MARINE BIODIVERSITY CONSERVATION AND MANAGEMENT

Edited by

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VI. MARINE MOLLUSCS AND THEIR CONSERVATION

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Marine invertebrates in general, especially molluscs are able to withstand fishing pressure, because of their high fecundity, reproductive capacities and planktonic larval life. Where as there are cases of depletion of stock due to over exploitation by commercialised fishing and indiscriminate collection of rare species. Appropriate conservation measures are to be taken for judicious exploitation of the existing reserve and to impose precautionary measures to resist overexploitation of rare specimens leading to extinction.

INTRODUCTION

Molluscs are soft bodied, heterogenous group of animals with great antiquity and diversity. The shells of molluscs are extremely diversified in shape and colour. They consist of coat-of-mail shell - amphineura, a single piece spirally twisted shell - gastropods, two valved - bivalves, cephalopods comprising of squids, cuttlefishes, octopus and nautilus and the elephant tusk shells - scaphopod. The majority of molluscs inhabit marine biotopes and they occur from the backwater zone, mangrooves, intertidal, shelf and down to deeper waters. The number of species of molluscs recorded from various parts of the world vary from 80,000 to 100,000 (Subba Rao, 1991). From India, a total of 3271 numbers of molluscs are known to occur belonging to 220 families and 591 genera, of which 1900 are gastropods, 1100 bivalves, 210 cephalopods, 41 ploylacophors and 20 scaphopods.

Oysters, mussels, clams, pearl oysters and chank are the important molluscs exploited from India from time immemorial. Except for chanks, pearl oysters and cephalopod, much attention was not paid for organised exploitation of molluscan resources from Indian waters till recently. Other gastropod and bivalve fishery are of sustenance nature

and are used for edible purpose, source of lime, as decorative shells or for industrial purpose. Twenty Eight species of bivalves and about Sixty Five species of gastropods are of importance in shell trade and for edible purpose. Fourteen species of cephalopods are exploited commercially at present.

PRESENT STATUS OF MOLLUSCAN FISHERY IN INDIA

Molluscs form a valuable resource along east and west coast of India and Andamans and Nicobar Islands, providing source of food, lime, pearl, decorative shells for shell handicraft trade, raw material for calcium carbide industry and constituent for medical preparations. The world molluscan production is 8.58 million t (1992). Compared with other countries, India's total production of molluscs is insignificant. In recent years, due to greater demand for molluscan meat, both in internal market and for export, there is considerable pressure in fishing efforts leading to increased molluscan landings forming 4-5% of the total fish landings.

BIVALVES

Oysters

Eight species of oysters are reported from Indian waters of which only four are considered commercially important. They are *Crassostrea madrasensis, C. gryphoides, C. discoides* and *Saccostrea cucullata. C. madrasensis,* the common Indian edible oyster is the most important species, since it has got extensive distribution along Indian coasts, occurring at Sonapur in Orissa, Sarada estuary, Bheemunipatnam, Uppleus, Godavari, Krishna and Gokulappalli in Andhra, Pulicat, Ennore and Adayar, Killai Backwaters, Muthupet, Athankari, Pinnaikayal and Tuticorin in Tamilnadu, Ashtamudi, Vembanad, Kadalundi, Korapuzha, Dharmadam and Kasargode in Kerala, Nethravathi, Sharavathi, Kali, Mulky, Uppunda, Bhatka, Venketpur and Condapur in Karnataka. Oysters are exploited on sustenance level for edible purpose from all these water bodies. Apart from utilization of meat for edible purpose, dead shells are collected for industrial purpose. Mining of subfossil deposits of oyster shells by lessees is also done in many of the estuaries.

The approximate quantity of oyster exploited from Indian waters is 1600-2000 t annually from all the estuaries and the subfossil shell yield is around 15,000 t.

Mussels

Two species of mussels *viz* green mussel, *Perna viridis* and brown mussel, *Perna indica* contribute an annual landings of 4000-5000 t. Green mussels are abundant in thick beds at Quilon, Alleppey, Cochin, Malabar coast between Calicut and Tellicherry, Karwar, Goa, Malwan, Ratnagiri and Gulf of Kutch in west coast and at Vizakhapatnam, Kakinada and Madras in east and also in Andamans. Brown mussel has a limited distribution from Quilon to Kanyakumari in the west coast with good settlement at Varkala, Kovalam, Vizhinjam, Poovar, Muttom and Kolachal. Fishing is done throughout the year, except monsoon months from June-August. The annual production of mussel in 1994 is 4309 t.

