

***“Commercially Important Gastropod Shell Resources and Trade in India:
Distribution, Status & Conservation strategies”***

FINAL REPORT

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1. Introduction

The phylum Mollusca is currently the second most diverse animal group, ~~with origin date back before originating before the Cambrian Cambrian era~~. These ~~soft-bodied, invertebrates animals~~ are ~~a soft-bodied~~ heterogeneous ~~group, with more than 85,000 extant species including group with great antiquity and are extremely diversified in shape and colour. This group includes~~ snails, clams, mussels, oysters, octopus, squid, and cuttlefishes. The majority of molluscs inhabit marine biotopes and they occur from backwater zone, mangroves, intertidal area, shelf and deeper waters. There are various estimates of number of total species varying from 80000 to 135000 numbers (Appukuttan, 2008). A summary of the published information indicate that there are 31463 marine molluscs, 24503 terrestrial and 8765 freshwater. The molluscs are a great source of human food in various parts of world and these molluscan shells are used for making ornaments and jewellery (Jordan and Verma, 2005).

With an extensive coastline of 7516 Km and an Exclusive Economic Zone of 2.1million km², the molluscan biodiversity along our main land and islands are rich and varied, especially in the coral reefs and intertidal areas. It is reported that 3271 species of molluscs coming under 220 families and 591 genera and 1900 species of gastropods, 1100 bivalves, 210 cephalopods, 41 polyplacophores and 20scaphopods are recorded in Indian waters (Appukuttan, 2008)

It is man's inborn nature to collect, whether it is rocks, shells, coins, stamps, cars, or baseball cards. There are almost as many reasons for collecting shells as there people collecting them: many people simply admire the endless beauty and variety of shells, a large collection can have up to 30,000 species, while others collect more for scientific reasons - there is still a great deal to learn from and about the shells of the world. Although exact figures on the value and trade of the ornamental fish industry do not exist; the value of ornamental fish and invertebrates imported into different countries worldwide is approximately \$278 million US dollars (FAO 1996-2005).

Some of the commercially important gastropods which occur in the intertidal and inshore waters are edible. These and several other gastropods received considerable attention in recent years due to greater demand for meat and as ornamental shell for shell handicrafts. The ornamental molluscs is an emerging resource in Indian seas. Molluscs in general had a tremendous impact on Indian tradition and economy and were popular among common man as ornaments and currency. This has the increasing global demand. The ornaments and handicrafts made out of molluscan shells are becoming highly priced objects in Indian and foreign markets (Appukuttan, 1996). The over – exploitation and juvenile exploitation of some species have led to gradual decline of the stock. Overfishing of

some molluscan species as a source of food has led to gradual decline of the species and has brought them under the shade of endangered species.

A few studies have only been conducted in the commercially important gastropods. However, information on the gastropod species of commercial (ornamental) interest from the Indian coast remains scarce. Only a few published records of these species are mentioned in the literature, they include checklists and museum collections. Therefore, the present study is focused on providing information on the abundance, distribution and stock status of ornamental gastropods in the Indian coast and analysing the distribution pattern, abundance and commercial value of these gastropods in trade, exploitation rate and implementing effective recommendations on conservation strategies for sustainable maintenance of the stock and rationale exploitation.

2. Background

The molluscan distribution is very diverse and found along sandy shore, sandstone, mangroves, Eulittoral boulders, Eulittoral granite boulders, reef crust and reef flat. In submerged or sublittoral habitats like the un-vegetated land, submerged dead coral shingle, sea grass. There are also molluscs associated with algae, corals and in the benthic habitat.

Today's seafood market is a global business and crustaceans are one of the world's most omnipresent seafood. India has long been a major supplier to the Japanese, U.S. and European markets. This demand of global sea food has been supported by capture fisheries as well as farming to a larger extent. The side effects of capture fisheries result in landing of huge amounts of by-catch which includes molluscs, crustaceans (certain varieties of crabs and *squilla*), finfishes (non-edible varieties), sea snakes and echinoderms. The molluscan fisheries hold a very important link in the fisheries chain since it consists of varied, diverse and unique groups of animals. Amongst other molluscs, gastropods have an important role to play. The shells of molluscs are extremely diversified in shape and colour. Gastropods occupy an important place in the commercial shell-craft industry. Approximately 80,000 species of these snails live on land, in freshwater and sea. The marine gastropod resources in India comprise a variety of species and are exploited regularly for various purposes. This exploitation goes unnoticed in several places because it constitutes a very minor fishing when compared to other fishery resources. Many of these gastropods are exploited for food, at the same time the beautiful shape and colour of the shells have attracted and aroused the imagination of man to use them for ornamental purposes also. The shells are used in making ornaments and curios of different shapes and sizes. They are being used whole or cut into pieces of desirable shapes during processing.

The (shellfish and fin fish) by-catch is utilized to an extent but majority of them is dumped back to the sea as it has no commercial value. The molluscan by-catch mainly consists of gastropods and bi-valves, which are used in production of handicrafts and curios. It forms a niche industry restricted mainly to the coastal regions and supports a huge number of the coastal population. The molluscan fisheries hold a very important link in fisheries chain since it consists of varied, diverse and unique group of animals. Amongst other molluscan gastropods have an important role to play in commercial trade. The current study was focused on commercially important gastropods and the present status of its distribution, and their trade value in east and west coast of India. The study was aimed on analysing the level of exploitation and conservation measures in practice in order to evaluate the diversity of gastropod resources and establish sustainable development.

3. Study area

East coast of India

The study stations were selected from coastline regions of Tamil Nadu, South Eastern India. Tamil Nadu is the southern-most state of India with a coastline of 1076 km. Essentially, an east coast state, it extends around 60 km into the south west coast of India, gaining a foot hold on the fisheries of the west coast as well. Another geographical aspect of great significance is that while half the coast line faces the open sea with a 200 nautical mile EEZ, the other half is proximate to the Sri Lankan coast line with an international maritime boundary that restricts the area available for fishing. At the closest point, the international boundary line is just 16 km away from Dhanushkodi Rameswaram Island.

Geographical and ecological feature of the TN coast is that it can be divided into four distinct eco-systems from a fisheries point of view. It has four “seas”, as follows (north to south):

- i. ***Bay of Bengal, from Pulicat to Pt. Calimere (also called the “Coromandel Coast”)***
- ii. ***Palk Bay, from Pt. Calimere to Rameswaram Island***
- iii. ***Gulf of Mannar, from Rameswaram Island to Cape Comorin (Kanyakumari)***

iv. Arabian Sea, from Cape Comorin to Neerodi on the Kerala border (also called the Kanyakumari coast).

The core study area in the East Coast lies within Palk Bay 9°17'N 79°18'E (Rameswaram, Mandapam and Keezhakarai) and Gulf of Mannar region namely Tuticorin 8° 48' N, 78° 11' E and Tirunelveli.

