muricodrupa anaxares*** **(Kiener,1835)**	+	+	-	**Uncommon**	First record in Kerala
76	***Pascula muricata*** **(Reeve, 1846)**	+	-	+	**Uncommon**	
77	***Pascula ochrostoma*** **(Blainville, 1832)**	+	-	+	**Uncommon**	First record in west coast
78	***Tenguella granulata*** **(Duclos, 1832)**	+	-	+	**Uncommon**	
79	***Indothais blanfordi*** **(Melvill,1893)**	+	-	+	**Uncommon**	
80	***Indothais sacellum*** **(Gmelin, 1791)**	-	-	+	**Rare**	
81	***Mancinella alouina*** **(Röding, 1798)**	-	+	-	**Rare**	
82	***Purpura bufo*** **Lamarck, 1822**	+	+	+	**Common**	
83	***Purpura panama*** **(Röding, 1798)**	+	+	+	**Common**	
84	***Semiricinula tissoti*** **(Petit de la Saussaye, 1852)**	+	+	+	**Common**	
85	Superfamily: Mitroidea Family: Mitridae ***Pseudonebularia chrysalis*** **(Reeve, 1844)**	-	+	-	**Rare**	
86	***Pseudonebularia proscissa*** **(Reeve, 1844)**	-	-	+	**Rare**	
87	Superfamily: Conoidea Family: Conidae ***Conus achatinus*** **Gmelin, 1791**	-	-	+	**Rare**	
88	***Conus biliosus*** **(Röding, 1798)**	+	-	-	**Rare**	
89	***Conus bizona Coomans,*** **Moolenbeek & Wils, 1981**	+	-	-	**Rare**	
90	***Conus catus*** **Hwass in Bruguière, 1792**	+	-	-	**Rare**	
91	***Conus ceylanensis*** **Hwass in Bruguière, 1792**	-	-	+	**Rare**	

No	Classification	Mulloor	Kovalam	Vizhinjam	Abundance	Remarks
92	***Conus chaldaeus*** **(Roding,1798)**	+	-	-	**Rare**	
93	***Conus coronatus*** **Gmelin, 1791**	+	-	-	**Rare**	
94	***Conus ebraeus*** **Linnaeus, 1758**	-	+	-	**Rare**	
95	***Conus flavidus*** **Lamarck, 1810**	+	-	+	**Rare**	
96	***Conus glans*** **Hwass in Bruguière, 1792**	+	-	-	**Rare**	
97	***Conus juliaallaryae*** **(T. Cossignani, 2013)**	_	-	+	**Rare**	
98	***Conus lividus*** **Hwass in Bruguière, 1792**	-	+	+	**Uncommon**	
99	***Conus miles*** **Linnaeus, 1758**	+	+	-	**Uncommon**	
100	***Conus parvatus*** **Walls, 1979**	-	+	+	**Uncommon**	
101	***Conus rattus*** **Hwass in Bruguière, 1792**	+	-	+	**Uncommon**	
102	***Conus tessulatus*** **Born, 1778**	+	-	-	**Rare**	
103	***Conus zonatus*** **Hwass in Bruguière, 1792**	-	-	+	**Rare**	
104	Family: Clathurellidae ***Lienardia koyamai*** **Bozzetti, 2007**	+	-	-	**Rare**	New record to west coast of India
105	Family: Raphitomidae ***Pseudodaphnella barnardi*** **(Brazier, 1876)**	-	-	+	**Rare**	New record to west coast of India
106	Subclass: Heterobranchia Superfamily: Acteonoidea Family: Acteonidae ***Pupa solidula*** **(Linnaeus, 1758)**	+	-	-	**Rare**	New record to west coast of India
107	Order: Cephalaspidea Superfamily: Haminoeoidea Family: Haminoeidae ***Haloa aptei*** **(Bharate, Oskars, Narayana, Ravinesh, Biju Kumar & Malaquias, 2018)**	-	-	+	**Rare**	
108	***Lamprohaminoea cymbalum*** **(Quoy & Gaimard, 1833)**	+	-	-	**Rare**	

