TAXONOMIC IDENTIFICATION OF SUBCLASS CAENOGASTROPODA

Project Work By

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CERTIFICATE

This to certify that the project work entitled **‘‘TAXONOMIC IDENTIFICATION OF SUBCLASS CAENOGASTROPODA’’**submitted by Ms. GLEN RUTH JOSEPH, is a bonafide work done under my guidance and super vision and to the best of my knowledge, this is her original effort.

DECLARATION

I, Ms. GLEN RUTH JOSEPH, hereby declare that the project report entitled "**TAXONOMIC IDENTIFICATION OF SUBCLASS CAENOGASTROPODA** " is a bonafide record of work done by me during the academic year 2022-2023 in partial fulfilment of the requirements of Bachelor of science degree of Mahatma Gandhi University, Kottayam.

This work has not been undertaken or submitted elsewhere in connection with any other academic course and the opinions furnished in this report is entirely my own.

GLEN RUTH JOSEPH

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ABSTRACT

Wildlife [Protection] act has declared many areas as conserved and many species are well protected under the act. The act also created restrictions on collecting molluscs. This created a need to taxonomically study the available specimen in the museum. Most of the specimens were classified only up to their generic level. In the present work, an attempt is made to classify up to its species level. Except for three egg masses, all others are shells. The classification is done based on morphological features like protoconch structure, the shape of the shell, no of whorls, digitations etc. 28 specimens are classified up to species level which range under 18 different families in 4 different orders.

INTRODUCTION

The phylum Mollusca is the second-largest animal phylum, with over 100,000 species. The molluscs include many familiar animals, including clams, snails, slugs, and squid, as well as some less familiar animals, like tusk shells and chitons. Molluscs are found in nearly all freshwater and marine environments, and some are found also on land. Molluscs comprise 23% of all named marine organisms. Marine molluscs are the ones that are well known. Along with the insects and vertebrates, it is one of the most diverse groups in the animal kingdom. Each group includes an ecologically and structurally immense variety of forms: the shell-less forms, the narrow-footed gliders, the serially valved chitons (Polyplacophora); the cap-shaped neopilinids (Monoplacophora); the limpets, snails, and slugs (Gastropoda); the clams, mussels, scallops, oysters, shipworms, and cockles (Bivalvia); the tubiform to barrel-shaped tusk shells (Scaphopoda); and the nautiluses, cuttlefishes, squids, and octopuses (Cephalopoda).

Molluscs occur in most habitats from the deep sea to high mountains. Although mollusc differ greatly in their morphology, these features are common in all molluscs.

1. Specialized foot for digging, grasping or creeping.
2. Presence of mantle or mass of soft flesh that cover their soft body and internal organs.
3. Organization of nervous system.

Although molluscs are coelomates, the coelom tends to be small. Most species have radula, which is used in feeding. Bivalves being filter feeders lack radula. Many molluscs have calcareous shell. The main body cavity is a hemocoel through which blood circulates; as such, their circulatory systems are mainly open. The generalized mollusc has two paired nerve cords, or three in bivalves. Most molluscs have eyes, and all have sensors to detect chemicals, vibrations and touch. Molluscs breathe with gills called ctenidia that sit in a cavity between the mantle and body mass.

Molluscs like clams, mussels, octopuses, squids, oysters have been an important food source. Although most shelled mollusc produce pearls, only those produced by bivalves and some gastropods have value. Bivalves are used as bioindicators to monitor health of aquatic environments. Many economically valuable products like pearl, Tyrian purple dye, sea silk etc.

are obtained from molluscs. Many molluscs are harmful to human, some act as pests. The bite of blue ringed octopus may cause death. Venom secreted by cone shells can kill a person. Water snails act as vectors in causing schistosomiasis in human. Freshwater and terrestrial molluscs appear exceptionally vulnerable to extinction. 2,000 nonmarine molluscs and 41 endangered marine molluscs were added to IUCN Red List of Threatened species in 2004.

Phylum Mollusca are generally classified into:

Class 1: Aplacophora
Subclass: Chaetodermomorpha e.g: *Chaetoderma*
Subclass: Neomeniomorpha e.g.: *Neomenia, Proneomenia*

Class 2: Polyplacophora
Order: Palacoloricata
Order: Neoloricata e.g.: *Lepidopleurus, Cryptoplax*.

Class 3: Monoplacophora e.g.: *Neopilina.*

Class 4: Gastropoda

Subclass: Amphigastropoda
Order: Bellerophontidae eg; *Plectonotini*

Subclass: Archaeobranchia
Order: Pelagiellida eg; *Aldanella*
Order: Helcionellida eg; *Scenella*

Subclass: Patellogastropoda
Order: Patellida eg; *Cellana*

Subclass: Neomphaliones
Order:Neomphalida eg;*Ctenopelta*
Order:Cocculinida eg;*Coccopigya*

Subclass: Vetigastropoda
Order: Pleurotomariida eg;*Bembexia*
Order: Seguenziida eg; *Davisiana*
Order: Lepetellida eg*; Lepetella*
Order: Trochida eg; *Agagus*

Subclass: Neritimorpha
Order: Cyrtoneritida eg;*Orthonychia*
Order: Cycloneritida eg; *Alcadia*

Subclass: Caenogastropoda
Order: Littorinimorpha eg; *Cypraea*
Order: Neogastropoda eg; *Turbinella*

Subclass Heterobranchia
Infraclass: Euthyneura eg;*Rissoella*
Infraclass: Mesoneura eg; *Rhodope*

Class 5: Bivalvia

Subclass Protobranchia
Order: Nuculoida e.g.: *Nucula*.
Order:Solemyoida e.g.: *Solemya.*

Subclass: Pteriomorphia
Order: Arcoida e.g.: *Anadara*,
Order: Mytiloida e.g.: *Mytilus, Modiolus*.
Order: Pterioida e.g.: *Pteria, Pinna*.
Order: Ostreoida e.g.: *Ostrea, Pecten, Chlamys*
Order: Limoid ae.g.: *Lima*.

Subclass: Palaeoheterodonta
Order: Unionoida e.g.: *Unio, Anodonta*
Order: Trigonioida e.g.: *Trigonium*.

Subclass: Heterodonta
Order: Veneroida e.g.: *Cardium, Mactrea, Tellina, Solen, Ensis.*
Order: Myoida e.g.: *Mya, Pholas. Teredo*
Order: Hippuritoida e.g.: *Chama.*

Subclass: Anomalodesmata e.g.: *Pandora, Poromya*

Class 6: Scaphopoda c.g.: *Dentalium.*

Class 7: Cephalopoda

Subclass Nautiloidea e.g.: *Nautilus.*

Subclass Ammonoidea e.g.: *Ammonites.*

Subclass: Coleoidea
Order: Belemnoidea e.g.: *Belemnites.*
Order: Sepioidea e.g.: *Sepia, Sepiola, Spirula, Rossia*.
Order: Teuthoidea e.g.: *Loligo, Sepiolenthis. Architeuthis*
Order: Vampyromorpha e.g.: *Vampyroteuthis.*
Order: Octopoda e.g: *Opisthoteuthis, Octopus*.

Class Gastropoda is the largest class in phylum Mollusca. Gastropoda includes more than 62,000 described living species and comprise about 80% of living molluscs. Gastropods are well established in all three habitats: ocean, freshwater and land. 721 families of gastropods are known, of which 245 are extinct and appear only in fossil record. Fossil record of gastropods dates to Late Cambrian. The anatomy, behaviour feeding and reproductive adaptations vary from one group to another. Generally, gastropods with a big external shell to which their soft parts can be completely withdrawn are called as snails. Term slug is used to refer gastropods without external shell or with a much-reduced internal shell.

Shells of gastropods are one piece shell either coiled or spiralled. Many species have operculum that is used to close the shell. Gastropods have olfactory organs, eyes, statocysts and mechanoreceptors. Gastropod nervous system includes both peripheral nervous system and gangliated central nervous system. In gastropods, radula is adapted depending on the food they eat. Most of the gastropods are burrow dwelling for this they have siphons. Most of the gastropods use gills for respiration. Many freshwater and majority of terrestrial species have lungs. Primary organ of excretion is nephridia. They are either ammonotelic or uricotelic.

Caenogastropoda includes approximately 100 families. The earliest caenogastropods appear in late Silurian and early Devonian rocks from about 400 million years ago. From this initial appearance, the caenogastropods have radiated into the most diverse gastropod group living today. This diversity spans every aspect of biodiversity and includes morphology, habitat, behaviour, and reproductive mode, among others. Caenogastropod shells are typically coiled and almost every shell form is found within this group, from flat squat shells to globose ones and even long, narrow, tightly coiled ones. A few are limpet-like, and one group, the Vermetidae, has shells that uncoil and look like worm-tubes; in a few caenogastropods, the shell is reduced to an internal remnant in the snail's body. The most pronounced morphological change is in groups such as the Entoconchidae, which are shell-less, worm-like internal parasites of echinoderms.