West Coast of India

The study area along West Coast of India is in Kollam 8° 54' N, 76° 38 E, Kerala. Ashtamudi Estuary, one of the biggest backwater areas present here forms an important part of the bio-diversity here. The main study areas in Kollam are Sakthikulangara and Neendakara harbour where the maximum number of shrimp trawlers land at a time along the Kerala coast

Figure.1 Study area along the West Coast of India

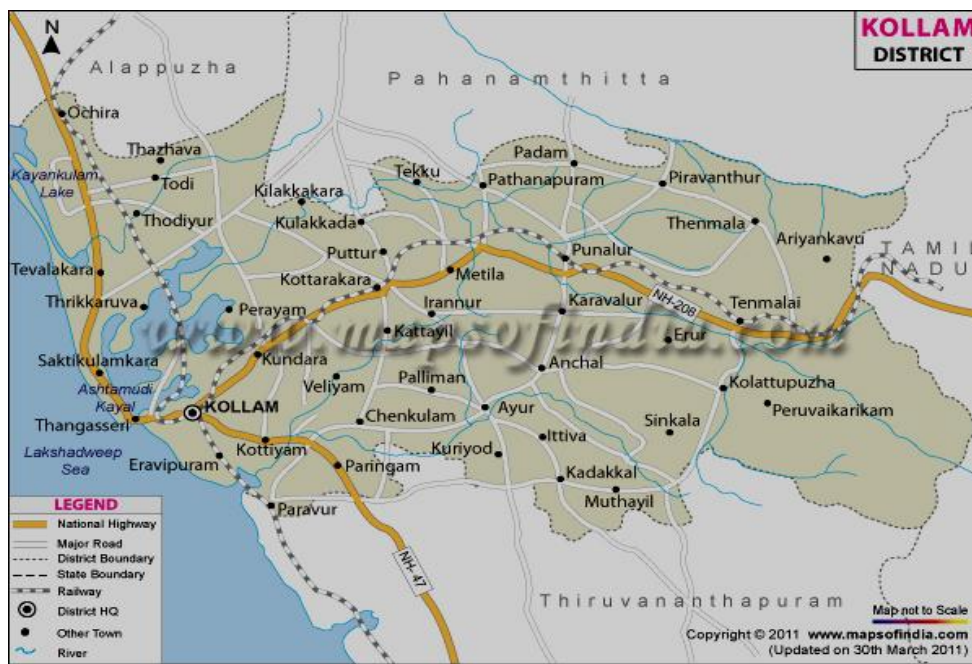


Figure 2. Study area in Palk Bay region

Sample collection

Gastropod samples were collected from the landed bycatch from major trawl operated areas, country boat bycatches, shell processing units, Shells collected along the seashore and small scale shell traders during the study period of one year at seasonal intervals. The specimens collected were cleaned with a brush and identified by the works of (Satyamurty, 1952, 1956; SubbaRao, 2003, Deepak Apte, 1998). Data collection on catch and availability of shells and seasonal variations were surveyed from traditional fisher folks and commercial shell traders were collected fortnightly, pooled seasonally and this was repeated throughout the study period.

4. Fishing crafts and gears

Plank built country craft (Vathai)

Tamil common name: *Masula boat/Padagu/Thony/ Thoothadudivallam/Vathai*

These are made of wooden frames and planks without in-built diesel engines. Length of the boat is 18 to 25 feet. This is the traditional type, which is operated for a long time. There is no change in the length and in the size. Required man power is 1 to 6 persons. These boats are locally called vathai or vallam.

Plank built boat for the operation of shore seine (Thoni) (Fig. 4)

These are constructed by the use of wooden frames and planks and Length of the boat is 30 to 36 feet. Man power is 25 to 30 persons. There has been no change in the size and length over the years.

Mechanized plank built country craft

These are plank built country crafts previously used without engine. Nowadays these crafts are fitted with diesel engines with 12 to 18 HP. The Tuticorin type of vallam is 28 to 32 feet.

Cattamaran

Locally called *Kattumaram* (Fig. 5.) is made of 3 to 4. Number of wooden logs tied together to form an unit. The major species of Mollusc landed from the aforementioned crafts are as follows:

- *Babylonia spirata*
- *Babylonia zeylanica*

- *Murextribulus*
- *Chichoruesramosus*
- *Chichoreusvirgineus*
- *Bursa rana*
- *Bursa spinosa*
- *Harpulinasp.*
- *Lambislambis*, etc.



Fig.4. Country boats (Vallam, Thoni)



Fig.5.Cattamaram



Fig. 6. Trawler



Landing of Xancuspyrum



as bycatch



Segregation of gastropod bycatch

Gastropods

Gears Operated along the East and West coast

Gears that are used in capturing the gastropods as by-catch are explained as follows:

Trawl net

Trawl nets are one of the active gears operated during the day from dawn to dusk. Trawling is conducted in 50 – 200 meters depth but may extend upto 700 meters. These nets are made of nylon threads or synthetic fibres. The length of the net varies from 15 to 22m. The otter board helps to open the trawl nets and helps herd the fish towards the opening and into the net. The trawl nets are bag like structures dragged at the bottom of the sea. The mesh size at the mouth is higher than at the cod end. The size near the cod end is 10-25mm. A haul is normally made once in two or four hours. Normally two or three haul are carried out in an area. Most of the bycatch are discarded at sea and only the larger fishes are brought to shore for sale. The most abundantly caught commercial species are Shrimps, *Nemipterus* sp., *Lethrinus* sp., *Lutjanus* sp., *Thynnus* sp., *Sphyræna* sp., etc. The composition and catch varies according to the area, season and depth of operation. This is a very non selective gear and other bottom dwelling forms are captured as bycatch.

This bycatch includes good amount of mollusc, crustaceans and echinoderms. Molluscan gastropod shells are segregated from the trash and are used for commercial purposes. Molluscan gastropods from trawl bycatch includes *Ficus ficus*, *Bulla ampulla*, *Tibia curta*, *Strombus marginatus*, *Naticatigrina*, *Cyprea* sp., *Erronea* sp., etc.

The various other types of gears operated are:

Pelagic/Surface trawling – Fish trawls

This net is operated by mechanized trawls for various depths along the coastal water for ground fish resources. Elasmobranchs and finishes are the main capture species of the net, and it does not produce significant gastropods by-catch.

Bottom trawl - Shrimp Trawl

Also known as *EralMadiin* vernacular language is used for capture fisheries of crustaceans namely shrimps and crabs. Operated by mechanized trawlers they are mostly used as bottom trawl, disturbing the benthic zone. This nets produce considerable amount of by-catch in terms on mollusc namely gastropods and bivalves.

Gill net

Gill netting is a passive fishing method and can be used to harvest bottom or pelagic fish. A gill net is a wall of netting set in a straight line, equipped with weights at the bottom and floats at the top and is usually anchored at each end. Fishes swim through the virtually invisible netting and are entangled when their gills are caught in the webbing. Hence the name called as Gill netting. Three major types of gill nets are used in this area – surface gill net, drift gill nets and bottom set gill net. Bottom set gill nets like *nanduvalai*, *singivalai*, *Changuvalai*, *Thirukkaivalaikattavalai* are used in this region. Their mesh size varies. They are generally considered as selective gears on the mesh size.