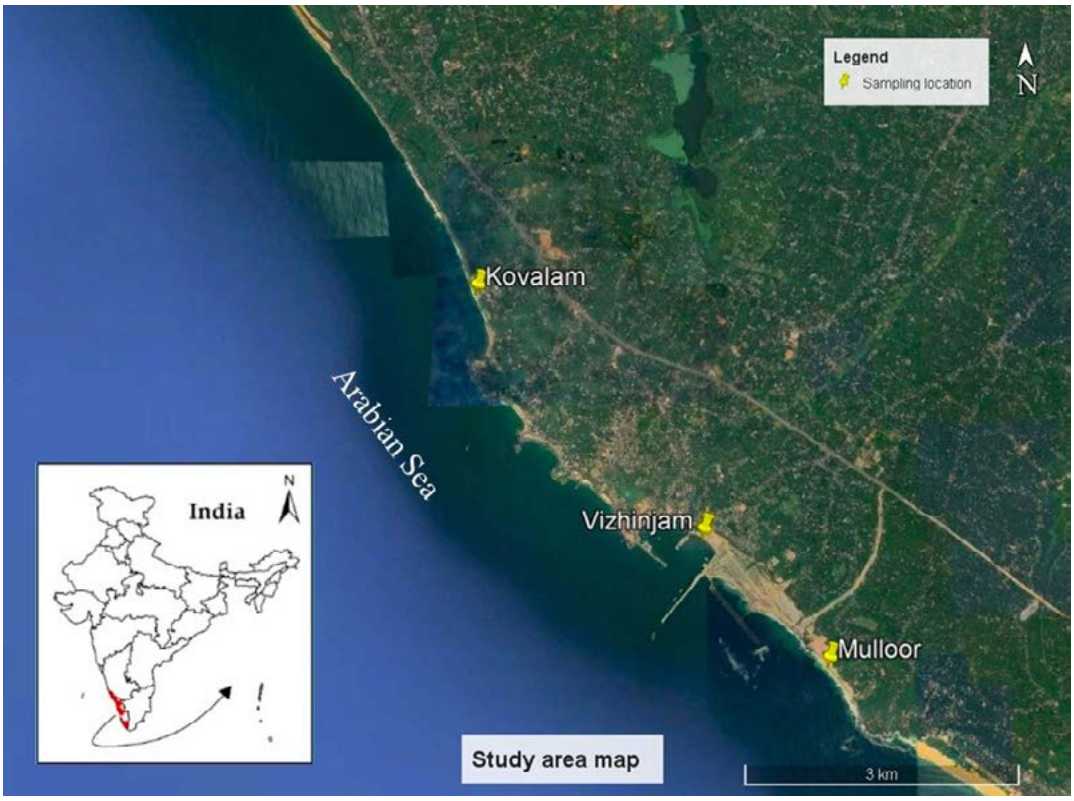


Fig 1: Map showing the study sites

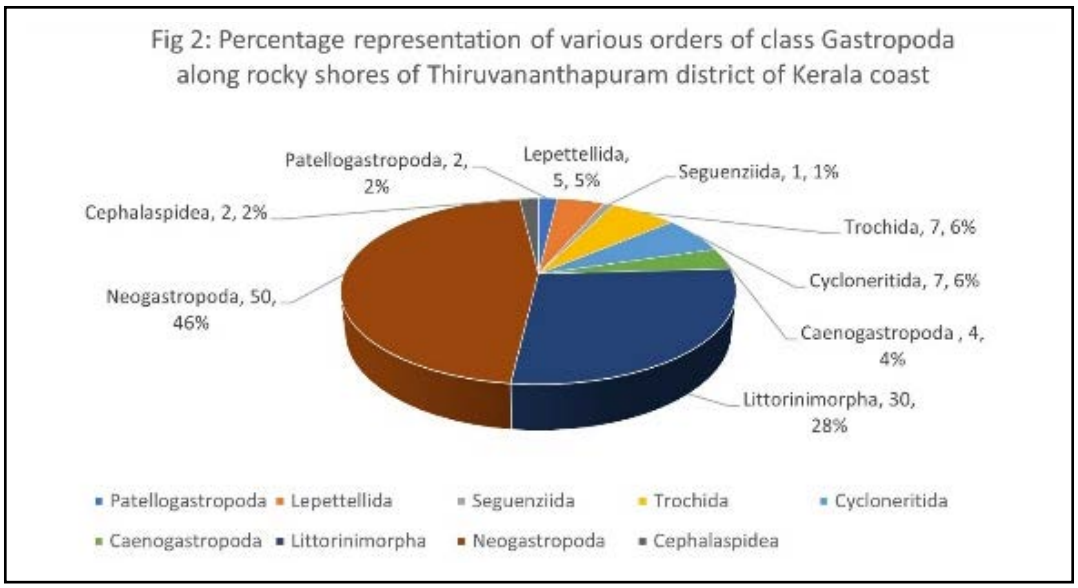


Fig 2: Percentage representation of various orders of class Gastropoda along rocky shores of Thiruvananthapuram district of Kerala coast

