

III EDIBLE BIVALVES : CLAMS AND OTHERS

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Clams belonging to a number of species and a few other edible bivalves occur in appreciable quantities in different parts of the Indian coasts and support subsistence fisheries. Thousands of square kilometres of our coastal seas, backwaters and estuaries form ideal habitat for the growth of these bivalves and many among the poorer classes of the coastal population use them as food although it should be admitted that a vast majority of other fish-eating population of our country have not developed a liking for these shellfish. The flesh of clams being rich in glycogen, protein and health giving minerals is highly nutritious.

In spite of the availability of substantial edible clam resources along the Indian coasts very little attention has been paid to clam fisheries. Hornell (1916d) who made a detailed study of the utilization of shells for manufacturing lime was the first to draw attention to the importance of the clam resources of the Madras Presidency. He (1917) recorded that the clam *Meretrix casta* formed a most important food mollusc. Rai (1932, 1933) showed that *Meretrix meretrix* was the species of prime fishery importance among bivalves of the Bombay coast. Rao (1941) has stated that the clams and mussels are perhaps a more important element in the shellfish populations of our coasts than oysters and that the back-water clams form the basis of a more important fishing industry than sea clams. Recent studies worthy of mention in this context are those of Rao (1951, 1958), Abraham (1953), Nayar (1955), Rao *et al.* (1962), Ranade (1964), Alagaraswami (1966), Alagaraswami and Narasimham (1968) and Narasimham (1969).

CLAMS

MERETRIX spp.

The clams belonging to the genus *Meretrix* are distinguishable by their thick, triangularly ovate shell which sometimes possesses faint concentric striae. The hinge area is thick and has three grooved cardinal teeth. The pallial sinus is feebly developed. There are three species, *M. meretrix*, *M. casta* and *M. casta* var. *ovum* which are of commercial importance. The first is distributed on both coasts, the second is restricted to the east coast and the third is confined to the west coast. From Bombay on the west coast to Orissa on the east coast one or

the other of these clams is found in fair abundance in muddy sand in estuaries and backwaters wherever the water remains saline all round the year.

MERETRIX MERETRIX (Linnaeus)

This is a large clam with a thick shell and grows to a length of about 75 mm. The periostracum is thin, delicate and of grey or straw colour. On the postero-dorsal margin of the shell a greyish blue or bluish brown band is present (Fig. 3 A).

This species is found at the mouths of the majority of estuaries on the east coast especially those of Adyar, Courtalayar, Vellar and Cooum in Tamil Nadu. It is also found in Pulicat Lake and Chilka Lake on the seaward side. In the west coast it is common in Tellicherry coastal area along the Malabar coast and in river mouths in south Kanara. In north Kanara and Bombay coast the innumerable creeks and vast stretches of estuaries and backwater areas are suited for extensive beds of this clam particularly Bhatya creek, Kalbadevi creek, Myria Bay, Mahaluxmi creek and Mahim creek. Rich beds exist in Bombay, Alibagh, Ratnagiri, Jaytapur and a number of places in north Kanara, of which Karwar (Kali river mouth), Kodibag, Ankola, Tadri (Aghanasini river mouth), Moorba, Wadgoni, Mirgan, Harwada, Mudgian and Sanikatta are important.

According to Hornell (1922b) the clam spawns about the beginning of September and again in May in the east coast. The spawning period varies in different places depending on the physical and chemical properties of the surrounding water. Rai (1932) observed that the principal breeding season of *Meretrix* on the Bombay coast lasts from March to June and with favourable weather it may continue to breed throughout the year except during the monsoon season.

The flesh of the clams is tasty before the bivalves spawn and the fisherfolk exploit the clams at this stage indiscriminately. Naturally people engaged in the collection of clams as well as the local public acquainted with the beds for a number of years in the past, complain that the beds have considerably dwindled in the course of the last ten years. A woman toiling hard for 2 to 4 hours a day may collect about 300 clams from a good bed. The flesh is not commonly sold but used for domestic consumption. The cost of a hundred clams is about 20 paisae.