Three different types of gill nets are operated in both the coast, explained as follows:

- a. Drift Gill Net**
- b. Set Gill Net**
- c. Bottom Set Gill Net**

These different varieties of gill nets are mostly used for finfishes and do not produce gastropod by-catch of specific interest, whereas a certain quantity is captured by bottom set gill nets.

Trammel net

This net is three layered drift bottom gill net. Trammel nets are considered as nonselective and result in the wedging, entangling and gilling of fishes. The outer layers are nylon multifilament with mesh sizes of 14cm and the inner layer is a nylon monofilament

with a mesh size of 3.8-4.2cm. The length of the net is 24-30 m per piece and normally the fishermen use 25-30m per piece and normally the fishermen used 20-35 nets per boat.

4.2 Total catch Analysis

Mollusc in bycatch - Landing Survey

Methodology adopted is stratified multi-stage random sampling technique,.Data of catch each day were enquired from fisher folks working in daily trip trawlers and other boats. Total number of fishing days (sampling was done normally for 16 -18 days per month in each selected study areas), no. of fishing crafts operated on the particular fishing day in the particular fish landing site and fish catch by different fishing gears were enquired from the boat crew and carefully noted down. Species level composition of fish bycatch and their weights from the operated boats on the effort / day were surveyed, calculated and tabulated. The resultant data gives the total bycatch landed in the given day in the surveyed boats and then the data is made up to total number of boats involved in fishing in the particular fishing day and finally, the number was raised for one month by multiplying the total number of effort days during the month.Molluscan fisheries in East coast and West coast was observed with greater significant variations in fishing operations, density , seasonal variations, species compositions and total catch of the target species. The details are as follows:

Table - 1. Fishery details on East coast and West coast of India

Study Period - May 2012 - June 2013							
Study Area	West coast		East coast				
Stations	Neendakara	Sakthikulangara	Rameswaram	Pamban	Mandapam	Keezhakarai	Tuticorin
Total no. of crafts	400-450	300-350	350-500	150-200	250-300	350-400	600-700
Boats operated /Month	250-375	200-300	150-200	100-150	100-200	200-300	350-400
Effort days /Month	26	26	12-16	12-16	12-16	12-16	26

Fishing ban Periods	40 days July 2012 & 2013	40 days May 2012 & 2013
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Results

Catch Analysis

In the west coast of India, molluscan fisheries catch at two regions of Kollam district – Neendakara and Sakthikulangara, and in east coast, five coastal regions of Gulf of Mannar namely Rameswaram, Mandapam, Pamban, Keelakarai and Tuticorin were studied during the period of June 2012 – June 2013. Survey on total number of boats, total number of boats operated during the study period, effort days / month, information on fishing ban periods were collected from the traditional and commercial fisher folks. The results are illustrated in table 1.

Commercial bycatches includes mollusc with greater significance to gastropod shells for their high economical value on trade both export and import. The main focus of the study was commercial gastropod shells. Each species of gastropod were collected from the Bycatch at the landing centre, (Table 2) identified, length – weight analysis of the species were done and the abundance and occurrence were also studied, the results are in the Table. 3.

Percentage composition of total catch of Gastropod obtained from east coast and west coast of India were portrayed in the Figure 8 & 9. In west coast, high range of catch was observed during October 2012 (50%), March and April, 2013 (50%) in Neendakara, during the month of September (35%) and October 2012 (35%), high number of gastropod catch was noticed in Sakthikulangara. In east coast, during June 2012 high number of catch (60%) was noticed in Rameswaram and Tuticorin landing areas. Species composition in both the coastline (Figure 10) occurs varied with respect to seasons and Dominant species noticed throughout the study period were observed and illustrated in Table 4.

Table - 2. Commercially important gastropods – Information collected from different landing centres

<i>Sl.No.</i>	<i>Species</i>	<i>Place of Collection</i>
1	<i>Architectonica laevigata</i>	Kollam, Rameswaram
2	<i>Babylonia spirata</i>	Rameswaram
3	<i>Babylonia zeylanica</i>	Rameswaram
4	<i>Bursa spinosa</i>	Pamban
5	<i>Conus miled-edwardsii</i>	Kollam
6	<i>Cymatium pileare</i>	Rameswaram
7	<i>Ficus gracilis</i>	Kollam
8	<i>Fulgoraria sp.</i>	Kollam
9	<i>Fusinus longicauda</i>	Kollam
10	<i>Harpaconoidalis</i>	Kollam
11	<i>Murex tribulus</i>	Kollam
12	<i>Olivia gibbosa</i>	Rameswaram
13	<i>Phalium glaucum</i>	Kollam
14	<i>Polinices didyma</i>	Kollam

15	<i>Strombusmarginatus</i>	Kollam
16	<i>Tibia curta</i>	Kollam, Rameswaram
17	<i>Tonnadolium</i>	Kollam
18	<i>Turitelladuplicata</i>	Rameswaram
19	<i>Xancuspyrum</i>	Kollam
20	<i>Xenophora corrugate</i>	Kollam
21	<i>Umboniumvestiarium</i>	Rameswaram
22	<i>Chichoreusvirgineus</i>	Rameswaram
23	<i>Turitellaterebra</i>	Kollam, Rameswaram
24	<i>Thais bufo</i>	Kollam
25	<i>Hemifususpugilinus</i>	Rameswaram
26	<i>Melomelo</i>	Kollam
27	<i>Cypreaetigris</i>	Rameswaram

Table 3. Length Weight Analysis and Occurrence of Gastropods in East and West coast of India

Sl.No.	Species	Length (cm)	Weight (g)	Diameter (cm)	Distribution	Occurrence
1	<i>Architectonica laevigata</i>	4.1 - 4.3	8 - 10	1.2	West Coast and Rameswaram to Tuticorin	Common
2	<i>Babylonia spirata</i>	2.9 - 6.1	9 - 23	1.8 - 3.7	Entire WC and EC	Abundant
3	<i>Babylonia zeylanica</i>	3 - 6.2	8 - 25	1.2 - 2.7	Entire WC and EC	Abundant
4	<i>Bursa spinosa</i>	5.3 - 8.6	12 - 22	2.9 - 4.3	Gulf of Mannar region and Westcoast	Common
5	<i>Conus miled-edwardsii</i>	11 - 15.5	28 - 72	3.5 - 4.6	West Coast	Rare
6	<i>Cymatium pileare</i>	7.2 - 9.1	25 - 32	3.7 - 5.1	West Coast and Rameswaram to Kanyakumari	Moderately Common
7	<i>Ficus gracilis</i>	4.3 - 13.4	7 - 63	2.7 - 8.3	West Coast and East coast	Abundant
8	<i>Fulgoraria sp.</i>	11	28	3.5	West Coast	Rare
9	<i>Fusinus longicauda</i>	3.9 - 16.1	3 - 32	2.3 - 4.4	West Coast	Moderately Common
10	<i>Harpaconoidalis</i>	7.4 - 8.3	5.2 - 25	5.7 - 24	West Coast	Moderately Common

