



CHAPTER 34

Molluscan Fisheries: Present Status

Molluscs, which include bivalves, gastropods and cephalopods, belong to large and diverse phylum Mollusca, forming the second largest species rich phylum in the world after Arthropoda. Marine molluscs are important component of the marine ecosystem, contributing significantly to the biodiversity from the coastal regions to the abyssal depths of the ocean. The five major classes in Mollusca, namely Polyplacophora, Gastropoda, Bivalvia, Cephalopoda and Scaphopoda representing about 586 families, out of which 279 families occur in Indian region which includes 3600 species of marine, 1129 terrestrial and 199 freshwater forms. (Ramakrishna & Dey, 2010).

Marine molluscs occur in a large variety of substrates such as rocky shores, coral reefs, mud flats and sandy beaches. The gastropods and chitons are found on hard substrates while bivalves usually burrow on soft substrates (sediment). However, the cephalopods, which are marine, are mostly oceanic and active predators.

BIVALVES: There are about 10000 bivalve species. The bivalves form mostly a subsistence level fishery contributing to the livelihood of coastal populations and proving nutritional security. The bivalves have two shells, left and right valve and are bilaterally symmetrical. The shell is composed of calcium carbonate. The meat is consumed mostly by the local population. The bivalves include the clams, mussels, oysters, pearl oysters and cockles.

CEPHALOPODS: Cephalopods are purely marine and about 600 living species occur in the marine realm. The cephalopods include the squids, cuttlefish and octopus. While the squids and cuttlefish have an internal skeleton known as gladius (chitinous) and cuttlebone (calcareous), the octopus do not have the internal skeleton.

GASTROPODS: Gastropoda is the largest molluscan group with about 35000 extant species. The gastropods, which possess usually a single external coiled shell, are commercially important since they form a fishery all along the Indian coast. The meat is edible, shells are highly ornamental and operculum of the gastropods have medicinal and cosmetic uses. The meat is consumed locally as well as exported, while there is a huge ornamental shell trade along both coasts.

Molluscan fisheries

Cephalopods: Cephalopods from the most important molluscan group contributing significantly to the marine fishery. They are landed as by-catch and as targeted fishery mostly in the mechanized trawlers which are operated up to 200m depth and sometimes beyond.

Exploitation: In India, cephalopods are mainly caught by bottom trawlers operating up to 200 m depth zones. Most of the cephalopod catch used to be landed as bycatch from shrimp and fish trawls, however now it is an exclusively targeted fishery during the post monsoon period (September to December) particularly cuttlefish, using off bottom high opening trawls along South west and North west coasts. Traditional gears like shore seines, hooks and lines and spearing are used along Vizhinjam coast where no trawl fishing is done. Experimental squid jigging has been attempted in India but not yet commercialized.

The cephalopod production which increased from 1500 t in 1971 to over 15000 t in 1979 has been rapidly increasing ever since, reaching a high of over 250000 t in 2017, due to the export of frozen cephalopod products to several countries. Thus, cephalopods which used to be discarded or treated as bycatch, have now become targeted fishery due to the high foreign exchange being generated.

The estimated all India cephalopods catch during 2019 was 2,17,733 tonnes, however declined drastically during 2020 at 161004 t, due to the Covid-19 pandemic resulting in loss of fishing days. Gujarat contributes maximum to the cephalopod production with an annual average of 24885 t followed by Kerala at an annual average of 23195 t during 2017-2020, followed by Maharashtra and Tamil Nadu. The average annual production of cephalopod was 92798 t (2017-2020), recording a maximum production of 251678 t in 2017. The region wise production of cephalopods was highest in the northwest with an average annual landing of 40841 t followed by south west at 33445 t (2017-2020). The south east region recorded an average annual production of 16672 t and the south west region landed 1917 t during the period. Cephalopods constitute 5-6% of the total marine fish landings of India (CMFRI annual reports). However, they are under heavy fishing pressure due to their high value as export commodity and are subjected to target fishing particularly in the post monsoon seasons along the west coast of India.

The cephalopods are landed maximum during January to March and October to December along the upper east and west coast while they are landed during July to September also in Kerala Karnataka and Tamil Nadu.