MERETRIX CASTA (Chemnitz)

COMMON NAME

Tamil - *Matti*

This clam has a thick, moderately large shell with a brown horny periostracum. A dark greyish band is present at the posterior margin of the shell (Fig. 3 B).

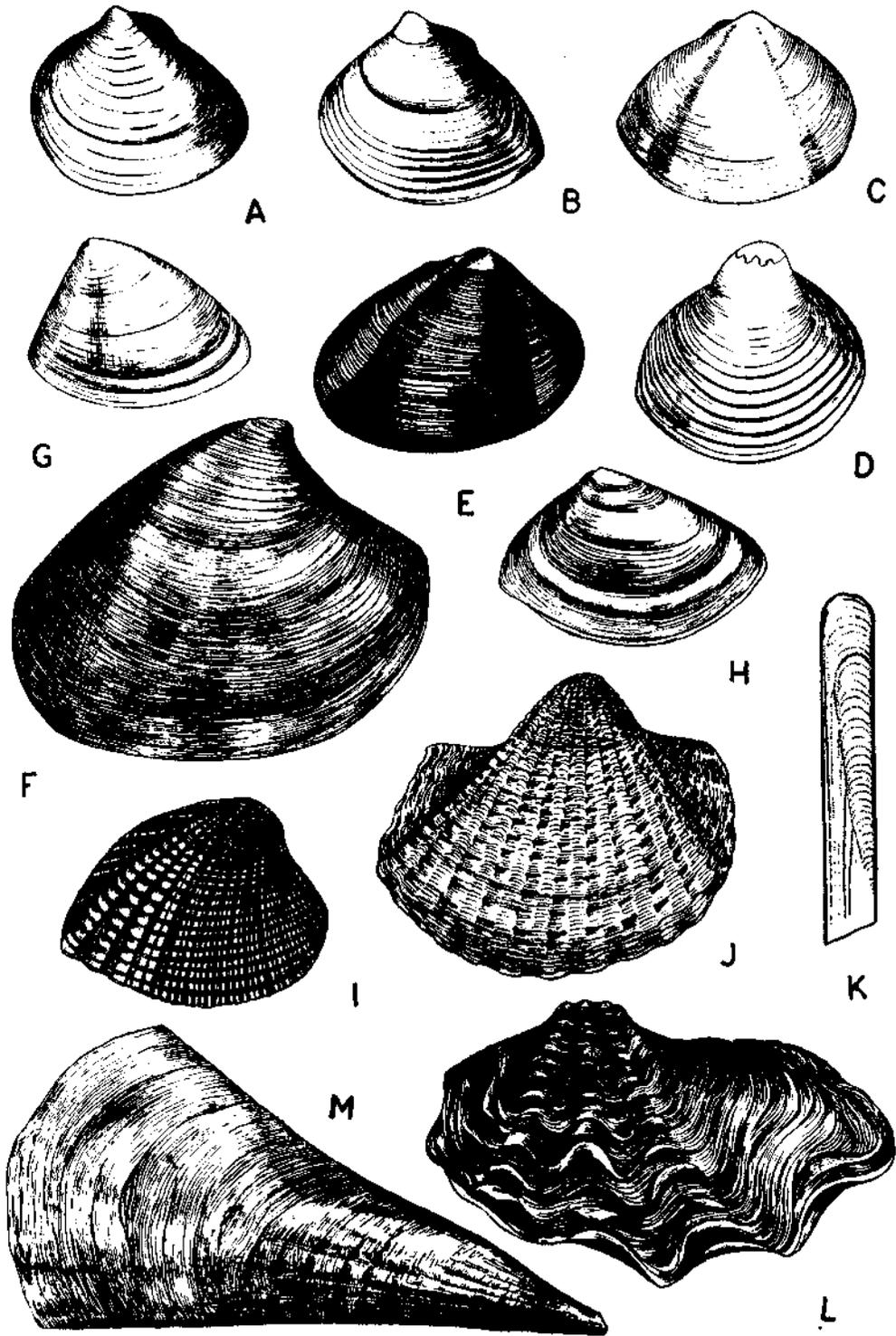


Fig. 3

Rich beds of this species are known to exist in Pulicat Lake, Ennore backwaters, Adyar estuary, Vellar estuary, Athankarai estuary and Pinnakayal estuary on the east coast.