11	<i>Murex tribulus</i>	6.7	8	3.3	West Coast and East Coast	Common
12	<i>Olivia gibbosa</i>	4.9	3.2	14	West Coast and Gulf of Manar region	Common
13	<i>Phalium glaucum</i>	4 - 7.5	5 - 35	3.1 - 5.7	West Coast and Gulf of Manar region	Common
14	<i>Polinices didyma</i>	3.4 - 4.5	6 - 12	4.2 - 5.6	West Coast and Gulf of Manar region	Common
15	<i>Strombus marginatus</i>	3.7 - 6.9	17 - 33	2.6 - 3.8	West Coast and Gulf of Manar region	Moderately Common
16	<i>Tibia curta</i>	3.8 - 10	14 - 44	2.2 - 4.2	West coast and East coast	Common
17	<i>Tonnadolum</i>	4.3 - 4.8	9 - 17	3.2 - 3.7	West Coast and East Coast	Abundant
18	<i>Turitella duplicata</i>	3.6 - 13.4	17 - 44	2.1 - 3.4	West Coast and East Coast	Abundant
19	<i>Xancus pyrum</i>	12.1	93	6.9	West coast and East coast entire stretch	Abundant
20	<i>Xenophora corrugate</i>	3.1 - 3.5	7 - 8	2.1 - 2.3	West Coast and East Coast	Common
21	<i>Umbonium vestiarium</i>	1.5	2	1.2	West Coast and East Coast	Abundant
22	<i>Chichoreus virgineus</i>	4.2 - 8.5	6 - 27	4.5 - 8.5	West Coast and East Coast	Common

23	<i>Turitellaterebra</i>	3.1 - 15.4	14- 54	2.3 - 4.6	West coast and East coast	Common
24	<i>Thais bufo</i>	3.6 - 6.8	5 - 28	3.5 - 5.3	West coast and East coast	Common
25	<i>Hemifususpugilinus</i>	3.5 - 28	4.5 - 6.8	2.5 - 4.8	West coast and East coast	Common
26	<i>Melomelo</i>	8.3 - 15.5	14 - 20	5.4 - 13.5	West coast and East coast	Common
27	<i>Cypreaetigris</i>	4.5 - 16.3	14 - 25	6.3 - 9.5	West coast and East coast	Common

Fig.8 . Percentage catch of Gastropods landed in West coast –Kollam district

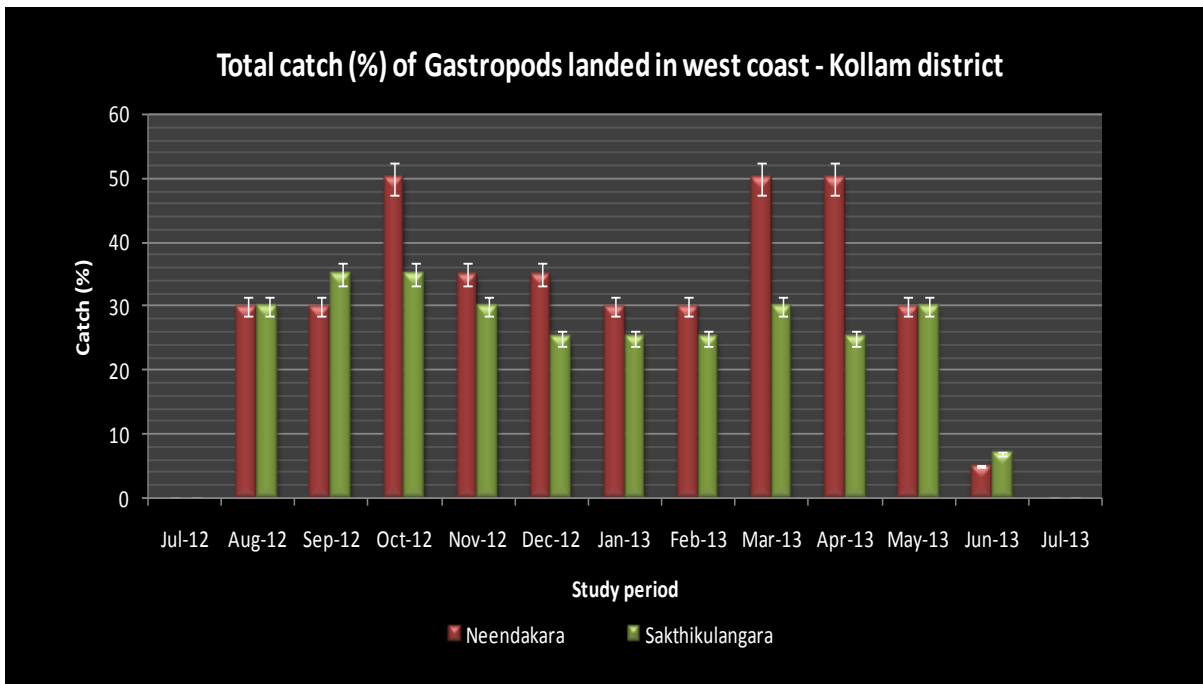
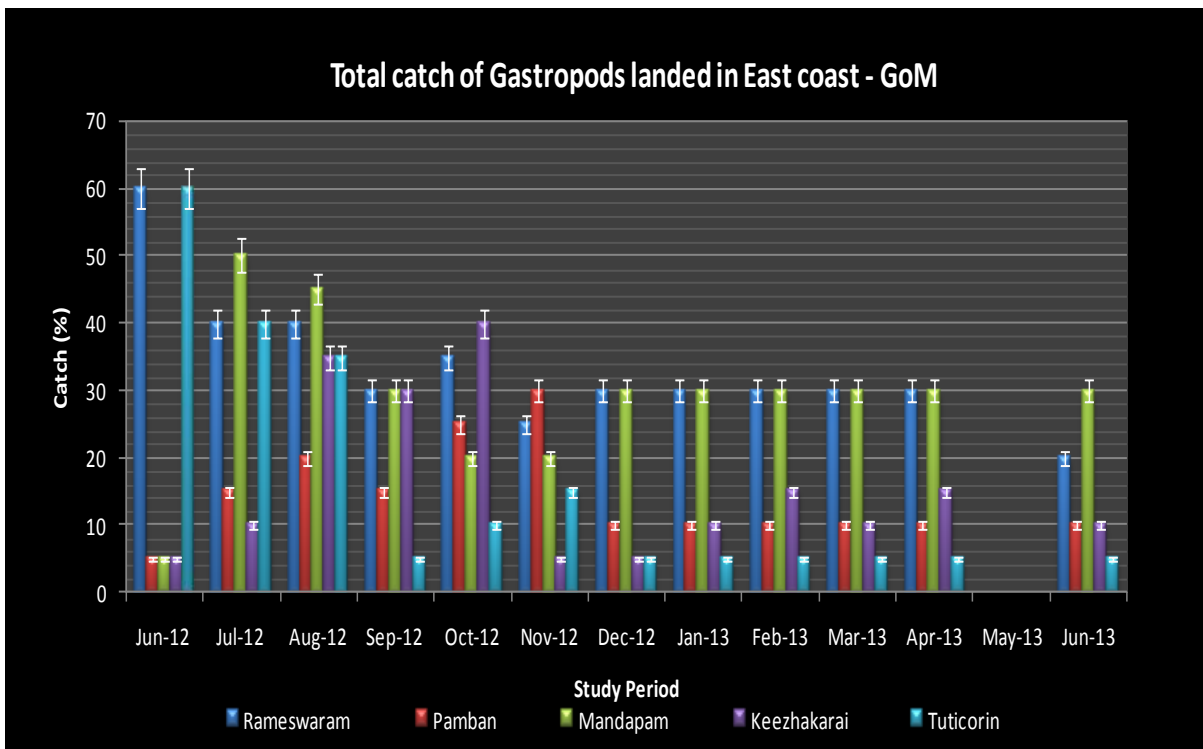


Fig.9. Percentage catch of Gastropods landed in East coast – Gulf of Mannar



4.3 Species Composition and Seasonal Variations

Babylonia sp., and *Chichoreusvirgineus* were the most dominant species with higher percentage composition in west coast whereas *Xancuspyrum*, *Tibia curta* are the observed the most dominant compositions of the bycatch in East coast. Most dominantly occurring species and their percentage of dominance with seasonal abundance were detailed in Table 4.