Among the cephalopods exploited from the Indian seas, three major groups are the major components in the commercial fishery, squids (Order Teuthoidea), cuttlefish (Order Sepioidea), and octopus (order Octopodidae). The squids constitute 49%, cuttlefish 47% and octopus 4% in the cephalopod landings. The list of commercially exploited neritic species of cephalopods is given below. The dominant species occurring in commercial catches are *Uroteuthis (Photololigo) duvaucelii*, *Sepia pharaonis*, *S. aculeata* and *Amphioctopus neglectus*.

List of commercially exploited cephalopods from Indian seas.

Resource	Common English name	Distribution
Cephalopods		
Squids		
<i>Uroteuthis (P.) duvaucelii</i>	Indian squid	All along Indian coast
<i>U (P) edulis</i>	Sword tip squid	SW coast
<i>U (P) singhalensis</i>	Long barrel squid	SW and SE coast
<i>Loliolus (L) hardwickii</i>	Little Indian squid	All along Indian coast
Cuttlefish		
<i>Sepia pharaonis</i>	Pharaoh cuttlefish	All along Indian coast
<i>S aculeata</i>	Needle cuttlefish	All along Indian coast
<i>S elliptica</i>	Golden cuttlefish	Veraval & Cochin
<i>S trygonina</i>		SW coast
<i>S prashadi</i>	Hooded cuttlefish	SW & SE coast
<i>S brevimana</i>	Short club cuttlefish	Chennai & Visakhapatnam
<i>Sepiella inermis</i>	Spineless cuttlefish	All along Indian coast
Octopuses		
<i>Amphioctopus neglectus</i>	Web foot octopus	SW & SE coast and islands
<i>A marginatus</i>	Veined Octopus	SW & SE coast and islands
<i>A aegina</i>	Marbled octopus	SW & SE coast and islands
<i>O lobensis</i>	Lobed octopus	SW & SE coast and islands
<i>O vulgaris</i>	Common octopus	SW & SE coast and islands
<i>Cistopus indicus</i>	Old woman octopus	SW & SE coast and islands

Management: The commercially important cephalopods have been intensely researched and stock status of important species have been assessed. Cuttlefish species such as *Sepia pharaonis* and *S aculeata* are under exploited or optimally exploited along east coast. Squid stocks along Karnataka are marginally overexploited. Trawl is the principal gear of exploitation of cephalopods and cod end mesh in these are much below the permitted or notified size and therefore considerable quantities of juveniles are caught in the trawls. Mesh size regulations are implemented by the State Fisheries Department however not very effective. Minimum Legal size of capture for three species of cephalopods has been notified by the Kerala and Tamil Nadu Governments. At present 5.3 % of *U (P) duvaucelii juveniles* 8.7% of *S pharaonis* and 5.9% of *A neglectus* is commercially exploited. The strict implementation through enforcement of MLS would lead to enormous economic gains by virtue of the export value of these species. Regulation of fleet size would also facilitate effective management of recruitment overfishing since cephalopods are targeted fishery except seasonally. The trawl ban during the monsoon period is implemented in all the maritime States for 45 to 60 which has a major regulatory effect on this important fishery.

The recommended MLS and weights of three major species are given below

Species	MLS (Mantle length) mm	Corresponding total weight (g)
<i>U (P) duvaucelii</i>	80	25
<i>Sepia pharaonis</i>	115	150
<i>A neglectus</i>	45	15

Utilization and marketing: Almost the total catch of Cephalopods is exported and there is very little domestic consumption. The export of cephalopods peaked during 1995 with an annual average of 24% of the total exports, however has continued at 15% from 1992 onwards without much change. The value of cephalopod exports is over ₹800 crores in 2003. Squids products followed by cuttlefish are the major commodity among which frozen, dried, whole, filleted, rings, IQF, bones and ink. Octopus products exported are meagre however in recent years there is growing demand for the in export from 1994. The major export markets are Europe, China and Japan.

Oceanic squids: In recent years, new oceanic squid resources have been identified in the Indian Ocean. The purple back flying squid *Sthenoteuthis oualensis* (Lesson 1830) is distributed in the tropical and subtropical areas of the Pacific and Indian Oceans. The Arabian Sea is considered one of the richest regions for these oceanic squids in the Indian Ocean. The squids are pelagic occurring at depths of 250-300. This species is considered as the master of the Arabian Sea due to its high abundance, large size, short life span, fast growth, and highest position in the ecological niche. The estimated stock of squid in the Arabian Sea is 0.9 to 1.6 million t. Purse seining and gill netting with light attraction seem to be most efficient gears for exploiting this resource.