Clams

The important species of clams commercially exploited are *Meretrix casta, M. meretrix, Paphia malabarica, Katelysia opima and Villorita cyprinoides.* The estimated annual production of clams is 45, 412 t (Narasimham, 1991). Black clam, *Villorita cyprinoides* contribute the maximum of 64% (29,077 t) forming good fishery along coasts of Goa, Karnataka and Kerala. Vernerid clams, *Paphia malabarica, Meretrix casta, M. meretrix* together contribute 30.9% (14,052 t) forming fishery in almost all maritime states. The blood clam *Anadara granosa* contribute 4.4% (2000 t) maily from Kakinada. Other important clams exploited are *Gafrarium tumidum, Mesodesma glabratum , Tellina sp, Anadara rhombea, Donax faba, D. cuneata, D. incarnatus, Mactra violacea, Tridacana maxima, T. crocea and T. squamosa.*

Among all the maritime states, Kerala gives maximum landing of 32,927 t mainly from Vembanad and Ashtamudi. The annual catch of Karnataka is 6,592 t (Rao *et al*, 1989) from 10 estuaries. Along the east coast, the clam resources are small with Vellar estuary and Pulicat contributing 1,087 t and in Andhra, Kakinada Bay, the Godavari estuary and Bheemunipatnam backwaters contributing 2,816 t annually.

The estimated exploited subfossil deposit of lime shell is 1,76,610 t annually. Shells of black clam from Vembanad contribute maximum quantity of subfossil clams (Narasimham, 1991). Annual clam meat export from India is between 800-1200 t and *P. malabarica* contribute the major portion of the export.

Window -Pane Oysters

The window-pane oyster, *Placenta placenta* shells are a source of shell lime, meat is edible and the right valve is exported in good quantities and are used for glazing windows. This species occur in Gulf of Kutch, Bombay, Malabar coast, Tuticorin, Mandapam, Nagapatnam, Madras and Kakinada Bay. They are exploited from Kakinada Bay and Gulf of Kutch. The annual production at Kakinada is 400 t and the estimated potential stock is 8495 t (Murthy *et al.*, 1979)

Pearl Oysters

Six species of pearl oyster occur along Indian coasts. They are *Pinctada fucata, P. margaritifera, P. chemnitzi, P. maxima, P. sugillata and P. annomoides.* Natural pearls have been collected from *P. fucata* in pearl fisheries of Tuticorin in Gulf of Mannar, Tamilnadu and to some extend from Gulf of Kutch in India since time immemorial. In the present century, only 14 pearl fisheries have been conducted, last being in 1961 in Tuticorin and in 1966 in Gujarat. A maximum of 21.4 million Pearl Oysters which brought a revenue of Rs. 4,51,098 to the Government was obtained in 1958 pearl fisheries in Gulf of Mannar. The Central Marine Fisheries Research Institute has produced spherical cultured pearls in *P. fucata* in 1971. Settlement of *P. fucata* was observed in Vizhinjam, west coast of India and attempts were made for pearl production. *P. margaritifera* which yields high quality pearls are available in Andamans.

Giant Clams

From India, four species of giant clams *viz, Tridacna crocea, T. maxima, T. squamosa and Hippopus hippopus* are reported. All these species are available in Andaman and Nicorbar Islands, where they are exploited for edible purpose. *T. maxima and T. squamosa* are available

in Laccadives, the former species is abundant in all the Islands and is exploited for edible purpose by local population.

Other Bivalves

Razor clam *Solen kempi* in Ratnagiri, wedge clams *Donax cuneata, D. incarnatus* are reported from different parts of the country. *Mesodesma glabratum, Gafrarium tumidum* in muddy habitats of Gulf of Mannar, fan shells *Pinna bicolor and Atrina (Servatrina) pectinata* occurring in coastal waters of Gulf of Mannar and Palk Bay and *Mactra violacea* from bays of west coast of India are other bivalves which could be exploited for edible purpose.

GASTROPODS

Sacred chank

Sacred chank *Xancus pyrum* is distributed in the coastal waters of Tamilnadu, Kerala, Gulf of Kutch and Andamans. Chank fishery along Tamilnadu is age old and the fishing is mainly by diving. The fishery is controlled by Tamilnadu Government which permits fishing by issuing licence to fishermen. Annual chank landing varies from 1 million to 1.5 million in Gulf of Mannar and Palk Bay and an estimated 17000-20000 chanks are caught in trawl catches along west coast of India and another 5000-6500 chanks by diving along Vizhinjam in the southwest coast of India. The sacred chanks with sinistral shells known as 'Valampuri chank' are highly priced for its rarity, fetch a value of Rs. 10,000 or more depending on the size and quality of shell. The chanks are graded and send to Calcutta for manufacture of shell bangles.