The clam reaches a length of 48.7 mm and a breadth of 38.7 mm in about 18 months. Growth is retarded at least twice in a year (Abraham, 1953). There is greater growth in backwater areas than in rivers. The species attains a size of 56.5 mm in length in about three years but nearly 90% of the clams are fished before they reach a size of 30 mm.

This clam breeds throughout the year in the backwaters but the reproductive activity is at its peak in July–August, in October–November and for a third time in the summer months of March–April (Abraham, *loc. cit.*) in Adyar estuary. In the river areas peak breeding is in summer months and again in September–November. Hornell (1922b) stated that spawning in *M. casta* appeared to take place twice in a year during April–May and in September. In the marine fish farm at Mandapam breeding was recorded in *M. casta* in all periods of the year except for a break in late summer which was attributed to unfavourable conditions (Durve, 1964). The species is known to attain sexual maturity when one month old and the length is 11 mm (Abraham *loc. cit.*). A change in the form of the shell of *M. casta* during growth has been observed by Durve and Dharmaraja (1969).

Silas and Alagarwami (1967) have observed that *Pinnotheres* sp. infests *Meretrix casta* at Malpe and reported that the pea-crab causes damage to the gills, mantle, digestive gland and gonad of the clams.

The percentage edibility of *Meretrix casta* of Ennore backwaters has been found to vary between 7.62 and 17.72 (Venkataraman and Chari, 1951) while in Mandapam marine fish farm it was low being 4.22–6.46 (Durve, *loc. cit.*). Venkataraman and Chari (*loc. cit.*) have investigated the seasonal changes in the chemical composition of this species (Table V). The data show that the clams contain good amount of protein and minerals. The fat content is less compared to that of oysters. Kasinathan (1963, 1964a, 1967) had studied the carbohydrate metabolism of this species. Injection of insulin lowered the blood glucose level initially but there was recovery later. Injection of insulin resulted in increase in glycogen content of digestive diverticula and foot. The latter appeared to be a stable storehouse of carbohydrate with some mechanism of

Fig. 3. A. *Meretrix meretrix* (Linnaeus). B. *Meretrix casta* (Chemnitz). C. *Meretrix casta* var. *ovum* (Hanley). D. *Villorita cyprinoides* var. *cochinensis* Hanley. E. *Tellina pinguis* Hanley. F. *Katylsia opima* (Gmelin). G. *Donax cuneatus* Linnaeus. H. *Donax faba* Gmelin. I. *Gafrarium tumidum* Roding. J. *Anadara granosa* (Linnaeus) K. *Solen kempfi* Preston. L. *Tridacna maxima* Roding. M. *Pinna bicolor* Gmelin.

TABLE V

Seasonal changes in chemical composition of *Meretrix casta* of Ennore backwaters
(after Venkataraman and Chari, 1951)