Bivalves

The bivalves include the clams, mussels and oysters, which are distributed all along the Indian coasts. The clams and oysters are fished by the local community for domestic consumption and forms a subsistence level fishery. Bivalves are exploited by the traditional method of hand-picking, skin-diving or by operating hand-dredges. Mussels and oysters are chiselled out from the substratum. Men and women are engaged in the fishing activity during low tide; hence, daily fishing time varies with changing tides. Generally, clams and oysters are gathered by wading in shallow areas, where it is easy to operate the nets and to clean the harvest. Dredges are operated from canoe in deeper areas.

The marine clam, mussel and oyster annual production during 2009-2020 was 1,00,931 tonnes on an average from Kerala, Karnataka, Goa, Maharashtra, Andhra Pradesh and Tamil Nadu. Clams are the most important resource followed by mussels and oysters, among which *Villorita cyprinoides* contributes more than half to the bivalve fishery. *Paphia malabarica*, *Meretrix casta*, *M. meretrix*, *Marcia opima* and *Anadara spp.* are the other important species contributing to the commercial clam fisheries. The mussel fishery is comprised of two species viz., green mussel, *Perna viridis* and brown mussel, *Perna indica*. The major edible oyster species are the Indian backwater oyster *Crassostrea madrasensis* and the rock oyster *Saccostrea cucullata*. Pearl oyster fishery, which was known since ancient times in the Gulf of Mannar area is not conducted since 1962, due to paucity of oysters in the natural beds.

Clams: A number of clam species belonging to the families Arcidae, Veneridae, Cobuculidae, Tridacnidae, Soleridae, Mesodesmatidae, Tellinidae and Donacidae are exploited along the Indian Coast. The Arcid clams are called blood clams due to the presence of haemoglobin in the blood. A single species *Anadara granosa* is important and occurs Indian coast in soft muddy substratum and forms a significant fishery in the Kakinada Bay. The clams are essentially exploited for the meat, however, in most places the shell is in demand for the lime industry. The meat is also used in the shrimp farming sector as brood stock feed.

The venerid clams are the most exploited among the clams and three genera namely *Meretrix*, *Paphia* and *Marcia* are important. Along the Maharashtra Coast, *Meretrix meretrix*, *Marcia opima*, *Paphia laterisulca* are dominant species. In Goa, *M casta*, forms a fishery. In Karnataka there 14 estuaries with varying abundance of clams. *M casta* is found in all estuaries, *M meretrix* in Kalinadi and Coondapur estuaries, *Paphia malabarica* in the Mulky, Gurpur, Udayavatra and Coondapur estuaries. *Marcia opima* is found in Coondapur, Uppunda and Sita estuaries. Along Kerala Coast, *P malabarica* forms a fishery at Dharmadom, Koduvally, Azhikkal, Valapattinam, Karyangod and Chittari estuaries and Astamudi Lake. *Meretrix casta* forms fishery in Moorad, Korapuzha, Chaliyar, Mahe and Valapattinam estuaries along the Malabar coast. Along the east coast, *M casta* occurs in several estuaries and forms a fishery in Vellar estuary, Pulicat lake and Bhimunipatnam. *M opima*, *P malabarica* and *M meretrix* forms fishery in the Kakinada Bay. In Orissa, *Meretrix* sp occurs in the Chilka lake and Sonapur backwaters. Kerala leads in the clam production followed by Karnataka, while clam resources are smaller in the east coast.

Paphia malabarica exploited from the Ashtamudi Lake, had a flourishing fishery but has been declining over the past few years due to drastic change in climatic conditions especially due to flood over the last two years. The average annual production of the short neck clam was 8530 t during 2011 -2020. The average annual production was over 1 lakh t during 2011 to 2015 has declined to 1727 t in 2020. The spat fall has failed due to drastic change in the sediment profile of the Ashtamudi Lake due to continuous rains in the past two years.

The short neck clam fishery of Ashtamudi Lake is a regulated and managed fishery. About 500 fishers are depended on this fishery for their livelihood. Based on the recommendations of CMFRI, the Government of Kerala has enforced a ban on clam fishing during the breeding season (September to February), use of 30 mm mesh size to avoid exploitation of smaller clams, restrict the export of frozen clams grade t0 1400 nos/kg and initiate relaying of juvenile clams in suitable areas for stock enhancement. The Minimum Legal Size of fishing of *P malabarica* has been set at 20 mm.