Fig. 10. Species Composition of gastropod in East coast and West coast

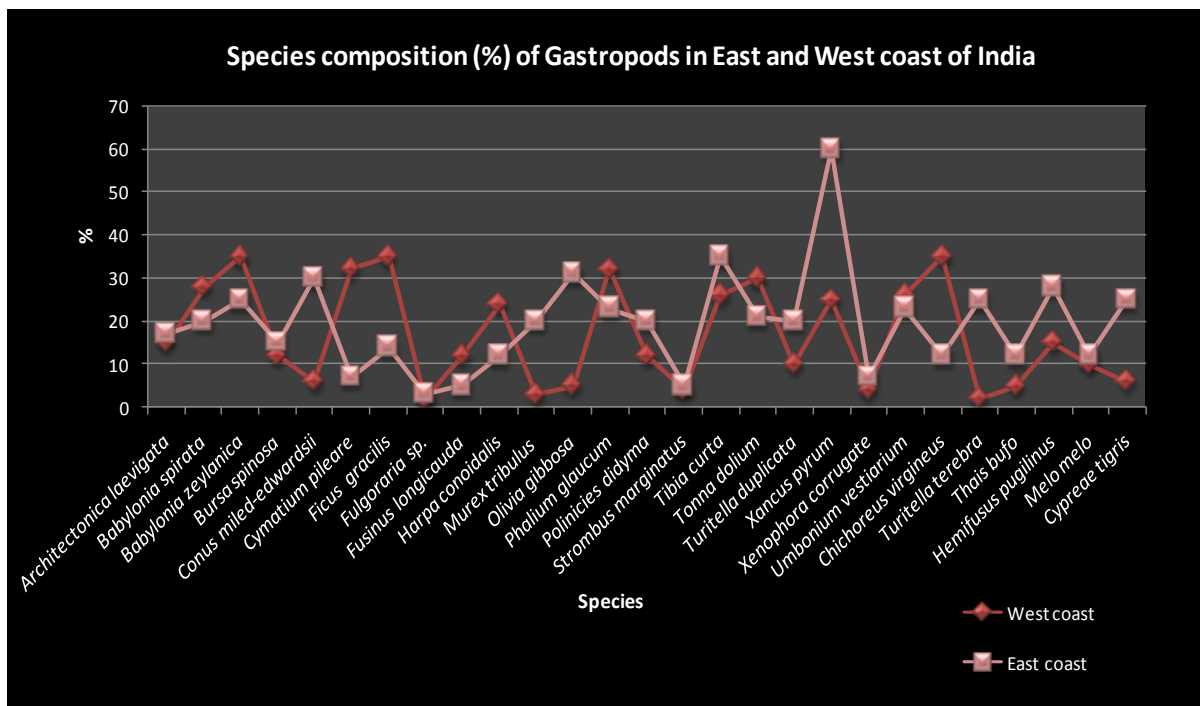


Table 4 - Species wise dominance of gastropods - East and West Coast		
Dominant Species	%-wise dominance	Seasonal variations

<i>Babylonia</i> sp.	33	Aug-12
	48	Oct-12
	43	Nov-12
	39	Mar-13
	37	Jun-13
<i>Bursa</i> sp.	46	Aug-12
	46	May-13
<i>Conus</i> sp.	34	Dec-12
	38	Apr-13
<i>Ficusp.</i>	42	Jan-13
	46	May-13
<i>Harpasp.</i>	36	Sep-12
<i>Murex</i> sp.	41	Dec-12
	43	Jun-13
<i>Phalium</i> sp.	35	Jun-12
<i>Rapanasp.</i>	43	Feb-13
<i>Tibia</i> sp.	37	Jun-12
	41	Sep-12
	37	Nov-12

	52	Jun-13
	51	Feb-13
	43	Mar-13
<i>Tonna</i> sp.	42	Oct-12
	41	May-13
<i>Xancuspyrum</i>	43	Sept - 2013

5. Threats

5.1 Major threats and Exploitation

Over fishing

Substantial quantities of molluscan forms (gastropods & bivalves) landed as bycatch along with trawl catch is having aesthetic value as ornamental articles. Shells of the species, *Conus*, *Oliva* etc. have excellent demand in international market. Sacred chank, *Xancuspyrum*, matter of veneration for Hindus is also a trawl Bycatch. Special emphasis should be directed on this line to augment the proper exploitation of these resources. The major concern is that the Juveniles or undersized animals of target species are also thrown as trash as it does not have good market demand. These are carefully segregated from trash onboard and should be returned to sea itself, which will aid in the proliferation of natural stock. For instance, live, undersized and soft shelled (freshly moulted) crabs of desired species like *Scylla*, *Portunus*, baby lobsters of *Palinurus* sp. are to be taken and subjected to culture in confined grow outs (cages or ponds). This acts as an alternate source of income for the fisher folk during lean months of fishing.

The other major threats to the marine system are from tourism related activities on the beach, dumping of untreated industrial and domestic wastes into the sea, dredging operations deposit large quantities of silt which increases the turbidity of the water resulting in severe damage to the nursing and feeding ground of larvae and juveniles of gastropods

6. Products and marketing

6.1. Processing of shell

These shells are collected by shell agents and heaped in the bay for the meat to be separated from the shell and dried in the sun. The assortment of shells (Fig.11) are separated species wise by women (Fig.3) employed on daily wages . Two species of edible whelks, *Babylonia spirata* and *B. zeylanica* were exported since early 1993. The sorted shells are filled in gunny bags and transported to Tamil Nadu (mainly Rameswaram) for the handicraft industry.



Fig. 11. Assortment of shell (Bycatch in trawl net)



Sorting of shells Shells ready for transport

In Rameswaram the traders procure the cleaned shells from different places(Fig. 12) and the shells are washed in commercial acid (H_2SO_4 or HCl) in different concentration for 2-5 min depending upon species, size and thickness of the shell (Fig. 13).

Shaping and polishing(Fig. 14) is the next process which is a very tedious process which comes only through experience and play a vital role in making various eye catching objects. These are not only depending on the shape, size and species of shell but also depend on the market demand and

customer. Beautiful curios and several utilitarian objects with molluscan shells. The cleaned chank shells are mainly sent to West Bengal for the bangle industry.