A major feature of the caenogastropods is modification to the pallial cavity, which contains the gill (or ctenidium) and associated sense organs and openings from the kidneys, gonad, and intestine. The shell is never nacreous, and an operculum is present in most adults. Apart from members of the Neogastropoda, the radula usually has only seven teeth in each row. The radula of Neogastropods has five teeth to one tooth in each row; it is altogether absent in some species. Caenogastropods occur worldwide in all marine, estuarine, freshwater, and terrestrial habitats. Most are found in the marine environment, where they extend from the high tide mark to the deepest oceans; several groups live in freshwater or terrestrial habitats. In the terrestrial realm, caenogastropods can be found in the wettest environments of tropical rainforests and in the driest deserts. Some of the smallest caenogastropods live below ground in the lightless world of aquifers and caves, and others interstitially in groundwater. Marine diversity is highest near shore and becomes reduced as depth increases beyond the shelf slope.

Caenogastropod behaviour can be characterized as feeding, fighting, fleeing, and mating, and most of these behaviours are primarily driven by chemoreception. In intertidal region, caenogastropod activity and feeding behaviours vary with the tidal cycle: snails are inactive at low tide (except at night) and become active as the tide rises. In the subtidal, diurnal/nocturnal behaviours are important in avoiding predation; in the open ocean, vertical migrations of pteropods have been documented, with the snails moving to deeper water during daylight, but coming within 328 ft (100 m) of the surface at night. Migrations of upper and lower shore *Littorina* species have also been do.

Due to anthropogenic activities, we have lost many species. In the future many more will become extinct or endangered. To protect biodiversity from man, Wildlife [Protection] Act was enacted in 1972. As per the Wildlife (Protection) Act, there is ban on collecting mollusc specimens directly from certain conserved areas so in future students will not be able to see and taxonomically study about them. This is the first time in which a detailed taxonomic study of subclass Caenogastropoda is conducted. The aim of the works is (i) identifying, classifying the specimens available at our museum to its species level (ii) maintenance of the preserved specimens. This helps to study more about their unique characteristics whenever possible. They should be preserved and studied so that future generation can refer it. Thus, studying more about their classification helps to know and understand more about the diversity of molluscs and their importance to nature.

REVIEW OF LITERATURE

A comprehensive review of malacofauna of circumpolar Arctic was lacking. A complete analysis on biogeography, distribution, and taxonomy of freshwater molluscs were performed by Vinarski et al [2021]. They divided Arctic into 4 subregions: Europe, Siberia, Beringia and North America. The final number of species included in the checklist created by this study is 104. So, the true species richness of the circumpolar freshwater molluscs lies between 100 and 120 species. The circumpolar Mollusca constitute less than 2% of the global diversity of these animals. Only 10 of 42 families of freshwater mollusc extend their ranges into the Circumpolar Arctic. There are no species of freshwater Mollusca endemic to the Circumpolar Arctic. The most species-rich subregion is Siberia, whereas the north of North America maintains the poorest fauna of molluscs. This is because of their difference in area.

The family Hydrobiidae Troschel, 1857, one of the largest families of the superfamily Rissooidea, occur in permanent freshwater or (a few taxa) brackish habitats all over the world. The main problem that arises when one tries to resolve the hydrobiid phylogeny is in evolutionary convergence commonly found in their shell form and anatomy. In 2006, Magdalena Szarowska filled up many gaps in the knowledge of phylogenetic relationships among hydrobiid snails and evolution of their characters. Out of 33 Balkan Rissooid genera studied, 24 genera belong to monophyletic family Hydrobiidae. Hydrobiidae is divided into two subfamilies: Hydrobiinae and Sadlerianinae. The latter includes mostly very closely related genera. The rest 6 genera belong to Assimineidae, Amnicolidae, Bythinellidae, Lithoglyphidae, Cochliopidae, Bithyniidae, Emmericiidae and Moitessieriidae. The caecal appendix on the stomach, reduction of the basal cusps and spermathecal duct evolved parallelly and are homoplastic.

Apple snails are freshwater gastropods in the family Ampullariidae. In 2019, A new species of apple snail in the genus Pomacea (Gastropoda: Caenogastropoda: Ampullariidae) was described by Qian-Qian Yang and Xiao-Ping Yu. They studied the morphology of the newly discovered invasive Pomacea species, focusing on how it is distinct from *P. canaliculata* and *P. maculata*. The new species is *Pomacea occulta*. A molecular phylogenetic analysis showed that *P. canaliculata* group (Hayes et al., 2009) includes *P. canaliculata, P. dolioides, P. maculata and P. paludosa*. Phylogenetic studies based on COI sequences and whole

mitochondrial genomes showed that *P. occulta* nov. sp. is a member of this *P. canaliculata* group. The position of the penis sheath glands can be used as the most reliable character to distinguish *P. canaliculata, P. maculata*, and *P. occulta* nov. sp. *P. maculata* has an apical and a basal gland, whereas *P. canaliculata* has an apical and a medial gland (Hayes et al.., 2012). *P. occulta* nov. sp., similar to *P. canaliculata*, has an apical and a medial gland. However, the location of the medial gland of *P. occulta* nov. sp. is in the sheath channel, while the medial gland of *P. canaliculata* is located to the right of the sheath channel.

Less than 1% of marine gastropod species live a holoplanktic life. Of these, the shelled heteropods of the family Atlantidae are among the most poorly understood. Palmer et al. in 2016 worked on atlantid taxonomy, palaeontology, ecology and biogeography, aiming to provide a foundation for future research on this group. The taxonomy of the Atlantidae largely relies on shell morphology, in particular protoconch shape (number of whorls) and ornamentation. The eyes, radula and operculum are also necessary for identification. In the Indian Ocean, monsoon influenced heteropod abundance, with greatest numbers generally collected during November and December. Seasonal abundance of atlantid heteropods is complex and closely linked to changes in water currents and food availability, rather than water temperature alone. Although there are few records of atlantids living in cold-water regions, the Late Pleistocene fossil record demonstrates that they can be common in cold waters.

Venoms are a rich natural source for the discovery of drugs with painkiller, anti-inflammatory, or antihypertensive properties, and thus, they have great potential for human therapeutics. In 2021, Abalde, et al. The transcriptome of the venom duct from one specimen of *Cylinder ammiralis* was sequenced. Combined transcriptomic and proteomic approach was used to characterize the composition of the venom produced by the admiral cone snail, *Cylinder ammiralis*, a molluscivorous species. The predation- and defense-evoked venoms of *C. ammiralis* showed markedly distinct yet equally complex profiles. A total of 217 different peptides were identified, of which only about half were common to the two venoms. 174 peptides and 158 peptides are included in predatory venom and defensive venom respectively. There are 13 hormone-like conopeptides in the venom gland transcriptome of *C. ammiralis*. There is a cono-insulin in the predation-evoked venom and used in prey capture.

The toxin accumulators *Nassarius glans* and *Nassarius siquijorensis* are widely distributed in the subtidal regions of the Indo-Pacific Ocean. As scavengers, nassariids are important in

maintaining the balance of benthic ecosystem. In 2020, Yi Yang, et al. sequenced the complete mitochondrial genomes of *N. glans* and *N. siquijorensis* to understand their phylogeny. Both encode for 13 protein-coding genes (PCGs), 22 transfer RNA (tRNA) genes and two ribosomal RNA (rRNA) genes. *N. glans. N. siquijorensis* was revealed as the sister group of *N. nodifer* + *N. conoidalis* while *N. glans* clustered with *N. foveolatus* + (*N. javanus* + (*N. succinctus* + *N. sinarus*).

Some gastropods are kleptoparasitic filter feeders that take advantage of the water current produced by the host. This is particularly true for the genus *Hyalorisia* Dall, 1889, [Capulidae] which occurs in deep water in the Caribbean and Indo-West Pacific provinces. In 2020, Fassio, et al. combined morphological, ecological, and molecular data and assessed the diversity of the genus, its phylogenetic position inside the family and its association with its bivalve host, the genus *Propeamussium* de Gregorio, 1884 (Pectinoidea). This resulted in description of nine new species. They examined 116 specimens belonging to 6 out of the 18 accepted extant genera of Capulidae. In the phylogenetic reconstructions, all specimens assigned to *Hyalorisia* formed a maximally supported clade and this is sister to a clade including *Capulus ungaricus*, the type species of the genus *Capulus.* Current classification of *Hyalorisia* as a separate genus can be justified by the presence of lamella and the association with propeamusiid bivalves.

In 2012, Falniowski, et al. studied the morphology of the shell, penis, and female reproductive organs, as well as the mitochondrial COI and ribosomal 18S (112 and 38 sequences, respectively) in 40 populations of the Balkan hydrobiids, *Radomaniola* and *Grossuana.* Despite wide variation, there are no morphological differences between *Radomaniola* and *Grossuana* or between the nominal species assigned to these genera. The COI Bayesian tree proved the monophyly of the group, while the ML tree did not. Both methods revealed three groups: one of *Grossuana* from Serbia, Bulgaria, Romania and NE Greece (disjunct distribution); and two of *Radomaniola* from part of the former Yugoslavia and SE Greece. However, only the *Radomaniola* from the former Yugoslavia was monophyletic. The striking difference between the two samples of *R. curta anagastica* from the same locality collected at different seasons is probably connected with seasonal variation in shell morphology, which is an important source of variation in a character set that is normally considered as reflecting species distinctness. All three species of Grossuana, *G. codreanui, G. serbica* and *G. delphica* formed a clade.