The corbiculid black clam *Villorita cyprinoides* is a major resource of the Vembanad Lake and is also exploited in several other backwaters and estuaries (Korapuzha, Chaliyar, Moorad, Mahe, Valapattinam, Padanna and Chandragiri) of Kerala, Goa and in the Netravati, Gurpur, Udyavara, Swara and Coondapur estuaries of Karnataka.

Villorita cyprinoides exploited from the Vembanad Lake in Kerala contributed almost 90% to the total clam production in India. The average annual production of the black clam in the Vembanad Lake is 44330 t during 2005-2020. A maximum production was 75592 t was recorded in 2006; in 2018 the production was 49394t however has declined to 39243 t in 2020. The Minimum Legal Size of fishing of *V cyprinoides* has been set at 20 mm. Recently, the relaying of baby clams in new areas where clams did not exist, was highly successful with a production of over 10 t per day for the fishers.

Mussels: India has two species of mussels, the green mussel, *Perna viridis* and the brown mussel, *Perna indica*. The green mussel contributes substantially to the total mussel production and it is more widely distributed compared to the brown mussel. Green mussels are found along the intertidal coasts of Quilon, Alleppey, Kochi, Kozhikode (Calicut), Kannur and Kasargod districts of Kerala, a state on the south west coast of India. It is most abundant from Kozhikode – Kannur to Kasargod which is known as the mussel zone of India. Along the east coast of India, it ranges along Chilka Lake (Orissa), Visakhapatnam (Andhra

Pradesh), Chennai (Tamil Nadu), and Cuddalore (Pondicherry). It is also found along Mangalore, Karwar, Goa, Ratnagiri, and in the Gulf of Kutch and the Andamans and Nicobar Islands.

The green mussel fishery along the Malabar Coast is an activity independent of the other marine fishery activities of the coast. The mussel pickers are an exclusive coastal community engaged in the exploitation of this sessile resource and 1551 persons are involved in mussel picking. The green mussel fishery begins from mid-August or September onwards and lasts up to mid-June. The fishery stops during the South West monsoon (June -August). Mussel picking usually begins in the early hours from 07 00 hours and last for 4-5 hours. Picking is generally done during low tide, on bright sunny days when the water is clear. Pickers dive down to the mussel beds and use chisel or knife to scrape off the mussels from the intertidal rocks. The depth ranges from 0.5 to 10 m. The pickers stock the picked heaped in the canoe, while in Thikkodi, the pickers use "catamarans" (made by tying up 3 wooden logs) to reach the mussel beds (Figure 3: A). The fishing duration varies depending on the demand for the mussel and the availability of the particular size range.

The major mussel beds along the South west coast are distributed across three districts of Kerala and in Mahe (Union Territory of Pondicherry). The mussel beds in Kozhikode (Calicut) district are Chombala, Thikkodi, Moodadi, Kollam, Elathur, South beach and Chaliyam, constituting about 435 ha. Mussel bed off Mahe (Pondicherry) constitutes nearly 20 ha. The major mussel beds in Kannur district are along Kadalayi, Koduvally, Thalasseri and Thalayi, constituting 125 ha. In Kasargod district, the mussel beds are off Chembarika, Kottikulam, and Bekal constituting 40 ha. The total area of mussel beds along the Malabar Coast constitutes 620 ha in area. Spat settlement occurs on lateritic formations along South beach, Chaliyam, Elathur, Kollam, Moodadi and Thikkodi. Granite rocks are observed in Chembarika, Kottikulam, Bekal, Kadalayi, Koduvally, Thalasseri, Thalayi, Mahe and, Chombala. mussels in nylon bags tied around their waists. In most centers, the 2-3 pickers go out in a small canoe and return with their individual collection

The green mussel fishery of the South west Coast of India has unique features which contribute to the sustainability of the fishery. The increased demand for green mussel in recent years has led to increased effort and exploitation of the green mussels. However, the fishery is self-managed and sustained by the mussel pickers themselves by suspending fishing during monsoon season. The special topographic distribution of the mussel beds and the interactions of the climatic factors sustain the livelihood of several wild mussel harvesters in the region.

