THE MOLLUSCAN FISHERY RESOURCES OF INDIA

S. JONES

Central Marine Fisheries Research Institute, Mandapam Camp, India

ABSTRACT

The present status of the different molluscan fisheries of India and their potentials are discussed in the paper. Molluscs of commercial importance are all essentially marine and broadly come under two major categories, *viz.*, (i) edible and (ii) ornamental. Squids, mussels, oysters, clams, etc., which are used for human consumption come under the edible molluscan fisheries. Of these the most widely distributed is the squid fishery. The mussel fishery is of considerable local importance in rocky areas especially along the West Coast. Backwater oysters, clams, etc., form sustenance fisheries of limited importance in some localities. Most of the edible molluscs are consumed by the poor class of people along the coastal areas. Special reference is made regarding the scope for the development of the mussel fishery in certain parts of India. Under ornamental molluscan fisheries, pearl oyster, chank, window-pane oyster, *Trochus*, *Turbo* and a variety of curio shells are included. In addition to the above, dead shells and shell products are used for a variety of purposes including the manufacture of lime and cement.

MANY are the utilisable molluscs which occur in freshwater, salt-water and terrestrial habitats, but those found in marine and brackish-water environs are particularly plentiful and are put to divergent uses. By far the most important use, man has put molluscs into is as his food. Land, freshwater and marine molluscs are eaten in all parts of the world. Easily accessible, more productive than the cattle or fish per unit area of farm, and less expensive to raise, the oysters, mussels, clams and cockles have been systematically cultivated in well-laid aquafarms in various parts of the world. The abalones and turban-shells are epicurean items. Squids and cuttle fishes support local and important fisheries as in Japan.

They have furnished adornments in one way or the other. Lustrous pieces of shell or a few bright shells themselves caught the fancy of the woman of the bygone days who strung them together to adorn her neck, a custom which still prevails among the tribals. Pearls produced by the molluscs, particularly the oriental pearls, have been objects of proud possession of monarchs and the opulent from ancient times and even today form an important item of jewellery.

Until recently shells were used either whole or in part in place of money in several parts of the world including India especially by some of the primitive or backward communities. Homes are built using mortar or cement, the essential constituent of which is lime; the walls are periodically whitewashed with lime which is mostly derived from sea-shells. Fresh shells and subfossil deposits of molluscs form an important raw material in the carbide and cement industry. Doors and windows are sometimes glazed with shell panes. Shells are popular as curios and in interior decorations. The mother-of-pearl layer of oysters, *Turbo*, *Trochus*, etc., takes the pride of place in the manufacturing industries of buttons and varied useful articles to man despite the fact that less expensive fairly attractive plastics and other synthetic materials have considerably slackened the trade.

Most shells are used for multifarious purposes, but the chank surpasses them all for it has played no insignificant role in the observance of traditional customs of religious faiths of the Indian people in general and the Hindu communities in particular who regard it as a divine symbol of success, peace and prosperity and is therefore dedicated for worship especially the sinistral chank which is worth its weight in gold.

Medicinal properties have been attributed to some of the molluscs and it is believed that certain diseases like asthma and rickets can be cured by eating particular molluscs. The power of seed pearls is said to be specific in healing certain skin ailments.

Molluscs also play destructive roles. The terrestrial snails like *Achatina* destroy useful vegetation and other gastropods as *Natica* and *Urosalpinx* pierce and suck the juices leaving dead economically important bivalves. Some harbour intermediate stages of parasites which bring about deadly diseases to man and farm animals. Molluscan wood borers in the sea attack floating or submerged timber of the cargo boats or fishing craft or piers, and the rock-borers as the piddocks attack concrete piles, etc., in the harbours. Molluscan species abound in quantities among the fouling organisms which hamper the progress of the boats and ships which therefore require periodical dry-docking to clean the hulls of innumerable organisms that settle on them.

In Indian waters the molluscan resources are fairly ample especially the clams, oysters, mussels, chanks and pearl oysters though not exploited at the optimum level of production. James Hornell who could be considered as the father of marine fisheries research in India was the first to highlight the importance of the molluscan resources of India and his contributions till date remain authentic references on many problems concerning the Indian molluscs. With the establishment of the Central Marine Fisheries Research Institute in 1947, investigations on individual species of economic value were initiated and much headway has been made in understanding the various aspects of biology and fishery of some. In the present account the principal molluscs which support fisheries of some magnitude along the coastline of India, their distribution and importance are briefly dealt with.

Sea-Mussels (Fig. 1)

Firmly fastened by byssus threads, mussels are found closely crowded over rocks in shallow waters or in waters of moderate depths. Two species of sea-mussel occur in the Indian waters, the green mussel *Mytilus viridis* and the brown mussel *Mytilus* sp. While the former is distributed all along the east and west coasts, the latter is confined only to the southern region from Quilon to Cape Comorin on the west coast and along the southern part of Tinnevelly District on the east coast. Mussels occur wherever rocks or any hard submerged substrata are present. They grow to a large size up to 13 cm. or more. Along the Gujarat and northern Maharashtra coasts, mussels are sparse. There are sporadic mussel beds at Ratnagiri, Malwan, Goa, Karwar, Gangoli, Malpe, Kap and Mangalore. But the exploitation in these beds is limited and only about 5 to 10 persons are engaged in collecting the mussels at each centre, mostly for personal consumption, very rarely taking them to market for sale. It is only south of Cannanore upto Calicut along the Kerala coast that the mussel fishery has developed on regular lines. Canoes and logs are employed to reach the beds and mussels are sold in the markets regularly during the season, October to May. At least 200 fishermen depend on mussel fishing for their livelihood during major part of the year. Mussel is a popular food in this area. Again in the southern sector of Kerala coast mussel predominates among the shellfish, Vizhingam, Colachel and Muttom being the important centres. Along the east coast distribution of mussels is localised and a few patches are found in Cape Comorin, southern Tinnevelly coast, Madras, Pulicat, Kakinada and Sonapur occurring conjointly with oysters. Mussel culture is not practised anywhere in India at present. By adopting suitable methods of culture the production of mussels could be increased manifold. Sea-mussels have a dull thin nacreous layer and it is not uncommon to find a few pearls which, however, have no value as gems.