In 2022, Karapunar, et al. tried to describe the pleurotomariid taxa of newly gathered collections from various Pennsylvanian outcrops in Texas, Oklahoma, Kansas and Ohio. Most species have a protoconch of one whorl as that of living Vetigastropoda. Planktotrophic protoconchs (multi-whorled larval shells) are reported for *Platyzona* and *Peruvispira*. *Peruvispira* has a clearly multi-whorled, heliciform caenogastropod-style larval shell of the planktotrophic type. This type of larval shell has been shown to be present in several late Palaeozoic caenogastropods including some having a selenizone on the. Hence, *Peruvispira delicata* and the genus *Peruvispira* were placed in Caenogastropoda and Goniasmatidae. *Peruvispira gundyensis* shows the characteristic shell shape, whorl profile, position of selenizone and ornamentation of the Devonian genus *Lukesispira* Frýda and Manda, 1997; therefore, it is assigned to *Lukesispira*: *Lukesispira gundyensis*. *Platyzona* comprises turbiniform shells with rounded convex whorls, an unusually wide selenizone and a spirally ornamented teleoconch. Based on the caenogastropod type larval shell, the genus *Platyzona* was placed in the family Goniasmatidae and then to Family Pithodeidae .

In 2018, Hilgers, et al. conducted study on first radula building tissue transcriptome and compared it to transcriptomes of mantle edge and foot muscle of same species. Muscle genes dominated in the foot cluster and were enriched in the shell building mantle, and radula clusters were dominated by genes associated with vesicle mediated secretion, chitin, carbohydrate, and aminoglycan processing. A significantly increased proportion of radula-specific genes originated since the origin of stem-molluscs, indicating that novel genes were especially important for radula evolution.

The Aciculidae is a western Palaearctic family of highest diversity in Central Europe, the Pyrenees, the Alps and the Balkans. Due to their hidden life, most of the aciculid species are rarely found and especially rarely found alive. In 2021, Lika et al. synonymized three aciculid taxa, namely *Platyla corpulenta* under *Platyla procax*; *Platyla ceraunorum* under *Platyla similis* and *Renea kobelti albanica* under *Renea kobelti*. The work reviewed historical and recently collected material of family Aciculidae from Albania and the neighbouring region.

In 2021**,** Diana Delicado re-evaluated the taxonomic status of species of *Arganiella* by analysing mitochondrial (mtCOI) and nuclear (18S rRNA) sequences of topotypes. The work proposed two new genera for *A. wolfi* and *A. tabanensis. Aretiana Delicado* and *Ramos* gen. nov. for *Arganiella wolfi* and *Docleiana Delicado* and *Pešić* gen. nov. for *Arganiella*

tabanensis. Results conflicted with the classification of valvatiform hydrobiid species solely based on traditional phenotypical methods and suggest further taxonomic evaluation within a molecular framework. Phylogenetic analyses depicted *Arganiella* as a non-monophyletic group within Hydrobiidae.

In 2020, Ting Hui Ng, et.al. provide a comprehensive update on the nomenclature, status and distribution of Pila species in Thailand, based on DNA barcoding and geometric morphometric analysis of recently collected material. The work confirmed that at least five *Pila* species are extant in Thailand*: Pila virescens, P. celebensis, P. turbinis, P. gracilis* and *P. pesmei.* Throughout Thailand, invasive confamilial *Pomacea* species appear to be replacing native *Pila* species. *Pila celebensis*, which has distinctive egg masses among all the known Southeast Asian *Pila*, appears to be sister to a clade comprising other SEA and some African *Pila.*

In 2019, Das, et al. attempted a holistic reappraisal of naticid taxonomy based on an extensive database of shell morphological characters and identified many distinct family and subfamily specific characters that survived fossilization. This approach has enabled us to identify three new naticid species from the Late Jurassic horizons of Kutch, India, thus extending back the time of origin of the family Naticidae by 30 Ma. Analysis of character matrix data reveals—*Gyrodes mahalanobisi* new species, *Euspira jhuraensis* new species, and *Euspira lakhaparensis* new species—belong to two subfamilies, Gyrodinae and Polinicinae. Analysis of characters of 63 species within 17 genera of the four subfamilies reveals that only a few characters can be used as conservative traits for the family Naticidae: (1) very few numbers of nucleus whorls, (2) relatively large aperture, and (3) presence of umbilicus and (3) presence of umbilicus.

In 2022, Napper, et al. reviewed the taxonomical status of the species in the genus *Stellaria* Møller, 1832. Prior to the work, the genus included several recent and fossil species, showing considerable morphological variation. In the work, its taxonomy is discussed and two new genera are proposed. The morphological features that separate the genus *Ponderiana* gen. nov. from *Stellaria* Møller, 1832 include a higher spire and different types of digitations. Another difference between the two genera is that the base of *Ponderiana* is lacking a distinct separation between the peripheral flange and the base, a feature present in *Stellaria*, in the updated data there are total 30 species under *Stellaria* that include live and fossil species.

In 2020, Rachel Collin, demonstrated *Crepidula aculeate* which was previously considered to a single species is an ancient cryptic species complex made up of at least eight species, and that this group should be placed in the genus *Bostrycapulus*. DNA sequences, protoconch morphology, embryonic morphology and developmental characters clearly differentiate these eight species. These ancient species differ only slightly in morphology from each other and genetic differentiation does not correlate with geographical distance. The work also described four new species (*B. pritzkeri, B. odites, B.latebrus and B. urraca*)

In 2018, Pimenta, et al taxonomic revision of the Nystiellidae from Brazil, including samples from the Rio Grande Rise, South Atlantic, was performed based on shell morphology. *Eccliseogyra maracatu* expanded the known geographic range of this species to off south-east Brazil. *Eccliseogyra nitida* is now recorded from north-eastern to south-eastern Brazil, as well as from the Rio Grande Rise. The genus *Iphitus* is newly recorded from the South Atlantic. A third species, *Narrimania raquelae* sp. nov. is described from eastern Brazil, diagnosed by its numerous and thinner cancellate sculpture. *Narrimania*, previously recorded from Brazil based on dubious records, is confirmed, including the only two living species described for the genus: *N. azelotes* and *N. concinna*. A third species, *Narrimania raquelae* sp. nov. is described from eastern Brazil, diagnosed by its numerous and thinner cancellate sculpture.

Bythinellian species delimitation, traditionally based on shell morphology and genital anatomy, is often a matter of debate. In 2007, Haase et.al. analyzed the relationships of species occurring in the south Austrian province Carinthia and in neighboring Slovenia as a model for similar cases of systematic and taxonomic ambiguity. The analyses based on sequence data of a fragment of COI comprising 638 bp, morphological and anatomical investigations confirmed the presence of three species, *B. opaca* (Gallenstein, 1848), B. *robiciana* (Clessin, 1890) and *B. angelitae* nom. nov. for *B. opaca* (Frauenfeld, 1857). The latter, while genetically distinct, is morphologically and anatomically cryptic in that it can only be distinguished from *B. opaca* by the denticulation of the radular marginal teeth. *B. robiciana*, on the other hand, is morphologically well defined, but genetically not separable from *B. opaca*, its stem species. Thus, taxonomy in *Bythinella* must be based on the integration of morphology, anatomy and genetics. *B. opaca* has colonized Carinthia, which has largely been covered by glaciers during the last ice age, along two routes, one from the south and a second one from the southeast.

Hungerfordia Beddome, 1889 is a terrestrial caenogastropod genus endemic to the Palau islands. It exhibits substantial morphological diversity. In 2015, Yamazaki et.al. redesribed the taxonomy of *Hungerfordia* species with low axial ribs. The work described 19 new species. The following new taxa are described: *H. aspera* sp. nov., *H. basodonta* sp. nov., *H. microbasodonta* sp. nov., *H. rudicostata* sp. nov., *H. unisulcata* sp. nov., *H. longissima* sp. nov., *H. eurystoma* sp. nov., *H. crenata* sp. nov., *H. crassilabris tridentata* subsp. nov., *H. crassilabris attenuata* subsp. nov., *H. lutea hemilaevis* subsp. nov., *H. loxodonta* sp. nov., *H. omphaloptyx* sp. nov., *H. robiginosa* sp. nov., *H. angaurensis* sp. nov., *H. ringens rotundata* subsp. nov., *H. ringens ventrinodus* subsp. nov., *H. pyramis pteroma* subsp. nov., *H. spinoscapula* sp. nov.