Oysters: The edible oyster *Crassostrea madrasensis* is fished to a very small extent in Kerala, Karnataka, Goa, Andhra Pradesh and Tamil Nadu. It is essentially collected for local consumption and often subsistence fishery. In Ashtamudi Lake, the oyster formed a considerable fishery, however has declined drastically over the last five years. The average annual production was 587t during 2016-2020. The oyster meat is edible and the shell is of composed of calcium carbonate and used in the lime industry.

Window pane oysters: The pearl bearing oyster *Placuna placenta* is distributed in the Gulf of Kutch (Gujarat), Kakinada Bay (Andhra Pradesh) and Nauxim Bay (Zuari estuary in Goa) and the Tuticorin Bay and Velapatti near Tuticorin (Tamil Nadu). *P placenta* is found on muddy or sandy substrata from shallow water to depths of 100 m. The Kakinada Bay in Andhra

Pradesh is a rich ground of live window pane oyster as well as dead shells. The pearls are used in the pharmaceutical preparations of medicines. The shell is large, very flat, thin and rounded and used a glass substitute and other ornamental curio items. The meat is edible.

Commonly exploited bivalve resources	Common English name	Local name
<i>Clams and cockles</i>		
<i>Villorita cyprinoides</i>	Black clam	Karutha kakka
<i>Paphia malabarica, Paphia sp.</i>	Short neck clam,	Manja kakka (Ma), Chippi kallu (Ka), Tisre (Ko)
<i>Meretrix casta, Meretrix meretrix</i>	Yellow clam	Matti (Ta)
<i>Marcia opima</i>	Baby clam	Njavala kakka (Ma), Vazhukku matti (Ta)
<i>Sunetta scripta</i>	Marine clam	Kadal kakka (Ma)
<i>Donax sp</i>	Surf clam	Mural, Vazhi matti (Ta)
<i>Geloina bengalensis</i>	Big black clam	Kandan kakka (Ma)
<i>Anadara granosa</i>	Cockle	Aarippan kakka (Ma)
<i>Placuna placenta</i>	Window pane oyster	Kapis
<i>Mussel</i>		
<i>Perna viridis</i>	Green mussel	Kallumakkai, Kadukka (Ma) Alichippalu (Te)
<i>Perna indica</i>	Brown mussel	Kallumakkai, Chippi (Ma)
<i>Edible oysters</i>		
<i>Crassostrea madrasensis</i>	Indian backwater oyster	Kadal muringa (Ma); Ali, Kalungu (Te) Patti (Ta)
<i>Saccostrea cucullata</i>	Rock oyster	Kadal muringa (Ma); Ali, Kalungu, Patti (Ta)

Ka – Kannada, Ko – Konkani, Ma- Malayalam, Mr – Marati, Ta- Tamil, Te- Telugu

Gastropods

The gastropod constitutes a large and highly diversified class within the phylum Mollusca with 1,00,000 living species, of which the estimated number of valid marine species is around 50,000 to 55,000 marine (Mollusca Base, 2021). The marine gastropod resources in India comprise a variety of species. Several species of gastropods have high economic value in international markets and play important social roles in small-scale artisanal fisheries. In India from both east and west coasts several gastropod species are being exploited from time immemorial. The gastropods form a niche in the export industry and becoming highly priced objects in Indian and foreign markets and the fishery supports a huge number of the coastal population either directly or indirectly for making the ornaments and handicrafts from gastropods shells. There is a variety of ornamental gastropods and it is used as the raw material for the shell handicraft trade. In southeast coast of India, where the most part of landings of marine gastropods are occur is considered as the hub of shell craft industry. The meat of several gastropods is consumed. The operculum of the gastropods is also in high demand for use in the pharmaceutical industry. The southwest and southeast coasts and the coral reef ecosystem in the Lakshadweep and Andaman and Nicobar Islands harbour some of the richest gastropod beds along the Indian coast. These resources are mainly exploited by either mechanised trawlers, bottom set gillnets or by diving. Very few species form a regular fishery and most of them are obtained in smaller magnitude. Among the several gastropod

species that are exploited very few species are used for edible purpose. In view of the intense exploitation of several species of gastropods as raw material for the shell craft as well as pharmaceuticals, 24 species of the ornamental molluscs have been classified as endangered and are protected under the Indian Wildlife Protection Act (1972).

In India, commercial exploitation of gastropods is mainly in three States., Tamil Nadu, Andhra Pradesh and Kerala. The average annual exploitation of gastropods in India was 4909 tonnes (2012-2020). Tamil Nadu was dominant in the gastropod fishery with 58 % of the total gastropod catch followed by Kerala (25 %) and Andhra Pradesh (17 %).