Trochus and Turbo

Top shell, *Trochus niloticus* and turban shell, *Turbo marmoratus* form an important fishery in Andaman and Nicobar Islands. As early as 1929, the trochus fishery was organised in Andamans and after realising the importance of the fishery, Government started giving the fishing grounds on lease to merchants for fishing and collected royalty from them. The annual production of *T. niloticus* was estimated between 400-600 t and *T. marmoratus* between 100-500 t (Nayar and

Appukuttan, 1983). There is a decrease in the catch of latter species recently mainly due to overfishing. Shells of both the species are in much demand for making curios and a variety of utilitarian articles. The meat is boiled, dried and consumed by local people.

Other Edible and Ornamental Gastropods

Gastropods, *Turbo intercostalis, Oliva sp, Lambis lambis, Babylonia spirata, B. zeylanica, Chicorea virgineus, Pleuroploca trapezium, Umbonium vestiarium, Strombus canarium, Thais rudolphi* and *T. bufo* 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 whelk meat from Indian Seas is an emerging resource and at Annapenpettai near Porto Novo, Southeast coast of India, *Babylonia spirata* is exploited in good quantities and the annual production was 211 t during March, 1992 - May, 1993 with a meat yield of 52.5 t (Patterson Edwards *et al*, 1994). At Sakthikulangara -Neendakara area, 2 species of whelks, *B. spirata and B. zeylanica* form an important component of the by-catch of shrimp trawlers and contributed an annual production of 421.4 t in 1994. The whelk meat is now exported mainly to Japan (Appukuttan and Babu Philip, 1994). Ayyakannu (1994) reported that *Chicorea virgineus and Pleuroploca trapezium* form a potential resource along southeast coast and estimated landing for the former species was 272.8 t in 1992 and 537.1 t in 1993 and for the latter 225.2 t in 1992 and 402.5 t in 1993. The meat yield for the former was 41.6 and the latter 31.9 t in 1992-93 period. Meat is exported to southeast Asian countries.

Other important ornamental gastropods caught from Indian coasts are cowries *Cypraea tigris, C. arabica, C. moneta, C. caput-serpentis,* cone shells, *Conus* spp, Olive shells, *Oliva* spp, begger's bowl, *Melo indica,* harp shell, *Harpa conoidalis,* Helmet shell, *Phalium* spp, King shell, *Cassis cornuata,* Queen shell, *Cypraeacassis rufa, Mureces, Murex* spp, *Strombus* spp, tusk shell *Dentalium, Pyrene* spp and *Nautilus sp.* These shells are caught as by-catch of shrimp trawlers or collected by diving, hand picking in intertidal areas or got entangled in gill nets operated

in inshore waters. There is good population of these shells, in Gulf of Kutch, Southwest coast of India, Gulf of Mannar and Palk Bay, Lakshadweep Islands and Andaman and Nicobar.

CEPHALOPODS

Commercially important cephalopods from Indian coasts are squids, *Loligo duvaucelli, Sepioteuthis lessoniana, Doryteuthis sp, Liliotus investigatoris,* Cuttle fishes *Sepia pharaonis, S. aculeata, S. brevimana, S. elliptica, S. prashadi, S. inermis,* Octopus, *Octopus dollfusi, O. aegina, O. membranaceus, Cystopus indicus and Berrya keralensis.* In India cuttle-fishes, squids and octopuses are caught mainly as by-catch in trawl nets used for shrimp trawling, shore seines, boat seines, hooks and lines and stake nets. The bulk of cephalopod catch come from trawlers (59%). The country's cephalopod, landings was meagre till 1973, 31577 t in 1985 and 96889 t in 1993. The increasing trend was mainly due to the corresponding demand for cephalopods for export. The contribution of cephalopod to total Indian marine landing in 1993 was 4.3%. Kerala, Maharashtra and Gujarat together contribute 79% of total cephalopod landings of India. Investigations reveal that there is every possibility to increase production of cephalopods from the continental shelf and oceanic areas of Indian waters.

SOCIAL AND ECONOMICAL VALUE

Molluscs in general had a tremendous impact on Indian tradition and economy and were popular among common man as ornaments, currency and a panacea to ward off evil spirits even at the inception of human culture and civilization. A wide variety of molluscs contribute edible and non-edible species in a range of habitat in Indian waters. James Hornell, the British biologist was the pioneer person who indicated the commercial potential of Indian molluscs through his papers and reports published during 1905 to 1951. Till recently, except mussels and cephalopods there was no systematic recording of landing details from Indian coasts. Precise estimation of molluscan resources are not done since there is no established assessment system for ascertaining the catches. Although molluscan meat is considered highly nutritious, it has got a limited market in the country. With the increasing global

demand for molluscan meat, exploitation of molluscan resources also increased and even led to export of clams and gastropods meat.