In Bangladesh, there is a general lack of detailed information on any gastropod species. In 2016, Saha, et al. conducted a study to note the taxonomic record and distribution pattern of *P. globosa* from Rajshahi University Campus. These snails prefer soft or clayey substratum instead of sandy one. In the dry season, i.e., with the advancement of fall of water level in the temporary water-bodies (ditch, canal, paddy field), the snails started to aestivate in soil. Earlier it was abundant in the area now it is declining rapidly.

In 2012, Luiz Simone and Carlo M Cunho presented a paper dealing with a taxonomic treatment and formal descriptions of all collected mollusc taxa, focusing on the Xenophoridae Troschel, 1852, Cypraeoidea Rafinesque,1815, the mitriforms and the Terebridae. Regarding the Xenophoridae, *Onustus aquitanus* is a new species. In respect to the Cypraeoidea: family Cypraeidae Rafinesque, 1815: *Erosaria acicularis* (Gmelin, 1791) and *Luria cinerea* (Gmelin, 1791) had the deepest record, respectively 607–620 m and 295–940 m. Family Ovulidae Fleming, 1822: *Pseudosimnia lacrima* is mainly characterised by its strong biconic outline, small size and a thick peripheral callus. Family Triviidae Troschel, 1863: *Cleotrivia antillarum* (Schilder, 1922) is recorded for the first time as deep as 620 m, and its distribution expanded from Rio Grande do Norte to Espírito Santo. In respect to the mitriform neogastropods: family Costellariidae found in a depth range of 60-1600. Family Mitridae: 295–620 m depth. Family Volutomitridae: 1500–1575 m depth. Family Mitromorphidae: 60–940m depth. Regarding the conoidean Terebridae a new species — *Terebra assu* Simone, 295 m depth, characterized by its narrow outline, yellowish colour, weak sculpture on the last whorls, and a proportionally broad, paucispiral protoconch.

In 2003 ,Ricardo Silva Absalão and Alexandre Dias Pimenta described *Anasser* n. subgen., a new subgenus of *Olivella* Swainson, 1831. It was proposed based on the absence of any kind of pillar structure and the presence of a parietal callus reaching the apertural end but not above it. Three new species are described from Brazilian deep waters: *Olivella (Anasser) careorugula* n. sp. is medium sized, oblong outline, whorls strongly convex and with a large subsutural white band; *Olivella (Olivina) hyphala* n. sp. is large, relatively big belled and presents a milk-white subsutural belt; and *Olivella*.

Gastropods rely completely on innate immune system. In haemolymph, gastropod specific phagocytic cells called haemocytes are present. In 2017, Lange, et al. investigated how gastropod-derived invertebrate extracellular phagocyte traps work as early immune reactions in different gastropod species. Gastropod haemocytes were isolated from the slug species *Arion lusitanicus* and *Limax maximus*, and the snail *Achatina fulica*, and exposed to larval stages of *Angiostrongylus vasorum*, *Aelurostrongylus abstrusus* and *Troglostrongylus brevior* and investigated for gastropod-derived InEPT formation. Gastropod haemocytes react to different lungworm parasites in a species independent manner.

The Calyptraeidae is a family of distinctive caenogastropods. Except for *Crepidula*, *Bostrycapulus*, and *Crepipatella*, neither the main genera in the family nor the family have been reviewed since the 1800s. In 2019, Rachel Collin reviewed distribution and diversity of the family, based primarily on material in the collections of the Natural History Museum of Los Angeles County. The study provided descriptions and photographs of three species of *Calyptraea*, 13 *Crepidula*, 3 *Crepipatella*, and 1 species each of *Bostrycapulus*, *Crucibulum*, and *Grandicrepidula*. Three new species, *Bostrycapulus decorus* n. sp., *Crepidula huertae* n. sp. and *Crepidula wolfae* n. sp. are described.

In 2017, Gugulothu, et al undertook a study on the biodiversity of *Conus* species in Gulf of Mannar coast. 16 species belonging to single genus *Conus* were recorded in Gulf of Mannar, southeast coast of India. Among the 16 species the Therespuram station representing highest number of species followed by Keelakarai and Vembar stations. The catch of *Conus* species was very high in pre-monsoon and summer season itself. Among 16 species recorded *C.*

Leopardus species dominated with 19.95%. The second highest contributed species was *C. eburneus* with 14.18%.

In 2012, Anandaraj, et al. collected samples of gastropods and bivalves from different stations of coastal area in Thanjavur District, Tamil Nadu, India. About 20 species of class gastropod and 20 species of class Bivalvia were recorded from September 2011 to December 2011. The maximum density of gastropod was observed Sedhubhavasatram coastal area. *Chicoreus ramosusm, Murex trapa, Natica trigrina, Oliva gibbosa* and *Tonna dolium* were dominant in the area.

In 2005, Harasewych, et al. conducted phylogenetic analyses of partial sequences spanning approximately 450 nucleotides near the 5'end of the 18s rDNA. It strongly supports the monophyly of Apogastropoda and its constituent clades, Caenogastropoda and Heterobranchia. While the Cyclophoroidea and Ampullariidae are monophyletic, the varying position of Viviparidae in all outcomes contradicts its hypothesized sister group relationship with Ampullariidae, and thus the monophyly of Ampullarioidea. This analysis supports monophyly of the Caenogastropoda, with three main clades recovered within the group: (1) *Neocyclotus* and *Marisa,* (2) *Lampanella, Petaloconchus, Strombus, Crepidula, Bithynia,* and (3) *Littorina* as the sister taxon to a group including *Neverita, Cypraea, Nitidiscala* and the neogastropods *Panarona*, *Prunum*, *Conus*, *Ilyanassa*, *Urosalpinx*. Thus, this analysis supports a monophyletic Architaenioglossa, Sorbeoconcha and Neogastropoda.

METHODOLOGY

MATERIALS REQUIRED

Formalin, Bucket, Water, Gloves, Bleach, Scale, Thread, Bottle of dry and wet specimens.
30 specimens placed in the museum grouped under phylum Mollusca were observed.

Based on their morphological features, specimens are identified and classified into different phylum. First of all, the specimens were taken out of the museum .Then their external features were observed and scientific measurements were made .The dry specimens were dipped to bleach solution made with 3 spoons of bleach in water for certain hours and were rubbed with a brush for further cleaning and old formalin solution of wet specimens were removed and fresh formalin solutions were added in the ration 9:1 after cleaning the specimen bottles .The specimens were then put back into the bottle. Finally labels were tagged on each specimen bottles which contain information on their Kingdom, Phylum, Class, Order, Family, Genus and Species.

OBSERVATION AND RESULT

The specimens studied come under the subclass Caenogastropoda. Out of the 30 specimens, 28 are classified up to its specific level, 1 up to generic level and 1 up to family level.
PHYLUM: MOLLUSCA, CLASS: GASTROPODA, SUBCLASS: CAENOGASTROPODA

1. CONUS EGG CAPSULES — Plate 1; Fig. 1a & b

ORDER: NEOGASTROPODA
FAMILY: CONIDAE
GENUS: CONUS

Habitat: They are found in sublittoral regions usually attached to rocky substratum.

Distribution: Indo-Pacific

Morphology: They have a flattened pouch or flask like shape. The capsule is white or straw-coloured. The capsules are deposited in clusters which frequently consist of several short rows of a few capsules each. There is a narrow, short stalk, above which is the capsule proper. Its walls are thin, nonrigid, and translucent, and they usually bear ridges on the flat surfaces. The lateral edges are typically convex, and there is a preformed exit window along the straight, uppermost part of the capsule. Number of capsules deposited in a cluster and the number of eggs per capsule are variable.

2. NATICIDAE EGG CAPSULES — Plate 1; Fig. 2a & b

ORDER: LITTORINIMORPHA
FAMILY: NATICIDAE

Habitat: Brackish and marine waters

Distribution: Eastern Atlantic: Mauritania to Angola and Indo-West Pacific: from the Mascarene Islands and India to Queensland.

Morphology: They have a shape of blouse collar. They are also known as sand collars. The sand collar consists of sand grains cemented together by a gelatinous matrix, with the embedded eggs contained within the matrix. Sand collar are stiff but flexible, as if it were made of plastic. Each sand collar contains thousands of capsules.

3. ***Turbinella angulata*** Lightfoot, 1786 Egg Mass Plate 1; Fig. 3a & b

ORDER: NEOGASTROPODA
FAMILY: TURBINELLIDAE
GENUS: TURBINELLA
SPECIES: ANGULATA

Habitat: Marine, live associated with reef at a depth range of 0 - 81 m. Also live on subtidal and offshore mud, rock or sand beds and mangrove lagoons vegetated with seagrass.

Distribution: Cuba, Gulf of Mexico and Madagascar

Morphology: It has wafer like structure.It looks like a wood. It has ridges in equal intervals throughout the length. Egg mass has an average length of 7 cm. It is white in colour. Egg masses are arranged in folds inside the thin outer covering.

4. ***Stellaria solaris*** Linnaeus, 1764 Plate 2; Fig. 4a & b

ORDER: LITTORINIMORPHA
FAMILY: XENOPHORIDAE
GENUS: STELLARIA
SPECIES: SOLARIS

Habitat: Marine. Benthic waters from 0–250 feet deep on continental shelves and slopes.