Closely related to *Mytilus* is the weaving mussel *Modiolus barbatus* which grows to about 2·5 cm. in length and is found in thick patches either by itself or in association with the pearl oysters on hard sea-bottom. It occurs from shallow waters to about 12-15 m. depth and is abundant in the Palk Bay and Gulf of Mannar. The weaving mussels could be dredged and utilised as poultry feed.

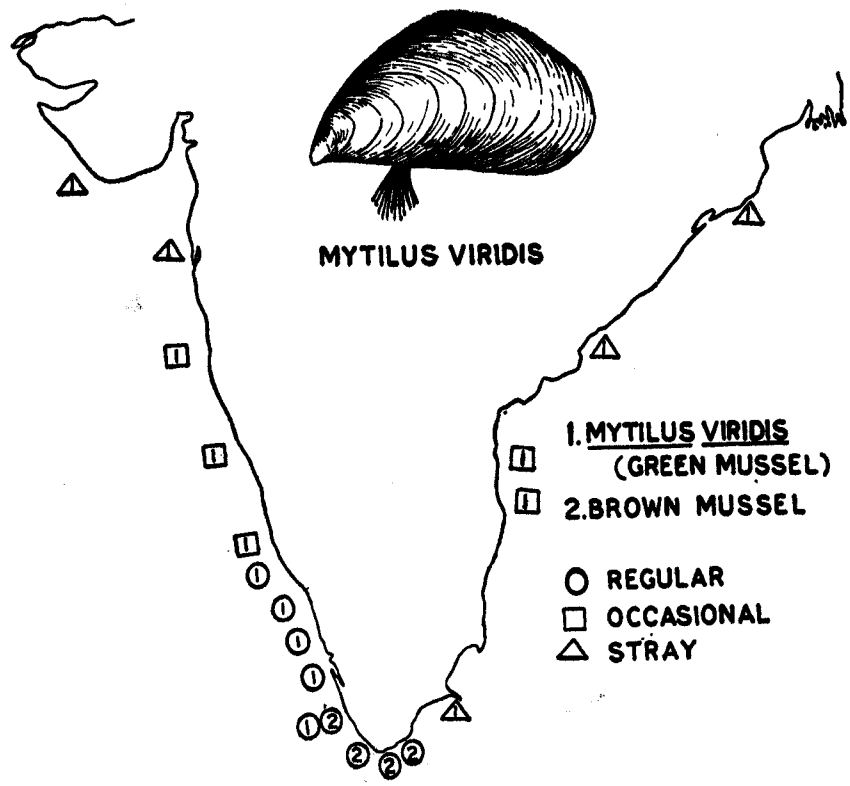

FIG. 1. Distribution of the sea-mussels along Indian coasts.

EDIBLE OYSTERS (Fig. 2)

Among the molluscan shellfish, oysters are considered very delicious and also nutritious with appreciable amounts of glycogen, proteins and vitamins A and B and minerals. They belong to the family Ostreiidae under Bivalvia. *Crassostrea madrasensis* (Preston), *C. gryphoides* (Newton and Smith), *C. cucullata* (Born), *C. discoides* (Gould), *C. cristagalli* (Linn.), *C. cornucopia* (Chemnitz), *C. glomerata* (Gould) and *C. belcheri* (Sowerby) are the well-defined species occurring along our coasts and of them the first four form large fishable beds.

C. madrasensis (Preston) is the common backwater oyster found in all estuaries and backwaters on the east coast, but confined mostly to the southern region on the west coast. It occurs in particular abundance in Ennur and Pulicat areas in Madras State, Sonapur in Orissa and the Vembanad Lake in Kerala. In purely marine habitats, as harbours and bays, its growth is stunted. In backwaters subjected to good tidal flow, the growth is fast and it attains marketable size in about two years.

C. gryphoides inhabits the muddy creeks and bays from Kutch in the north to Honavar in the south along the west coast in the deltaic areas of the Ganges on the east coast. It grows to full size in about four years. *C. cucullata* is the common rock oyster of India found in all the intertidal rocks of the east coast and the west coast. *C. discoidea* occurs in fairly deep waters of the littoral zone.

Oyster culture is extensively practised in many countries, notably Japan, United States of America, Canada, France and the United Kingdom. Different methods of culture are employed from just transplanting the oysters from natural beds to nearshore areas for better growth and fattening to catching the spat on the cultch and growing them to marketable size in enclosed areas at the sea-bottom or suspending the spat on ropes from floating rafts or spreading them over trays. Though adequate information on the biology of the Indian species which would promote cultural practices has been obtained, no extensive oyster farming is practised due to very limited demand. In Bombay, Jaytapur, Goa, Karwar, Madras and Sonapur oysters are collected from natural beds and marketed. In the Kelva backwaters near Bombay and Ennur near Madras some kind of farming is practised on a small scale. The oyster shells are utilised for the preparation of lime used for whitewashing the buildings. Poultry feed is also prepared from the shells in Madras and Sonapur.

