

**MANUAL ON IDENTIFICATION
OF
SCHEDULE MOLLUSCS**

FROM INDIA

**Ramakrishna
A. Dey**

ZOOLOGICAL SURVEY OF INDIA

**Manual on
IDENTIFICATION OF SCHEDULE MOLLUSCS
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INTRODUCTION

Traditional practices and values are often a rich mine of conservation policy, however, in few instances the cultural practices become lethal when they are combined with certain medical, religious and technological features of the dominant consumeristic culture (Soule, 1986). In other words, the exploitation of natural resources is motivated by simple greed. The application of economic processes to natural resources will lead to substantial loss of biological diversity.

The degradation of the tropical marine communities is one such example, which can be traced back to the rapid increase of the populations and also the deep seated idea, in the social fabric, is the inability to reconcile the drive for economic gain with the obvious wisdom of long term planning and conservation (Gomez, 1983). This therefore, does not qualify for conservation issues a high priority area for those whose basic *fabric of economic development and nutritional values are not met*.

The retention of traditional knowledge and experience gained over the years together with the law of conservation aims at sustainable development and intergenerational equity, so that the natural resources are preserved for future generation. India being a signatory of international environmental instruments has its obligation to fulfill this environmental mandate. In this regard, Article 48 A part of the Directive Principles of State Policy, in the Indian Constitution mandates that the state should endeavour to protect and improve the environment and safeguard the forests and wildlife of the country. Furthermore, India being a signatory to the International Environmental instruments *viz.*, Convention on International Trade in Endangered Species (CITES) and Convention on Biological Diversity (CBD) is obliged to take steps to fulfill the environmental mandate. The main aim of all these conventions is to reduce the biotic pressure with the assumption that any such pressure was detrimental to the wildlife resources. IUCN encourages and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable.

The Wildlife (Protection) Act, 1972 and Wildlife Protection Amendment Act, 1991 is intended to provide a comprehensive national legal framework for wildlife protection with two pronged conservation strategy as a part of environmental mandate of the country with a major goal, *viz.*,

- ☞ Specified endangered species are protected regardless of location
- ☞ All species are protected in specified areas

In essence the Act prohibits the hunting of wildlife, protects their habitats, and restrains trade in wild animals and trophies etc. The Ministry of Environment & Forests, Government of India frames the guidelines and the implementation authorities are the Wildlife Advisory Board, Wildlife Wardens and their staff of the state government for effective implementation.

Recent inclusion of molluscs under schedule animals (Part II Section - 3 sub section (ii)I, Extraordinary of the Gazette of India, dated the 5th December, 2001) is one such step to protect and conserve several species, which are under threat due to overexploitation, for commercial purpose. The main aim of this recent inclusion of selected marine molluscs is to maintain distinct biological communities, ecosystems and their processes to maintain representative examples of all habitats and linkages across the country's marine resources. However, a perusal of the list reveals, that a few more could have been included in the list, for their protection is essential in the present.

DEFINITION

Molluscs are soft bodied, bilaterally symmetrical, coelomate metazoans, often secondarily altered to an asymmetrical condition, without evidences of metamerism. Animals are protected by a calcareous shell of one or more than one piece, secreted by a fold of body wall, the mantle (or pallium). The ventral body wall is modified into a muscular organ of locomotion, the foot. Pharynx commonly with radula and gills; heart with open circulatory system and excretory organs metanephredia are the other features of the phylum.

The striking feature of the phylum is the presence of mantle and radula, not found in any other groups. Typically, molluscs have the following features : a head (absent in bivalves) bears a terminal mouth, eyes, tentacles and other sensory organs; a muscular ventral region for locomotion, the foot; a postero-dorsal visceral mass; a fold of body wall, the mantle, the mantle cavity, into which open the terminations of the digestive, nephridial, and the reproductive systems and which houses the gills; and the external shell, secreted by the mantle and wholly or partly enclosing the soft body.

DIVERSITY

Molluscs are highly diversified group, differs in shape, size, numbers as well as habit and habitats. A global estimate of molluscan diversity varies between 50,000 to 150,000 species. Abbott (1954) estimates a total of 100,000 existing species (80,000 snails, 10,000 bivalves and rest the others groups). Winckworth (1949) estimates 31,643 marine, 8765 freshwater and 24,503 land making a total of 64,911 (approx. 65,000). Subba Rao (1998) make a conservative estimate 66,535 species, out of which 5070 (7.62%) species recorded from India.

Molluscs have adapted themselves to diverse habitats except aerial. Originally originated in marine water, spread to freshwater and on to land, where they now almost nearly equal

to the marine forms. Marine Molluscs are for most part benthonic but gastropods have developed three pelagic groups, Janthinids, heteropods and pteropods, and many cephalopods are pelagic. Primarily, molluscs are the inhabitants of the intertidal and littoral zones of the sea, occasionally descend to a great depth up to 10,190 m (bivalve), 8210 m (gastropod) and 6940 (scaphopoda).

In India the molluscs are recorded from diverse habitats, from deep sea (3000 m) of Andaman & Nicobar Islands to higher elevations of Himalayas up to 5000 m. Molluscs are found more diverse and abundant in the rocky intertidal zone along the coast and in the coral reef areas of Gulf of Mannar, Lakshadweep, Gulf of Kutch and Andaman & Nicobar Islands. Sandy stones, inter tidal flats, mangrove areas have also a very diversified marine molluscs.

Andaman & Nicobar Islands have a rich molluscan diversity, which include about 1434 species distributed in marine (1282 spp.), land (101 spp.) and freshwater (51 spp.) ecosystems.

Molluscan Diversity from India

Forms	Families	Genera	Species
Land forms	26	140	1487
Freshwater	22	53	183
Marine	242	591	3400
Total	290	784	5070

Gulf of Mannar have 428 species, Lakshadweep (424 spp.), Gulf of Kutch (350 spp.) Orissa coast (337 spp.) and West Bengal coasts (425 spp.). This diversity is mainly due to preponderance of marine molluscs.

HABITATS

Marine : Molluscs adapted a widely variable range of habitats. From rocks merely splashed by the sea, down to the oozy floor of the deepest abyss, there are several well-defined types of habitat, each of which has its own characteristic molluscan fauna. The tide influences the character and distribution of molluscs that live at the sea's edge.

Molluscs find living condition most congenial in the tropics, and this is where the greatest diversity and the most spectacular shells are found. A coral reef has colourful shells, like cowries, cones, volutes, mitres, etc., while in mangroves, oysters cling to roofs, nerites crawl on the stem and leaves, cerithids trail through squelchy mud. A sandy shore shelters many different bivalves, as well as burrowing gastropods such as moon snails, etc. In estuaries mud mixed with sand provide a food rich environment (detritus), which is sometimes astonishingly productive for crockles. A rocky shore is a good hunting ground for gastropods.

Molluscs survive in different situations. Some burrows into coral and grow with it, while other coral shells attach themselves in its reefs like bases. Thin shelled, burrowing species abundant in the coral sand. Bivalves frequently seen molded to the roots to which they cling; other narrow shelled firm in sand. Razor clam burrows even faster than a man can dig, limpets are found on rocks and their dome shaped shell are admirably adapted to stand buffering by the waves.

VALUE

Majority of molluscs belonging to class Gastropoda, Cephalopoda and Bivalvia has consumptive and productive uses. Land snails do not have any consumptive value in India. About 20 species of freshwater molluscs (belonging to classes Gastropoda and Bivalvia) are consumed in eastern India. About 30 species of marine molluscs (belonging to class Gastropoda, Cephalopoda and Bivalvia) are edible in India. A few of them are also exported. Squid fishing is a profitable industry in Gujarat coast. The edible molluscs include mainly bivalves such as edible oysters, mussels and clams, and a few species of gastropods. The gastropods are exploited mainly for meeting the export market of Southeast Asia (Appukuttan, 1996).

Freshwater mussels, pearls oysters, turban and top shells are the source of mother of pearl. Freshwater mussels are popularly used for manufacture of buttons, in North Bihar (about 20 lakhs/annum), Banerjee & Satish 1988.

Productive use is mainly from the marine molluscs. Seashells are used in the manufacture of ornaments and household articles such as table lamps, ash-try, agarbatti stands, door hangings etc. Shell lime industry depends completely on seashells. They are also used in the poultry feed additive. Some shells like *Villorita cyprinoides* and *V. cornucopia* used as raw material in the cement and rayon industry, the fine lime obtained from the shells is used in pottery glazes, toothpaste. Molluscs also have potential resumes of biomedical compounds.

Besides the direct value, molluscs have an important role in the ecosystem. It also plays role in decomposition in the terrestrial ecosystem and formation of organic detritus in estuaries.

Table : 1 Some uses of marine mollusc Shell

	Molluscs used	Products
Shell craft	a) i) <i>Strombus</i> spp. ii) <i>Cassis</i> spp. iii) <i>Cypraea</i> spp. iv) <i>Conus</i> spp. v) <i>Terebra</i> spp. vi) <i>Umbonium</i> spp.	Cameos, Lampshade, Window chains, Boxes, Handbags, Jewellery & others.
	b) i) <i>Anadara</i> sp. ii) <i>Placuna</i> sp.	Decorative "Souvenirs"
	c) Chank (<i>Turbinella</i> sp.)	Bangles, Jewellery

PLATE - 1



1. Display of Pen stand, Lampshade in a shell shop.



2. Display of decorative articles in a shell shop.

PLATE - 2



3. Display of ornamental shells in a shell shop.



4. Commercial shells inlaywork, shell etc. in a shell shop.

	Molluscs used	Products
Ornamental Shells	Mostly large, colourful, relatively cheap, plentiful. Mostly Gastropod, Some Bivalves.	Whole shell used as Souvenirs and decorations. Trade; private collections.
Rare or Specimen Shell	Few in trade, expensive mostly, narrow endemic and deep water gastropods.	Collections item in trade; private collections.
Molluscs of Pearl or Commercial Shells	i) <i>Trochus niloticus</i> Linnaeus ii) <i>Turbo marmoratus</i> Linnaeus iii) <i>Pinctada</i> spp.	Button, in laywork, jewellery, shell craft.
Industrial Shell	Giant clams	Constituent of pottery glazes, manufacture of floor tiles.

METHODS OF COLLECTION & PRESERVATION OF MARINE GROUPS

Seashells delight all of us since ancient times. Their curious shape, bright and beautiful colour, spectacular patterns make them among the most fascinating of nature's creations. Due to their intrinsic beauty and tactile qualities they are universally popular.

There are three ways to build up shell collections :

- I. by Collecting from natural habitat;
- II. by exchange from the other collectors;
- III. by purchase from shell dealers;

Out of these three, the first one is the most enjoyable. The active collector will undoubtedly develop his own technique/style of collection in time and obtain good results. To a new collector, who begins this as a hobby, a few collection methods are given here :

Majority of marine molluscs inhabits shallow waters of the intertidal zone. This zone can be defined as the reef flat extending from just below the high tide level to the edge of the reef on the seaward side. Molluscs take cover under loose coral boulders, among weed, in sand and in cracks and crevices of the reef flat during sunlight. Some of them hide at the base of soft coral and all the hiding places should be thoroughly explored. Coral dwelling gastropods will be successfully located under loose coral boulders where they will either cling to the underside or be wedged in crevices of the coral.

When turning the coral boulders, care should be taken and hand should not be inserted deeply, because the deadly poisonous stone fish sting so also the sea urchin and sea snakes.

For protection from sharp corals, sea urchins and stone fishes, heavy gumboots should be used. Pliable chrome leather gloves will prevent the injury to hands.

Shell collection on reef flat is best during the low tide, when the reef are completely exposed. After partial return of the tide shell collection may be continued with aid of mask, snorkel and flippers.

Many molluscs inhabit on clean or muddy sandy lagoons or sand pockets, buried beneath. They can be located either following the footprints on the sand when they move or by inserting finger at either end of the track and flipping the shell out or fanning the sand.