The shells are made into exquisite crafts as well as home decorating articles (Fig. 15), such as lamp shades pen stands, clocks photo frames, paper weights, key chains and toys and also ornamental products for ladies such as ear rings, rings, combs, hair clips, bangles, chains etc .



Fig. 12. Shell stocking yard



Fig. 13. Shell processing (cleaning and washing of shells in acid)



Fig. 14. Shaping and polishing



Fig. 15. Painted shells for export



Lamp shades from shells



Shell handicraft



Engraving on shell



Processed shell for export



Shell products packed in cartons for market

6.2. Livelihoods associated with shell industry

An understanding of the shell handicraft industry in Rameswaram shows that the handicraft industry forms a major percentage of both trade and revenue, benefiting huge number of peoples either directly or indirectly. The handicraft industry comprises of 10–15 manufacturing units employing 10–40 people/unit (Fig.16) based on the production demands. The frontrunners in the trade are Rainbow Sea Shell Handicrafts and Sultan sea shell based in Rameshwaram. The functioning of these units areas follows:



Rainbow Sea Shell Handicrafts	Employs around 20 people	Outsources work to ladies and smaller SHG	Provides raw material and sub-structures		
Sultan Sea Shell	Employs around 10 people	Outsources work to ladies and physically challenged groups	Procures shells from Cuddalore	The handicrafts industry while outsourcing provides structures which are then decorated with shells and converted into the final products	



Fig. 16. Women employed in shell industry

These industries provides livelihood for at least 3000 people in and around Rameswaram.

The pricing patterns of the shells that are sold to traders for processing are as follows.

- Prices vary from Rs 3–5/shell based on the size and species
- Some shells of smaller size (*Babylonia* sp.) are sold based on Gunny bags, i.e. 1GB will cost around Rs 150–250.
- After processing the prices are escalated by 4–6 times of the actual price.
- The sacred chank or *Xancuspyrum* fetches a good price depending upon size.
 - Small Rs 5–30/shell

- Medium Rs 30–75/shell
- Large Rs 75 and above.

The shell craft industry supports a wide range of livelihood from fishers, agents, labours employed by the companies, to the traders . The following flow chart gives an idea of the trade and the level of involvement by each stakeholder

As the volume of this industry is huge it has given rise to many ancillary organizations or SHG’s which contribute to economy of the trade. One such SHG is “*Feed Trust*”. This SHG employs around 16–20 members aged around 20–30 years of age. Each of these individual has certain physical limitations, wherein these kind of initiative help in capacity building and developing self esteem. These SHG procure raw materials (only shells) from traders and other materials like strings, straws etc are provided by *Feed Trust*. They make different handicraft product and sell it back to the trader who supplied the shell. Each piece after processing is sold for Rs. 10–50 depending on the size of the product. Earning of each member ranges from Rs. 2000–3000 depending upon their capacity. Feed trust has a monthly turnover of 50,000 per month. These SHG’s operate strictly on the principles of buy back policies.

6.3. Import and export trade of ornamental shells.

Ornamental shells are imported from various countries, processed here and re exported. On enquiry with traders and the Wildlife Crime Bureau, Chennai, the following information was made available to us on the import (Table. 5) and export (Table. 6) of shells.

Table. 5. Import of ornamental shells

<i>Name</i>	<i>Country of import</i>
<i>Cypreatigris</i>	Australia, Philippines
<i>Busyconsp.</i>	USA
<i>Haliotus</i>	South Africa and New Zealand
<i>Hemifusus pugilinus (available in India)</i>	Philippines
<i>Mitrella sp. (some n species available in India)</i>	Spain, and African countries

Table. 6. Export of ornamental shells

<i>Export from India</i>	<i>Countries of export</i>
Tuticorin	USA France Netherlands Los angeles Australia Germany Colombo
Chennai	Croatia Belgium Norfolk (England) New York Haiti Island
Rameswaram	Australia South Africa Germany

	Vietnam
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6.4. Concerns associated with the trade

Interaction with the traders has highlighted that the traders were being unlawfully held by law enforcing authority even though they were abiding by the law (Shells banned under WPA 1972). This problem can be linked to misidentification of gastropods by concerned authority due to lack of information. Resemblance between species, small ones interpreted as juveniles of the banned

Shells (Fig. 17)

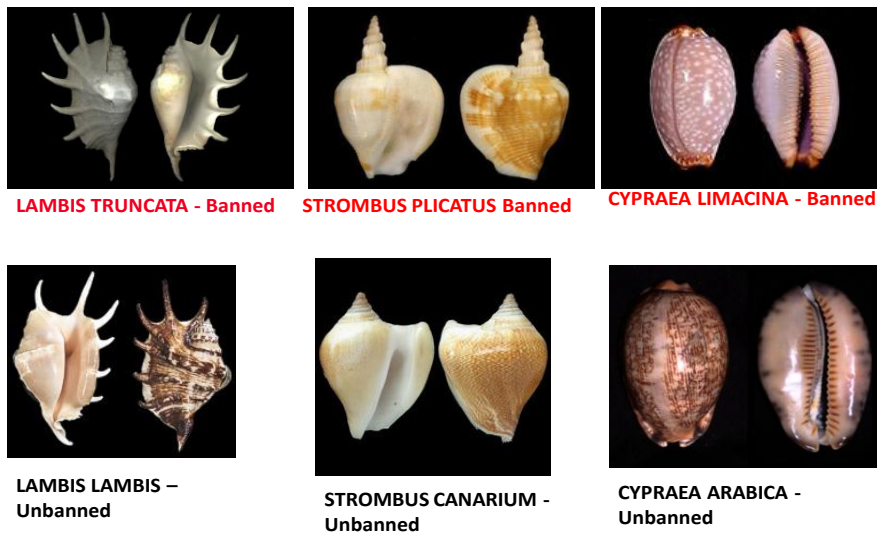


Fig. 17. Resemblance of banned and unbanned shells

It was also brought to our notice that certain banned shells that are being traded in other countries are causing financial losses to the shell trade industry in India. *Lambis* sp. is one such example which is being freely traded at Philippines, whereas banned in India though available in plenty.

As per the trader the army and navy camps in coastal areas acts as a hindrance to the trade. In many cases the fisherman or the collection agents are detained, and also sometimes shot by the army or navy personnel.

Placenta sp. which is protected under WPA 1972 are landed in huge quantities as trawl by-catch. These are used in chemical factories for manufacturing of paints, insecticides etc. Some companies use *Placenta shell* for its manufacturing processes.