| Months | Edibility % | Water % | Protein % | Fat % | Ash % | P ₂ O ₅ % | CaO % | Iron mg % | Copper mg % |
|---------------|----------------|------------|--------------|----------|----------|------------------------------------|----------|-----------------|-------------------|
| January, 1950 | 9.71 | 78.23 | 9.71 | 0.69 | 2.15 | 0.294 | 0.496 | ... | 0.52 |
| February | 9.92 | 84.02 | 10.20 | 0.81 | 2.01 | 0.288 | 0.237 | 3.45 | 1.56 |
| March | 8.11 | 74.42 | 11.93 | 0.97 | 1.76 | 0.385 | 0.455 | ... | ... |
| April | 10.81 | 79.28 | 10.46 | 0.84 | 1.70 | 0.275 | 0.173 | 1.42 | 0.26 |
| May | 7.62 | 78.59 | 10.96 | 1.10 | 2.31 | 0.360 | 0.185 | 7.65 | 0.83 |
| June | 10.30 | 75.77 | 12.29 | 0.94 | 1.76 | 0.356 | 0.159 | 13.89 | 1.97 |
| July | 8.10 | 75.34 | 11.24 | 0.86 | 1.73 | 0.341 | 0.184 | 14.29 | 1.92 |
| August | 10.00 | 80.00 | 9.11 | 1.07 | 1.12 | 0.284 | 0.256 | 16.56 | traces |
| September | 10.33 | 76.53 | 10.09 | 1.03 | 1.14 | 0.257 | 0.156 | 8.79 | 0.39 |
| October | 15.01 | 75.48 | 8.08 | 0.72 | 0.67 | 0.316 | 0.118 | 3.95 | 0.56 |
| November | 15.06 | 76.28 | 7.98 | 0.57 | 0.97 | 0.291 | 0.142 | 7.67 | 0.94 |
| December | 15.75 | 74.92 | 9.89 | 0.63 | 1.51 | 0.322 | 0.169 | ... | ... |

regulation. The saponification value of male clams has been found to be higher than that of females and iodine number of fat of females higher than that of males (Kasinathan, 1964 b).

FISHERY

Fishing is done almost throughout the year. But the summer months are most convenient for good fishing. It is a common sight to see fisherwomen and girls going about collecting the clams from Adyar estuary, Ennore estuary and Pulicat Lake during low tide. From time to time as they gather the clams, they pile them in heaps on the adjacent sand or mud bank. When they stop fishing they smash the clams one by one with granite stones. The meat is scooped out with the thumb and put in an earthen pot. The shells are left behind and only the flesh is taken home. A woman may collect about 300-400 clams a day. In some cases where the bed is dense the catch may range from 2000-3000 per individual and these are collected and taken home in baskets. The clams are kept as such for two or three days, to be opened as and when required. The clams are not sold in markets regularly though it is not uncommon to see people purchasing clam meat from fishing hamlets when they want. There is no standard price for the meat. It is generally sold on barter system for commodities like sweets, paddy or other grains or pulses. The price ranges between 30 and 50 paisae for 100 clams. Poorer fisherfolk along the coastal areas of Madras, Chingleput, South Arcot and Ramnad fish this species of clam. In spite of indiscriminate fishing these clams are found in fair density because of the rapid rate of growth in the younger stages, the early attainment of sexual maturity and tolerance of a wide range of salinity.

MERETRIX CASTA VAR. OVUM (Hanley)

This clam can be distinguished from *M. casta* by its more elongated shell (Fig. 3 C). The shell is sub-equilateral, covered with a thin, greyish-yellow periostracum and with or without narrow brown bands radiating from the hinge region. The posterior margin is stained greenish grey.

This clam is generally separated as a distinct species. It occurs in great abundance in west coast backwaters. The clams grow to a size of 35-40 mm in length and 25-28 mm in breadth. This clam also is fished indiscriminately. This is one of the important clams of the Kerala State. The flesh is tender and has good flavour. On the Malabar coast the poorer classes of fishermen search for these clams when the general fishing is dull. Men, women and lads go about in small canoes in the backwaters and when a good fishing area is found they anchor the boat, get down into the shallow water, locate the clams with their feet and dislodge them from loose mud. If the area happens to be a little deeper the fishermen dive and gather the clams.

VILLORITA CYPRINOIDES (Gray)

This black-clam called in Malayalam as *kar erunthee* is a small thick-walled one found only in the west coast estuarine backwaters. This species cannot withstand high salinity. It is usually found in vast beds near the farthest ends of the backwaters where the salinity is lower than 15‰. This clam is said to burrow deep into the soil to escape adverse conditions when the salinity rises above 15‰ during summer months. The distribution does not extend to the vicinity of harbour areas or the sea mouth. But *V. cyprinoides* var. *cochinensis* (Hanley) (Fig. 3 D) is capable of tolerating a wide range of salinity upto 34‰ and therefore found in parts of backwaters near the bar mouth in sand and silt deposits although exclusive silt deposited areas are avoided by this clam (Cherian, 1968).