Oyster production in the country is meagre now, but in most of the estuaries in South India, good population exists. The demand for oyster meat is increasing and the possibilities of increased production through farming is bright. The mussel fishery along the southwest coast from Kanyakumari to Vizhinjam for brown mussel and from Calicut to Kasaragod for green mussel is age old and forms a sustenance fishery of greater importance with peak fishing season from November to May. At present there is only internal market for mussel meat but if production through farming is achieved, large-scale export is possible. The well known pearl fishery in Gulf Mannar had failed from 1961 and in Gulf of Kutch in 1966. Central Marine fisheries Research Institute developed pearl culture techniques and pearl production and has been found successful. Large-scale commercial production of pearls in the country is yet to start. Clam fishery is of sustenance nature and is confined to the coastal areas along estuaries and backwaters in south Indian states. Clam meat demand is confined to the coastal population, but export demand is increasing in recent years. A total quantity of 1068.8 t worth Rs. 3.48 crores was exported in 1992 as frozen boiled clam and dehydrated clam meat from India. *Tridacna* fishery is confined to Andaman & Nicobar and Lakshadweep Islands and the meat is consumed by the local people.

Among the gastropods, sacred chank occupies an important place in the lives of Hindus, being used in worship and in the manufacture of bangles worn by ladies in Bengal. The sacred chank fishery is controlled by government and the right for fishing is regulated by licensing system. *Trochus* and *Turbo* shell fishing is confined to Andaman and Nicobar Islands. Both these shells are most sought after for industrial purpose. When cleaned and processed these shells are highly attractive and form curios. In Calcutta there are several shell processing units which manufacture a variety of shell articles from these shells and export them to France and USA. Many fishermen families along the coastal areas are engaged in collecting shells for the shell craft industry.

The shells are graded, processed and send to important shell craft centres in Tamilnadu, Pondicherry and Goa. Garlands, evechains, necklaces, earring, studs, rings, bangles, table lamps, bathi stands, ashtrays, key chain pendants and curtains are made out of these shells. Gastropod meat export trade is a recent development in India and there is good scope for increased production by fishing in new areas. *Babylonia spp (Whelks), Chicorea virgineus and Pleuroploca trapezium* are emerging resources with good export demand. Ornaments and curios made out of molluscan shells are becoming highly priced objects in Indian and foreign markets. A small scale export of ornamental shells from India is already there now. However we have to explore more avenues to export molluscan shells and shell craft products.

The cephalopod production was meagre till 1973 but gradually increased to meet the export demand. The total cephalopod export from India amounted to 3,028 t worth Rs. 75 million in 1981 and 44442 t worth Rs. 2357 million 1992. Frozen squids and cuttlefishes contributed the bulk of the export. Frozen *Octopus* export contributed 381 t worth Rs. 10.7 million in 1992. *Octopus* is an emerging resource from Indian waters mainly caught as by-catch of shrimp trawlers. Cuttlefish bone is also exported from India.

CONSERVATION OF MOLLUSCAN RESOURCES

At the moment marine molluscs appears to be least endangered in the same sense as we observe in birds, mammals, reptiles and freshwater molluscs. Commercial exploitation accounts for the greater reduction of molluscan population in nature, pollution and environmental hazards also cause death of molluscs and to a lesser magnitude, the professional shell collection from wild. Indiscriminate fishing from natural bed may lead to depletion of stock of most of the molluscan resources. Very little is known about the distruction of molluscan stock by pollution and collection of ornamental shells by professional collectors from Indian coast.

Oyster fishery in India is of sustenance nature and as such there is no possibilities of over-exploitation and depletion in the immediate future, even if fishing is intensified. Suitable farming techniques for

increased production are being taken up in several places. Mussel production of India is low compared with many Asian countries and recent studies indicate that fishing efforts can be increased to get more yield from Kanyakumari-Vizhinjam zone for brown mussel and Calicut-Tellichery zone for green mussel. It is observed that during peak fishing season huge quantities of seed mussels (10-20 mm) are being exploited from natural bed along with adult and is discarded. Conservation of this seed either by utilising them as seed for mussel farming or keeping them back in their natural habitat will enhance the present production of mussels manyfold. Suitable farming techniques to augment mussel production in India is being taken up in recent years. The informations on the clam resource potential of India is scanty. The available data from Karnataka and Kerala estuaries indicate that clam resources in these estuaries are by far abundant and there is considerable scope for increased exploitation from many of the estuaries. The mining of subfossil deposits in the estuaries and river beds in Kalinadi and Vembanad lake damages the natural habitat and adversely affected traditional occupation of fishermen (Nayar, *et al*, 1984; Narasimham *et al* 1984; Achari, 1988). The disturbance caused by dredging has affected the growth and survival of bivalves such as *Paphia malabarica, Meretrix casta* and *Villorita* spp. Identical situation exists in several other Indian estuaries. In Ashtamudi estuary, where commercial exploitation of short-neck clam, *Paphia malabarica* is done in an area of 15-25 ha for the last 15 years witnessed over exploitation of undersized clams in recent years leading to depletion of stock. The limeshell fishing rights and issue of licences are regulated by the State Department of Mining and Geology which administers the Kerala Minor Mineral Concession Rules, 1967 and the rules made there under. Though there are well established licencing system for exploitation of clams of Vembanad, there is no licensing system in Ashtamudi for clam exploitation. In 1994, State Government, after discussions with clam fishermen, scientists and government officials decided to implement certain conservation measures for replenishment of stock of clams in Ashtamudi.