A better method for collection of sand dwellers is by using a hand dredge. Dredge with copper mesh is most suitable than galvanized iron mesh. A good shelling bag is necessary for shell collection.

Many countries impose restrictions on shell collections. The collector should familiarize himself with the laws of the country or island group before shell collection.

The collector has to decide early in his career whether he wants the collection for sentimental or souvenir value or to build up collection for scientific value. A collection without locality details will be valueless for scientific purpose.

After the shell collection the soft parts of the animal should be removed. The best ways to allow the shell with animals remain in a cardboard box, with the aperture facing upward. The box should be placed well away from house. The animal starts decaying in the course of time due to temperature and microbial activity. After 2-3 weeks the shell should washed properly and taken out. Many shell collectors bury their shells in the sand or boil them to take out the soft parts of the body. This method not so suitable, because it impinges a dull surface of polished shells. Care should be taken from the growth of fungus. Regular cleaning with rag will be better for this purpose.

Shell cabinet that are built for the shell collection, a number of small holes ($1/6^{\text{th}}$ of inch diameter) should be drilled in the bottom of the drawers. Two 40 watt light can be secured on the floor underneath the drawer will deliver sufficient warm air upwards through the drawers. Cabinet with airtight drawer's containers of silica gel can be placed inside the drawers to absorb humidity.

All pertinent data i.e. name of the shell and author; locality of collection (depth, coral, weed, sand etc); name of collector; date of collection should accompany the shell.

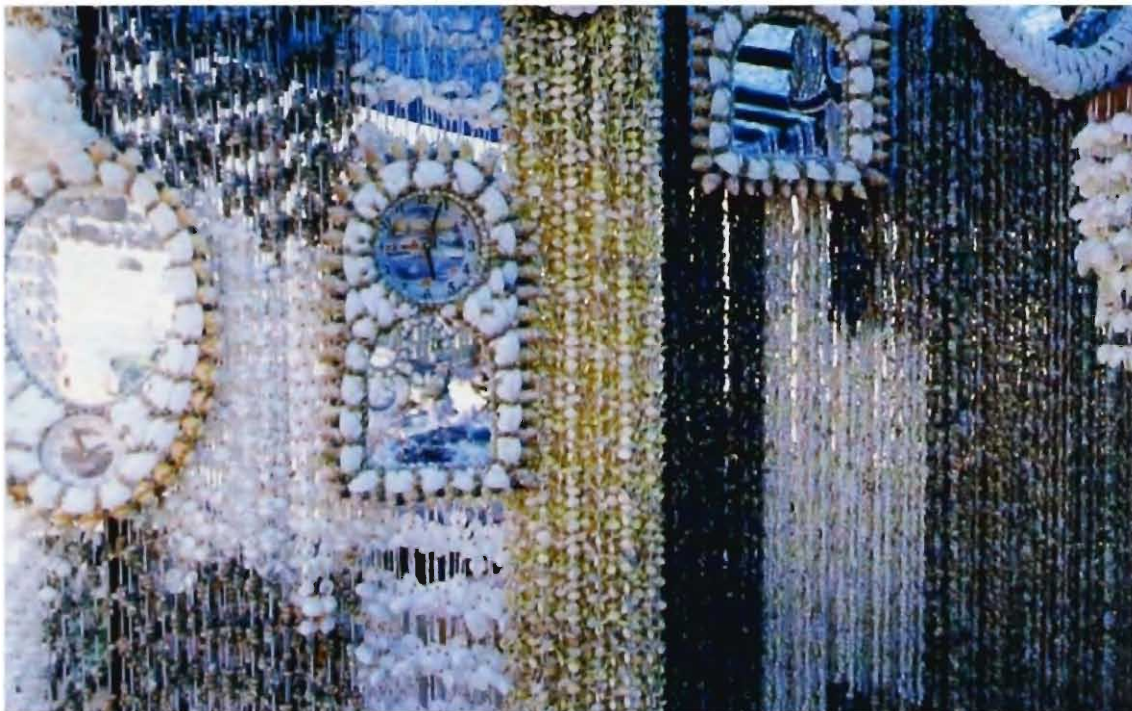
CODE OF ETHICS FOR COLLECTORS

The most important goal of this presentation is for the conservation of molluscs, for the preservation of living resources in its nature/natural condition. A certain degree of code of

PLATE - 3



5. Ornamental shells in display in a shell shop.



6. Well decorative in display in a shell shop.

ethics is followed throughout the world, which is prime concern of all naturalists and biologists. These codes are :

- * **Cause minimal disturbance to its habitat** : Habitat destruction is the most potent threat to all biota including molluscs. To achieve this goal the collectors have to observe simple rules such as :
- * **Observe the laws regulating access sites** : Protected Areas, (*viz.*, Biosphere Reserves, National Parks, Sanctuaries etc.) the rules and laws have been established by the Government to protect habitats and their constituent communities.
- * **In the areas where, observations, collections are permitted, disturbance to the habitats (vegetation, boulders) should be minimal, so that the other communities living in the system is not disturbed.**
- * **Collect minimum number of specimens necessary, i.e., indiscriminate collection has devastating effect on the local population. To achieve this goal one should keep in mind the following :**
 - ☞ Local, national and international laws governing species and habitats should be abided
 - ☞ Species in the reproductive stages (such as during egg laying, breeding and other developing stages) should not be collected
 - ☞ Juvenile, live individuals with damaged shells are of little value for the collectors and therefore, collections of such specimens should be avoided
 - ☞ Only required number of specimens that are strictly for the study should be collected.
 - ☞ Empty and shells washed ashore are to be preferred
 - ☞ Photography in the natural conditions is mostly preferred for the naturalists.

CLASSIFICATION

Although, general architecture remains same for all the molluscs, several variations in the structural plan justify the division of the phylum into classes. The Aplacophora or Solenogasters are worm like, with differentiated head and the body with calcareous spicules. The Polyplacophora or chitons the head is distinct but eyes, tentacles absent and the eight longitudinal valves represent the shell. The Monoplacophora resemble the gastropod limpets but differs in the metameric repetition of many parts. The Gastropods or Snails, with well-developed head and spirally coiled shell usually regarded as typical mollusc. The Pelecypods, (bivalve)-lack head and radula and are completely enclosed in a bivalve shell of which the valves are lateral. The scaphopoda or tusk shells, without gills and with a poorly differentiated

head, enclosed in a tusk-shaped shell with apical lobe. Most divergent type plan is found in Cephalopoda, which includes Nautilus, Octopus and squids. These are highly cephalised molluscs with foot modified into a circlet of arms provided with the suckers.

The classification of molluscs appears to have reached a reasonable degree of stability for the larger groups but the arrangement into smaller units is in the usual state of flux. In the recent years, many changes and additions have been made in the general classification of the phylum Mollusca. The classification adapted here following the Vaught (1988), the classification of phylum Mollusca is :

Phylum **MOLLUSCA** Cuvier, 1795

- Class 1. **APLACOPHORA** von Jhering, 1876
- Class 2. **POLYPLACOPHORA** de Blainville, 1816
- Class 3. **MONOPLACOPHORA** Wenz, 1940
- Class 4. **GASTROPODA** Cuvier, 1795
- Class 5. **BIVALVIA** Linnaeus, 1758
- Class 6. **SCAPHOPODA** Bronn, 1862
- Class 7. **CEPHALOPODA** Cuvier, 1795

Class 1. **APLACOPHORA**

Vermiform, bilaterally symmetrical, untorted molluscs without head, mantle, foot, shell or nephridia; cuticle with calcareous spicules; digestive tract straight with a radula; a pair of coelomoducts in the form of gonoducts, which open into the terminal part of the intestine or directly.

These are exclusively marine occurring at depths of 18-4000 m often living on the colonies of hydroids on which they feed. Distributed in European coasts, Mediterranean, Atlantic coast of North America, North Pacific, Indo-Pacific (scantly represented), Antarctic. Members of Aplacophora are not known from India Seas.

Class 2. **POLYPLACOPHORA**

Members of the class Polyplacophora have dorso-ventrally flattened bilateral symmetrical, untorted body. The head, devoid of eyes and tentacles, mantle, and external gills and radula; shell comprised of eight, longitudinal series of successive pieces. Foot flat bordered by lateral grooves containing gills. Members have coiled intestine, terminal anus a pair of metanephidia connected to the pericardium and a pair gonoducts.

Members are commonly known as Chitons or coat of mail shells, occur in all seas, in all latitudes, found mostly on rocky shores in the intertidal or upper littoral region. Indian Chitons are represented by 32 species which are found occurring on the coasts of Andaman

and Nicobar Islands, Gulf of Mannar, Andhra Coast, and in the coast of Gujarat. The class is divided into one order, and four families.

Class 3. MONOPLACOPHORA

Bilateral symmetrical univalve shells segmented untorted body with head, foot, mantle and radula. Metamerically repeated external gills, nephredia, muscles, nerve branches, with terminal anus.

The class is represented by a single genus, four species found in the deep Atlantic Sea, at the depth of 2700 m to 5700 m on dark, muddy clay.

Class 4. GASTROPODA

Unsegmented, asymmetrical, torted or detorted molluscs, with a spirally coiled univalve shell, with well developed head bearing eyes, tentacles, well developed foot, whose ventral surface is flat forming a creeping sole. The mantle lining the last whorl of the shell, radula well developed, visceral mass spirally coiled, with paired or unpaired heart auricle, osphridium gill and nephridium, with a single reproductive system. Sexes are separate or united. Mostly oviparous, with only a few viviparous.

Class Gastropoda includes nearly 80% of the known molluscan species, occurring in all seas at all latitudes and at all depths from the intertidal zone to abyssal zone of nearly 8200 m. The following families in Gastropoda are considered to be economically important viz., Haliotidae, Olividae, Patellidae, Trochidae, Turbinidae, Strombidae, Potamididae, Muricidae, Mitridae, Vasidae, Turbinellidae, Conidae and Cassidae.

Subclass I. PROSOBRANCHIA

Members with gills or ctenidia situated anterior to the heart, complete torsion, anteriorly located mantle cavity containing pallial complex, dioecious. Majority of them is marine benthonic forms but also includes brackish water, freshwater, terrestrial and pelagic members. The subclass includes 3 orders, 153 families.

Subclass II. OPISTHOBRANCHIA

Detorted, rarely torted, with exposed conical shell or shells concealed in the mantle or absent, with mantle cavity retreated along the right side or usually wanting, usually without operculum, with one gill or substitute respiratory system, hermaphrodite.

Exclusively marine, inhabiting mainly the littoral zone from high tide mark to the edge of the continental shelf and extending up to 2000 m, found among sea weeds and rocks. It included 9 orders, 114 families.

Subclass III. HETEROBRANCHIA

Animals of this class are with long invaginable proboscis housing a stylet. Semiparasitic. It includes one superorder and 4 families.

Subclass IV. GYMNOMORPHA

Molluscs with two pairs of invaginable tentacles, second pair bearing an eye at the tip, male and female gonophores usually united. Subclass includes 2 orders, 4 families.

Subclass V. PULMONATA

Detorted, with or without shell, mantle cavity transformed into a pulmonary sac, hermaphrodite. Majority of the members are freshwater or terrestrial, a few are marine forms. It includes 3 orders, 102 families.

Class 5. CEPHALOPODA

External bilateral symmetry, with spiral chambered shell or usually with or without reduced shell imbedded in the dorsal mantle, highly cephalised, with large eyes, jaw and radula, foot modified into arms encircling the mouth and beset with suckers (except Nautiloids), 2 – 4 bipectinate gills, heart 2- 4 chambered, close circulatory system, nephridia four, dioecious.

The class Cephalopoda is divided into two subclasses.

Subclass I. NAUTILOIDEA

Animal with external shell, two pairs of gills and numerous arms encircling the mouth, marine predaceous carnivores. The subclass includes single order and single family.

Subclass II. COLEOIDEA

Shell internal, imbedded into dorsal mantle, one pair of ctenidia (gill) and 8 to 10 arms, Members of this subclass are exclusively marine. The subclass includes 4 orders, 44 families.