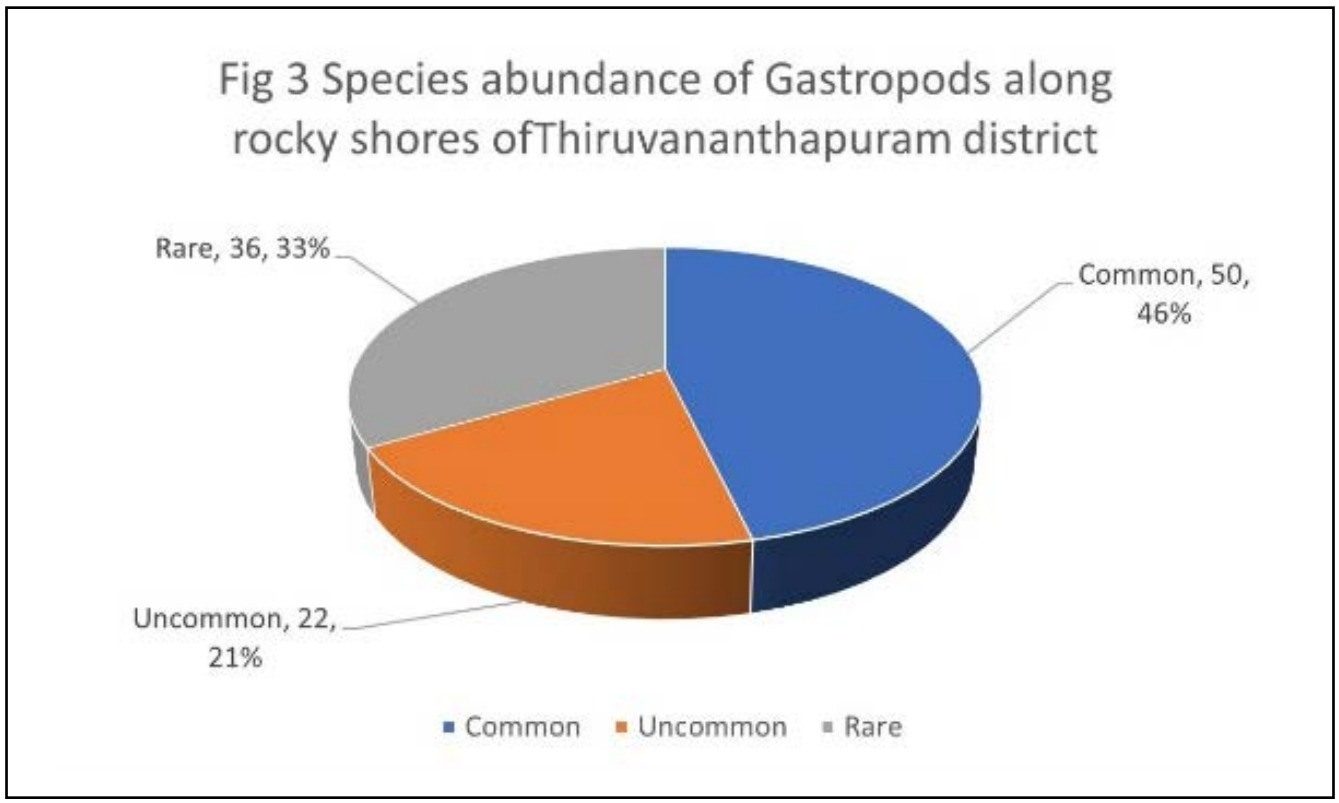


Fig 3: Species abundance of gastropods along rocky shores of Thiruvananthapuram district