The clams are fished by the same people who eat *Meretrix*. The shell seldom exceeds 40 mm in length. Nothing is known about the biology of this clam.

TELLINA PINGUIS Hanley

The shell of this species is ovate and moderately large. The pallial sinus is large and deep (Fig. 3 E).

This is one of the most important commercial clams on the Bombay coast. It is a brackish water clam found from Bombay to the south along the west coast. It is found at a depth of one to three fathoms in sandy bottom and also in areas where there is admixture of mud (Rai, 1932). Small numbers of this clam occur in the vicinity of Cochin harbour (Cherian, 1968).

KATELYSIA OPIMA (Gmelin)

In this species the shell is thick, inflated, smooth and of yellowish brown colour (Fig. 3 F). The inner surface of the valves is white and the pallial line deeply sinuate.

This clam is found in great abundance along the estuaries and backwaters of South India and is called *vazhukku matti* in Tamil. It is next in importance to *M. casta* on the east coast especially in Adyar estuary.

The clam prefers water edge near the river-mouth since it is essentially a marine form. It is found burrowing in quiet shallows as in the mud-flats of Pamban in the Gulf of Mannar and Ratnagiri coast. It has also successfully invaded the estuaries and backwaters where it is found near the river-mouths in Bombay, north Kanara and Madras coasts. It is never found up the river-mouths or in the interior of the backwaters where the salinity is low, a striking contrast to *Villorita cyprinoides* and *M. casta*.

The life span is about three years. Clams of the size 26-33.8 mm in length are over one year old but not completed second year. Similarly 38.8 to 4.35 mm size represents two year old clams. The first definite indication of sexual maturity is seen in three months old clams when they are 11-12 mm in length. In the Adyar estuary growth appears to be restricted to the period from January to July and arrested between August and December when there is a fall in salinity. The clams have been found to spawn thrice in their life span. Spawning starts in December when the estuary is in communication with the sea and lasts about a month (Rao, 1951 b).

The clam beds are extensive in Adyar river-mouth in the east coast and Batya creek and Kalbadevi creek in Ratnagiri where there is a good fishery. Elsewhere along the east coast and west coast it is found separately along the tidal flats and does not form regular fishery.

The clams are fished by fisher-folk along with other clams and the commercial catch does not seem to be composed of any particular size, being there no restriction on size limit in fishery. Fishing is indiscriminate as it exists to-day.

PAPHIA Spp.

Paphia malabarica, *P. textile* and *P. marmorata* are the common species exploited. In *P. malabarica* the shell is triangularly ovate, the anterior and posterior margins are narrowly rounded and the surface of the shell has well-developed concentric ridges. *P. textile* is characterized by an elongate shell with the anterior and posterior margins rounded and the outer surface is smooth, of pale yellowish white colour and marked with pale purplish grey inverted V-shaped markings.

There is a good fishery of *Paphia* spp. in Karwar and north Kanara river-mouths. The clams occur in depths of up to 4 metres in sandy mud and are called *chippe kallu* in Kannada and *tisre* in Konkani. During low tide fishermen take small scoop nets in one hand against the current and the clams are pushed into the net with the other hand. Information gathered from fishermen shows that during the full moon and new moon days better quantities of clams are collected.

The fishery extends throughout the year with a peak between January and July. In January the fishery is supported by younger ones and in May-July by adults. After the monsoon the flesh is said to be not tasty. During peak fishing each individual collects about 40 kg per day and about 1000 kg are landed daily in each centre (personal communication from Dr. Anthony Raja).

DONAX Spp.