1) To impose ban on clam fishing from October to January in the estuarine zone, when spawning and pat settlement occur.

2) The mesh size of hand dredges and other nets used for *Paphia* fishing to be more than 30 mm and for other clams 20 mm.

3. The meat count of clams exported should be always less than 1400 nos/kg.

4) Strict vigilance in exploitation of undersized clams.

It is felt that commercial leasing out of estuaries or river beds for exploitation of subfossil and live resources should be controlled by seeking advise from expert National Committee on Marine Parks, as there is every possibility of over-exploitation and fishing of undersized clams from known beds. It is desirable to demarkate the area for dredging through detailed geological investigations for exploitation of the subfossil resources. To replenish the stock of live clams 'Clam sanctuaries' or 'Clam park' are to be established in known clam fishing estuaries. Clam farming by semi-culture (transplanting the seed clams from dense beds to other suitable places in the estuary) is suggested to augment production.

The pearl banks in Gulf of Mannar are under the control of the Government of Tamilnadu which conducts pearl fisheries, where pearl banks known as paars are populated by pearl oysters in abundance. Natural population of pearl oysters are influenced by numerous factors like recruitment, presence of pests, occurrence of predators like sea stars, sharks, rays and skates, strong current, drifting of sand and unauthorised fishing. Maintaining a 'breeding reserve' of pearl oysters in the Gulf of Mannar has been a popular suggestion put forward by earlier workers. The sea ranching of hatchery produced pearl oyster spat to known pearl oyster beds in Tuticorin by Central Marine Fisheries Research Institute commenced by 1985, is under constant monitoring.

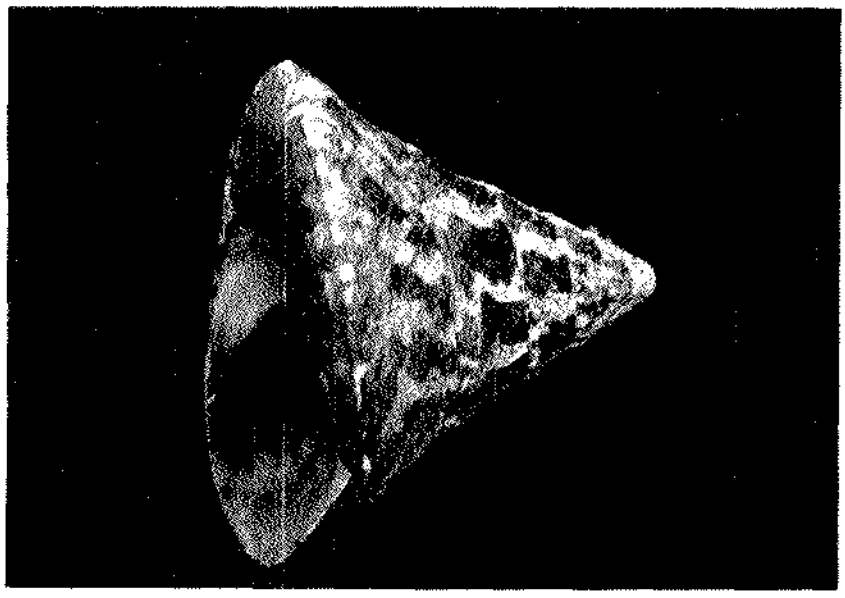
Giant clams are exploited mainly from Lakshadweep and Andaman & Nicobar islands. All the four species of giant clams from Indian water have been accepted for listing in Appendix II of the conservation on International Trade in Endangered species of wild Fauna and Flora and listed in IUCN Invertebrate Red Data Book (1983).

However, the listing under the endangered species would not interfere with mariculture efforts or attempts to improve harvests for local people.