Class 6. BIVALVIA

Bilaterally symmetrical, laterally compressed, untorted, enclosed in a calcified shell of two valves, hinged together mid dorsally. Outer surface of the shell bears longitudinal or concentric growth striations. Ventral surface of each valve of the shell bears impressions of ligaments, which opens the shell and adductor muscles that close it. A ventral axe shaped or wedges shaped foot present. Mantle bilobed, without head pharynx, jaws, radula or tentacles, with

two auricles, a pair of gill, nephridia and gonads, diocious or hermaphrodite. Members are Marine or freshwater.

The class is divided into 5 subclasses.

Subclass I. PROTOBRANCHIA

Equivalve, thin, ligament amphidetic or opisthodetic, nacreous or crossed lamellar, hinge margin edentulous or taxodont. It includes 2 orders, 12 families.

Subclass II. PTERIOMORPHA

Arks, cryptodonts, anisomyarians and monomyrians, sedentary forms with free mantle margins, anterior adductor reduced or lost, duplivincular ligament, gill and stomach variable. It includes 5 orders, 24 families.

Subclass III. PALEOHETERODONTA

Equivalve with close margins, prismatonacreous shells, ligament amphidetic or opisthodetic, external, dentition of a few teeth radial and divergent from umbonal region, striated in some genera, rarely becomes taxodont; lateral teeth if present originate below beaks and not separated from cardinals. It includes 2 orders, 7 families.

Subclass IV. HETERODONTA

Cardinal area prosodetic or divided into lunule and escutcheon; ligament opisthodetic, without with resilium, heterodont type of dentition, hinge plate and teeth differentiated into distinct cardinals and laterals, shell structure crossed lamellar, complex or prismatic, never nacreous, gills eulamellibranchiate, mantle lobe more or less jointed and usually possessing developed siphons. It includes 2 orders, 61 families.

Subclass V. ANOMALODESMATA

Short to elongate, equivalve to subequivalve, isomyarian, hinge margin thickened or enrolled edentulous or with one amorphous tooth and corresponding socket in one or each valve, lateral teeth absent, ligament opisthodetic or absent, gill eulamellibranchiate or septibranchiate. It includes one order, 13 families.

Class 7. SCAPHOPODA

Symmetrically, torted, molluscs, without eyes, tentacles, gills, enclosed in a tusk like shell open at both ends, mantle tubular through fusion of its edges, foot enlarged, mouth surrounded by lobular outgrowths, base of snout with pair clusters of protrusible filaments, rudimentary heart, diocious. Members of the class Scaphopoda are exclusively marine. It includes 2 orders, 9 families.

SHELL PARTS

Nearly all the five main classes of molluscs have a shelly covering. Most of the seashells belongs to two main classes, Gastropoda (about 80 %) and Bivalvia. The gastropods have a single piece of shell, which usually coiled at axis. Bivalves have two piece of shell, normally hinged. Other shells are tusk shell are monotonously similar (Class- Scaphopoda), a few Cephalopoda (Family - Nautilidae) have shell and the chitons has eight articulated piece or valves (Class - Polyplacophora). For identification a person must familiarise himself with various parts of the shell.

Multifaceted hypothetical shells of gastropod and bivalve given below to familiarised with the terms used in the text :

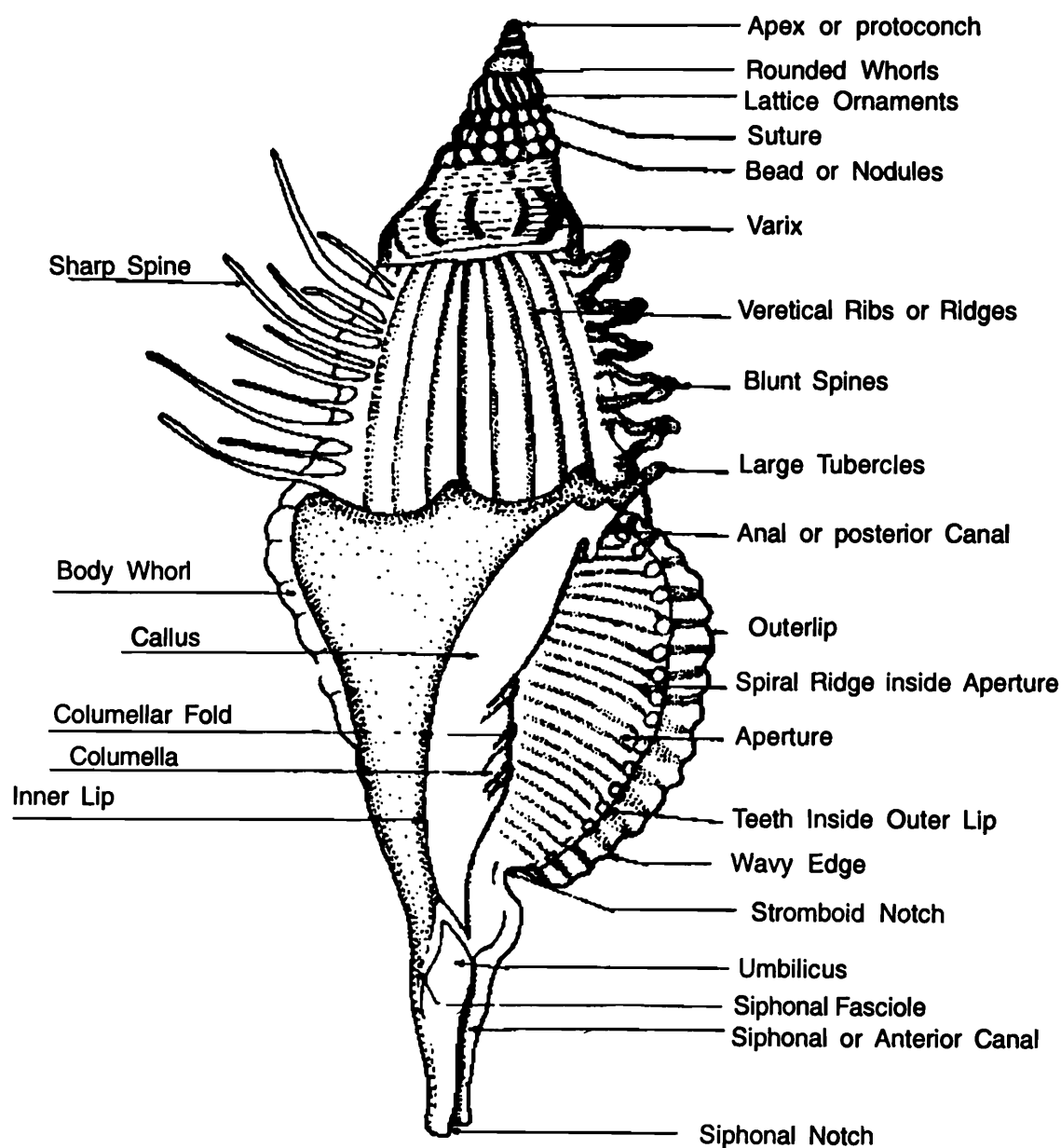


Fig. 1. Hypothetical gastropod shell : Showing the most common features.

The bivalve shells have left and right valve jointed by a ligament, which is usually visible, externally when the valves are closed. When a closed bivalve shell with its umbone uppermost and external ligament in between you and umbone, the right hand valve is right valve and the left hand is the left valve. The important characters of bivalves used for identification are shell shape, sculpture, cardinal complex, hinge teeth, adductor scar, shape of pallial line and pallial scars.

Illustration of hypothetical bivalve shell shows the common features occurs in different valves.

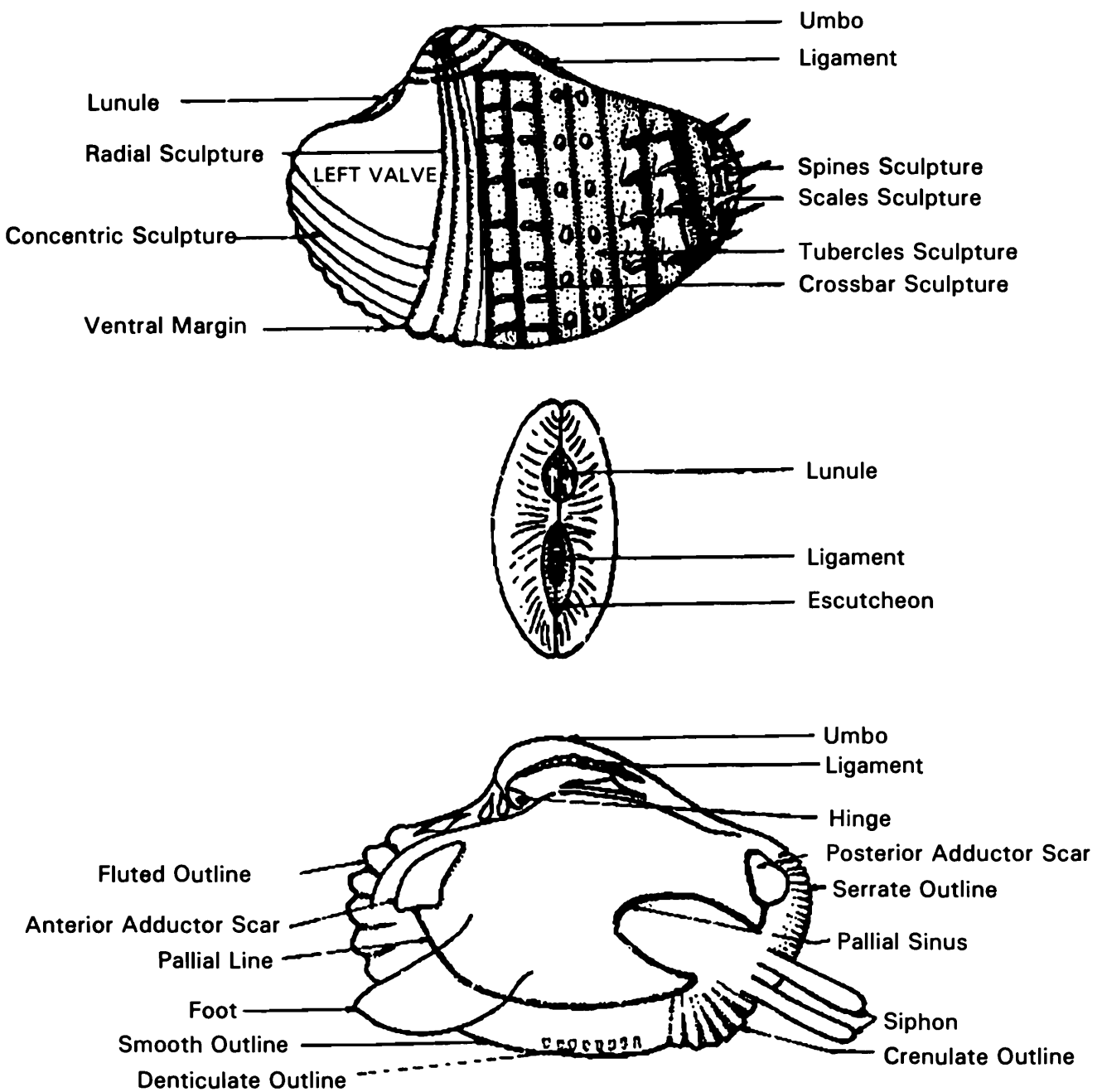


Fig. 2. Hypothetical Bivalve shell

SYSTEMATIC LIST OF SCHEDULED MOLLUSCS

SCHEDULE I.