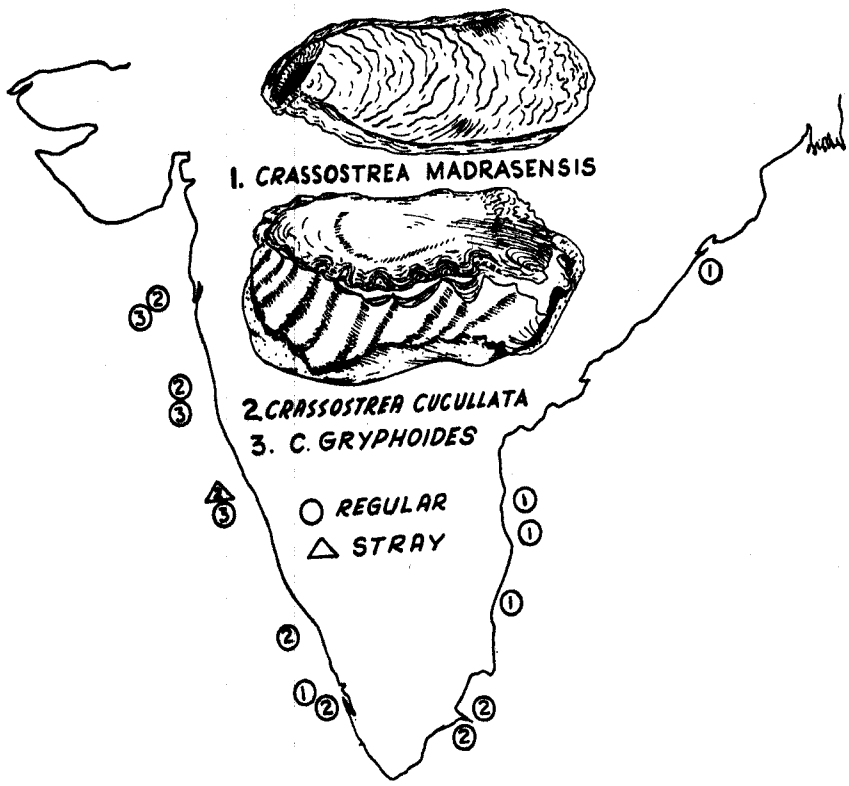

FIG. 2. Distribution of edible oysters along the Indian coasts.

CLAMS AND OTHER EDIBLE BIVALVES (Fig. 3)

Clams represented by several genera and species are a rich source of protein food available in a much greater abundance than the mussels and oysters and are widely used by the poorer classes and at times even the middle classes of the coastal population in the country. In general, they thrive in all estuaries, backwaters and bays and a few are specially adapted to life in the surf-beaten sandy inshore region. They support mostly sustenance fisheries, wherever they occur, but in the central and northern part of the west coast, the surplus catch is marketed. In monsoon months when the fish is scarce, the demand for shellfish is greater than at other times. Fresh clams are cooked with condiments and made into curries. They are also sundried and cooked later in a similar manner,

All clams burrow into the sandy or muddy substratum and the fishers feel their presence in the submerged areas by probing the bottom with their fingers or toes and the dislodged clams are hand-picked. In the exposed regions any thin flat tool is used including shells of mussels for removing the clams. Canoes are used in some estuaries and with scoop-nets the diver collects the clams.

This vast food resource remains not adequately utilised due mostly to certain prejudices against including them in the regular diet. Clams live thick and dense in the beds, breed profusely and grow rapidly and per acre the yield of protein-rich food from them is far more than from any other organisms of the same habitat. They can be cultivated by least expensive methods of collecting the seed clams and transplanting in specially prepared beds which should be semihard but soft enough for the clams to burrow. Japan, the United States and Britain are the countries which have a tradition of cultivating clams. Notes on clams and other bivalves fished for food in India are given below.

Meretrix meretrix (Linn.) known as the "great clam" grows to a fairly big size up to about 7 cm. in length. Clams of about 5 cm. are most common in commercial catches. It has a very clean shell with a shiny lustrous periostracum of yellowish tint. Dorsally in the posterior region it is greyish-brown. Purple or pinkish radial bands on the periostracum are not uncommon. It inhabits the bays, creeks and backwaters in the vicinities close to open sea. It supports good fisheries along the entire Maharashtra coast and the North Kanara coast but in the southern region of west coast and all along the east coast it is comparatively rare.

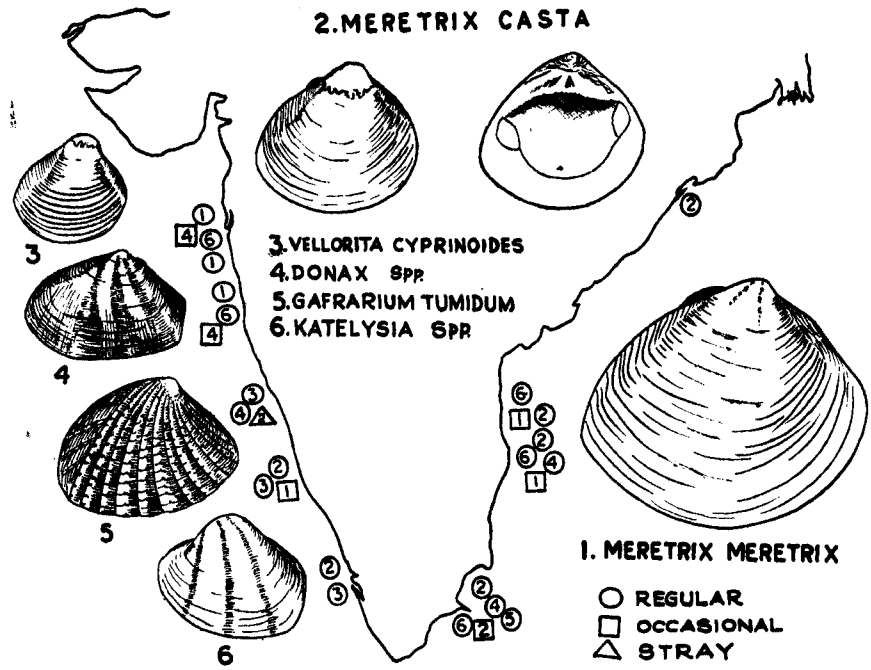

FIG. 3. Regional distribution of the varied clam species.