Most of the commercially important gastropods are distributed in the shallow waters, lagoons and reef areas of the coastal sea. In India nearly 60 gastropod species form commercial fishery. Among the exploited gastropods, *Babylonia spirata*, *Turbinella pyrum*, *Chicoreus ramosus*, *Lambis lambis*, *Pirenella cingulata*, *Laevistrombus canarium*, *Telescopium Telescopium*, *Umbonium vestiarium*, *Neverita didyma*, *Nassaria coromandelica*, *Volegalea cochlidium*, *Agaronia gibbosa*, *Tonna dolium* and *Conus spp.* were the dominant species. *Turbinella pyrum*, the sacred chank, has formed an inextricable bond with humanity out of all the shells. It has played a key role in the observance of traditional customs of the Indians, especially Hindus, as a divine symbol. It occupies the top status and they are exploited from both the east and west coasts of India. Exploitation of *T. pyrum* by skin diving method is most popular in south east coast of Tamil Nadu.

List of commercially exploited gastropods from Indian waters

Resource	Common English name
Gastropods	
Turritellidae	
<i>Turritella attenuata</i>	Turret/Screw shell
<i>Turritella duplicata</i>	Duplicate turret
Terebridae	Auger shell
<i>Duplicaria duplicata</i>	Duplicate auger
Harpidae	Harp shell
<i>Harpa major</i>	Major harp
Olividae	Olive shell
<i>Agaronia gibbosa</i>	Gibbous olive
(<i>Oliva gibbosa</i>)	
<i>Ancilla acuminata</i>	Pointed ancilla
Ficidae	Fig shell
<i>Ficus ficus</i>	Common fig shell
Naticidae	Moon shell
<i>Tanea lineata</i>	Lined moon shell
(<i>Natica lineata</i>)	
<i>Natica vitellus</i>	Calf moon shell
<i>Polinices mammilla</i>	Pear-shaped moon
<i>Polinices fibrosa</i>	
Architectonicidae	Sundial shell
<i>Architectonica perspectiva</i>	Perspective sundial
<i>Architectonica purpurata</i>	Purpurata sundial
Rostellariidae	Tibia shell

<i>Tibia curta</i>	Curta tibia
Cassidae	Helmet/Bonnet shell
<i>Phalium glaucum</i>	Grey bonnet
<i>Semicassis bisulcata</i>	Japanese bonnet
<i>Cassis cornuta</i>	Horned helmet
Tonnidae	Tun shell
<i>Tonna dolium</i>	Spotted tun
Muricidae	Rock shell
<i>Rapana rapiformis</i>	Turnip shell
(<i>Rapana bulbosa</i>)	
<i>Murex trapa</i>	Rare spined murex
Muricidae	
<i>Chicoreus virgineus</i>	Virgin murex
(<i>Murex virgineus</i>)	
<i>Haustellum haustellum</i>	Snipe's bill murex
(<i>Murex haustellum</i>)	
<i>Vokesimurex malabaricus</i>	Malabar murex
(<i>Murex malabaricus</i>)	
<i>Purpura bufo</i>	Toad purpura
(<i>Thais bufo</i>)	
Strombidae	Conch shell
<i>Mirabilistrombus listeri</i>	Lister's conch
(<i>Strombus listeri</i>)	
<i>Dolomena plicata siboldi</i>	Pigeon conch
(<i>S.plicatus siboldi</i>)	
Volutidae	Volutes shell
<i>Harpulina lapponica loroisi</i>	Lorois's volute
Babyloniidae	Babylon shell
<i>Babylonia spirata</i>	Spiral babylon
<i>Babylonia zeylanica</i>	Indian babylon
Melongenidae	Crown conch
<i>Hemifusus cochlidium</i>	Spiral melongena
Fasciariidae	Spindle shell
<i>Fusinus colus</i>	Distaff spindle
<i>Fusinus forceps</i>	Forceps spindle
Turbinellidae	chank shell
<i>Turbinella pyrum</i>	Sacred chank
(<i>Xancus pyrum</i>)	
Bursidae	Frog shell
<i>Bufonaria echinata</i>	Spiny frog shell
(<i>Bursa spinosa</i>)	
<i>Bufonaria crumena</i>	Frisled frog shell
(<i>Bursa crumena</i>)	
<i>Tutufa bufo</i>	Red-mouth frog shell
Ranellidae	Triton shell
<i>Cymatium (Lotoria) perryi</i>	Perry's triton
(<i>C. (Lotoria) lotorium</i>)	