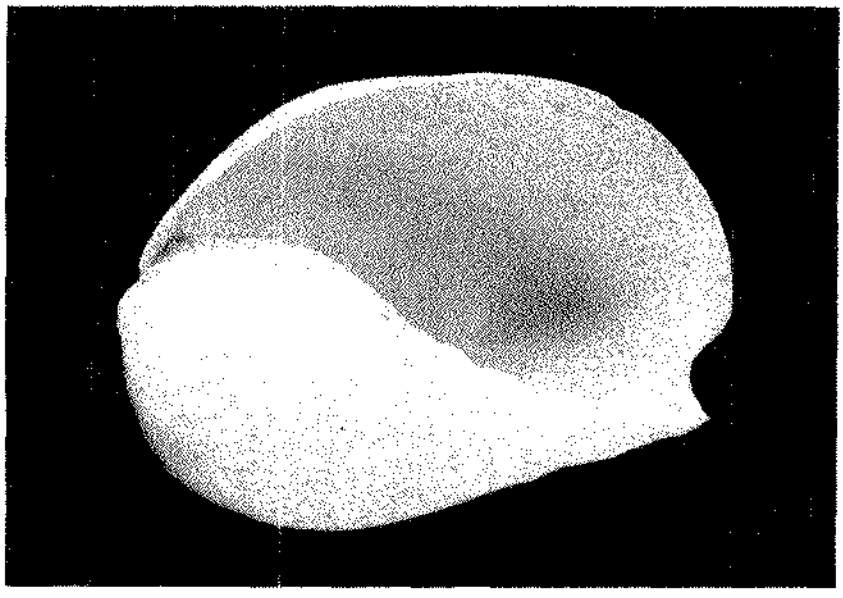
The licensing system for fishing chanks by conventional diving exists only in Tamilnadu and Kerala. The landings of chanks in good quantities are reported recently from Tamilnadu, Kerala and Karnataka. In few observations along Tamilnadu coast, presence of undersized juvenile chanks and egg masses in trawl catches were noted and indicated large-scale destruction of potential stock. It is suggested to regulate trawling operation over the chank beds by observing closed season during chank breeding season for conservation of this resource. Existing rules do not permit the divers to collect undersized chanks from the traditional chank beds in Gulf of Mannar and areas in southwest coast of India. The recent research programmes of Central Marine Fisheries Research Institute to augment chank production by rearing and sea-ranching are quite encouraging measures for conservation of this resource. It is suggested that instead of extensive exploitation of chanks in Gulf of Manner, few protected areas may be demarkated to serve as perennial breeding reserves.

Extensive and indiscriminative fishing by divers of Andaman & Nicobar Islands for *Trochus* and *Turbo* causes a decrease in the landings in recent years. The areas around Little Andamans, Nicobar, Katchal and Comorta Islands should be declared as prohibited areas for fishing upto 500 m from shore line, since exploitation appears to be intensive and there is need for management of the resource based on biological principles governing their production and growth. Artificial seed production and sea-ranching can enhance wild stock position.

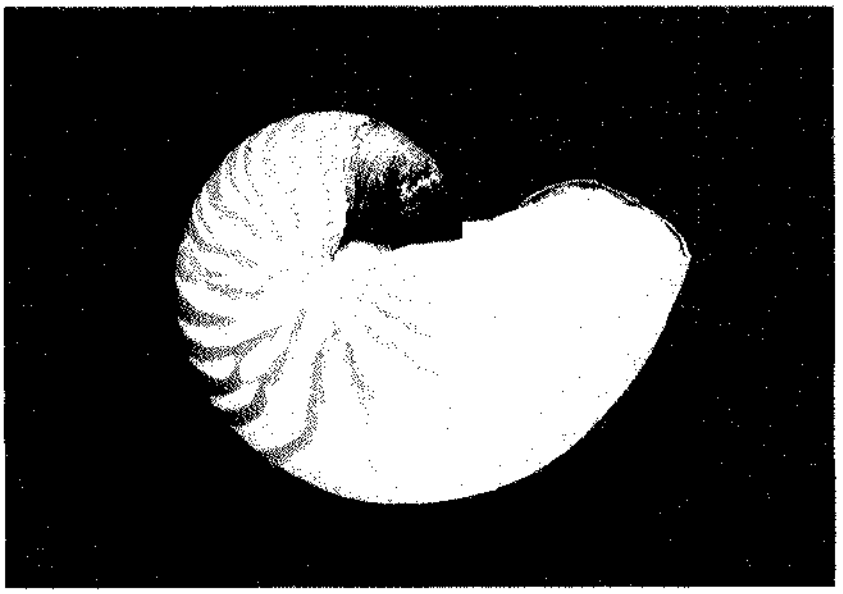
Juvenile whelks (*Babylonia spirata*) are exploited in good quantities from east coast of India and at this stage, measures should be taken to avoid over-exploitation and destruction of the stock. The intensive trawling over the whelk beds in the southwest coast of India may lead to large-scale destruction of egg mass and exploitation of juvenile *Babylonia* spp. Regulation to avoid trawling over the whelk bed and a mesh size regulation to prevent exploitation of undersized whelk are to be implemented to conserve this resource. Hatchery