7. Conservation and Management

The only law that governs the protection of the mollusc species is the listing of endangered species under the Indian Wildlife (Protection) Act. The Wildlife (Protection) Amendment Act, 2002 is an Indian legislation enacted by the Parliament of India amending the existing Wildlife Protection Act, 1972. The Wildlife (Protection) Act, 1972 was enacted with the objective of effectively controlling poaching and illegal trade in wildlife and its derivatives. The 2002 Amendment Act which came into force in January, 2003 have made punishment and penalty for offences under the Act more stringent. 23 species of molluscs have been listed in the Indian Wildlife (protection) Act, 1972, amended in 2001

Table 5. List of Mollusc under the Indian (Wildlife) Protection Act



Schedule I - Part IV B

Cassis cornuta

Hippopus hippopus

Cypracastrufa

Tridacna squamosa

Nautilus pompilius

Conus millneanensis

Charonia tritonis

Tudicospira

Tridacna maxima

Schedule IV

Cypraea murex

Cypraea lamina

Cypraea talpa

Harpulina aurea

Fasciolaria trapezium



LambisChiragra

Lambistruncata

Lambisrocea

Lambisscorpis

Lambismilliped

Strombusplicatussibbaldi

Trochusniloticus

Placenta placenta

Turbo marmoratus

Shells in Schedule 1 of Wildlife Protection Act



CYPRACASIS RUFA



CHARONIA TRITONIS



CASSIS CORNUTA



CONUS MALNEEDWARDSI



TUDICLA SPIRALIS



TRIDACNA SQUAMOSA



HIPPOPUS HIPPOPUS



NAUTILUS POMPILIUS



TRIDACNA MAXIMA

List of shells in schedule IV of WPA



CYPRAEA TALPA



CYPRAEA MAPPA



CYPRAEA LAMACINA



FASCIOLARIA TRAPEZIUM



LAMBIS CHIRAGRAARTHITICA



HARPULINA ARAUSIACA

Species of gastropod listed in the Wildlife protection Schedule observed during the study



Lambis scorpius



***Cypraea* sp.**



Conus millnedwardsi



Cassis cornuta



Cypraea tigris



Harpulina sp.

8. Recommendations

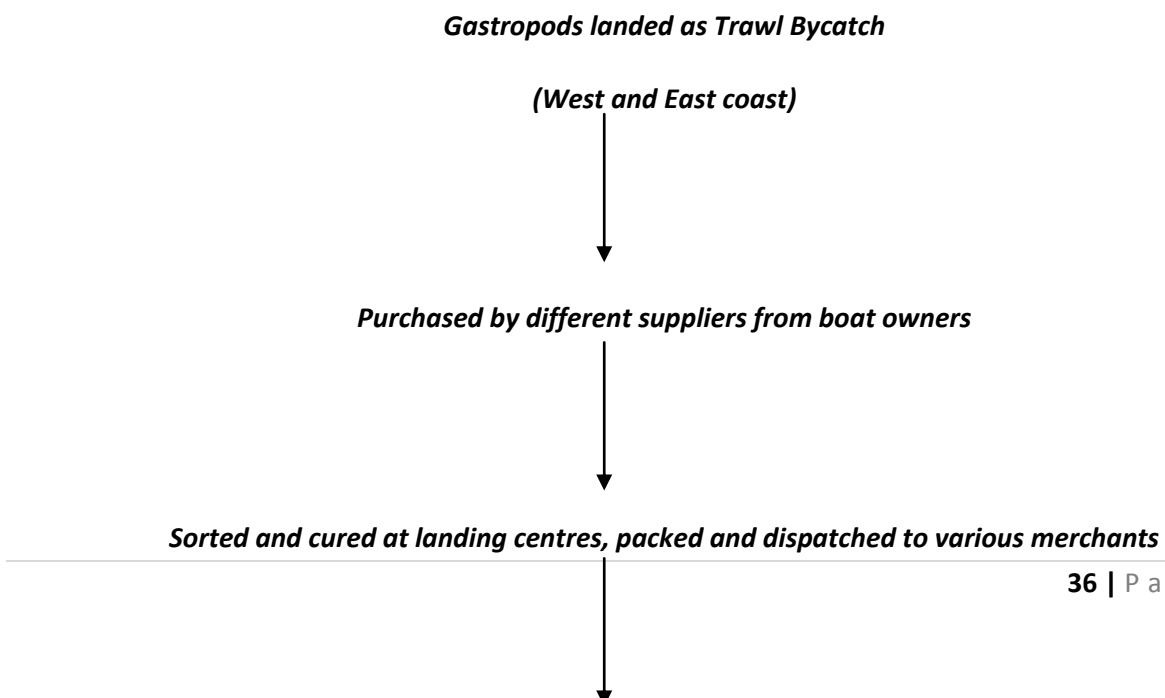
1. Currently there is no regulation / control at the landing point and most of the ornamental gastropod are landed as trawl bycatch. Periodical inspection at the landing sites by enforcement authorities can help in curtail the processing of shells listed in the Indian Wildlife (Protection) Act.
2. More detailed survey and studies need to be done to assess the status of the shells listed in the Indian Wildlife (Protection) Act.
3. Imposition of Minimum Legal Size (MLS) at capture for Intertidal and targeted fishery species.
4. Detailed resource survey and potential yield of gastropods to be conducted for management interventions like stock replenishment and declaring closed seasons and protected areas.