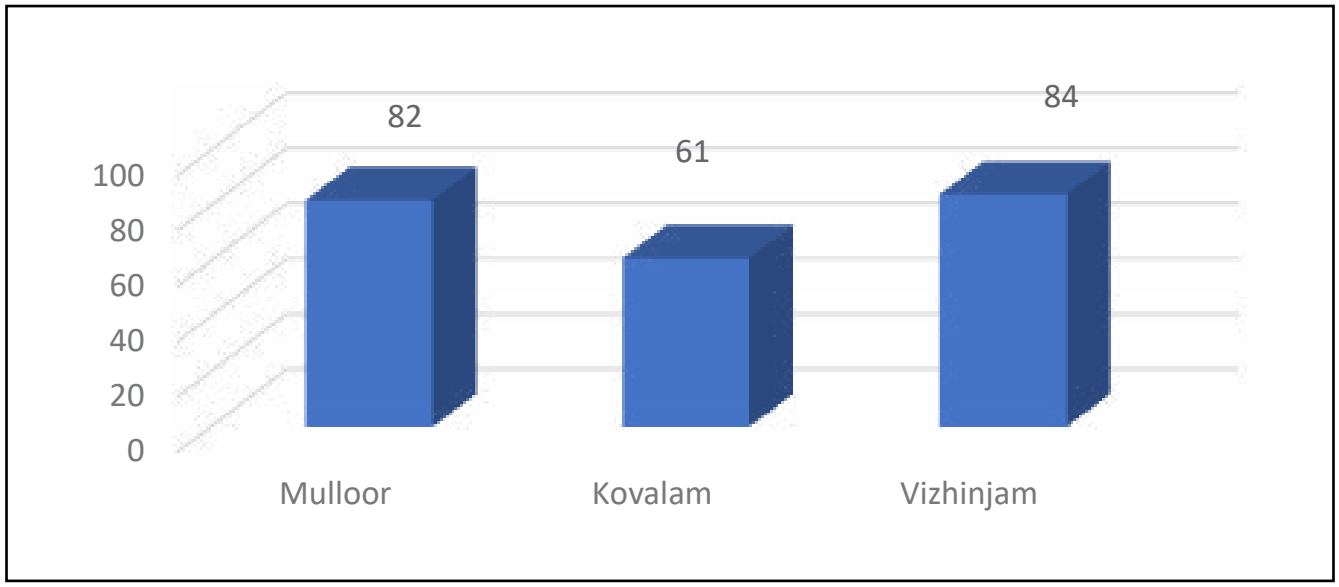


Fig 4: Site wise comparison of Gastropod diversity

New reports from the study –

Plate 1

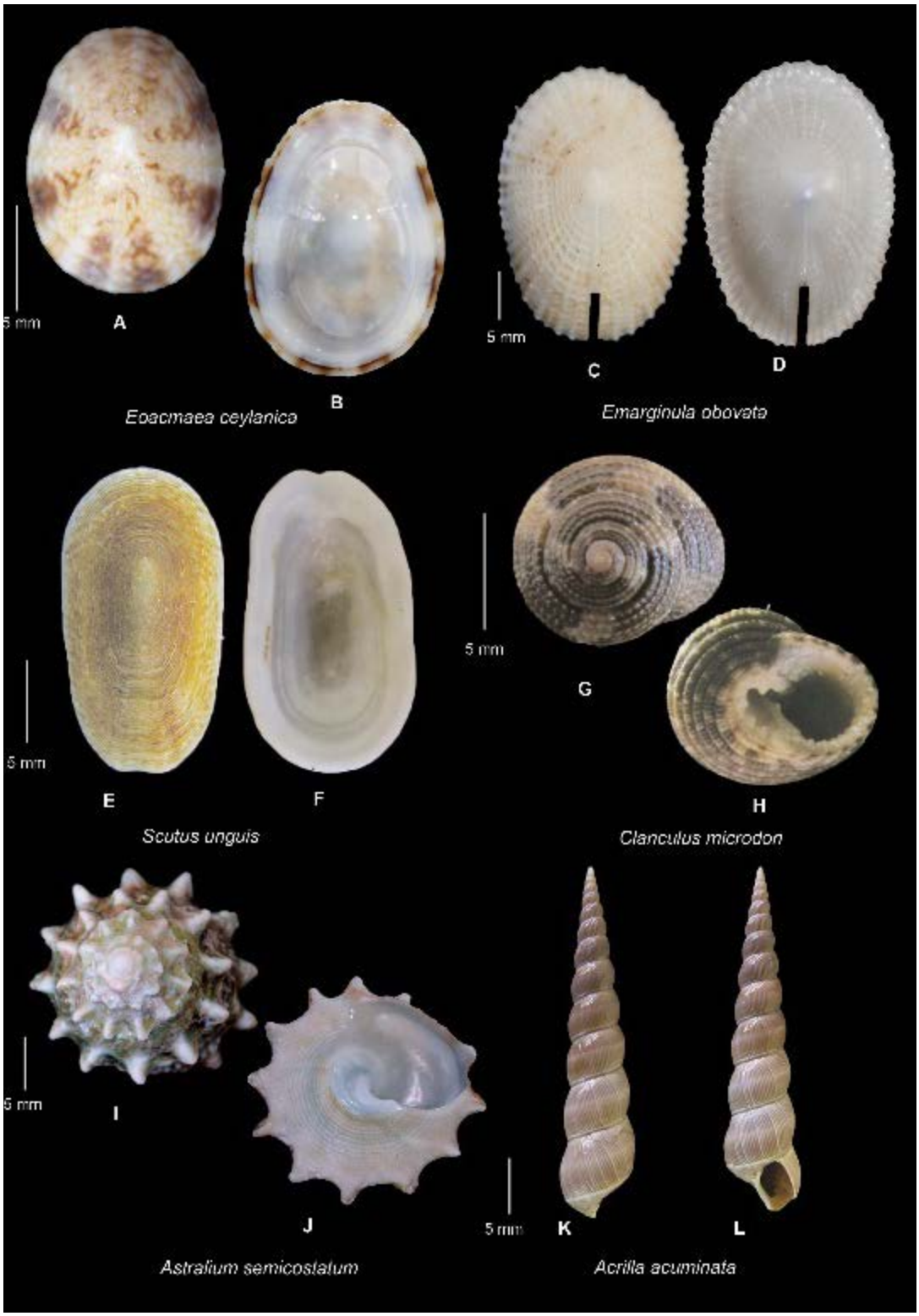


Plate 2

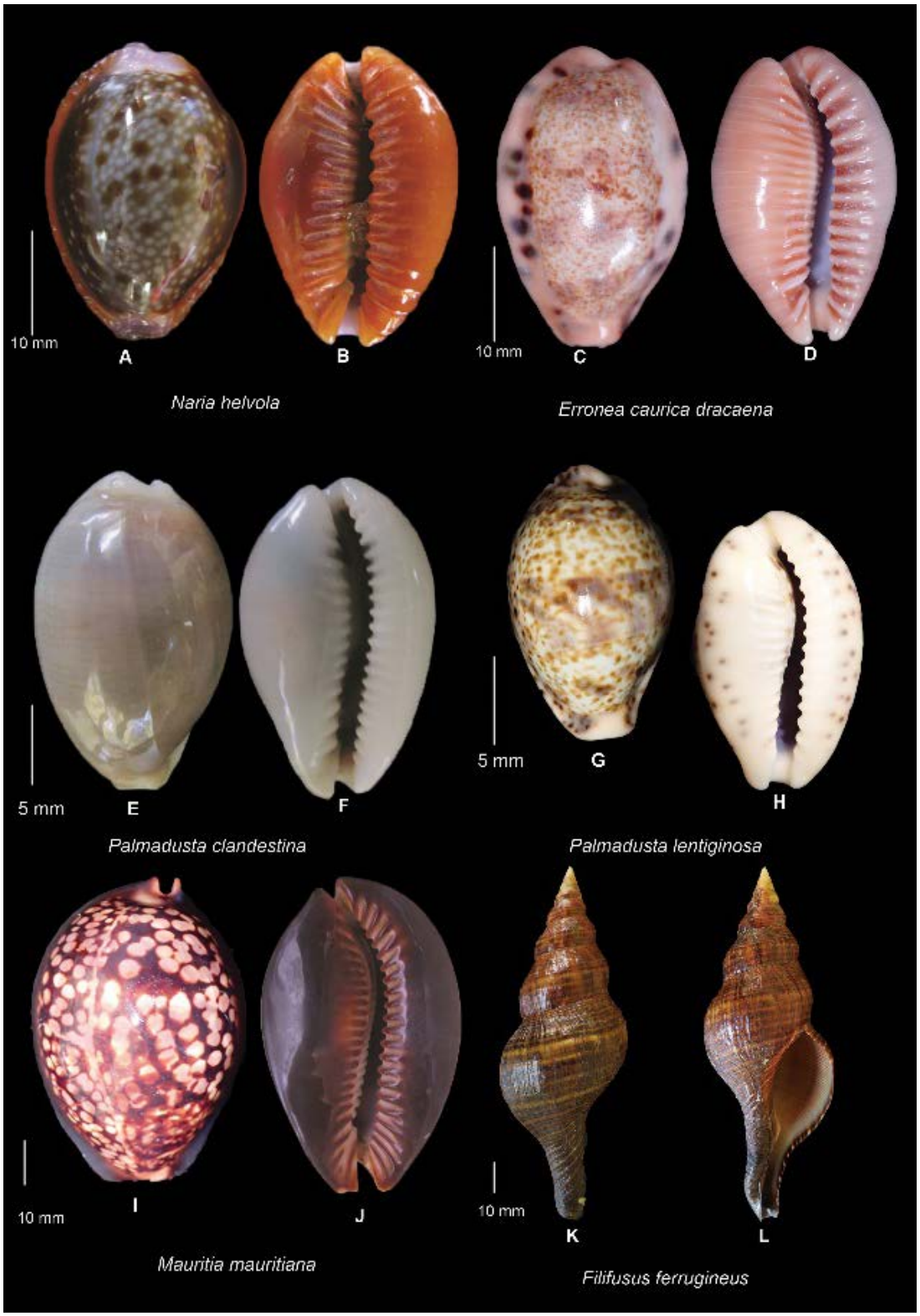
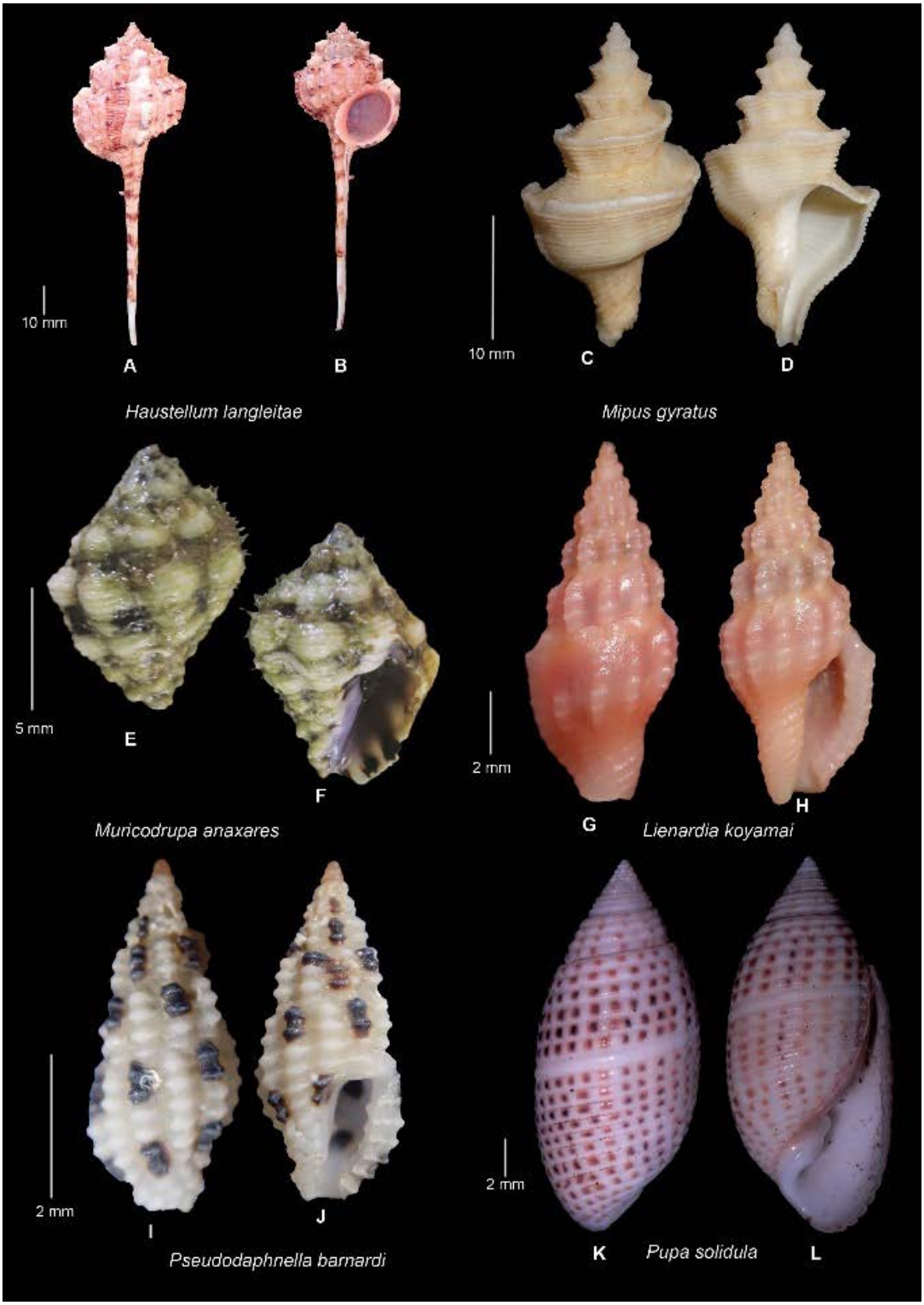

10 mm
A
B
Naria helvola
10 mm
C
D
Erronea caurica dracaena
5 mm
E
F
Palmadusta clandestina
5 mm
G
H
Palmadusta lentiginosa
10 mm
I
J
Mauritia mauritiana
10 mm
K
L
Filifusus ferrugineus

Plate 3


10 mm
A
B
Haustellum langleitae
10 mm
C
D
Mipus gyratus
5 mm
E
F
Muricodrupa anaxares
2 mm
G
H
Lienardia koyamai
2 mm
I
J
Pseudodaphnella barnardi
2 mm
K
Pupa solidula
L

Acknowledgements

The authors thank the Department of aquatic Biology and Fisheries, University of Kerala, Karyavattam, Thiruvananthapuram for the facilities and encouragement.