- | | | |
|-------------|---------------------------------------|-------------|
| Phylum | Mollusca | |
| Class | Gastropoda | |
| Order | Mesogastropoda | |
| Superfamily | Tonnoidea | |
| Family | Cassidae | |
| Subfamily | Cassinae | |
| 1. | <i>Cassis cornuta</i> (Linnaeus) | Part IVB, 1 |
| 2. | <i>Cypraecassis rufa</i> (Linnaeus) | Part IVB, 4 |
| | Family Ranellidae | |
| | Subfamily Cymatinae | |
| 3. | <i>Charonia tritenis</i> (Linnaeus) | Part IVB, 2 |
| | Family Vasidae | |
| 4. | <i>Tudicla spirillus</i> (Linnaeus) | Part IVB, 9 |
| | Superfamily Conoidea | |
| | Family Conidae | |
| 5. | <i>Conus milne-edwardsi</i> Jousseume | Part IVB, 3 |
| | Class Cephalopoda | |
| | Subclass Nautiloidea | |
| | Order Nautilida | |
| | Family Nautilidae | |
| 6. | <i>Nautilus pompilius</i> (Linnaeus) | Part IVB, 6 |
| | Class Bivalvia | |
| | Subclass Heterodonta | |
| | Order Veneroida | |
| | Superfamily Tridacnoidea | |
| | Family Tridacnidae | |
| 7. | <i>Tridacna maxima</i> (Roeding) | Part IVB, 7 |

8. *T. squamosa* Lamarck Part IVB, 8
 9. *Hippopus hippopus* (Linnaeus) Part IVB, 5

SCHEDULE IV.

- Phylum Mollusca
 Class Gastropoda
 Sub-class Prosobranchia
 Order Archaeogastropoda
 Superfamily Trochoidea
 Family Trochidae
1. *Trochus niloticus* Linnaeus Part 19, XIV
 Family Turbinidae
2. *Turbo marmoratus* Linnaeus Part 19, XV
 Order Mesogastropoda
 Superfamily Stromboidea
 Family Strombidae
3. *Strombus (Dolomena) plicatus siboldi* Sowerby Part 19, XIII
4. *Lambis (Harpago) chiragra chiragra* (Linnaeus) Part 19, VI
5. *L. (Harpago) chiragra arthitica* Roeding Part 19, VII
6. *L. (Lambis) crocata crocata* (Link) Part 19, VIII
7. *L. (Lambis) truncata truncata* (Humphrey) Part 19, XI
8. *L. (Millepes) millepeda* (Linnaeus) Part 19, IX
9. *L. (Millepes) scorpio scorpio* (Linnaeus) Part 19, X
 Superfamily Cypraeidea
 Family Cypraeidae
10. *Cypraea limacina* Lamarck Part 19 (i)
 11. *Cypraea mappa* Linnaeus Part 19 (ii)
 12. *Cypraea talpa* Linnaeus Part 19 (iii)

- | | | |
|-------------|--|---------------|
| Order | Neogastropoda | |
| Superfamily | Muricoidea | |
| Family | Fascioliidae | |
| Superfamily | Fascioliinae | |
| 13. | <i>Fasciolaria trapezium</i> Linnaeus
[= <i>Pleuroploca trapezium</i> (Linnaeus)] | Part 19 (iv) |
| Family | Volutidae | |
| Subfamily | Zidoninae | |
| 14. | <i>Harpulina arausiaca</i> (Lightfoot) | Part 19 (v) |
| Class | Bivalvia | |
| Subclass | Pteriomorpha | |
| Order | Ostreoida | |
| Suborder | Pectinina | |
| Superfamily | Anomoidea | |
| Family | Placunidae | |
| 15. | <i>Placuna placenta</i> Linnaeus | Part 19 (xii) |

KEY FOR SHELL IDENTIFICATION

The shell listed in the Schedule I and Schedule IV of the wild life (Protection) Act, 1972, belongs to the three classes :

- i) Cephalopoda
- ii) Gastropoda
- iii) Bivalvia

Step 1 : The class cephalopoda has a single species i.e. *Nautilus*. The shell is helmet shape, lightweight when empty, thin and spirally coiled.

Step 2 : Shells made of two pieces (valves) are bivalve shells. They can be easily distinguished from the gastropods shells.

The four species of bivalves are included in the Schedule, out of which three species under Schedule I and one under Schedule IV of the wild life (Protection) Act, 1972.

- i) Shell discus shape *Placuna*
Shell fan shape *Tridacna, Hippopus*

- ii) Posterior adductor scar centrally located *Hippopus*
 Posterior adductor scar slightly posterior *Tridacna*
- iii) Valves equilateral; hinge line not shorter than ventral margin; sculpture projecting broad, leaf like scales; byssal orifice smaller *T. squamosa* Lamarck
 Valves strongly inequilateral; hinge line considerably shorter than ventral margin; sculpture without projecting broad, leaf like scales; byssal orifice large
 *T. maxima* (Roeding)

Step 3 : The remaining shells belong to class Gastropoda. Identification of these based on shape of the shell is given. They may be Barrel shape, Club shape, Egg shape, Irregular shape, Spindle shape and Top shape. These shells can easily be grouped like : -

Barrel shape : *Cassis, Cypraecassis*

Club shape : *Tudicla, Conus*

Egg shape : *Cypraea, Harpulina*

Irregular shape : *Lambis*

Spindle shape : *Strombus, Fasciolaria*

Top shape : *Trochus, Turbo*

After grouping of shell the following steps should be taken for identification up to species level.

Barrel shape

Shell very heavy; ornamented with heavy knobs and spiral cords; outer lip large; columella with large calloused shield *Cassis cornuata* (Linnaeus)

Shell less heavy; ornamented with 3-4 rows of large blunt knobs decrease in size towards base, and smaller nodules and pitted grooves in between large knobs; outer lip broad; columella lirate and denticulate *Cypraecassis rufa* (Linnaeus)

Club shape

Shell conical; columella simple and without fold; sculpture consist of striae, ridges, grooves and coronation; siphonal canal short *Conus*

Shell vase shaped; columella with strong fold; sculpture with nodose spines, blunt knobs and heavy spiral cords; siphonal canal long and slender *Tudicla*

Spindle shape

Sculpture with axial ribs on the early whorls and additional spiral threads; outer lip thickened and anteriorly situated, deep or shallow concave excavation (sromboid notch); columella smooth or lirate *Strombus*

Sculpture with axial ribs, nodules and spiral striae; outer lip denticulate and plicate; columella smooth *Fasciolaria*

Top shape

Shells conical, flat, circular base; last whorl concave in the centre and smaller in the base; operculum chitinous, circular; sculpture with concentric striae **Trochus**

Shells globose (turbinate); last whorl concavo-convex; operculum calcareous, spiral; sculpture with 1-3 nodulose keel **Turbo**

TECHNICAL DESCRIPTION**Family CASSIDAE**

Commonly known as helmet-shells. Small to large shells with a short spine but large body whorl and with a long aperture. Sculpture with knobs, nodules, thread or granules; outer lip thick and prominent plications and columellar folds varies present in some species; operculum thin, corneous and brown. Males and females differ in size. Found mostly in worm waters around the world, deepwater forms. The sand dwelling forms feeds upon sea urchins and other invertebrates. Egg mass tower like and free swimming larval stage.

1. *Cassis cornuta* (Linnaeus)

Common name : Horned Helmet

(Pl. 4, Figs. 7 & 8)

1758. *Buccinum cornutum* Linnaeus, *Syst. Nat. ed. 10* : 735.

2000. *Cassis cornuta* : Subba Rao & Dey, *Rec. zool. Surv. India, Occ. Paper, 187* : 85.

Shell up to 350 mm length, solid and heavy; aperture narrow, outer lip large, columella with large calloused shield which connects the columella with the outer lip; teeth on both lips are large and prominent; sculpture with heavy knobs and spiral cords; grey or white, ornamented with faint spiral rows of dark spots, aperture and columellar shield yellow or orange, teeth whitish, interstices dark orange; females longer than males and have smaller but more numerous knobs on the back; the knobs in males are elongated and slightly curved and wider spaced. Males smaller than females.

Distribution : Indo-pacific. India : Andaman Islands, Gulf of Mannar (Tamil Nadu).

Remarks : Distributed in Coral reef, 1 to 20 m; Common.

2. *Cypraecassis rufa* (Linnaeus)

Common name : Bull mouth Helmet

(Pl. 4, Figs. 9 & 10)

1758. *Buccinum rufa* Linnaeus, *Syst. Nat. ed. 10* : 736.

2000. *Cypraecassis rufa* : Subba Rao & Dey, *Rec. zool. Surv. India, Occ. Paper, 187* : 85.

PLATE - 4



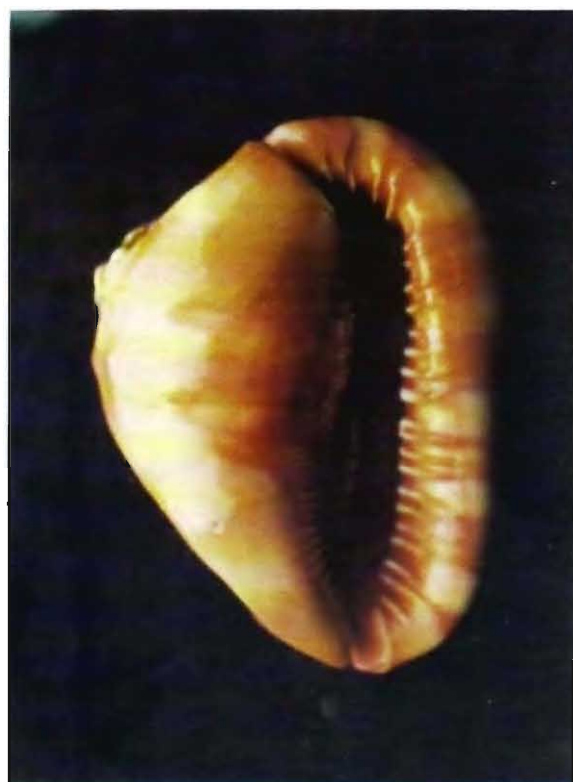
7



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7 & 8. *Cassis cornuta* (Linnaeus)
9 & 10. *Cypaecassis rufa* (Linnaeus)

Shell up to 90 mm in length, solid, heavy, broadly ovate in dorsal view, spine obscured by columellar callus and outer lip in apertural view, early whorls exerted, otherwise spine almost flat; sculpture with 3 to 4 large blunt knobs decrease towards base, and smaller nodules and pitted grooves in between large knobs; columellar callous large, columella lirate and denticulate; reddish brown, banded with faint orange and apricot aperturally; dorsal and teeth white, interstices dark brown.

Distribution : Indo-pacific. India : Andaman and Nicobar Islands.

Remarks : Distributed near Coral reefs; common.

Family RANELLIDAE

Commonly known on Triton-shells; small to large, predominantly thick, heavy and coarsely ornamented with knobs and cords and tubercles. Occasionally with varices and some of them with long siphonal canal. Periostracum usually conspicuous and may be thin or thick and bristly. Operculum brown, chitinous and is often smaller than aperture. Dwellers of tropical and warm water, occurring in rock pools or in rock crevices at low tide level or below; some of them buried in sand. Egg capsules attached to rocks. A long free swimming larval stage (Veliger) upto 3 months, the reason of wide distribution of some species.

3. *Charonia tritonis* (Linnaeus)

Common name : Trumpet triton

(Pl. 5, Figs. 11 & 12)

1758. *Murex tritonis* Linnaeus, *Syst. Nat. ed. 10* : 754.

2000. *Charonia tritonis* : Subba Rao and Dey, *Rec. zool. Surv. India, Occ. Paper*, 187 : 91.

Shell large upto 380 mm in length with a elongated spine, whorls narrow rounded; spines less than ½ of the total length; body whorl broad with two prominent varices and flattened spiral ribs having deep grooves and an occasional thin, extra ribs below; suture well impressed and the ribs below each whorl is wavy and puckered; siphonal canal broad and short; then folds along the columellar wall. Shell creamy with dark brown blotches and crescents; aperture orange-brown, with white channels between teeth on outer lip. Columellar teeth white dark brown between.

Distribution : Indo-pacific. India : Andaman and Nicobar Island, Lakshadweep.

Remarks : Distributed in Coral reefs in shallow water, moderately common.