Distribution: Distributed along the Indo-West Pacific, the Red Sea, and the Persian Gulf in mostly tropical or temperate waters.

Morphology: Shells medium-sized to large, rather depressed, brown in colour, with slightly convex whorls and convex base, widely umbilicate, with long and thin tubular digitations. Basal sculpture composed of strong granulose collabral ribs, intersecting with spiral ribs close to the umbilicus. Attachments present only in the first two to four whorls. Smooth multispiral protoconch of around four whorls. Operculum thin, yellow, sides nearly straight, external surface smooth except for concentric growth lines.

5. ***Telescopium telescopium*** Linnaeus, 1758 Plate 2; Fig. 5a & b

SUBTERCLASS: SORBEOCONCHA
ORDER: NOT ASSIGNED
FAMILY: POTAMIDIDAE
GENUS: TELESCOPIUM
SPECIES: TELESCOPIUM

Habitat: They are found in marine, brackish benthic areas of tropical regions.

Distribution: Indo-West Pacific.

Morphology: The shell size ranges from 8–13 cm when fully grown. The shell is thick and heavy. The opening of the shell is perpendicular to the shell's longitudinal axis, creating the straight sided cone shape. The shells are either black or very dark reddish brown. They have columella with fold.

6. ***Tibia curta*** Sowerby, 1842 Plate 2; Fig. 6a & b

ORDER: LITTORINIMORPHA
FAMILY: STROMBIDAE
GENUS: TIBIA
SPECIES: CURTA

Habitat: Marine benthic regions of tropics

Distribution: Western Indian Ocean: India.

Morphology: The size of shell is 120 to 185 mm. The shell has a finitely tapered spiral form, smooth and brown, the mouth whorl expands into a wide wing armed with several short and stout spines along the margin and with the anterior end prolonged into a slender, Semi-tubular rostrum or beak. The operculum is fan shaped and prettily sculptured with radiating lines.

7. ***Lambis lambis*** Linnaeus, 1758 Plate 3; Fig. 7a & b

ORDER: LITTORINIMORPHA
FAMILY: STROMBIDAE
GENUS: LAMBIS
SPECIES: LAMBIS

Habitat: Marine, they are found in tropical regions, usually found in benthic areas in a depth range of 0 - 24m. Living in shallow reefs and dead boulders of coral.

Distribution: Indo-Pacific: from East Africa, India, Sri Lanka, Andaman and Nicobar Islands, east to southeast Asia and Australia, as far east to French Polynesia and north to Japan.

Morphology: The maximum shell length for this species is up to 29 cm, and average length stands for 18 cm. It has a very large, robust and heavy shell. One of its most striking characteristics is its flared outer lip, ornamented by six hollow marginal digitations. These digitations present subtle differences in shape between genders in this species, as the three

anterior most digitations are short and posteriorly bent in male individuals, and longer and dorsally recurved in females. The colour of the shell is highly variable, being white or cream externally and often presenting brown, purplish or bluish black patches. The interior is glazed and may be pink, orange or purple.

8. ***Fusinus colus*** Linnaeus, 1758 Plate 3; Fig. 8a & b

ORDER: NEOGASTROPODA
FAMILY: FASCIOLARIIDAE
GENUS: FUSINUS
SPECIES: COLUS

Habitat: Marine, Tropical benthic regions on a depth range of 0 - 40 m.

Distribution: Indo-West Pacific: from East Africa to Melanesia; north to southern Japan, and south to southern Queensland.

Morphology: It has an average height of 200 mm with 9-11 whorls. It is generally milky white, sometimes with brown shades. Suture not evident; shell heavy, solid, with an evident columellar callus, Whorls well rounded and decorated with a series of variably pronounced tubercles, which in the last whorl are situated in the median part and in subsequent whorls in the area above the suture; sometimes tubercles are absent or only weakly outlined.

9. ***Marmorofusus nicobaricus*** Röding, 1798 Plate 3; Fig. 9a & b

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ORDER: NEOGASTROPODA
FAMILY: FASCIOLARIIDAE
GENUS: MARMOROFUSUS
SPECIES: NICOBARICUS

Habitat: Marine, tropical benthic region at a depth range of 0 - 40 m.

Distribution: Indo-Pacific: from Sri Lanka to Polynesia; north to Japan and Hawaii, and south to northern New South Wales.

Morphology: Shell medium to large (average 108.3 mm). Angular fusiform in shape. Protoconch of approximately two whorls, less than 1mm diameter, smooth, glassy. Axial sculpture of thick, rounded ribs that span sutures on early whorls; ribs becoming buttresses below shoulder in later whorls, reduced to vertical racks of knobs by body whorl. Long neck and canal region. Shell white or ivory overall overlaid with pattern of dark brown to black blotches.

Economic Importance: Crude methanal, chloroform, ethyl acetate, methanal and chloroform (1:1) and ethyl acetate and chloroform (1:1) extracts of *M. nicobaricus* is a good source of antibacterial agent and would replace the existing inadequate antibiotics.

10. ***Cypraea tigris*** Linnaeus, 1758 Plate 3; Fig. 10a & b

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ORDER: LITTORINIMORPHA
FAMILY: CYPRAEIDAE
GENUS: CYPRAEA
SPECIES: TIGRIS

Habitat: Marine, tropical benthic region at a depth range of 0 - 30 m.

Distribution: Indo-pacific

Morphology: Thick pear-shaped shell with a strongly elevated dorsum and a slight concavely depressed basal surface. The sides are evenly round off and not much thickened with callus. Dorsal side of the shell is pale in colour with dark circular spots. The ventral shell opening has a serrated margin.

Economic Importance: The tiger cowrie *Cypraea tigris* feed on *Rhabdastrella globostellata*, a common marine sponge that feed on corals. By this way, *C. tigris* helps the corals to fight against these sponges [Raj et al.,2019].

11. ***Monetaria caputserpentis*** Linnaeus, 1758 Plate 4; Fig. 11a & b

ORDER: LITTORINIMORPHA
FAMILY: CYPRAEIDAE
GENUS: MONETARIA
SPECIES: CAPUTSERPENTIS

Habitat: Marine, tropical benthic region.

Distribution: Indo-west pacific: Hong Kong, India, Philippines and Kermadec Islands

Morphology: The shell is reddish-brown, with many whitish dots on the top of the dorsum, which sometimes shows a clear longitudinal line. The underside is light beige. On the ventral surface shell has serrated margin. Shell slightly curved inwards around the opening. It has a whitish brown colour on the anterior end.

12. ***Conus betulinus*** Linnaeus, 1758 Plate 4; Fig. 12a & b

ORDER: NEOGASTROPODA
FAMILY: CONIDAE
GENUS: CONUS
SPECIES: BETULINUS

Habitat: Marine, Tropical benthic region at a depth range of 0 - 20 m.

Distribution: Indo-Pacific.

Morphology: The size of the shell varies between 40 mm and 170 mm. The colour of the shell is yellow orange-brown, or white, with revolving series of spots, and short lines of chocolate upon narrow white bands. The spire is radiated with chocolate. The base of the shell is strongly grooved.

13.***Conus tessulatus*** Born, 1778 Plate 4; Fig. 13a & b

ORDER: NEOGASTROPODA
FAMILY: CONIDAE
GENUS: CONUS
SPECIES: TESSULATUS

Habitat: Marine, Tropical benthic region at a depth range of 0 - 20 m.

Distribution: Indo-Pacific.

Morphology: The size of the shell varies between 22 mm and 82 mm. The top is rather flat with a rather pointed spire and rounded shoulders. The ground colour of the shell is white, covered with bands red, chestnut or orange squares and rectangles. The base of the shell is sometimes tinged with black.

14. ***Filifusus manuelae*** Bozzetti, 2008 Plate 4; Fig. 14a & b

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ORDER: NEOGASTROPODA
FAMILY: FASCIOLARIIDAE
GENUS: FILIFUSUS
SPECIES: MANUELAE

Habitat: Marine benthic region.

Distribution: Southern Madagascar and Gulf of Mannar, India.

Morphology: Shell medium sized with respect to genus, height 100 – 102 mm, maximum width 36 – 35 mm. It is fusiform broad and massive. Teleoconch of 8 convex whorls, evident after the 3rd whorl, a straight or slightly concave subsutural ramp. Axial sculpture consisting of 10 rounded ribs per whorl, covering the total coil height on the first 4 whorls, vanishing or becoming shorter. Columella is uniformly concave. First 2 teleoconch whorls whitish, rest of teleoconch uniformly brown stained, interspaces between spiral cords covered by darker brown spiral lines.

15. ***Filifusus filamentosus*** Röding, 1798 Plate 5; Fig. 15a & b

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ORDER: NEOGASTROPODA
FAMILY: FASCIOLARIIDAE
GENUS: FILIFUSISUS
SPECIES: FILAMENTOSUS

Habitat: Marine benthic regions of tropics.