References

Abbott, R.T.(1991). Seashells of South East Asia, Tynron Press, Dumfriesshire, Scotland. 145pp., 52pls

Anu, S., Ravinesh, R., Shijith, V.B. and Biju Kumar, A. (2017) Biodiversity associated with the mussel beds of Vizhinjam coast, Kerala, India, Journal of Aquatic Biology & Fisheries, 5: 36-53.

Araújo, R., Bárbara, I., Sousa-Pinto, I. & Quintino, V. (2005). Spatial variability of intertidal rocky shore assemblages in the northwest coast of Portugal. *Estuarine, Coastal and Shelf Science* 64:658-670.

Baiju, P. T.; Prabhakaran, M. P. ; Ajas Miraj, C. H. ; Kiran, J. & Benno Pereira, F. G. (2023). Opisthobranch (Mollusca: Gastropoda) Fauna of Rocky Reef Ecosystems of Kerala Coast, India. *Braz. J. Aquat. Sci. Technol., 27(1)*

Benedetti, C. L. (2001). Variability in abundance of algae and invertebrates at different spatial scales on rocky sea shores. *Marine Ecology Progress Series,* 215: 79–92.

Biju Kumar, A and Ravinesh R. (2011) Will shoreline armouring support marine biodiversity?. Current Science, 100: 1463.

Bouchet, P. and Strong, E. E. (2010). Historical namebearing types in marine molluscs: An impediment to biodiversity studies? *Systema Naturae,* 250: 63–74

Branch, George & Thompson, Richard & Crowe, Tasman & Castilla, Juan & Langmead, Olivia & Hawkins, Stephen & Polunin, N.V.C. (2008). Rocky intertidal shores: Prognosis for the future. *Aquatic Ecosystems: Trends and Global Prospects*. 209-225. 10.1017/CBO9780511751790.020.

Cruz L. E., Agudelo L. A. L. M., Galvez F. A., Paz D. L. H., Prado A., Cuellar L. M., Cantera J., (2014) Distribution of macroinvertebrates on intertidal rocky shores in Gorgona Island, Colombia (Tropical Eastern Pacific). *Revista de Biologica Tropical* 62:189–198.

D'Souza, S.L., D'Souza, N. & Shenoy, K. (2022). Molluscan diversity of coastal Karnataka, India and role of physicochemical parameters on their diversity. *J Coast Conserv* 2022) 2 ,26). https://doi.org/10.1007/s11852-021-00849-w

Davies, M.S., Williams, G.A., (1998). Aspects of littorinid biology—epilogue. *Hydrobiologia* 378, 243–246.

Edward, J.K.P., Ravinesh, R. & Biju Kumar, A. (2022). Molluscs of the Gulf of Mannar, India and Adjacent Waters: A Fully Illustrated Guide (Dekker, H. & Oliver, P.G. Eds.). Suganthi Devadason Marine Research Institute, Tuticorin & Department of Aquatic Biology & Fisheries, University of Kerala, India, 524pp.Eglantine Chappuis, Marc Terradas, Maria Elena Cefalì, Simone Mariani and Enric Ballesteros,2014. Vertical zonation is the main distribution pattern of littoral assemblages on rocky shores at a regional scale. Estuarine, Coastal and Shelf Science, Volume 147: 113-122,

Eglantine Chappuis, Marc Terradas, Maria Elena Cefalì, Simone Mariani and Enric Ballesteros. (2014). Vertical zonation is the main distribution pattern of littoral assemblages on rocky shores at a regional scale. Estuarine, Coastal and Shelf Science, Volume 147: 113-122,

Hammer, Ø., Harper, D.A.T., and Ryan, P. D. (2001). PAST: Paleontological Statistics Software Package for Education and Data Analysis. *Palaeontologia Electronica*, 4(1): 9pp

Islami MM. (2012). Studi kepadatan dan keragaman moluska di pesisir pulau Nusalaut, Maluku. *Oseanologi dan Limnologi di Indonesia* 38 (3): 293-305.