Family VASIDAE

Common name : Dog Chank

The vase shells also known as Dog chank, belongs to a small family Vasidae with about 25 species, abundant in tropical seas with carnivorous in habit. Shell moderately large, solid

and heavy; sculptured with nodose spines, blunt knobs and heavy spiral cords; aperture narrow and lirated, columella calloused and plicate; siphonal canal moderately short or extended. Inhabitants of reef flats within in intertidal region. Many authors considered Vasidae and Turbinellidae (Formerly Xancidae) into a single family Turbinellidae due to close related among them.

4. *Tudicla spirillus* (Linnaeus)

Common name : Spiral Tudicla (Spiral Vase)
(Pl. 5, Figs. 13 & 14)

1791. *Murex spirillus* Linnaeus, *Syst. Nat. ed. 12* : 1221.

1881. *Tudicla spirillus* : Kobelt in Martini and Chemnitz, *Conch. Cab. 3* : 16, tab. 24, figs. 1, 2.

Shell up to 90 mm in length, solid with wide inflated body whorl; spire short, compressed, apex bulbous, white; suture fine, body whorl with a sharp keel at the shoulder and shallow spiral grooves below; columella with a single fold; siphonal canal long, curved at the end; whitish with brown blotches on the keel.

Distribution : India : South India (Pondicherry).

Remarks : Distributed in Offshore to 20 m; locally common.

Family CONIDAE

Common name : Cone shell

Cones have long attracted the shell collector and the biologist due to the different varieties and colouration and patterns. Found under rocks, in rock crevices, and in clean or muddy sand. Feed on worms, other molluscs or even fish. Egg deposited in purse shaped capsules. Certain species have a highly developed venom apparatus, may be lethal to humans. About 200 species represented throughout the world. Occurs in warm, tropical seas abundant in tropical coral reef habitats. They live in the intertidal zone between the reef and the shore, in the rock and coral crevices and in sandy habitats easily recognizable by their thick, conical and mostly unornamented colour shells with a narrow aperture and smooth columella. Cones are common in the Andaman and Nicobar Islands, Gulf of Mannar, Gulf of Kachchh and Lakshadweep. A few species were collected off the mainland coast of India from the intertidal sandy zone to a depth of about 40 m. About 68 species of Cones are known from India, and of these 53 are reported from Andaman and Nicobar Islands.

Small to large shells, moderately long, conical spire and long and narrow aperture; sculpture consists of spiral cords, grooves, granules or sutural coronations; periostracum thin and moderately translucent or thick and opaque; operculum small, horny and dark brown. Some are primarily reef dwellers.

PLATE - 5



11



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11 & 12. *Charonia tritonis* (Linnaeus)
13 & 14. *Tudicla spirillus* (Linnaeus)

**A CHECK LIST OF CONUS SPECIES RECORDED FROM ANDAMAN
& NICOBOR ISLANDS (Subba Rao and Dey, 2000)**

The following species of *Conus* were also reported from Indian localities (Subba Rao, 2001)

1. *Conus adamsonii* Broderip
2. *C. amadis* Gmelin
3. *C. araneosus* var. *nicobarica* Hwass
4. *C. arenatus* Hwass
5. *C. aulicus* Linnaeus
6. *C. balteatus* Sowerby
7. *C. biliosus* (Roeding)
8. *C. canonicus* Hwass
9. *C. capitaneus* Linnaeus
10. *C. characteristicus* Fishcher
11. *C. catus* Hwass
12. *C. ceylanensis* Hwass
13. *C. chaldaeus* (Roeding)
14. *C. coronatus* Gmelin
15. *C. distans* Hwass
16. *C. ebraeus* Linnaeus
17. *C. eburneus* Hwass
18. *C. edwardi* Preston
19. *C. emaciatus* Reeve
20. *C. ermineus* Born
21. *C. figulinus* Linnaeus
22. *C. flavidus* Lamarck
23. *C. generalis* var. *maldives* Hwass
24. *C. geographicus* Linnaeus
25. *C. glans* Hwass
26. *C. hyaena* Hwass
27. *C. litteratus* Linnaeus
28. *C. lividus* Hwass
29. *C. marmoreus* Linnaeus
30. *C. miles* Linnaeus
31. *C. miliaris* Hwass
32. *C. mitratus* Hwass
33. *C. monile* Hwass
34. *C. nobilis* Linnaeus
35. *C. pennaceus* Born
36. *C. rattus* Hwass

37. *C. straturatus* Sowerby
38. *C. striatus* Linnaeus
39. *C. sumatrensis* Hwass
40. *C. terebra* Born
41. *C. tessulatus* Born
42. *C. textile* Linnaeus
43. *C. tulipa* Linnaeus
44. *C. virgo* Linnaeus
45. *C. zonatus* Linnaeus

5. *Conus milne-edwardsi* Jousseume

Common name : Glory of India
(Pl. 6, Figs. 15 & 16)

1894. *Conus milne-edwardsi* Jousseume, *Rev. Illust. Des. Sci. Natur. Paris*, (2) **182** :

Shell upto 100 mm, heavy, glossy, elongate biconic; spire elongate, whorls stepped, concave above and spirally ridged; shoulder of last whorl slightly keeled; body with white netted with large, orange brown to darker brown tents and irregular areas and 3 irregular spiral bands of reddish-brown blotches; spire whorls with similar colour, aperture white to cream.

Distribution : Indian Ocean. India. Andaman and Nicobar Islands.

Remarks : Distributed in Off shore area; rather rare.

Family NAUTILIDAE

The family of chambered or pearly Nautilus contains a few (about half a dozen) species with large, compressed and coiled shells, with a large aperture and are either imperforate or umbilicate. The interior is divided by perforated partitions or septa with separate the interior into chambers. The chambers are filled with gas and keep the animal in balance in mid water. The animal, like octopus, is positioned in the first chamber, exposes numerous (Ninty) tentacles, a hood and 2 eyes. Confined to deep waters throughout Indo-pacific region.

6. *Nautilus pompilius* Linnaeus

Common name : Chambered Nautilus.
(Pl. 6, Figs. 17 & 18)

1758. *Nautilus pompilius* Linnaeus, *Syst. Nat.*, ed. **10** : 709.

2000. *Nautilus pompilius* : Subba Rao & Dey. *Rec. zool. Surv. India Occ. Paper*, **187** : 190.

Shell up to 200 mm large, spirally coiled, light, bilaterally symmetrical, partitioned; the resulting chambers are connected each other by a hollow tube. Aperture large but without umbilicus. White or creamy, with zebra like reddish stripes radiating from the umbilical region throughout extending into the broadest part of the body whorl. Free swimming.

The only cephalopod with true external shell. Geometrically perfect and aesthetically appealing is the shell of Nautilus, which gets washed ashore on the coasts of Andaman and Nicobar Islands. There are as many as 38 chambers in a full-grown Nautilus. The first four chambers are formed when the young Nautilus is still within the egg and new chambers are added at the rate of one every 2 or 3 weeks. The successive chambers of Nautilus are built on a framework of logarithmic or equiangular spiral. As the shell grows to accommodate the growing animal, the size of chambers correspondingly increases, but the shape remains unchanged. The increase in length is balanced by a proportional increase of radius so that its form remains unchanged (Subba Rao, 2002).

Distribution : Indian Ocean, western and central Pacific. India : Andaman Islands.

Family TRIDACNIDAE
Common name : Giant Clam

The giant clam, the largest among the molluscs and weighted up to 580 pounds and 4½ feet in length. About less than a dozen of species reported from this family.

Shells usually large, heavy and ponderous; sculpture with broad radial folds which are occasionally scaly, and blunt or pointed inter locking marginal digitations. They attached by a byssal orifice next to the beaks and the dorsal margin with the pointed or fluted digitations. Edge of byssal orifice are plicate, ligament on the same side as the hinge teeth. Adductor muscle scars and pedal retractor muscle scars are almost in the center of the pallial line and tend to merge with each other.

Tridacnidae produce occasionally non-nacreous pearls. A pearl of 9½ x 5½ inches weighed 14 pounds reported from a Philippine specimen *T. gigas* (Rosewater, 1965). Shells are used as ornaments, water-containers and tools by the natives of Pacific Islands; perforated disc manufactured from Tridacnidae used as money in Soloman Islands.

Occurs in the tropical Indo-Pacific, around coral reefs.

7. *Tridacna maxima* (Roeding)
Common name : Elongate Giant clam
(Pl. 7, Fig. 19)

1798. *Tridacna maxima* Roeding, *Mus. Bolten.*, p. 171.

1965. *Tridacna maxima* : Rosewater, *Indo-pacific Mollusca*, 1 (6) : 384.

Shell up to 350 mm, elongate to short, obtuse triangular in shape; angle formed at umbos

by margins of hinge and ventral broader less than 150°; moderately strong, inflated and having a large byssal orifice. Valves heavy thick, colour usually greyish white but often tinged with yellow, pinkish orange; radial sculpture with 6-12 broad, moderately convex rib like folds becoming crowded and obsolete on ventral slope; concentric sculpture of closely spaced undulate line of growth which produce crowded, but usually low scales on primary fold; scales often worn off near umbo; hinge line short, less than ½ of shell length; cardinal teeth single on both valves; laterals low in right and one in left valve; umbos posteriorly directed; pallial line entire; posterior adductor scar large, sub circular, adjacent to pallial line dorsally; posterior pedal retractors scar larger than ½ size of posterior adductor scar.

Distribution : Indo-pacific. India : Andaman and Nicobar Islands.

Remarks : Distributed in shallow coral reefs, common.

It can easily distinguished from *T. squamosa* by its strongly inequilateral valve, the hinge line being considerably shorter than the ventral margin and by sculpture.

8. *Tridacna squamosa* Lamarck

Common name : Fluted Gaint clam
(Pl. 7, Figs. 20 & 21)

1819. *Tridacna squamosa* Lamarck, *Hist. Nat. Anim Sars. Vert.*, 6 : 106.

2000. *Tridacna squamosa* : Subba Rao & Dey, *Rec. zool. Surv. India, Occ. Paper*, 187 : 247.

Shell up to 408 mm in length, semicircular in outline; the angle found at umbo by hinge line and ventral margin more than 150°; strongly inflated and having medium-sized to small byssal orifice; valves thick, heavy. Radial sculpture consists of 4 to 12 strong, rib like folds, which became crowded and obsolete on ventral slope; 2 – 4 from anterior end vertical; other slants on anterior or posterior direction; concentric sculpture consists of undulate lines of growth, widely spaced, leaf like; scales worn or broken on ventral half. Dorsal margin broadly fan shaped, with 4 – 6 median projections crenulated. Cardinal teeth single in both valves; lateral two in right valve and one in left valve; ligament prosodetic; ventral margin slightly concave in the region byssal orifice; Pallial line entire, moderately wide; Posterior adductor scar large, sub circular, adjacent to pallial line dorsally; posterior pedal retractor ½ of the posterior adductor scar.

Distribution : Indo-pacific. India : Andaman Islands.

Remarks : Distributed in shallow reefs to 10 m; locally common.

9. *Hippopus hippopus* (Linnaeus)

Common name : Bear Paw clam
(Pl. 8, Figs. 22 & 23)

1758. *Chama hippopus* Linnaeus, *Syst. Nat., ed. 10* : 691.

PLATE - 7



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19. *Tridacna maxima* (Roeding)
20 & 21. *Tridacna squamosa* Lamarck

2000. *Hippopus hippopus* : Subba Rao & Dey, *Rec. zool. Surv. India, Occ. Paper*, 187 : 246.

Shells up to 400 mm, elongate to ovate triangular or sub-rhomboidal in shape; strongly inflated; valves thick and heavy; radial sculpture 13 to 14 moderately convex rib like folds; riblets varying somewhat in width; concentric sculpture fine, wavy; dorsal margin undulate, with 8 to 12 squarish, medially projecting processes, with extremities of rib interstices. Hinge line more than half of the length of the shell. Cardinal teeth one in each valve. Pallial line entire; muscle scar central, medium, kidney shaped in left valve; roundly ovate in right; Posterior pedal retractors less than $\frac{1}{2}$ the size of posterior adductor scar and located anterior; both scars contiguous to pallial line.