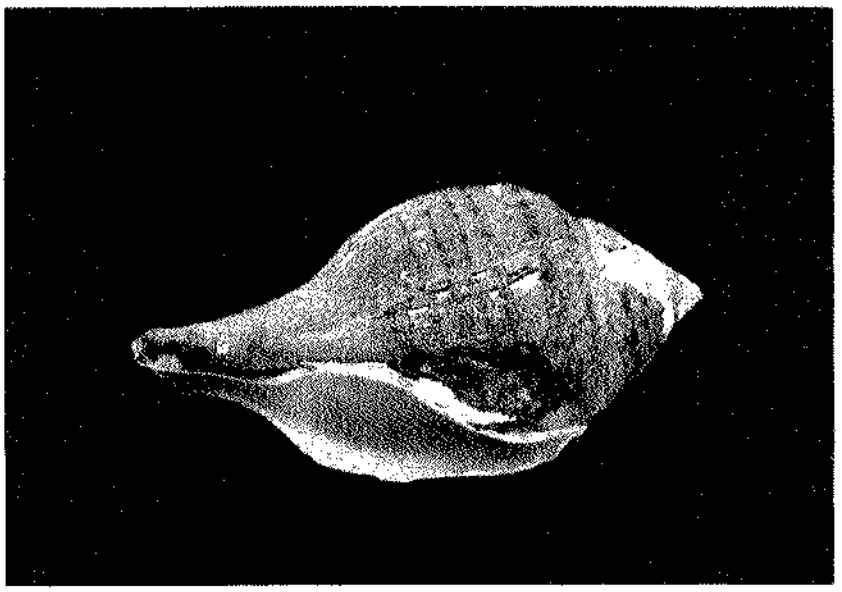
Trochus niloticus



Cymbium sp.