Distribution: Indian ocean and western Pacific Ocean

Morphology: Shell medium-sized (about 193 mm SL), elongate, fusiform, with high spire and long siphonal process; teleoconch sculpture of broad, short, rounded axial ribs forming nodes (sometimes absent) at shoulder angulation, and many relatively sharp spiral cords, often black and paired; outer lip with sharp, closely spaced, paired crenulations, inner side of outer lip with numerous fine slender lirae, usually straight but occasionally interrupted near abapical end; junction of outer lip with penultimate whorl without adapical notch; parietal ridge present; two columellar folds weak; entrance fold to siphonal canal sharp.

16.***Ficus ficus*** Linnaeus, 1758 Plate 5; Fig. 16a & b

ORDER: LITTORINIMORPHA

FAMILY: FICIDAE
GENUS: FICUS
SPECIES: FICUS

Habitat: Marine, Sub tidal; muddy and sandy substrates

Distribution: Indian Ocean and the West Pacific.

Morphology: Shell medium sized, thin, Spire not elevated. Inflated body whorl with deep suture. Thin axial ridges intercepted by prominent spiral ridges forms a reticulate appearance. Aperture is wide, outer lip slightly thickened towards the anterior end. Ground colour light brown with spiral bands off white and scattered dark brown blotches.

17. ***Harpa davidis*** Röding, 1798 Plate 15; Fig. 17 a & b

ORDER: NEOGASTROPODA
FAMILY: HARPIDAE
GENUS: HARPA
SPECIES: DAVIDIS

Habitat: Marine, tropical benthic region at a depth range of 62 - 64 m.

Distribution: Indo-Pacific, from eastern Africa to Hawaii.

Morphology: Shells of *Harpa davidis* can reach a size of 60–119 millimetres. These shells are usually smoothy and glossy, pale brown or reddish-brown, with strong axial ribs, a wide aperture and characteristic decorative markings. The ventral side of body whorl usually shows two-three large brown blotches, but may also be completely brown

18. ***Xenophora pallidula*** Reeve, 1842 Plate 5; Fig. 18a & b

ORDER: LITTORINIMORPHA
FAMILY: XENOPHORIDAE
GENUS: XENOPHORA
SPECIES: PALLIDULA

Habitat: Marine, Tropical benthic area at a depth range of 200 - 960 m.

Distribution: Commonly found in or near Australia, India, Nicobar Islands, Indonesia, Japan, Philippines and occasionally by South Africa.

Morphology: Shell is relatively small, averaging about 68-78mm in length and 72-82mm in width. Shells have a light colour, usually white or off-white in colour. Foreign objects are affixed to the upper shell surface. Coral skeletons, fragmented shells, and other debris are attached to the dorsal side of their shell. These attachments often create a radial pattern around the whorls. They are attached using spire. Most have a high spire, with a spire angle ranging between 65 and 92 degrees.

19. ***Turritella cochlea*** Reeve, 1849 Plate 6; Fig. 19a & b

SUBTERCLASS: SORBEOCONCHA
ORDER: UNASSIGNED
FAMILY: TURRITELLIDAE
GENUS: TURRITELLA
SPECIES: COCHLEA

Habitat: Intertidal and sand areas

Distribution: Western Indian Ocean: Saudi Arabia and Qatar, Persian Gulf.

Morphology: A thin, semitranslucent spire with a spire angle of around 13°. Each whorl is spherical with a strong, sharp median keel and an equally strong keel just above the next suture; the remainder of each whorl is covered by irregularly spaced spiral ridges. Aperture with a thin edge that is almost round. Brown mottlings and stripes on a yellowish white background. The diameter decreases gradually from whorl to whorl. It has rough appearance. Ridges are prominent. The strength of keels varies significantly.

20. ***Turritella terebra*** Linnaeus, 1758 Plate 6; Fig. 20a & b

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SUBTERCLASS: SORBEOCONCHA
ORDER: UNASSIGNED
FAMILY: TURRITELLIDAE
GENUS: TURRITELLA
SPECIES: TEREBRA

Habitat: Marine, tropical benthic region at a depth range of 0 - 30 m.

Distribution: Indo-West Pacific: from East Africa, including Red Sea, to Melanesia; north to Taiwan Province of China and south to central Queensland.

Morphology: The shell of *Turritella terebra*, has a long tower-like shape which resembles a drill, hence its name. The shell is narrow and tall, with as many as 30 whorls. The shell is about 14 cm long. Its colour is light to dark brown. The shell has more glossy appearance. The difference in diameter increases from whorl to whorl. The opening is circular.

21. ***Murex trapa*** Röding, 1798 Plate 6; Fig. 21a & b

ORDER: NEOGASTROPODA
FAMILY: MURICIDAE
GENUS: MUREX
SPECIES: TRAPA

Habitat: Marine, tropical benthic region at a depth range of 16 - 37 m.

Distribution: Indo-West Pacific: from Madagascar and Mascarene Islands, India, Sri Lanka and the Andaman Sea, to the Philippines; north to southern Japan and south to southern Indonesia.

Morphology: Shells have an average length of 50–124 millimetres with a diameter of 8–21 millimetres. They are fusiform or club-shaped, with height and acute spire and prominent spiral ridges. Shell surface is normally light brown or blue-grey with some yellowish-brown on spines. The body whorl shows three spiny varices. The aperture is lenticular, with a white interior margin and deep red-brown within. The outer apertural lip is crenulated. The siphonal canal is straight and moderately long (about 13–47 mm). Three to four short spines are restricted to the basal half of siphonal canal.

22. ***Ranularia caudata*** Gmelin, 1791 Plate 6; Fig. 22a & b

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ORDER: LITTORINIMORPHA
FAMILY: CYMATIIDAE
GENUS: RANULARIA
SPECIES: CAUDATA

Habitat: Marine, tropical benthic region at a depth range of 0 - 57 m.

Distribution: Indo-Pacific.

Morphology: Maximum shell length is 212mm. They have a tall spire and a strongly inflated body whorl. Outer lip is thick. Outer lip forms a ear like structure. It has a long tail like region. There is a bend in the posterior end of the tail. Ridges are present in the body whorls. The ridge is more prominent in the outer lip.

23. ***Bufonaria echinata*** Link, 1807 Plate 7; Fig. 23a & b

ORDER: LITTORINIMORPHA
FAMILY: BURSIDAE
GENUS: BUFONARIA
SPECIES: ECHINATA

Habitat: Marine, tropical benthic regions.

Distribution: Western Indian Ocean- India.

Morphology: The shell size is between 50mm and 85 mm. Spirally arranged spines on each whorl. Long spines are present on outer lip surface. Spire elevated; sculptured with fine close set granular spiral ribs peripheral row of small nodules, and single strong recurved spine present adjacent to anterior canal. Inner margin of outer lip flared and denticulate with irregular shaped tooth on inner margin. Operculum fan shaped; colour light brown with dark brown markings occasionally.

24. ***Tonna dolium*** Linnaeus, 1758 Plate 7; Fig. 24a & b

ORDER: LITTORINIMORPHA
FAMILY: TONNIDAE
GENUS: TONNA
SPECIES: DOLIUM

Habitat: Marine, tropical benthic region at a depth range of 10 - 30 m.

Distribution: Indo-Pacific: from East Africa, to the islands of the Central Pacific, north to Japan and Hawaii, and south to southern Melanesia and New Zealand; might also occur in northern Australia. Tropical to subtropical.

Morphology: The size of the shell varies between 100 mm and 181 mm. Shell is thin, ovate-globose and ventricose. The spire is generally short. It is composed of six whorls, slightly flattened above. The body whorl is large and very convex. All the whorls have wide and distant ribs, slightly convex, numbering ten upon the body whorl. The surface of this shell is of a white colour, slightly greyish, and sometimes rose-coloured. It is ornamented upon the ribs, with alternate white and red spots. The aperture is very large, the outer lip is thin, notched, canaliculated within, and its edge is white and undulated. The inner lip is only slightly perceptible towards the base, where it forms a part of the umbilicus, which is hardly developed. The columella is twisted spirally, and furnished externally. Furrows are equally wide, render it easily distinguishable.

25. ***Turbinella pyrum*** Linnaeus, 1767 Plate 7; Fig. 25a & b

ORDER: NEOGASTROPODA
FAMILY: TURBINELLIDAE
GENUS: TURBINELLA
SPECIES: PYRUM

Habitat: Marine, tropical benthic region at a depth range of 6 - 27 m. Found in shallow littoral zone. On sandy bottoms with mud and organic matter. Gregarious animal.

Distribution: Indian Ocean- Pakistan, India and Sri Lanka.

Morphology: The shell of this species is massive, with three or four prominent columellar plicae. It is usually pure white under a heavy brown periostracum, but it can also be a pale apricot colour. It can sometimes be dotted with dark brown. It has elevated spire and 2-3 body whorls. The last body whorl is inflated. It has tail of average length. Outer lip is thin and wide aperture.