Lars Tomanek, Brian Helmuth, (2002) Physiological Ecology of Rocky Intertidal Organisms: A Synergy of Concepts, *Integrative and Comparative Biology*, Volume 42, Issue 4, Pages 771–775, https://doi.org/10.1093/icb/42.4.771

Marshall, D.J., Baharuddin, N. & McQuaid, C.D. (2013). Behaviour moderates climate warming vulnerability in high-rocky-shore snails: interactions of habitat use, energy consumption and environmental temperature. *Mar Biol* **160**, 2525–2530. https://doi.org/10.1007/s00227-013-2245-1

Nair, N.B. and Thampy, D.M. (1980). A Textbook of Marine Ecology. Macmillan. Science, New Delhi, 352pp.

Katie O'Dwyer, Aaron Lynch, Robert Poulin (2014) Reduced attachment strength of rocky shore gastropods caused by trematode infection. *Journal of Experimental Marine Biology and Ecology* 458 (2014) 1–5

Pechenik J. A., (2016) Biology of invertebrates. Seventh edition, McGraw Hill Education, New York, USA, 606 pp.

Puryono, S., & Suryanti, S. (2019). Gastropod diversity in mangrove forests of Mojo village, Ulujami district, Pemalang Regency, Indonesia.

Ravichandran, Ramanibai & Sivalingam, Govindan. (2018). Mollusc diversity at pulicat Lagoon (India). Transylvanian Review of Systematical and Ecological Research. 20. 10.1515/trser-2018-0003.

Rao, S.N.V. (2003). Indian Seashells (Part-I): Polyplacopora and Gastropoda. *Occ Paper. Rec Zool Surv India*, 19 : 2-416.

Rao, U.M. and Sreeramulu, T. (1970). An annotated list of marine algae of Vishakapatnam (India). *Botanical Journal of the Linnean Society.,* 63: 23-45.

Ravinesh.R & Kumar, Biju. (2013). Comparison of intertidal biodiversity associated with natural rocky shore and sea wall: A case study from the Kerala coast, India. Indian Journal of Marine Sciences. 42.

Robin, A. (2008). *Encyclopedia of Marine Gastropods.* Conch Books, place of publctn, 480.

Röckel, D., Korn, W. & Kohn, A.J. (1995) Manual of the living Conidae. Vol. 1. Indo-Pacific region. Verlag Christa Hemmen, Wiesbaden, 517 pp.

Sary, P.S., Kiran, P. R. B., Balasubramanian, N.K. and Kumar, B. A. (2014). Diversity of Cone Snails (Mollusca: Conidae) along Kerala Coast. *Journal of Aquatic Biology and Fisheries*, 2:619 – 622.

Sary, P.S., Kiran, P.R.B. and Kumar, B.A. (2013). Diversity of Gastropod Shells (Mollusca: Gastropoda) of Vizhinjam Bay, Southwest Coast of India. Proc. Multidisciplinary national Seminar, November 4-6, 2013, P. M. Sayeed Calicut University Centre, Androth, 39-41pp.

Smith, D. (2013). Ecology of the New Zealand rocky shore community. *Otago: New Zealand Marine Studies Centre, Univercity of Otago*, *55*.

Taufik Adhi Prasetya , Fitria Kurnia Nazira, Irkhamna Noviyani Khusna Millaty, Wildan Gayuh Zulfikar, Fitri Ainun Nazara, Trijoko. (2017). Molluscan diversity (Gastropoda: Neogastropoda) in the intertidal zone of Nguyahan Beach, Gunungkidul, Yogyakarta, Indonesia.Ocean Life. Volume 1, Number 2, December 2017 Pages: 55-60

Tikader, B. K., Daniel, A., & Subba Rao, N. V. (1986). Sea Shore Animals of Andaman & Nicobar Islands.

Trott, T.J. (2022). Mesoscale spatial patterns of gulf of maine rocky intertidal communities. *Diversity* 14, 557. https://doi.org/10.3390/d14070557

Underwood, A.J., and Chapman, M.G. (1996) Scales of spatial patterns of distribution of intertidal invertebrates. Oecologia 107, 212–224 (1996). https://doi.org/10.1007/BF00327905

Underwood, A. J., & Chapman, M. G. (2013). Intertidal Ecosystems. Encyclopedia of Biodiversity, 332–344. doi:10.1016/b978-0-12-384719-5.00156-8

Worm, B., & Lotze, H. K. (2006). Effects of eutrophication, grazing, and algal blooms on rocky shores. *Limnology and oceanography*, *51*(1part2), 569-579.