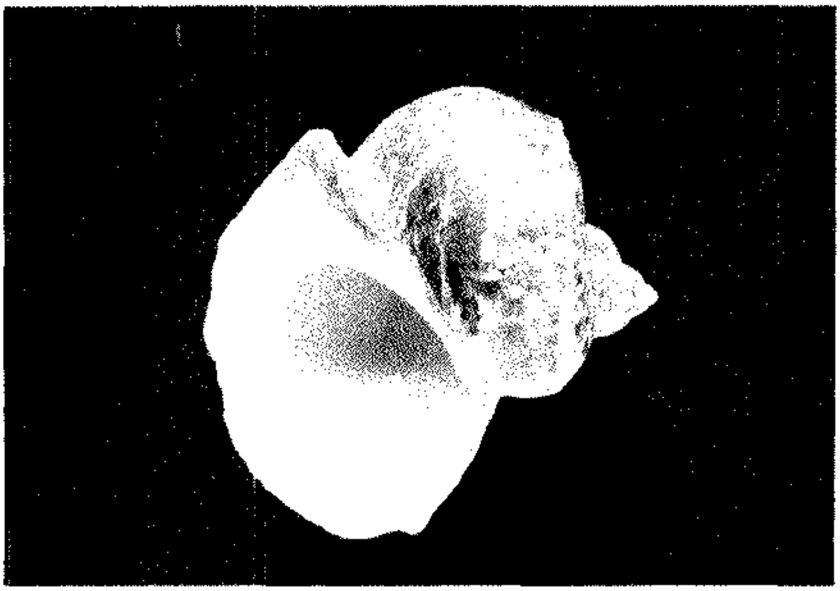


Nautilus sp

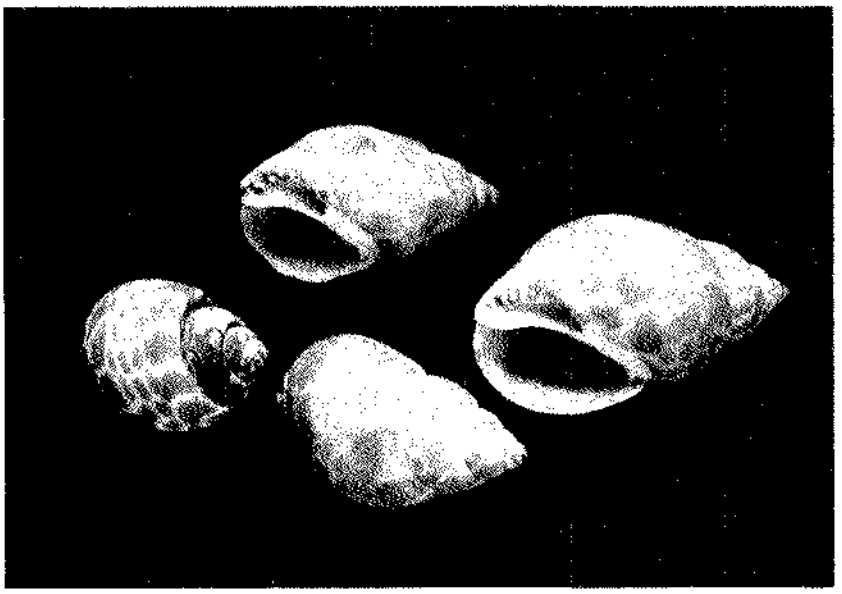


Xancus pyrum

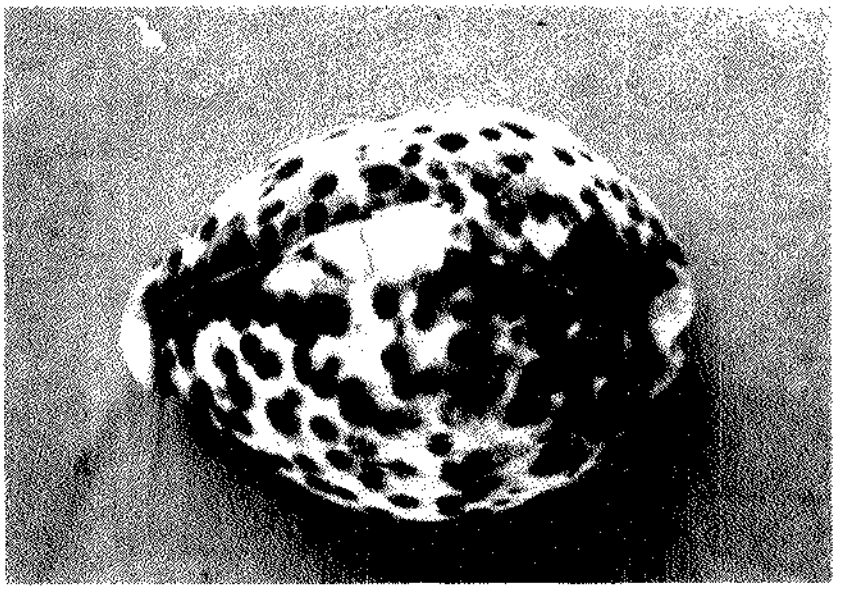
Tridacna squamosa



Turbo marmoratus



Babylonia zeylanica, B. spirata



Cypraea tigris

production and sea-ranching can also enhance the production. Trumpet shell, *Charonia tritonis*, Cowries, King shell, *Cassis cornuata*, Queen shell, *Cypraeacassis rufa*, five-fingered chank, *Lambis lambis*, beggers bowl, *Melo indica*, *strombus* spp. and *Nautilus* are commercially important sea shells which are at present rare due to over exploitation and are considered endangered species from Indian coasts. It is felt that there must be restriction in the collection of these shells from wild and the areas known for their abundance may be declared as protected areas by Government to conserve these endangered species of shells, especially *Charonia tritonis*, which is on the verge of extinction.

Conservation of cephalopods is not an immediate priority concern. Even then, squid and cuttlefish spawning grounds are being indiscriminately destroyed by trawling and other man-made activities. The effect of these are to be monitored and ascertain the damage caused to recruitment to the stock. Coral reefs are fragile ecosystem and excessive fishery for *Octopus* in Lakshadweep bound to adversely affect this resource and also create imbalances in the reef ecosystem. Palk bay squid is a rare species occurring in large quantities around Rameswaram Island and they lay their egg during breeding season in May and July on floating objects and submerged weeds. It is suggested that 50 sq.km. off Rameswaram coast should be declared as a reserve area and any attempt to operate shore seine or stake nets should be restricted to save the egg capsules of Palk bay squids. *Nautilus* is a rare cephalopod which is being caught along the east coast of India in fishing nets and this species also require proper conservation.

Marine invertebrates in general, especially molluscs are able to withstand fishing pressure, because of their high fecundity, reproductive capacities and planktonic larval life. Where as, there are cases of depletion of stock due to over exploitation, commercialised fishing and indiscriminate collection of rare species. Appropriate conservation measures are to be taken for judicious exploitation of the existing reserve and to impose precautionary measures to resist over-exploitation of rare specimens leading to extinction. Techniques of spawning, rearing, sea ranching and farming are to be adopted to augment ex-

isting production of commercially exploited molluscs from Indian coasts. Establishment of marine parks, total ban of exploitation of breeding stock, restriction of professional collection of ornamental gastropods, mesh-size regulation for commercial exploitation of molluscs and practice of farming techniques are some of the suggestions for conservations of molluscan resources from India.