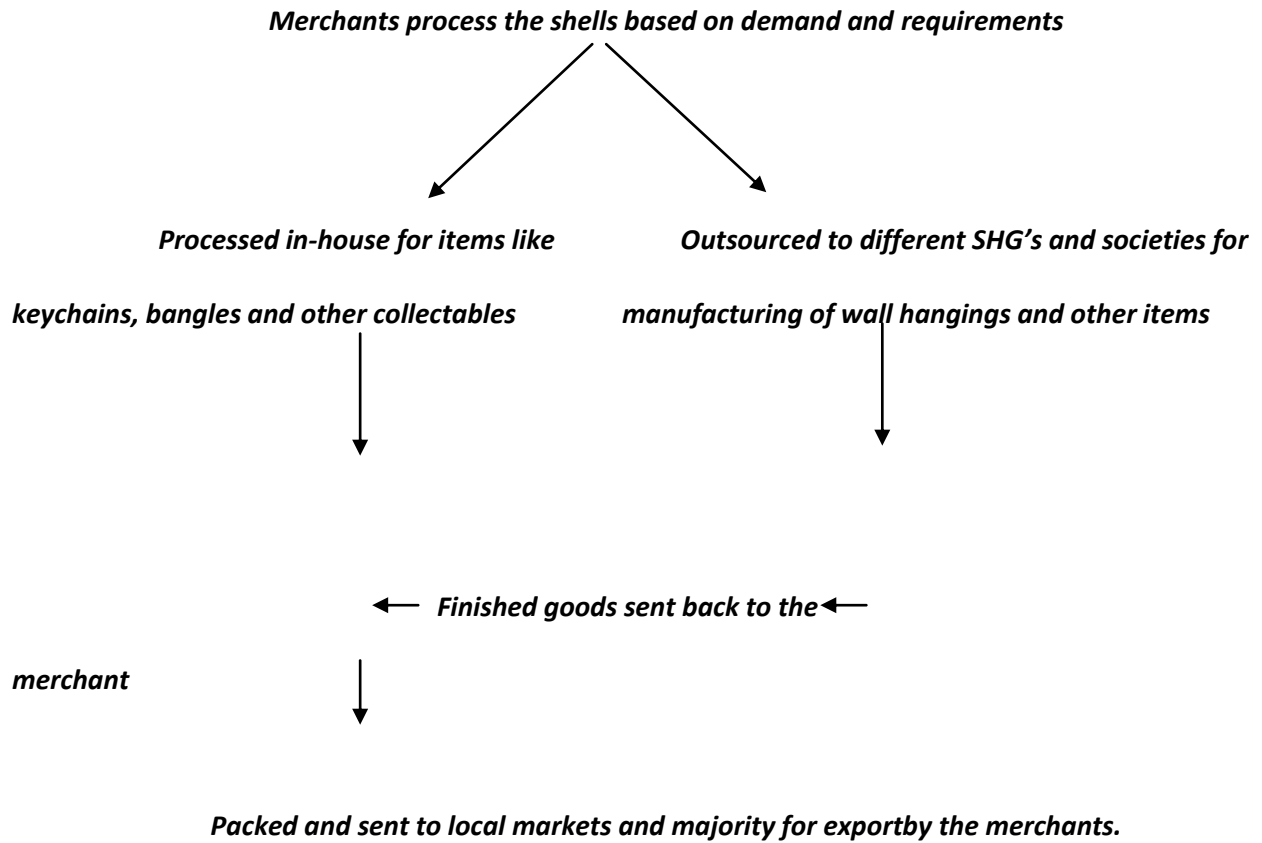
9. Way forward

1. Stakeholder consultation and awareness on the sustainability of the resources and the management interventions for the conservation of the resource
2. Detailed study on gastropod shells in Lakshadweep, Andaman & Nicobar islands and Gujarat which are rich in molluscan diversity

Value Chain Analysis of commercial trade of Gastropod products

The gastropods by-catch is generated mainly by bottom trawling for shrimp and crab longline. These are then processed and dispatched accordingly as per the requirements. The flow chart is as follows:





These steps include various stake holders at various stages which are mainly

1. Boat Owners
2. Middle Men/Agents
3. Manufacturer
 - i) Direct Processing
 - ii) Out Sourcing
4. Retailer
5. End User/Customer

1. Boat Owners:

The owners of the boat/trawlers engage a crew and provides for food and diesel. The shells landed along with the by-catch is either sold by the boat owner and the crew gets a part of the

booty or the owner might keep the shells with the crew for them to sell it and earn some profit. This practice depends completely on the owner and the decision may be based on the profit from days catch.

2. Middle Men/Collection Agents

The middle men or collection agents buy the shells from the owners/crew based on prices agreed by both parties and also depending upon the variety and size. The prices paid at this point are anywhere 50-100 times lower compared to the prices of the end product.

The middle men can be divided into three types.

- i) Collects all varieties of shells for local market**
- ii) Collects only specific varieties for local**
- iii) Collects specifically or just one type for an niche market,**

E.g. Bangle market in West Bengal

At this stage the shells are sun-dried and sorted based on different species. These are then packed in gunny bags and sent to the manufacturers. The pricing of shells at these stages are per gunny bag depending upon the species. In some cases where a rare species are involved, the pricing may be based on per shell.

3. Manufacturer:

These are the most important people in the value chain. The manufacturers are mainly based in the Rameswaram and Tuticorin region. The bulk of the manufacturers are located here and only a handful of manufacturers are present in other parts of India. The manufactures complete the entire product and some have their own facilities for production of handicrafts and curio items. In some cases they also outsource the handicrafts production under a buy-back policy. These are mainly small SHG's and charitable trusts where people employed are differentially abled. This serves as a livelihoodavocation for these people.

4. Retailer:

This forms a very small part of the link. This people usually buy in small quantities from the manufacturers and mainly aim at the domestic crowd. Small shops are set up at tourist locations for the sale of shell curious.

5. End User/Customer:

This industry has a strong trade niche and the bulk orders are mainly for export. The manufacturers on receiving orders process the shells within 15-20 days.

Pricing pattern of shells at various stages

The pricing pattern of shells varies hugely depending upon the various stages of the trade. The end price sometimes may be more than 50-100% of the original price paid to the boat crew/ owner.

Prices of certain species like *Xancuspyrum* vary hugely during entire trade process. The maximum value addition is at the manufacturer level, where it is polished, cleaned and sold. Though, the same holds true for other varieties of shell, the appreciation in cost is much higher in *Xancuspyrum*.

Eg. *Xancuspyrum* is sold for Rs 2000-2500, for a count¹ of 25-30 shells between the boat owners and middlemen/agents. Thus each shell cost approximately Rs. 80-100. In the second stage the middlemen/ agents sell it as individual shells at a profit of 40-50%. Here each shell would cost around Rs. 120-150. The manufacturers after completing the entire production process would sell each shell anywhere between 250-1000, depending upon the sizes.

Conclusion

There is good scope for the shell-craft industry to move forward as a profitable industry if attempts are made to locate areas of abundance of different species, if fishing is regulated without causing large scale destruction of stocks and last but not the least important if attempts are made to rear and culture some of the more common species.

Citations:

1. E. Ríos-Jara, M. Pérez-Peña, R. Beas-Luna, E. López-Uriarte and E. Juárez-Carrillo (2001) Gastropods and bivalves of commercial interest from the continental shelf of Jalisco and Colima, México Rev. Biol. Trop. 49(3-4): 859-863
2. Mohan Joseph and Sivakumar Jayaprakash (2003) CMFRI News letter
3. Appukuttan. K. K., Molluscan resources and management strategies. Proc. Natl. Sem. Env'tl. Mgt. Sust. Livelihood, 2008 : 6-12.

¹ Count refers to the number of shells, i.e. 1COUNT=1 GASTROPOD SHELL

4. Gopinathpillai and Appukuttan. K. K., Distribution of molluscs in and around the Southeastern coast of India. *Journal of Bombay Natural History Society*. Vol., 77, 29.11.1980

About Mangroves for the Future

Mangroves for The Future (MFF) is a unique partner-led initiative to promote investment in coastal ecosystem conservation for sustainable development. It provides a collaborative platform among the many different agencies, sectors and countries who are addressing challenges to coastal ecosystem and livelihood issues, to work towards a common goal.

MFF builds on a history of coastal management interventions before and after the 2004 Indian Ocean tsunami, especially the call to continue the momentum and partnerships generated by the immediate post-tsunami response. It initially focused in the countries worst-affected by the tsunami; India, Indonesia, Maldives, Seychelles, Sri Lanka and Thailand. MFF has expanded to include Bangladesh, Cambodia, Pakistan and Viet Nam. MFF will continue to reach out to other countries of the region that face similar issues, with an overall aim to promote an integrated ocean wide approach to coastal zone management.

The initiative uses mangroves as a flagship ecosystem, but MFF is inclusive of all coastal ecosystems, including coral reefs, estuaries, lagoons, sandy beaches, sea grasses and wetlands. Its long-term management strategy is based on identified needs and priorities for long-term sustainable coastal ecosystem management. These priorities emerged from extensive consultations with over 200 individuals and 160 institutions involved in coastal management.

MFF seeks to achieve demonstrable results in influencing regional cooperation, national programme support, private sector engagement and community action. This will be achieved using a strategy of generating knowledge, empowering institutions and individuals to promote good governance in coastal ecosystem management.

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