Distribution : Indo-pacific. India : Nicobar Islands.

Remarks : Distributed in shallow water, coral reefs; common.

Family TROCHIDAE

Exclusive, world wide family of small to large species with conical or globose shell having a flat or convex base and an oval aperture. Body whorl rounded or angular, columella smooth or with a single blunt tooth, base with or without an umbilicus; outer lip smooth or ridged internally. Brightly coloured and boldly patterned, top shells are pearly within. Operculum chitinous, thin, flexible, circular and usually multi-spiralled, brown striate and heavy. Predominantly rock dwellers, browsing algae. Microphagus feeders, subsisting on protozoans and detritus matter.

Commonly known as top shells. Over hundred species are found in all temperate and tropical water. Their shape and beautifully pearly layer within makes them commercially valuable. They are great demand for pearl button manufacturers.

1. *Trochus (Trochus) niloticus* Linnaeus
Common name : Commercial Trochus
(Pl. 8, Fig. 24 & 25)

1767. *Trochus niloticus* Linnaeus, *Syst. Nat.*, ed. 12 : 756.

2000. *Trochus (Trochus) niloticus* : Subba Rao & Dey, *Rec. zool. Surv. India, Occ. Paper*, 187 : 21.

Shell heavy, large (up to 150 mm) in length, solid, about 8 whorls. The body whorl widely flattened and more than length, concave in the center and shell almost swollen at the base, smooth, although the smaller younger specimens with nodules; spiral cords and fluted sutures up to (5 or 6 spire whorls); columella smooth off white in colour, ornamented with flame like stripes of vermilion in colour.

Distribution : Indo-pacific. India : Andaman and Nicobar Islands.

Remarks : Distributed in shallow reef to sub-tidal, 20 meters; abundant.

Family TURBINIDAE
Common name : Turban Shells

Commonly known as Turban shell. Extensive, world wide; small to large shells, solid, turbanate, globose, thick, with few whorled and strongly ornamented; smooth or sculptured with spiral cords or peripheral nodes, columella smooth, lacking teeth or folds; aperture liked with nacre. Body whorl is well rounded in some genera, keeled in others. Operculum circular or oval, semi globular, calcareous thick, heavy, its inner surface bearing a thin, chitinous layer, its outer surface being smooth or variously ornamented and often brightly coloured.

Inhabitant of reefs and found under coral rocks or sometimes exposed in the intertidal reef zone.

2. *Turbo marmoratus* Linnaeus
Common name : Great Green Turban
(Pl. 9, Figs. 26 & 27)

1758. *Turbo marmoratus* Linnaeus, *Syst. Nat.*, ed. 10 : 763.

2000. *Turbo (Turbo) marmoratus* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper*, 187 : 28.

Shell large, heavy solid up to 200 mm in length and ventricose. Sculpture with 1-3 nodules keel; spire obtuse, elongated; suture deep; body whorl concavo-convex; aperture large, inside pearly; columella concave and smooth, umbilicate; shell marbled with dark brown green and cream colour blotches; operculum large and heavy, smooth and white in colour.

Distribution : Indo-pacific : India : Andaman Islands.

Remarks : Distributed in Offshore under boulders 4 to 20 m; locally abundant.

General remarks on *Trochus* & *Turbo* : *Trochus niloticus* and *Turbo marmoratus* are two commercially important gastropods. Both the species are distributed in the coral reefs of Andaman and Nicobar Islands and occur up to 20 m depth. *Trochus* is exploited since 1900 and the introduction of new techniques by the Japanese divers in 1929 has depleted the stocks rapidly. Continued commercial fishing of *T. niloticus* in Andamans has reduced quantities of shells fished from 500 tons to less than 40 tons in one season. In 1933, an hour-long search by a diver could yield 20 shells, which had fallen to two to three by 1935 (Rao, 1937). During the years 1939-45 commercial fishing was stopped and the beds were allowed to recover. Growth of *Trochus* is quite fast for the first 2-3 years (8 cm base diameter). A ten-year-old attains the size of 12 cm (Subba Rao, 2002).

Family STROMBIDAE
(Winged Shells or Conch Shells)

Medium to large, thick, with expanded outer lip in the direction of the apex or furnished with several short or long digitations. The most distinguishing features of the shell are the

PLATE - 8



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22 & 23. *Hippopus hippopus* (Linnaeus)
24 & 25. *Trochus niloticus* Linnaeus

PLATE - 9



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26 & 27. *Turbo marmoratus* Linnaeus
28 & 29. *Lambis (Harpago) chiragra chiragra* (Linnaeus)

development of a large, glaring and thickened outer lip and the presence of a U-shaped notch or indentation on the edge of the lip near the end. It is referred as a 'stromboid notch' and facilitates the protrusion of eye stalk. Spire conical whorls often angulate and with varices; sculptured with axial ribs on the early whorls and additional spiral threads; interior of the aperture and the columella are either smooth or lirate. The animals have a very powerful foot and long eye stalks; the operculum is broader corneous and serrated on the margin.

Strombidae are sand dwellers and are found in either muddy, weedy or clean coral sand in shallow waters of the intertidal region and nearly to a depth of 60 fathoms. Animals are herbivorous or feed on detritus matter; inhabitant of warm water. They may occur as epifauna on the coral boulders or burrow into the sand in the reef area. Eggs laid on long gelatinous strands. Sexes are separate and sexually dimorphic, the shell in males being slightly smaller than in the females and differently sculptured. Male possesses a long, open-grooved penis. Female has an open gonoduct. The animals congregate at the time of spawning. Eggs are laid in long, jelly-like coiled tube. Larva is planktotrophic.

The family contains six genera and an estimated 100 species distributed in the tropical and semi-tropical seas. As many as five genera and twenty species are so far reported from Indian seas.

3. *Strombus (Dolomena) plicatus sibbaldii* Sowerby

Common Name : Sibbald's conch

(Pl. 12, Figs. 40 & 41)

1842. *Strombus sibbaldii* Sowerby, *Thes. Conch.*, 1 : 28, pl. 6, figs. 10, 11.

1960. *Strombus (Dolomena) plicatus sibbaldii* : Abbott., *Indo-pacific Mollusca*, 1 (2) : 91, pl. 18, figs 15, 16.

Shell up to 50 mm, white, blotched and banded with beige; sturdy, semi glossy, axially plicate, light weight with almost square side last whorl and narrowly elongate; spire slightly concave; outer lip rounded, thickened at the edge; shoulder with rows of nodules, coarse axial ribs on spire whorls; columella and aperture lirate; base of columella with 5 to 7 weak teeth columellar lirae tinged brown; upper half of the last whorl smooth, lower half spirally ridged; periostracum thin, varnish like, smooth; aperture white.

Distribution : Gulf of Aden to Sri Lanka. India : Kerala Coast.

Remarks : Uncommon.

4. *Lambis (Harpago) chiragra chiragra* (Linnaeus)

Common name : Chiragra spider conch

(Pl. 9, Figs. 28 & 29)

1758. *Strombus chiragra* Linnaeus, *Syst. Nat.*, ed. 10 : 742.

1961. *Lambis (Harpago) chiragra chiragra* : Abbott, *Indo-pacific Mollusca*, 1 (3) : 170, pl. 121, figs. 10-12.

Shell up to 250 mm with fine large labial digitations and left turned siphonal canal. Large "Stromoid" notch located between 4th and 5th labial digitations; whorls 10 to 11; spire concave, bordered above and below by two raised, spiral cords; spiral sculpture with numerous small threads on the body whorl, of 4 or 5 large spiral cords; upper cord at the shoulder bears 6 to 7 large knobs of, welded and large last two; lowest fourth cord weak; shell white with crowded zigzag streaks of light or purple brown colour; parietal was slightly glazed, cream and brown, axial streaks; operculum chitinous, dark brown, fusiform with fine strations on one side.

Male and female shells are different. The former has smaller shells, with strong white spiral lirae over a purple coloured columella, five knobs on the body whorl. Female has a bigger shell, whitish rosy aperture and smooth white columella.

Distribution : Indian Ocean to eastern Polynesia. India : Andaman and Nicobar Island, Lakshadweep.

Remarks : Distributed in shallow water, common. Associated with sand, coral and algal covered reefs.

5. *Lambis (Harpago) chiragra arthritica* Roeding

Common name : Arthritic spider conch

(Pl. 10, Figs. 30 & 31)

1798. *Lambis arthritica* Roeding, *Mus. Bolten.*, pt. 2, p. 67.

1960. *Lambis (Harpago) chiragra arthritica* : Abbott, *Indo-pacific Mollusca*, 1 (3) : 173, pl. 121, fig. 7, pl. 132, fig. 1.

Shell up to 190 mm in length with five labial digitations; siphonal canal turned to the left. Similar to *L. chiragra chiragra*, but differs with slightly depressed, broad rounded arching on the end of aperture, whereas the *L. chiragra chiragra* with a deep depression at the upper end of aperture. The colour of inside of outer lip yellowish or pinkish yellow with splotches of purplish underlying the white spiral lirae; columella brownish purple with strong whitish spiral lirae which tend to parallel the 4 spiral cords on the parietal wall; Periostracum thin, varnish like.

Distribution : East Africa to Central Indian Ocean. India : Pondicherry.

Remarks : Distributed in low water level on weed covered, stony reefs where a swift current moves. Common.

6. *Lambis (Lambis) crocata crocata* (Link)

Common name : Orange spider conch

(Pl. 10, Figs. 32 & 33)

1807. *Pteroceras crocatus* Link, *Beschr. Natur. Samml. Rostock*, pt. 2, pp. 109.

PLATE - 10



30



31



32



33

30 & 31. *Lambis (Harpago) chiragra arthitica* Roeding
32 & 33. *Lambis (Lambis) crocata crocata* (Link)

1960. *Lambis (Lambis) crocata crocata* : Abbott, *Indo-pacific Mollusca*, 1 (3) : 157, pl. 121, fig. 8, pl. 126.

Shell up to 150 mm in length with 6 labial digitations and long slender curved siphonal digitations; sculptured with a nodulose sutural carina and spiral cords on the early whorls, last whorl with a spiral row of large knobs and 2 additional rows of rounded noduloses; aperture solid, whitish orange and smooth; outer lip lodged, equipped with 6 slender and curved digitations; columella swollen and smooth; siphonal canal long and twisted; shells white, blotched with brown, or brown in colour and flecked with white; aperture and columella bright orange, aperture purple-brown deep within.

Distribution : Indo-W. Pacific. India : Andaman Islands.

Remarks : Seaward Coral reef, low tidemark to 10 feet; moderately common.

7. *Lambis (Lambis) truncata truncata* (Humphery)

Common name : Truncate spider conch

(Pl. 12, Figs. 38 & 39)

1786. *Strombus truncatus* Humphrey, *Portland Cat.*, p. 133.

1960. *Lambis (Lambis) truncata truncata*: Abbott, *Indo-pacific Mollusca*, 1 (3) : 155, pl. 122, fig. 2.

Shell up to 370 mm in length with six slightly arching labial digitations; siphonal canal straight and small; whorls 9 to 10; apex with 4 to 5 flat whorls, shoulder of whorls in spire with rather large, rounded nodules (10 to 12 in number); Dorsum of body whorl with 2 or 3, swell knob like, which may be large and mound; spiral aperture with numerous weak, irregular threads or cords.; aperture and parietal area glossy, aperture tan or purplish brown; columella straight; periostracum moderately developed; operculum brown, chitinous, elongate, slightly curved.

Distribution : East African coast to Bay of Bengal and Cocos keeling Atoll. India : Andaman and Nicobar Islands.

Remarks : Distributed in Coral Reef, 10 to 12 feet; shallow water; common.

8. *Lambis (Millepes) millepeda* (Linnaeus)

Common name : Milleped spider conch

(Pl. 11, Figs. 34 & 35)

1788. *Strombus millepeda* Linnaeus, *Syst. Nat.*, ed. 10 : 743.