Meretrix casta (Chem.) is the small backwater clam growing to a maximum size of about 4 cm. The shells are ovate and heavy. The species abounds in all the estuaries and connected backwaters both on the east coast and the southern regions of the west coast of India. Its meat is considered more delicious than that of the "great clam". The species has a high degree of tolerance to salinity variation and prefers muddy sand bottom. Wherever the species occurs it forms extensive beds,

The living ones of *Vellorita* spp. especially *V. cyprinoides* (Grey) called black clams are confined in their distribution to west coast backwaters and estuaries, but on the east coast their dead shells are found common among the subfossil deposits. The shell which grows to about 3 cm. is thick, closely ribbed and covered with a periostracum which is darkly pigmented and worn out at the umbo exposing the whitish porcellaneous layer. These clams have a greater tolerance to changes in salinity condition than others and their beds extend to regions in the estuaries where almost freshwater conditions exist. On the south-west coast they are very abundant in the Vembanad Lake in Kerala. In Goa and Mangalore these are sold in the market at a price higher than *Meretrix*.

Paphia laterisulca and *P. malabarica* support a good fishery especially along the Maharashtra and Mysore coasts and are regularly sold at the markets in Bombay, Ratnagiri, Goa, Karwar and Mangalore. The long siphon clams, *Katelysia marmorata* (Lam.) and *K. opima* Gmelin with inflated shells occur in the same environment as *Meretrix*. *K. marmorata* forms extensive beds in the Bombay area especially in Mahim creek. In the Ratnagiri area *K. opima* dominates. In the North Kanara District it occurs in abundance and on the east coast it is found in Madras and Kakinada. The cockle clam *Gafrarium tumidum* Roding supports a minor fishery in the Palk Bay and Gulf of Mannar at Rameswaram and Pamban. Several species of ark shells occur in the Indian waters of which *Anadara granosa* (Linn.) is fished to some extent from mud flats around Bombay and Kakinada. A neat small clam *Mesodesma glabratum* is available in fairly good numbers in the sandy shores of the islands in the Gulf of Mannar. Of the wedge clams, *Donax faba, D. cuneatus* and *D. scortum* are the common species occasionally fished from the sandy inshore regions along both the coasts. In Malwan *D. faba* is usually sold in the market. The razor clams *Solen kempi* along with *S. lamarckii* and *S. annandalei* support minor fisheries along the Maharashtra coast. *Sanguinolaria diphos* a large brackish-water clam is common along the Kerala coast. The true cockles of the genus *Cardium* are not abundant in any place though a good number of species are represented.

Besides the above there are large numbers of other bivalves which though edible are not used for the purpose presently. The pearl oysters (*Pinctada fucata*) and the pen shells (*Pinna atropurpurea* and others) could be used as food items taking advantage of their abundance.

Most bivalves are also used as fish baits, chief among them being the mussels and razor clams.

Edible Gastropods (Fig. 4)

The utilization of the gastropods as food is very much less than the bivalves. A few species, however, find favour with some in the coastal districts. The chank *Xancus pyrum* is the largest and the most abundant among them. When the animals are obtained in the regular chank fishery, often the flesh is extracted by the divers with a skewer. The hard muscular portion is later boiled, sliced and sun-dried for cooking. The native population of the Andaman and Nicobar Islands use the flesh of *Trochus niloticus* and *Turbo marmoratus* which are fished for mother-of-pearl from reefs at moderate depths. The smaller species of the turban shells and top shells as *Turbo brunneus* and *Trochus stellatus* respectively, the rock whelks, *Thais bufo, Thais rudolphi* and *Babylonia spirata* and the wing-shell *Strombus canarium*, all occurring on the rocky reefs at the low water mark, as also the olives like *Oliva gibbosa* from the sandy inshore bottom and the fingered chank *Pterocera lambis* from similar environments in deeper waters are occasionally collected for food from the Palk Bay and the Gulf of Mannar in the vicinities of Pamban, Dhanushkodi, Rameswaram, Devipattinam and Kilakarai in the south-eastern coast. Some of these and the little button shells *Umbonium vestiarium* are also known to be used for food in the north-western coast. *Babylonia spirata* and *Umbonium vestiarium* are sold in the markets at Bombay and Malwan respectively.

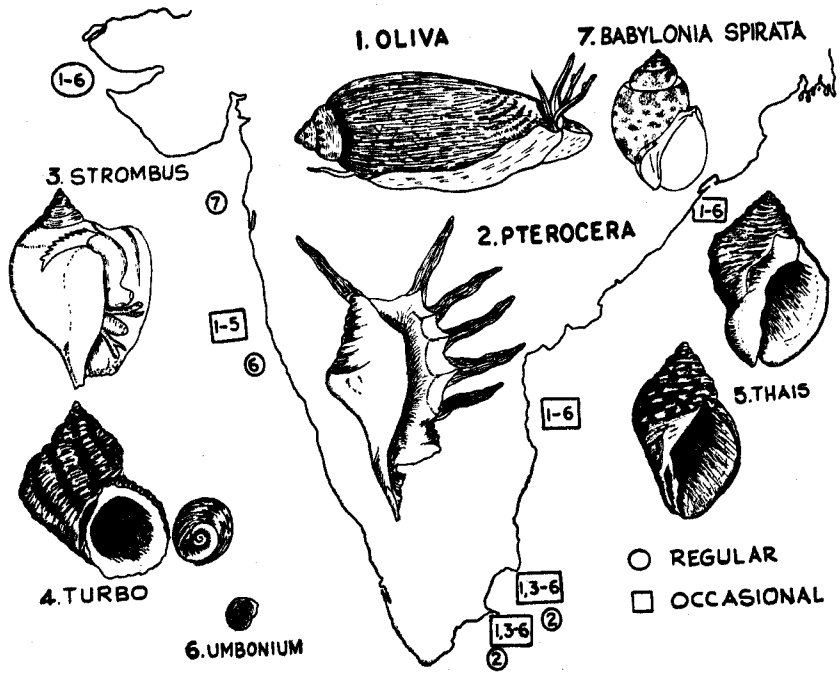

FIG. 4. Regional distribution of the gastropod molluscs of food value.