26. ***Agaronia gibbosa*** Born, 1778 Plate 7; Fig. 26a & b

ORDER: NEOGASTROPODA
FAMILY: OLIVIDAE
GENUS: AGARONIA
SPECIES: GIBBOSA

Habitat: Marine, tropical benthic region at a depth range of 0 - 30 m.

Distribution: Brunei, India, Indonesia, Malaysia and Sri Lanka

Morphology: Shell moderately large, stout, thick up to 60mm in height, fusiformly ovoid, surface smooth and highly polished; spire rather short, but acuminate, apex pointed; body whorl somewhat inflated. Lower part of body whorl is generally sharply demarcated from the upper by an oblique spiral line Aperture rather wide, with slit-like posterior canal. Aperture narrow and elongate. Posterior canal small and slit like. Anterior canal in the form of a semilunar notch. Colour pale yellowish brown with a prominent yellow band at the base, mottled with black spots.

27. ***Pila globosa*** Swainson, 1822 Plate 8; Fig. 27a & b

ORDER: ARCHITAENIOGLOSSA
FAMILY: AMPULLARIIDAE
GENUS: PILA
SPECIES: GLOBOSA

Habitat: Tropics, freshwater benthic regions.

Distribution: India, Bangladesh, Myanmar and Bhutan.

Morphology: The shell is thick and globose. The body whorl is highly convex. The aperture is wide, smooth and oblong. The spire is shorter than the body whorl and not acuminate.

Columella is in the shape of a hollow twisted rod. Operculum is a flat oblong plate-like structure. The outer flat surface of it shows many concentric rings of growth around a small sub centric circle, the nucleus. The inner surface is a distinct elliptical area of creamy colour. The ground colour is lemon-yellow, brownish or even blackish. The inner surface of the shell is pinkish.

Economic Importance: Used as biological control for *Salvinia molest.*

28. ***Naria erosa*** Linnaeus, 1758 Plate 8; Fig. 28a & b

ORDER: LITTORINIMORPHA
FAMILY: CYPRAEIDAE
GENUS: NARIA
SPECIES: EROSA

Habitat: Marine benthic regions.

Distribution: Indian Ocean along the coasts of Aldabra, Chagos, the Comores and Sri Lanka, the East Coast of South Africa, Kenya, Madagascar the Mascarene Basin, Mauritius, Mozambique, Réunion, the Seychelles, Somalia and Tanzania, as well in the Western Pacific Ocean

Morphology: Average shell size is 32–38 mm in length, with a maximum size of 75 millimetres and a minimum adult size of 15 millimetres. The dorsum is yellow-ochre or pale brown, with many small white spots. The extremities of the shell show dark brown spots. A dark brown area which is roughly rectangular is present on each side close to the edge. The base is white to light beige, with thin transverse stripes.

29.***Crucibulum auricula*** Gmelin, 1791 Plate 8; Fig. 29a & b

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ORDER: LITTORINIMORPHA

FAMILY: CALPTRAEIDAE
GENUS: CRUCIBULUM
SPECIES: AURICULA

Habitat: Marine, tropical benthic depth range of 1 - 115 m.

Distribution: Western Atlantic.

Morphology: The shell size ranges from 12 to 23 mm in diameter and 6 to 10 mm in height. It is greyish white. Shells are cap-shaped with a complete cup-like support, which is attached by its base or along one side. Shell is moderately elevated, convex slope posterior to the anteriorly curved apex. Exterior is surrounded with numerous, rough radial ribs. The edges of the inner cup are free from the interior of the shell.

30. ***Laevistrombus canarium*** Linnaeus, 1758 Plate 30; Fig. 30a & b

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ORDER: LITTORINIMORPHA
FAMILY: STROMBIDAE
GENUS: LAEVISTROMBUS
SPECIES: CANARIUM

Habitat: Marine, tropical benthic region at a depth range of 0 - 55 m.

Distribution: Indo-West Pacific: from southern India and Sri Lanka to Melanesia; north to Japan and south to Queensland and New Caledonia.

Morphology: The shell length is from 29 mm to 71 mm. The outer surface of the shell is almost completely smooth. Inconspicuous stromboid notch on the outer lip. The siphonal canal itself is straight, short, and ample. Adult specimens have a moderately flared, posteriorly protruding outer lip, which is considerably thickened and completely devoid of marginal spikes or plicae. The body whorl is roundly swollen at the shoulder, with a few anterior spiral grooves. The shell has a medium-to-high cone-shaped spire, with at least five delicately furrowed whorls. Shell

colour is variable, from golden yellow to light yellowish-brown to grey. The underside of the shell is rarely dark; more frequently it is paler than the top, or totally white. In all cases, the shell aperture is white.

	ORDER	FAMILY	GENUS	SPECIES
1	LITTORINIMORPHA	NATICIDAE		
2		XENOPHORIDAE	STELLARIA	SOLARIS
3			XENOPHORA	PALLIDULA
4		CYPRAEIDAE	CYPRAEA	TIGRIS
5			MONETARIA	CAPUTSERPENTIS
6			NARIA	EROSA
7		FICIDAE	FICUS	FICUS
8		CYMATIIDAE	RANULARIA	CAUDATA
9		BURSIDAE	BUFONARIA	ECHINATA
10		TONNIDAE	TONNA	DOLIUM
11		STROMBIDAE	TIBIA	CURTA
12			LAMBIS	LAMBIS
13			LAEVISTROMBUS	CANARIUM
14		CALYPTRAEIDAE	CRUCIBULUM	AURICULA
15	NEOGASTROPODA	FASCIOLARIIDAE	FUSINUS	COLUS
16			MARMOROFUSUS	NICOBARICUS
17			FILIFUSUS	MANUELAE
18			FILIFUSUS	FILAMENTOSUS
19		CONIDAE	CONUS	BETULINUS
20			CONUS	TESSULATUS
21			CONUS	
22		HARPIDAE	HARPA	DAVIDIS
23		MURICIDAE	MUREX	TRAPA
24		TURBINELLIDAE	TURBINELLA	PYRUM
25			TURBINELLA	ANGULATA
26		OLIVIDAE	AGARONIA	GIBBOSA
27	ARCHITAENIOGLOSSA	AMPULLARIIDAE	PILA	GLOBOSA
28	UNASSIGNED	POTAMIDIDAE	TELESCOPIUM	TELESCOPIUM
29		TURRITELLIDAE	TURRITELLA	COCHLEA
30			TURRITELLA	TEREBRA

1a

1b

2a

2b

3a

3b

Plate 1: 1a. Conus egg mass [museum].1b. Conus egg mass.2a. Naticidae egg mass[museum] 2b. Naticidae egg mass .3a. *Turbinella angulata* [museum] 3b. *Turbinella angulata*

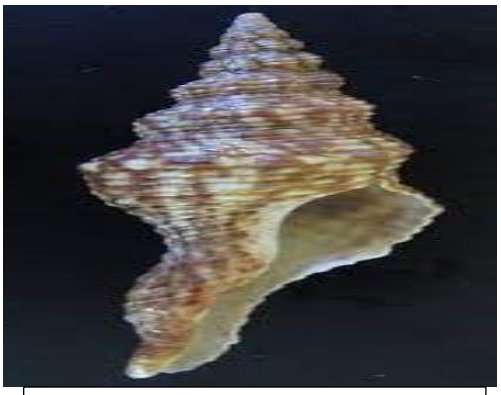
7a

7b

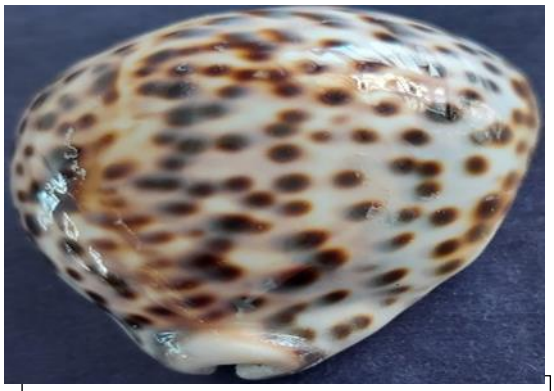
8a

8b

9a



9b



10a

10b

Plate3: 7a. *Lambis lambis* [museum]. 7b. *Lambis lambis* 8a. *Fusinus colus* [museum].8b. *Fusinus colus.* 9a. *Marmorofusus nicobaricus* [museum]. 9b. *Marmorofusus nicobaricus.* 10a. *Cypraea tigris* [museum] .10b. *Cypraea tigris*.

11a

11b

12a

12b

13a

13b

14a

14b

Plate 4: 11a. *Monetaria caputserpentis* [museum] 11b. *Monetaria caputserpentis. 12a. Conus betulinus* [museum]. 12b. *Conus betulinus*. 13a. *Conus tessulatus*[museum]. 13b. *Conus tessulatus* 14a. *Filifusus manuelae* [museum].14b. *Filifusus manuelae*.