1960. *Lambis (Millepes) millepeda* : Abbott, *Indo-pacific Mollusca*, 1 (3) : 161, pl. 121, fig. 6, pl. 129, fig. 3.

Shell moderately large up to 150 mm with digitations; sculpture with spiral cords and nodes; outer lip with 9 to 10 short labial digitations, of which lower 4 to 5 hooked towards apex; siphonal canal short and twisted; aperture mauve-brown with numerous white lirae; columella prominently lirate; creamy white or mauve brown between lirae.

Distribution : S. W. Pacific. Indian ocean.

Remarks : Distributed in shallow water; moderately common down up to 2 fathoms.

9. *Lambis (Millepes) scorpius scorpius* (Linnaeus)

Common name : Scorpio conch

(Pl. 11, Figs. 36 & 37)

1758. *Strombus scorpius* Linnaeus, *Syst. Nat.*, ed. 10 : 743.

1960. *Lambis (Millepes) scorpius scorpius* : Abbott, *Indo-pacific Mollusca*, 1 (3) : 164., pl. 121, fig.5, pl. 129, fig. 4.

Shells up to 170 mm with six knobbed labial digitations and a long slender, strongly curved right knobbed siphonal degitation; whorls nine; nuclear three smooth; Body whorl with thin spiral rows of low knobs; 1st row with four large, 2nd with 8 to 9 small and 3rd one with 5 to 6 intermediate size knobs; siphonal canal long; strong, curved to right; aperture small, quadrate; outer lip with numerous, raised spiral lirae inside; columella bounded by long narrow, white, axial swelling deep within aperture, operculum long, slightly curved with 10 small serration.

Distribution : Indonesia and Ryukyu Islands to Samoa. India : This subspecies not recorded from Indian waters. The Indian subspecies will be *L. (M.) scorpio indomaris* Abbott, occuring in Andaman and Nicobar Islands.

Remarks : Distributed in shallow water to 10 feet, moderately common. Usually on coral reef flats or among dead coral slabs and boulders.

Family CYPRAEIDAE

Common name : Cowries

Cowries are represented by about 200 species in all but maximum number of about 140 species occurs in the Indo Pacific region. Over 50 species are known from Indian seas. Greatest diversity is seen in the reefward edge and surf beaten zones in the coral reef ecosystem of Andaman and Nicobar Islands, Gulf of Mannar, Gulf of Kachchh and Lakshadweep. Majority of the species inhabits shallow water, but a few may extend into the reef front that remains unexposed even during spring tide. The family is represented by a single genus, which is divided into more than 53 subgenera, some of which are elevated to a generic status by many authors.

Popularly known as "Cowries" and are known as the "jewels of the sea" Cowries have a dome-shaped and almost hemispherical shell, size varies from 8mm to 150 mm, ovate to pyriform, highly enameled and have a smooth or occasionally pustulose surface. Aperture moderately narrow, and the labial and columellar lips are denticulate; fossula may be smooth

PLATE - 11



34



35



36



37

34 & 35. *Lambis (Millepes) millepeda* (Linnaeus)
36 & 37. *Lambis (Millepes) scorpius scorpius* (Linnaeus)

PLATE - 12



38



39



40



41

38 & 39. *Lambis (Lambis) truncata truncata* (Humphrey)
40 & 41. *Strombus (Dolomena) plicatus sibbaldi* Sowerby

or ribbed, extremities truncate or produced; base of the shell convex or flat. Spires absent in the adult. Juvenile shell is strikingly different from that of an adult. A spiral shell is present in the early stage but on maturity the outer lip turns in, thickens and teeth develop on it and the inner lip (columella). The shell then turns ovate pyriform, domed, globular or hemispherical.

There is a pair of long, filiform cephalic tentacles bearing eyes at their outer bases. Foot is broad and extensible. Mantle cavity contains an arched ctenidium with several lamellae, a triradiate osphradium and a large hypo-branchial gland. Radula is long and taenioglossate (2-1-1-1-2). Sexes separate. Female lays eggs on coral substrate or in crevices of the reef. Egg mass is laid in either a circular or oblong shape and consists of layers of capsules in a cluster. Each egg mass with 100 to 300 egg capsules. Egg capsules are various in colour like white yellow, mauve or purple, orange, pink and each capsule with 200 to 500 eggs.

“Cowries” are inhabitant of coral reefs, and seek refuge from the sea under loose coral rocks, and hide in reef crevices and at the base of soft coral. Lives in warm waters of oceans.

10. *Cypraea limacina* Lamarck
Common name : Limacina cowrie
(Pl. 13, Fig. 42)

1810. *Cypraea limacina* Lamarck, *Hist. Nat. Anim. Sans. Vert.* : 264.

2000. *Cypraea limacina* : Cernohorsky, *Marine shells of the Pacific*, 1 : 83.

Shells up to 20 mm light weight, solid, elongately ovate, with scarcely produced extremities, outer lip margin, pitted; teeth prolonged and bordered with brown; columellar teeth not reaches the margin; dorsum greenish to reddish brown covered with small white bluish spots, margins and extremities with irregular brown spots base and teeth-white.

Distribution : Indo-West pacific. India : Tamil Nadu, Gulf of Mannar.

Remarks : Distributed under stones, rock, mud and slit; Moderately common.

11. *Cypraea mappa* Linnaeus
Common name : Map cowrie
(Pl. 13, Figs. 43 & 44)

1758. *Cypraea mappa* Linnaeus, *Syst. Nat. ed. 10* : 718.

2000. *Cypraea mappa* : Subba Rao & Dey, *Rec. zool. Surv. India, Occ. Paper*, 187 : 72.

Shell up to 70 mm, ovate and inflated; dorsum brownish, ornamented with wide and clear dorsal line from which branch a number of feeler like extensions; base convex, pink or cream or purplish in colour.

Distribution : Indo-pacific. India : Andaman and Nicobar Islands.

Remarks : Distributed in Coral reefs, under slabs, shallow and deeper water; Uncommon.

12. *Cypraea talpa* Linnaeus
Common name : Mole cowrie
(Pl. 14, Figs. 45 & 46)

1758. *Cypraea talpa* Linnaeus, *Syst. Nat.*, ed. 10 : 720.

2000. *Cypraea talpa* : Subba Rao & Dey, *Rec. zool. Surv. India, Occ. Paper*, 187 : 74.

Shells up to 85 mm, solid glossy elongately ovate, margins slightly developed, extremities almost smooth and produced; apex well identified; base flat; teeth fine, short and deep; aperture narrow; dorsum pale yellowish-brown, with four broad, transverse dark-brown bands; margins, teeth and extremities chocolate brown, whitish between the teeth.

Distribution : Indo-pacific. India : Andaman and Nicobar Islands.

Remarks : On coral reefs in shallow and deeper water. Uncommon.

Family FASCIOLARIIDAE
Common name : Tulip & Spindle shell

Commonly known as Tulip and Spindle shells, world wide distribution; small to very large; sculptured with axial ribs, nodes and spiral striae; aperture ovate and usually striate within; outer lip and columella are denticulate and plicate, siphonal canal moderately short (e.g. *Latrius* and *Peristernia*) but in some case (e.g. *Fusinus*) very long. Operculum thick, horny and brown in colour; periostracum translucent or opaque and brown in colour.

Inhabitant of coral rocks of intertidal region (*Latrius*, *Fasciolaria* and *Peristernia*) while *Fusinus* lives in sand and coral-rubble bottom at depth of 2 fathoms to deeper, mainly tropical with carnivorous habit.

13. *Pleuroploca trapezium* (Linnaeus)
Common name : Trapezium Horse conch
(Pl. 14, Figs. 47 & 48)

1758. *Fasciolaria trapezium* Linnaeus, *Syst. Nat. ed.* 10 : 577.

1972. *Pleuroploca trapezium*: Cernohorsky, *Marine shells of the Pacific*, 2 : 153, pl. 45, fig. 6.

Shell strong heavy up to 300 mm; spire elongated, body whorl large, apex usually eroded; suture shallow; aperture large, crowded spiral lines in outer lip; Columella smooth. Spiral rows of large tubercles at periphery of spire whorls and shoulder of the body whorl; spiral lines are arranged in pairs, strong growth ridges; occasional mended beaks. Reddish and cream.

PLATE - 13



42



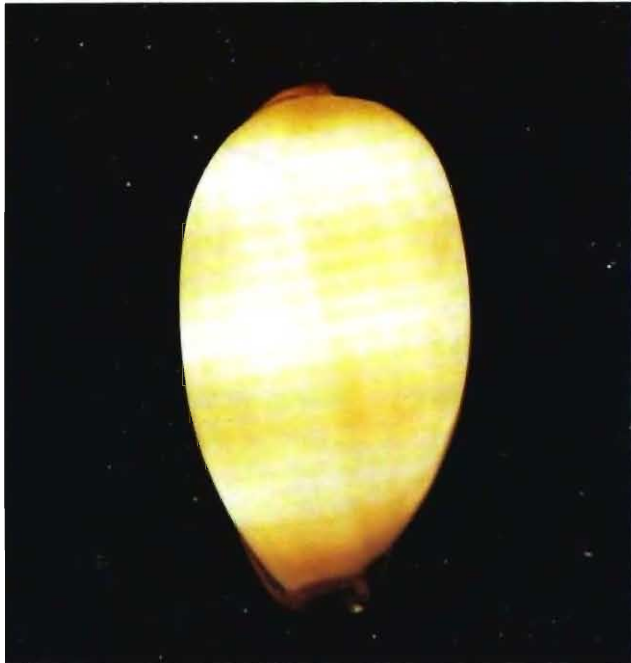
43



44

42. *Cypraea limacina* Lamarck
43 & 44. *Cypraea mappa* Linnaeus

PLATE - 14



45



46



47



48

45 & 46. *Cypraea talpa* Linnaeus
47 & 48. *Pleuroploca trapezium* (Linnaeus)

Distribution : Indo-pacific. India : Andaman Islands, West Bengal Coast.

Remarks : Distributed in shallow water; Common.

Family VOLUTIDAE

The volutes are carnivorous gastropods found mostly in warm waters. So far about 200 species known from this family with worldwide distribution. They have attractive shells, have made them popular with shell collectors and several books have been written about them.

Shell small to large, with short or high spire; aperture long and open; sculpture consists of axial ribs and spiral threads; columella often calloused with oblique plaits, or some of them without plaits.

Animal live in shallow water of intertidal zone and also in deeper water and few of them even in the polar region. Females lay their eggs in battery capsules.

14. *Harpulina arausiaca* (Lightfoot)

Common name : Vaxillate volute

(Pl. 15, Figs. 49 & 50)

1786. *Voluta arausiaca* Lightfoot, *Cat. Portland Mus.*, p. 131.

Shell upto 75 mm, thick, stout, spire long, sometimes much produced at apex, body whorl 3 times longer than spire, whorls obtusely nodulose; columella with eight plications; white with orange or red transverse bands which are generally more or less divided as they approach the outer lip.

Distribution : Sri Lanka and Southern India : Gulf of Mannar. Offshore to 10 m.

Remarks : Uncommon.

Family PLACUNIDAE

Common name : Windowpane oyster

The family Placunidae includes the window pane oysters. Shell usually irregularly rounded, often thin and translucent, smooth or sculptured. The inner surface usually pearly; Byssal notch absent. Right valve bears a deep byssal cleft in the young shell which disappears completely in adult.

The window pane shells are free living animals sheltered in muddy lagoons in shallow water.

15. *Placuna placenta* Linnaeus
 Common name : Windowpane Oyster
 (Pl. 16, Figs. 51 & 52)

1758. *Placuna placenta* Linnaeus, *Syst. Nat.*, ed. 10 : 703.

2000. *Placuna placenta*: Subba Rao & Dey, *Rec. zool. Surv. India, Occ. Paper*, 187 : 230.