EDIBLE CEPHALOPODS (Fig. 5)

In all types of fishing nets and more particularly in the shore seine, squids and cuttlefish are incidentally caught. Octopuses lurk in crevices among the reefs and in the shallow water lagoons where they are caught at low tide by the fishers. Occasionally, the squids are captured by jigging or by using special lures. The common species are *Sepia rouxii* Ferussac *et* d'Orbigny, *S. aculeata* F. et d'Orb., *S. rostrata* and *Sepiella inermis* (F. et d'Orb.) among cuttlefish, *Sepioteuthis arctipinnis* Gould, *Loligo indica* Pfeffer, *L. hardwickii* and *L. affinis* among squids and *Octopus globosus* Appellof, *O. rugosus* (Bosc.), *O. octopodia, O. herdmanii* and *O. hongkongensis* among the octopuses. Not many species of cephalopods are eaten in India with the exception of *S. arctipinnis, L. indica* and *S. rouxi. Sepioteuthis arctipinnis* supports an important seasonal fishery in the Palk Bay and the Gulf of Mannar in the vicinities of Periapatnam, Muthupet, Kilakarai, Devipatnam, Mandapam, Pamban, Rameswaram and Dhanushkodi. Squids in enormous numbers enter the inshore waters of the Palk Bay where they are caught from about March to June in a special type of shore seine, the 'olavalai'. Squids and cuttlefish are also incidentally caught in the trawl-nets. Possibly this is a breeding migration into inshore waters as the females deposit the egg capsules in quantities on weeds and other submerged objects. The females grow to over 180 mm. in mantle length weighing nearly 300 grams and the males to a much larger size of 260 mm. in length weighing 600 grams. In Ramanathapuram District the demand for squids is fairly high and they are marketed in all the coastal villages and towns. The major part of catch is consumed fresh but a small proportion is also sun-dried.

Apart from their use as food, most of the cephalopods are used as fish bait, particularly for the bigger fish as the seer fishes, carangids, sharks and rays. In the fishing villages of the south-eastern coast octopus lines made out of hundreds of *Pterocera* and other shells strung on coir rope and laid in the shallow waters of the lagoons and bays are a common sight. The octopuses lurk in the shells and are removed and taken by the longline fishermen to the fishing grounds for using them as bait.

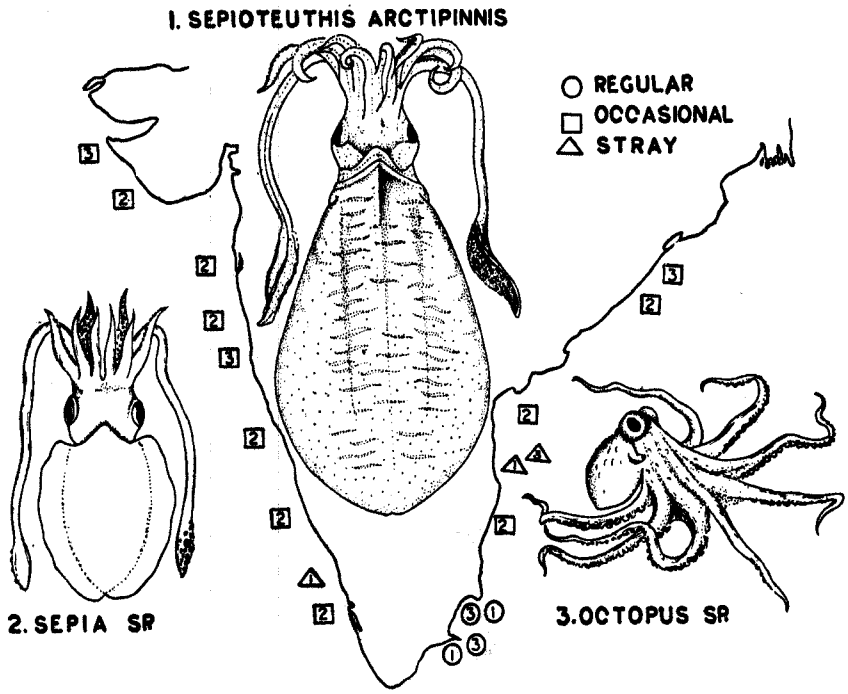

FIG. 5. Distribution of the cephalopod species in the coastal waters.

CHANK (Fig. 6)

The sacred chank, *Xancus pyrum* (Lamarck) supports a well-organised fishery which like those of the pearl oysters are exploited under Government control. Chanks are largely utilised in the manufacture of bangles. The species is confined in its distribution to the Indian coasts with the exception of the closeby coasts of Ceylon. The most important of the chank beds are in the Gulf of Mannar near Tuticorin and Kilakarai and in the Palk Bay near Devipatnam and Rameswaram. Some small numbers of chanks occur all along the east coast from point Calimere to Madras. On the west coast chanks are fished to some extent in the Gulf of Kutch near Port Okha and along the Kanyakumari and South Kerala coasts. In the Gulf of Kutch the beds are exposed at low tides and the chanks are hand-picked by the fishers, but in other parts they are in moderately deep waters and are obtained by diving. In the south-eastern districts annually several hundred thousands of chanks are fished providing occupation to thousands of divers from about November to March.

Table I shows the extent to which chanks are fished in the Madras State. The success of the fishery depends to a large extent on the number of divers that can be enrolled in a fishery of any particular year.

From the Vedic times chanks came to be used in the Hindu rituals and some of the customs are also shared by people of other religious faiths. It is revered and adored, dedicated to the temples for worship and used widely in daily life. It has found a place in hearldry and royal emblems and coins in this country.