<i>Gyrineum natator</i>	Tuberculate gyre triton
Turridae	Turrid shell
<i>Lophiotoma indica</i>	Indian turrid
Cypraeidae	Cowry shell
<i>Mauritia arabica</i>	Arabian cowry
(<i>Cypraea arabica</i>)	
<i>Erronea erronea</i>	Wandering cowrie
(<i>Cypraea erronea</i>)	
Nassariidae	Nassa shell/Dog whelk
<i>Nassarius conoidalis</i>	Cone-shaped nassa
<i>Nassarius olivaceus</i>	Olive nassa
<i>Nassarius stolatus</i>	
Conidae	Cone shell
<i>Conus betulinus</i>	Betuline cone
<i>Conus textile</i>	Textile cone
<i>Conus milneedwardsi</i>	Glory of India cone
<i>Conus inscriptus</i>	Engraved cone
<i>Conus figulinus</i>	
Personidae	Common distorsio
<i>Distorsio perdistorta</i>	Hunchback distorsio
Buccinidae	Whelk shell
<i>Cantharus tranquebaricus</i>	Tranquebar goblet
Ovulidae	False cowries
<i>Volva volva</i>	Shuttlecock volva
Cancellariidae	Nutmeg shell
<i>Trigonostoma scalariformis</i>	Scalariform nutmeg
Calyptraeidae	Slipper shell
<i>Desmaulus extintorium</i>	Conical slipper shell
Trochidae	Top shell
<i>Clanculus spp.</i>	
<i>Gibbula spp.</i>	

Gastropod species composition

In Tami Nadu, the average annual gastropod catch was 2848 tonnes (2012-2020). Along Tamil Nadu coast gastropods are mainly exploited from six districts in which, Ramanathapuram contributes 54 % of the total catch followed by Tuticorin (14 %), Nagapattinam (9 %), Cuddalore(7 %), Kanyakumari (7 %) Chennai(6 %) and Tirunelveli (3 %). Trawl net is the major contributing gear (53 %) followed by Skin diving (38 %), gill net (6 %) and other gears (3 %). In the Tuticorin and Ramanathapuram, gastropods formed a targeted fishery traditionally by skin diving, whereas in gillnet and trawl net, these resources are landed as by catch. The targeted gastropods from skin diving is *T. Pyrum*, *C. ramosus* and *L. lambis* . In the trawl net, Babylonia, Strombids, Olivids, Naticids, Nassarids, Bursa, Conus and Muricids are the most important group. In Tirunelveli, chank net (gill net) is the major gear for gastropod exploitation and *T. Pyrum* was the dominant species. In this region, gastropods are mainly exploited for its shell and plays an important role in the commercial shell craft industry in Southern coast of India. From Thoothukudi District, the meat of *C. ramosus* exported to Thailand. Apart from the shell and meat, the dried operculum of

gastropods is in immense demand in the international market. The operculum of gastropods has good market value ranging from Rs. 1,000 to 14,000 depends on the species and operculum powder is an important ingredient in fragrance making. In addition, from the Thoothukudi region the under sized and infested gastropod has been transported to Northern part of Tamil Nadu where the minced and powdered shell is used as an ingredient for the poultry feed. In Chennai, the ornamental gastropods are mainly landed as by-catch along with other resources in the trawl landing. The fishery was compromised of about 30 species of gastropods. *Babylonia sp.* is the targeted fishery along the coast and it contributes about 68.24% to the total gastropod landings. There is a high export demand on *Babylonia* in the foreign countries like China, Hongkong, Thailand. The other species which are regularly landed in by catch were *Ficus spp.*, *Bursa spp.*, *Turittella spp.*, *Tona dolium*, *Nassarius dolium*, *Conus spp.*, *Phalium spp.*, *Rapana rapiformes*. Major landing of gastropods was contributed by multiday trawl net (58%).