Shell more than 180 mm, subcircular, flat, very compressed; left valve little convex, whereas the right valve little concave. Hinge line straight, very short, with two ventrally diverging crural teeth supporting ligament material. Concentric sculpture of very thin appressed lamellae which are radially vermiculate, inner surface is smooth, glossy and displays a brilliant pearly iridescence. Umbo small, inconspicuous. Adductor impression occurs at about the center of the valve as well as defined reniform mark.

Distribution : Philippines; S.E. Asia. India : Andaman Island, Goa, Orissa, Tamil Nadu, West Bengal Coasts.

Remarks : Abundant.

DISCUSSION

It is known that the diversity of biological entities inextricably linked to ecological systems and, more generally, interrelated to an integral part of the biosphere. The Rio Summit (1992) emphasizes the global consensus on the biodiversity conservation on a broad interpretation that includes the conservation of ecosystems, preservation of endangered and threatened species or specific habitats or ecosystems. In this direction, an agency is needed that would be responsible for the integrity and long term well being of the Nation's natural life support system. Ministry of Environment & Forests, Government of India at the Centre and Forest Act of 1927, Wildlife (Protection) Act, 1972; The Wildlife (Protection) Licencing (Additional Matters for consideration) Rules 1983; The Wildlife (Protection) Rules, 1995; The Wildlife (Specified Plants - Conditions for Possession by Licence) Rules, 1993 are now in a position to play a major role in conservation and preservation of natural resources in its habitat.

The demand for molluscs have increased in recent years due to the demand from International shell trade, domestic shell craft industry, preparation of ornaments, curios (table lamps, ashtrays, agarbati stands, wall hangings, door hangings etc.), lime industry, poultry feed additives, pottery glazes, tooth paste, Nacre - commercialy "Mother of Pearl" used in decorative inlay work, jewellery items etc. Besides above, preparation of "Shanka Bhasma" from a marine shells is used in Ayurvedic medicine, usage of molluscan bangles as a socio-religious tradition in few states have caused immense strain on the marine resources.

From a survey made recently by a team of Scientists of Zoological Survey of India and the workshop on Shell Craft Industry held on August, 1999 reveals that nearly 400 tons of

PLATE - 15



49



50

49 & 50. *Harpulina arausiaca* (Light foot)

PLATE - 16



51



52

51 & 52. *Placuna placenta* Linnaeus

Trochus and 100 tons of *Turbo* used to be collected during 1976, from Andaman & Nicobar Islands alone. The collection had fallen to 12.5 tons of *Trochus* and 0.12 tons of *Turbo* by 1983-85. This indicates the rate of decline of the species in its habitat. Similarly the number of processing units at Andaman alone had come down significantly from 52 to 20. This trend affected significantly on the natural resources of molluscs and their products in the nearby Gulf of Mannar (Tamil Nadu) to meet the local demand well as for processing and export. Although there are a few chank based industries in Tamil Nadu but the main centres are in West Bengal, Orissa and Bangladesh. According to some reports there are about 5000 families dependent on chank shell industry in West Bengal alone, spread over the districts of Howrah, Bankura, Burdwan, 24 Pargonas (North and South) and Calcutta (Subba Rao, 2002).

The recent inclusion of Molluscs under Schedule Animals is one such step to protect and conserve several species. 9 species are included under Schedule - I and 15 species under Schedule - IV. The perusal on the distribution of Schedule molluscs reveal that, 8 out of 9 under Schedule - I and 11 out of 15 of Schedule - IV are distributed exclusively in Andaman and Nicobar group of Islands (Figure - 3 a & b). Therefore, the inclusion of molluscs under Schedule recently, in the long run may pave way for the restoration of species balance in nature, especially in the ecologically sensitive, biotically rich, fragile coral reef areas of Andaman and Nicobar group of Islands and Gulf of Mannar area of Tamil Nadu.

Distribution of Schedule - I Molluscs

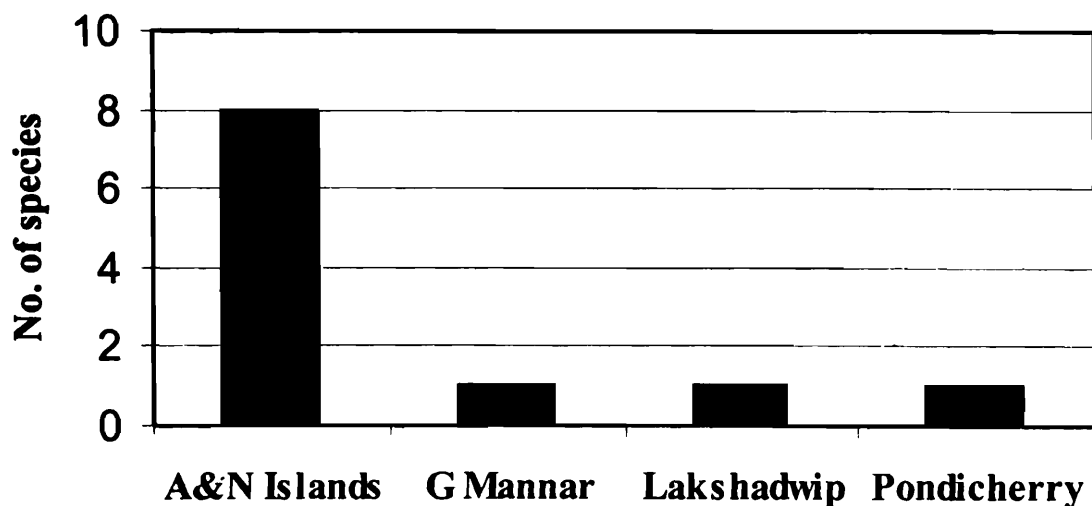


Fig. 3. a

Distribution of Schedule-IV Molluscs

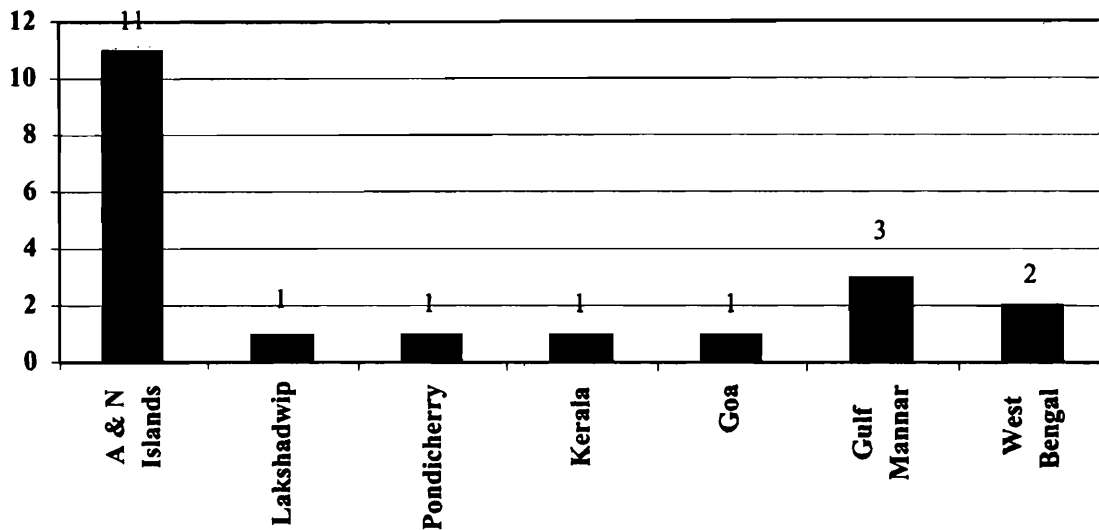


Fig. - 3. b

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GLOSSARY

Adductor scars : scars left on inner surface of valves by muscles which close shell.

Aperture : the opening at the front end of gastropod and tusk shell.

Apex : starting point of shell growth/top of a gastropod shell.

Apophysis : narrow projection from beneath umbones inside valves.

Base : the last formed part of the shell of a gastropod.

Beak : tip of bivalve shell umbo.

Biconic : tapering at both ends.

Bilateral symmetry : when the left side is an exact counter part of the right.

Bivalve : molluscs with a shell formed of two pieces.

Bodywhorl : last formed whorl of an adult gastropod.

Byssal Orifice : gape or notch between margins of valves through which byssus projects.

Byssus : bunch of silky threads anchoring some bivalves with solid substratum.

Callus : a thick/thin layer of shelly substance, usually smooth and glossy, often transparent.

Cancellate : lattice like ornament formed when ridges or threads meet at right angles.

Cardinal teeth : projections on hinge plate below the umbo.

Carina : keel or ridge.

Columella : lower part of inner lip of shell along central axis.

Columellar fold : fold or projection on columella.

Concentric : describes the direction of raised or depressed ornament on a bivalves, parallel to the valve's edge.

Cords : a ridge, usually spiral, thicker than a thread.

Corneous : made of chitin, a non-calcareous substance.

Crenulate : regularly notched or beaded.

Denticle : small, usually rounded tooth.

Denticulate : with small teeth.

Dorsum : rear side (i.e. behind aperture) of gastropod shell; upper surface of chiton.

Escutcheon : dorsal depression behind umbones generally set off from rest of shell by a change in sculpture or colour.

Globose : tending to be inflated, like a ball.

Granulose : covered with small raised pimples.

Growth line and ridge : a fine or coarse, raised line defining a temporary pause in the growth of the shell.

Hinge : inner edge of the valve of bivalve shell usually joined by a ligament.

Imperforate : non umbilicate.

Impressed : indented or shunken.

Incised : finely scratched.

Keel : more or less sharpe edge.

Ligament : elastic, corneous structure joining the valves of bivalve.

Lip : inside or outside edge of the aperture of gastropod shell.

Lirate(sculpture) : with lirae.

Lunule : depression or delimited area justs anterior to beaks.

Mantle : a fleshy lobe, which secretes the mollusc's shell and lines the inside of the shell wall.

Margin : shell edge.

Mother of Pearl : a shelly layer, or the inner lining of a shell, displaying pearly (nacreous) surface.

Muscle Scar : impression inside the valve of bivalve shell made by an adductor muscle.

Nacreous : see mother of pearl.

Node : a lumpy protuberance, smaller then tubercle.

Nodule : a knob, smaller than node.

Operculum : a calcareous or corneous structure attached to gastropod foot, used to close the shell aperture.

Ovate : egg shaped.

Pallial line : impressed line inside the bivalve shell parallel to margin, which marks the position of mantle edge.

Pallial sinus : conspicuous indentation of the pallial line, showing where the muscle operating the siphons were formerly attached.

Parietal : part of the inner lip of gastropod shell behind the columella.

Pedal retractors : muscle, which withdraws foot.

Periostrucum : the external often fibrous coating of corneous material covering many shells in fresh condition.

Prosodetic : situated in front of umbones.

Pyriform : pear-shaped.

Rib : a continuous elevation of the shell surface.

Riblet : continuous elevations of the shell surface, subordinate to rib.

Septum/Septa : partition of shelf.

Sinuuous : gently waved.

Siphon : tubular or trough like extension of mantle through which water enters or leaves mantle cavity.

Siphonal canal or notch : the tube or gutter at the front (lower) end of aperture, to hold the front siphon of gastropods.

Spine : a blunt or sharp projection.

Spiral : coiling about a central axis.

Spiral thread : thickened area on spiral zone.

Spire : the coiled part of a gastropod shell except bodywhorl.

Stria/Striae : scratch like furrow on the surface of the shell.

Sutural coronation : bead or thickened area on suture.

Suture : the line on gastropod shell where the whorls connect.

Tooth/Teeth : pointed or blunt structure (s) inside the outer or inner lip of gastropod shell, and on the hinges of the bivalve shell.

Tubercle : a large rounded protuberance.

Umbilicate : navel like; with depressed cavity.

Umbilicus : hole, often within a crater like depression, at basal end of central axis of shell.

Umbo/Umbones : surface of valve immediately behind beak.

Valves : one piece of bivalve shell or of a chiton.

Whorl : one complete turn of the tube of a gastropod shell about its imaginary axis.