TABLE I

Regional Fishery	Year	Number of chanks			Remarks/Rentals
		Full-sized	Wormed	Undersized	
Tinnevelly chank fishery	1961–62	4,41,044	53,327	21,608	Departmentally fished
Sivaganga chank fishery	1961–62	1,75,235	7,981	..	Rs. 30,156
Ramanathapuram chank fishery	1961–62	4,23,744	11,567	200	Rs. 78,286
Thanjavur chank fishery	1961–62	34,069	4,551	50,235	Departmentally fished. Includes wormed ones of the previous year
Thanjavur chank fishery	1961–62	42,957	13,790	163	Rs. 19,901
South Arcot and Chingleput chank fishery	1961–62	25,180	6,630	517	Rs. 15,111
Kanyakumari District chank fishery	1961–62	13,231	1,403	4	Rs. 4,786

Source: *Administration Report, Department of Fisheries, Madras*, 1961–62 (1964).

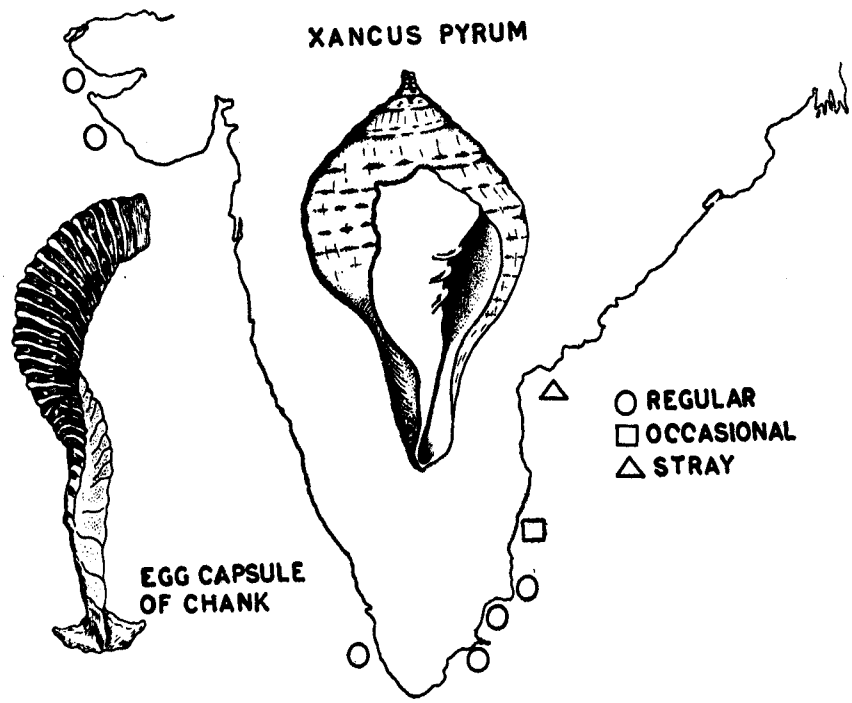

FIG. 6. Distribution of the sacred chank beds in the coastal waters.

PEARL OYSTERS (Fig. 7)

The pearl oysters belong to the genus *Pinctada* Roding under the family Pteriidae and are represented by *P. fucata* (Gould) (=*P. vulgaris* Schumacher), *P. margaritifera* (Linn.), *P. chemnitzi*

(Philippi), *P. anomioides* (Reeve) and *P. atropurpurea* (Dunker) in the Indian waters, where the first named species alone supports the pearl fisheries. *P. fucata* has a wide distribution in the Red Sea, Persian Gulf and the Indian and the Pacific Oceans. On the Indian coasts these oysters in large numbers are found in the Gulf of Mannar on the ridges of rocks or dead corals, known as the pearl banks which extend from Kilakarai to Cape Comorin at depths of 15 to 20 m. The northern and the southern banks are almost barren and those in the central sector between Kayalpatnam and Vaippar alone remain productive and the fisheries are operated from Tuticorin. In Palk Bay the pearl oysters are found on coarse sandy bottom and in the Gulf of Kutch on intertidal reefs. Off Tondi in Palk Bay there has been only one pearl fishery in 1914 and pearl oysters have not been found in abundance subsequently. In the Gulf of Kutch the fishery is more regular being conducted once every 3 or 4 years and sometimes at longer intervals.

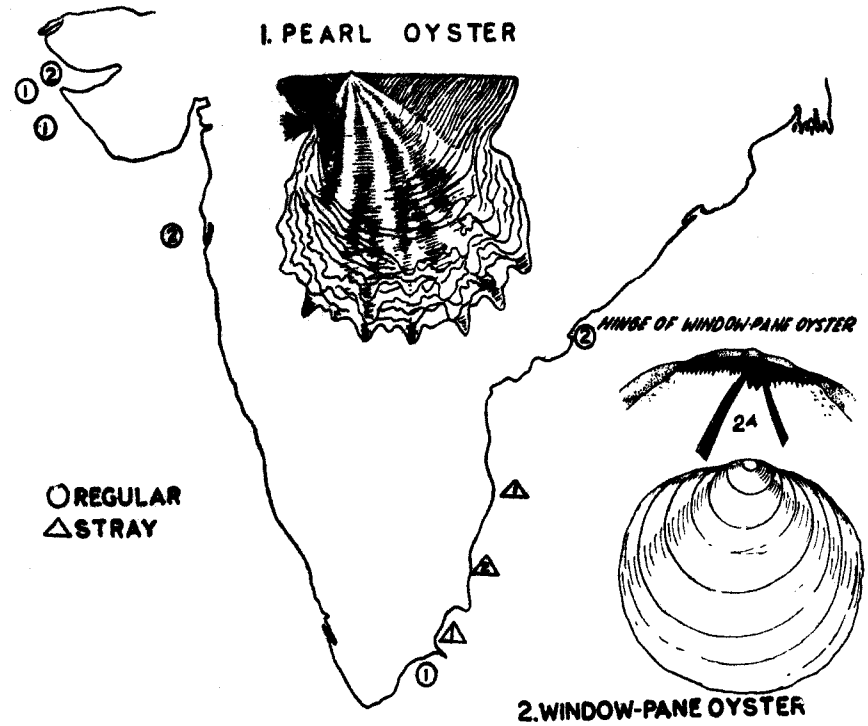

FIG. 7. Regional abundance of Pearl oysters and the Window-pane oysters.