15a

15b

16a

16b

17a

17b

18a

18b

Plate 5: 15a. *Filifusus filamentosus* [museum] 15b. *Filifusus filamentosus.* 16a. *Ficus ficus* [museum]. 16b. *Ficus ficus.* 17a. *Harpa davidis* [museum]. 17b. *Harpa davidis.* 18a. *Xenophora pallidula* [museum]. 18b. *Xenophora pallidula.*

19a

19b

20a

20b

21a

21b

22a

22b

Plate 6: 19a. *Turritella cochlea* [Museum]. 19b. *Turritella cochlea*. 20a. *Turritella terebra*[museum] 20b. *Turritella terebra*. *21a. Murex trapa* [museum]. 21b. *Murex trapa*. 22a. *Ranularia caudata* [museum]. 22b. *Ranularia caudata*.

23a

23b

24a

24b

25a

25b

26a

26b

Plate 7: 23a. *Bufonaria echinata* [museum]. 23b.*Bufonaria echinata*. 24a.*Tonna dolium* [museum]. 24b. *Tonna dolium 25a. Turbinella pyrum* [museum]. 25b.*Turbinella pyrum*. 26a.*Agaronia gibbossa* [museum] 26b. *Agaronia gibbossa.*

27a

27b

28a

28b

29a

29b

30a

30b

Plate 8: 27a. *Pila globosa* [museum] 27b. *Pila globosa*. 28a. *Naria erosa* [museum]. 28b. *Naria erosa*. 29a. *Crucibulum auricula* [museum]. 29.*Crucibulum auricula*. 30a. *Laevistrombus canarium* [museum]. 30b. *Laevistrombus canarium*.

DISCUSSION

No species of freshwater molluscs are endemic to the circumpolar arctic [Vinarski et al.,2021]. There are globally 42 families of freshwater molluscs. Only 1 of 18 families available in the museum is confined to freshwater. *Pila globosa* [Architaenioglossa, Ampullariidae] is found in India and nearby countries. The effort to find the distinctness of *Pomacea occulta* from *Pomacea canaliculata* and *Pomacea maculta* resulted in the understanding that it comes under the species *P.canaliculata*[Qian-Qian Yang and Xiao-Ping Yu,2019]. *P.occulta* is a subspecies of *P.canaliculata. Filifusus manuelae* and *Filifusus filamentosus* look almost similar. The presence of sharp spiral cords and paired crenulations make *F.filamentosus* a different species. Gastropods that lead a holoplanktic life are only 1% of total species. The Seasonal abundance of atlantidae, a holoplankton, is linked to changes in water currents and food availability and water temperature. The egg masses of *Turbinella angulata, Conus* and Naticidae are planktons. They can get deposited in faraway places from their parents. This helps in the dispersion of these caenogastropods.

There are some gastropods that take food from the water current created by their host. They are called kleptoparasitic filter feeders. The genus *Hyalorisia* is a kleptoparasitic filter feeder associated with the bivalve *Propeamussium*. The members of the genus *Conus* are also filter feeders that make use of their harpoon-like radula teeth to trap the prey and pull it into the mouth. Radula teeth are modified teeth, primarily made of chitin and formed inside the mouth of the snail. Unlike *Hyalorisia, Conus* are not kleptoparasitic. *Conus* is distributed over the Indo pacific while *Hyalorisia* has a distribution range over the Caribbean and Indo-West Pacific. *Hyalorisia* has a limpet-like, whitish and fragile shell, with a glossy lamella inside the posterior part of the aperture. The narrow aperture is elongated with parallel margins and is truncated at the base.

Five species of *Pila* are extant in Thailand [Ting Hui Ng, et al.,2020]. *Pila Globosa* is the only species of genus *Pila* present in India. *Pila globosa* has both gills and opercula that enable it to become amphibious. Being a freshwater snail, *Pila Globosa* undergoes aestivation during dry seasons by closing its operculum. During this period their weight decreases steadily. The shell plays a crucial role in the survival of the snail during aestivation. Being light yellow in colour, weight loss is comparatively less in *Pila globosa* than in other freshwater snails [Malleswara,

et al.,2012]. Seasonal variation in shell morphology is seen in *Radomaniola curta anagastica,* this usually indicates species distinctness [Falniowski, et al.,2012]. These variations help them in surviving in different seasons. *Pila* and *Pomacea* come under different Subfamilies of Ampullariidae but these genera are monophyletic [Jørgensen et al.,2008].

In Central Europe family Aciculidae has the highest diversity among snails [Lika, et al.,2021]. Aciculidae and Ampullariidae belong to the same order Architaenioglossa. Ampullariidae is a large freshwater snail with both gill and operculum while members of Aciculidae are small land snails which have only opercula as respiratory structure. The presence of gill and operculum enables Ampullariidae to be amphibious. There is a total of 30 species under the genus *Stellaria* which have their peripheral flange separated from the base [Napper, et al., 2022]. *Stellaria solaris* is widely umbilicate with long and thin tubular digitations. It has characteristic collabral ribs intersecting with spiral ribs.

In Sedhubhavasatram of Thanjavur, Tamil Nadu *Chicoreus ramosusm, Murex trapa, Natica trigrina, Agaronia gibbosa* and *Tonna dolium* are dominant species [Anandaraj, et al., 2012]. 16 species of the genus *Conus* are present in the Gulf of Mannar coast of India, among these *C. leopardus* and *C. eburneus* dominate the area. In the museum, egg masses of the genus and shells of the species *C. betulinus* and *C. tessulatus* are present. *Hungerfodia* is a terrestrial caenogastropod of order Architaenioglossa, endemic to Palau islands. *Tibia curta* and *Bufonaria echinata* are endemic to India. These species belong to the order Littorinimorpha.

CONCLUSION

Out of 721 families of gastropods, 100 belong to caenogastropods. Subclass Caenogastropoda includes four orders. They are Order Architaenioglossa, Order Littorinimorpha, Order Neogastropoda, and an Order that includes unassigned caenogastropods [Cox,1960]. The work dealt with 18 families belonging to 4 different orders. The families included in the work are Naticidae, Xenophoridae, Cypraeidae, Ficidae, Cymatidae, Bursidae, Tonnidae, Strombidae, Calyptraeidae, Fasciolariidae, Conidae, Harpidae, Muricidae, Turbinellidae, Olividae, Ampullariidae, Potamididae, Turritellidae.

Out of 30 specimens studied,28 is classified up to their species level,1 up to generic level and 1 upto family level. 14 specimens come under Order Littorinimorpha,12 under Order Neogastropoda,1 under Order Architaenioglossa and 3 under unassigned order which belongs to the Subterclass Sorbeoconcha.

Order Architeanioglossa includes snails with gills and often with an operculum. They are usually seen in land and freshwater. This is a polyphyletic group [Harasewych *et al..*, 1998.]. Members of this subfamily have a minimum length of 0.55m and a maximum length of 366m. *Pila globosa* comes under family Ampullariidae of order Architaenioglossa. This family includes 4 subfamilies, out of these subfamilies *P.globosa* comes under the subfamily Ampullariinae.

Nine families of order Littorinimorpha came under study. Out of the 14 specimens, 1 was classified up to its family level. The members under study live in a depth range between 0-960m in benthic areas. These are seen only in marine habitats except for Naticidae which is seen in brackish and marine waters. Most of them are distributed over the Indo-Pacific region. *Tibia curta and Bufonaria echinata* are distributed only over the western Indian Ocean. *Ficus ficus* is distributed over the entire Indian Ocean and the West Pacific.

Out of the 12 specimens that come under the order Neogastropoda,4 belong to Fasciolariidae, 3 belong to Conidae, 2 belong to Turbenellidae and 1 sample belongs to Harpidae, Murcidae and olividae. All specimens are shells except *Conus* and *Turbinella angulata* whose egg masses

are present. *Fusinus colus* and *Marmorofusus nicobaricus, Conus betulinus* and *C.tessulatus, Harpa davidis, Murex trapa* are distributed over the Indo-Pacific region. *Filifusus manuelae, F.filamentosus* and *Turbinella pyrum* are distributed over the Indian Ocean. *F. filamentosus* is also seen in the western Pacific. *Agaronia gibbosa* is seen both in the Indian and Pacific oceans. *Turbinella angulata* is naturally seen in both the Indian and Atlantic Oceans.

A large bulk of Caenogastropoda species are not assigned to any order and are altogether kept in the subterclass Sorbeoconcha [Bouchet and Rocroi,2005]. *Telescopium telescopium, Turritella cochlea* and *T. terebra* come under the superfamily Cerithioidea. Genus *Turritella* is found in marine waters near the sea beds and *Telescopium telescopium* is found in marine and brackish waters. *Telescopium telescopium* and *Turritella terebra* are distributed in Indo-Pacific regions. *Turritella cochlea* is distributed in the western Indian Ocean.

Members of the same family have more common morphological features than the entire order. Members of Xenophoridae, Cypraeidae are umbilicate and pear-shaped respectively. I Strombidae, Tibia curta and Lambis lambis have marginal spines but Laevistrombus does not have one. Members of Fasciolariidae have elongated tail. *Turritella cochlea* and *T. terebra* have a tower-like shape.

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