In Kerala, Shakthikulangara and Neendakara are the major landing centres of the Kollam district and ranked top gastropod landing centres along the western coast of India. An estimated annual gastropod landing of Kerala is 1225 tonnes (2012-2020). In Kollam, gastropods occur as a by-catch of shrimp trawlers and the exploited gastropods are mainly used for meat and ornamental shells. Although a large number of gastropod exporting firms exist in this area, due to lacking of shell craft industries exploited ornamental shells are traded to shell craft industries located in Tamil Nadu, Pondicherry, and Goa. Few years before in Kollam a large number of species are being exploited and traded and they include *Babylonia*, *Turbinella*, *Harpulina*, *Bufonaria*, *Rapana*, *Turritella*, *Conus*, *Natica*, *Tibia*, *Oliva*, *Nassarius*, *Ficus* and *Phallium*. In order to prevent juvenile fishery, in recent years, the strict vigilance from Coastal Police and State Fisheries Department has been carried out at the major landing centre of Kerala including Kollam. Owing to this, trash landings at the landing centres have been reduced because only the trash landings will bring the ornamental gastropods at the landing centres. Gastropods catch was mainly contributed by *Babylonia* species because of its targeted fishery every year during April – June. The entire gastropod catch was contributed by two main gears, 90 % by Single day trawl net (MTN) and 10 % by multi-day trawl net (MDTN). *Babylonia spirata* and *B. zeylanica* were the dominant species in the catch forming 99.8%. of the total gastropod catch. *Babylonia spirata* and *B. zeylanica* were the dominant species in the catch forming 99 %. *Babylonia spp* were obtained as by catch during shrimp trawling throughout the year. Whelk trawl net is specially designed notably it has heavy rigging which help this net to plough deep into the sediment and thereby catching these whelks. Observations on the landings of shells indicated that 54 species of gastropods belonging to 27 families; 9 species of bivalves belonging to 5 families and one species of scaphopod were landed as by-catch of trawlers.

In Andhra Pradesh, the gastropods are mainly exploited from Kakinada, Kancheru and Visakhapatnam regions. The targeted centres for gastropod fishery are Kakinada and Kancheru and in most landing centers the gastropods are mainly came under by-catch discard categories. The average annual landing of gastropods from Andhra Pradesh is 837 tonnes. The main species contribute to the fishery are *Cerethidia sp.*, *Bursa sp.*, *Babylonia spp.*, *Telescopium sp.*, *Umbonium sp.*, *Murex sp.*, *Hemifusus sp.*, *Harpa sp.* *Conus sp.* *Oliva sp.* *Tonna sp.* etc. The annual landings of Gastropods at Kakinada is 524.23 t and catch/effort was 509.52 kg/unit (2017-2019). About 43% is contributed by the *Cerethidia sp.* and rest mainly by *Murex sp.*, *Telescopium sp.* and *Umbonium sp.* etc. In Kancheru, average annual gastropod landing was 0.75 tonnes with the catch/effort of 3.53 kg/unit respectively. *Babylonia zeylanica*, *Harpa major*, *Murex Sp.*, *Bursa Spp.* contributes more to the landing

The landings is mainly in the by-catch form from gillnets; mostly from the "crab nets" –the bottom set gill nets used in August to December season. In Visakhapatnam the gastropod catch is mainly from trawl by-catch. The total gastropods landings during the year 2017-2019 were about 17.42 tonnes with an average annual landing of about 5.81 tonnes with the catch/effort of 5.65 kg/unit respectively. Nearly 32% of the catch was contributed by the *Bursa* species, 22% by *Ficus sp.* and rest 46% by other species like *Polinices sp.*, *Tonna spp.*, *Conus sp.* etc. The Shells were collected by ladies for domestic consumption mainly the *Ficus sp.* and *Melo sp.* The marketing of these shells is mainly depending on the nearby states like Tamil Nadu, Orissa, Maharashtra and Telengana; besides the small scale exporters of Kakinada, Yanam, Guntur and other regions of the Andhra Pradesh.

The molluscan fishery of India can be further developed and production can be increased on a sustainable level with better focused management and regulations. Bivalve and gastropod fishery are not adequately monitored and reported moreover, it is restricted to domestic consumption only and lack of awareness regarding the nutritive values of these high protein nutritive resources. Also, conservation and stock enhancement strategies are to be implemented for the endangered species. Exploitation of cephalopods can be enhanced up to the potential yield estimates only and hence fishery management and gear and fleet size restrictions need to be strictly enforced. Potential for exploitation of Oceanic cephalopods exists and has to be tapped.

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