From time immemorial the Gulf of Mannar fisheries on the Indian coast have been exploited and the fishing rights passed on in succession from one ruling power to another. They are at present under the control of the Government of Madras and are operated by the Department of Fisheries. These fisheries are conducted for the sake of natural pearls which are highly priced and world famous as gems of superior quality.

The pearl fisheries in the Gulf of Mannar are not of a regular nature. Productive periods alternate with periods when oysters are scarce and such gaps extend even over a few decades. After a long period of 27 years the Gulf of Mannar fisheries were resumed in 1955 and continued till 1961 and in the recent six years there have been no fisheries. The causes are many for the disappearance of the oysters, some of them being destruction by predators or suffocation when the sand-banks drift and smother the oysters. The factors controlling the spat fall have not been well understood.

The revenues from the pearl fisheries are large in successful years running over to a few hundred thousands of rupees. In 1955-61 period the average annual production was 10·83 million oysters. In 1958 which was the best year in the series 21·48 million oysters were fished and the income to the Government was 465 thousand rupees. Pearl fisheries of the Gulf of Kutch are of only a small magnitude earning a few thousand rupees.

In 1938–39 at Krusadi Island in the Gulf of Mannar attempts to obtain induced pearls were made. The initial experiments met with a certain amount of success in inducing nacre formation around shell beads, etc., introduced between the shell and the mantle. But attempts to produce spherical pearls did not prove successful. The Japanese produce culture pearls of perfect shape and lustre and of the desired graded sizes. Since the techniques of Japanese pearl culture are fairly well known, with a certain amount of trial and perseverance it may be possible to produce perfect round culture pearls in the locally available oysters and establish pearl farms on a modest scale.

The window-pane oyster, *Placenta placenta* (Family Anomiidae) is distinct from the pearl oyster group, but needs mention here as a producer of pearls. Small seed pearls of inferior quality used in medicine are produced from the oysters which occur in the muddy bottom of the bays, harbours and other environments of a similar kind. They abound in Balapur areas and the Rann Bay in the Gulf of Kutch, in Bombay and its vicinities and the Corangi Bay of Kakinada in Andhra Pradesh. Till fifty years ago the Gulf of Kutch fisheries were fetching high rentals but fall in demand for seed pearls for medicine in the Far East has had adverse effects on local exploitation.

The shell being large, shiny, lustrous and translucent is much used in glazing shutters or making lamp-shades, etc., in the Philippines but surprisingly it finds no use here for purpose other than in the preparation of lime.

Trochus and Turbo (Fig. 8)

Trochus niloticus and *Turbo marmoratus* with massive shells possessing shiny iridescent pearl layers, used in the manufacture of buttons, lamp-shades and other fancy articles, support fisheries of importance in the Andaman and Nicobar Islands. The shell resources were exploited at first

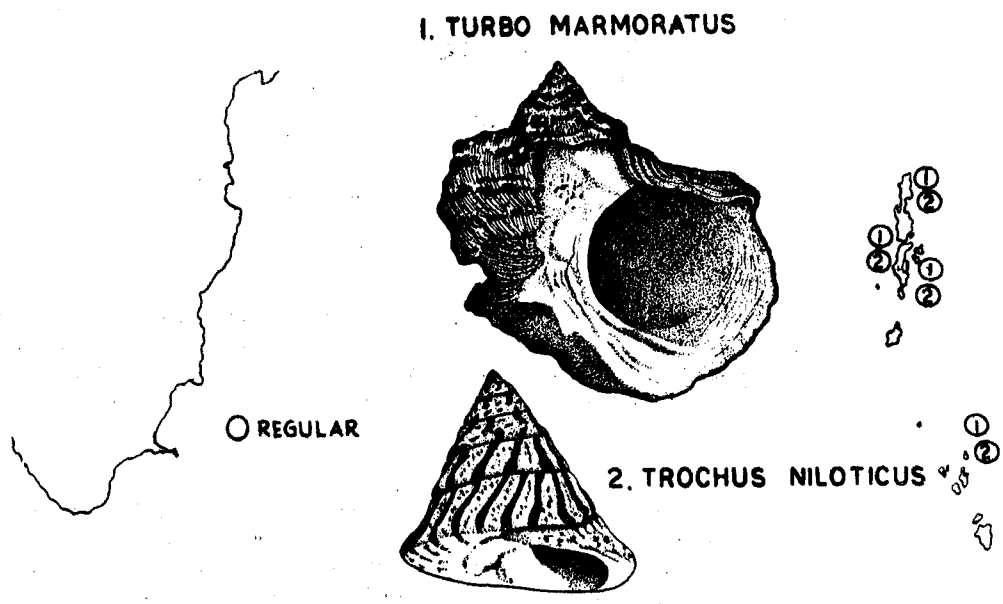

Fig. 8. Distribution of *Trochus* and *Turbo* beds around Andaman and Nibcoar Islands.

surreptitiously, and subsequently upto 1941 under a licencing system, by the Japanese shell-fisheries companies of Singapore. Under the present system licences are issued by the Andaman and Nicobar Administration; power boats and smaller country crafts (sampans) and the divers are licenced. Royalties are charged on the quantities of shells fished and penalities are levied for infringement of regulations. Carefully exploited, the annual yields are expected to be about 200 to 300 tons of shells.

The shells are found on the submerged rocky or coral reefs at moderate depths. Nine regional zones are demarcated which are in the vicinities of Cape Price, Maya Bundar, Austen Straits, Long Island, Shoal Bay, Chiriatapu, Port Mount, Ritchies Archipelago and the Central and the Northern Nicobar groups of Islands. The reefs are reached by 'sampan' and the shells collected by diving are boiled for removal of flesh. The shells are cleaned and dried before packing in gunny bags. The revenue realised from these fisheries in 1955-56 was Rs. 44,573 and in 1956-57 Rs. 45,722. In Germany, Austria and United States of America where the shells are used in the manufacture of cameos and other curios the prices ranged equivalent to five thousand to six thousand rupees a ton till a decade ago, but now the trade has shown unsteady trends owing to competition with apparently similar products made out of cheaper plastics flooding into the world markets.

Molluscs for Lime and Miscellaneous Purposes (Fig. 9)

Immensely great is the utilisation of molluscan shell lime in all masonry constructions and for whitewashing the buildings. Their use as fertilisers in plantations has also gained momentum in the recent years. From sandy shores washed shells are gathered in quantities. After the removal of meats for food, shells of all edible forms are collected. Dead shells in considerable quantities are annually gathered from oysters and clam beds. Shells of even pearl oysters, wormed chanks and

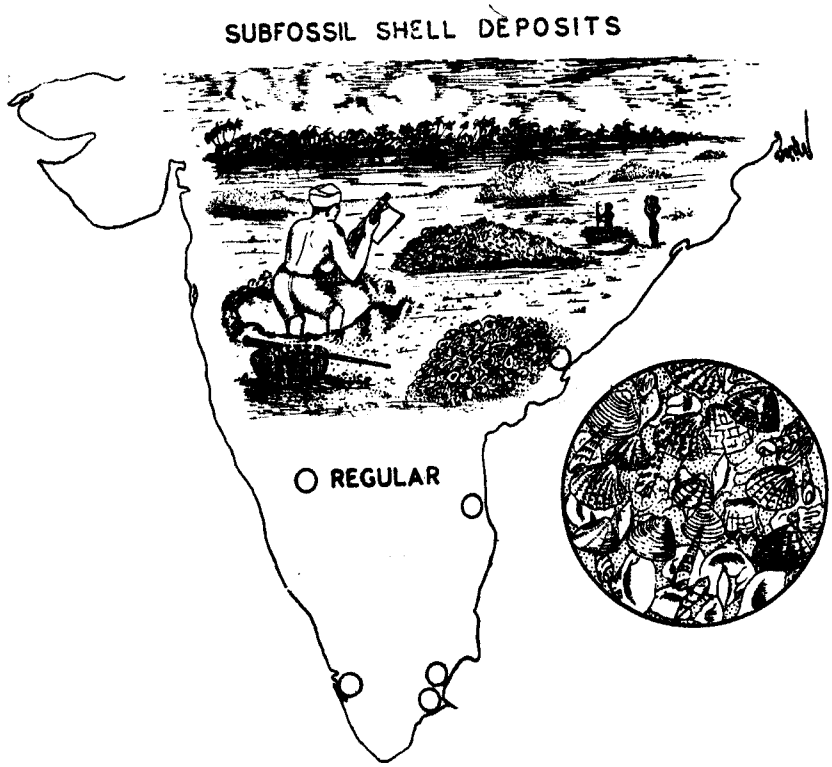

Fig. 9. Regions of occurrence of the sub-fossil deposits of molluscan shells.

window-pane oysters are much used for lime. Very abundant still are the subfossil deposits of shells in areas bordering Pulicat Lake in Madras, Surla backwaters in Orissa and Vembanad Lake in Kerala where they occur in layers several feet deep a little beneath the surface soil. The collection of shell deposits from almost all natural sources is under lease or rentals which bring fair revenues to the concerned governments. Shells are burnt in improvised or specially built kilns.

All molluscan shells, big or small, dull ones or beautifully tinted ones go into the making of toys, shell boxes, lamp bases of shades, garlands, rings, ash-trays, knife handles, etc. Most of the polished shells are sold as curios. Cameos are carved on large shells by removal of the surface layers and exposing the deeper layers of varied colour pattern. The corridors of the temple at Rameswaram are flooded with shops selling such articles. Almost obsolete now are such uses as the whelks for purple dye, cuttle bone for polishing furniture, sepia for drawing ink, *Pinna* byssus for silken gloves for stockings, etc. Molluscan shells are pulverized and used in poultry feed for the birds to lay eggs with thick and perfect shells. At Sonapur and Madras the oyster shells are utilised in this manner.

Molluscan resources being rich, vast and varied, the scope for greater use and exploitation than is obtained at present is bright. An industry is bound to develop for the export trade of frozen or canned meat of oyster, mussel and clam for which the demand in countries abroad is good. This requires only a little initiative and enterprise on the part of the business circles as the processing facilities are already available in most parts of the country. More than this a greater demand for the shellfish food within our own country could be created by educating the people on the nutritive merits of the molluscs. By developing cultural practices of useful shellfishes substantial increase in yield could be expected.

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DISCUSSION

MR. G. N. MITRA: The technique of mussel and oyster culture is stagnant in India for over 20 years. No breakthrough has been achieved. Two farms are in Madras and the other in Saranapore have not been successful in producing good results. Certainly long-range research programme should precede mussel culture. In the light of Dr. Jones' paper what steps are to be taken to step up the mussel culture in India ?

DR. S. JONES: As an enterprise, mussel culture is feasible in India since spat are enormously available in the mussel and edible oyster beds. After collecting the spat they must be transferred to favourable rearing grounds where growth would be uninhibited. If funds are made available from the Government a scheme can be taken up to show the feasibility of such a project. I am glad that this paper has created lot of interest among the participants.

DR. N. B. NAIR: Sufficient propaganda should be done to popularising the mussel eating habit among the people and also to remove any religious considerations which attach a stigma to taking mussels as food. Enough Government propaganda should be done to stress this point so that all people can eat them.

DR. S. JONES: Can Dr. Kewalramani give any information on the availability of mussels in Karwar Area ?

DR. H. G. KEWALRAMANI: We have mussels off Ratnagiri. No culture of mussels is possible there.