Of the several species of the genus *Donax* that occur on the east and west coasts in the surf beaten sands *Donax cuneatus* Linnaeus to a very large extent, and *D. faba* Gmelin and *D. scortum* Linnaeus to some extent are valuable as edible bivalves. At present there is no regular fishery for these clams for food or any organised lime making industry with the result that these valuable resources are neglected. Nayar (1955) and Alagarwami (1966) have studied the biology of *Donax cuneatus* and *D. faba* respectively which abound in the sandy beaches of the southeast coast of India. The clams occur in the surf line along the shore and their presence is revealed by a pair of openings formed by the siphons of each of the clams on the wet sands. The receding waves often dislodge the clams out of the sand. Then they rapidly burrow into the sand. The clams are usually collected by girls and lads who turn over the wet sand with their feet as each roller spends its force and slips back into the sea, and collect in their hands a good number of the clams.

D. CUNEATUS Linnaeus

COMMON NAMES

Tamil - *Mural*, *Vazhi matti*

In this clam the shell is trigonal, inequilateral and has a curved keel extending from the umbo to the postero-ventral corner; there are sharp concentric and finer radiating ones which are conspicuous in the anterior and posterior regions only. The anterior end of the shell is broad and rounded while the posterior end is narrow and rounded; the pallial sinus is deep. The shell is white suffused with pale violet especially towards umbo and the posterior region where the colour is darker. The inner surface of the valves is of deep violet colour (Fig. 3 G).

D. cuneatus grows upto 19 mm in length and its life span is two years. A maximum size of 13-14 mm is attained in 11 months. Sexual maturity is attained when the clams are 10 months old and 10-13 mm in length. The clams spawn for the first time when they are one year old and do not spawn more than twice in their life time. The spawning season is from January to April in Palk Bay (Nayar *loc. cit.*) while at Madras it is more extended, beginning in December and continuing till June (Rao, 1967).

D. FABA Gmelin

The shell of this species is ovate with fine concentric striae. There is no keel extending between the umbo and the posterior margin. The ventral margin bears a slight indentation at the posterior end; pallial sinus moderately deep.

Colour pattern variable. The outer surface is pale bluish grey or greyish blue with greyish concentric bands, rays or patches of brown colour (Fig. 3 H).

This species grows to a length of 19.5 mm in the first year and 23.5 mm at the end of the second year. The life span does not appear to exceed three years. The clams reach sexual maturity when they are 13-14 mm in length and have a prolonged breeding period extending from November to June with two spawning peaks, in November-December and May-June (Alagarwami, 1966a).

The above species are collected throughout the year.

MESODERMA GLABRATUM (Lamarck)

COMMON NAME

Tamil - *Kakkamatti*

The shell of this species is thick, inequilateral and approximately trigonal in shape. The surface of the shell has closely set, well developed concentric striae. The umbo is small and the hinge bears two cardinal teeth and there is an anterior lateral tooth. The pallial sinus is small and angular.

This bivalve is common in the sands of the islands of the Gulf of Mannar. It grows up to 35 mm in length. It is fished and eaten along with other clams.

GAFRARIUM TUMIDUM Roding

The shell of this bivalve is thick, strongly inflated and sculptured with thick, nodular radial ribs which tend to bifurcate towards the ventral margin. In the interstitial spaces between some of the main ribs there are secondary rows of nodules between the ventral margin and the middle of the surface. The pallial line is entire. The outer surface is white with irregular dark spots posteriorly and near the umbo (Fig. 3 I).

This is a cockle clam of considerable importance and is called *vari matti* along the southeast coast of India particularly in Palk Bay area. Along the Gulf of Mannar the mud-flats are rich grounds for this clam. Along the northern parts of the Coromandal coast and the west coast this species is very scarce. It inhabits the muddy sand near the low tide level on the open coast. The flesh is tender and is liked by fisherfolk who collect them during spring tides. The clam grows to a length of 45 mm and is said to spawn in the period September—October.

Three other species of *Gafrarium* are represented on the Indian coasts in restricted numbers, *G. dispar* at Pamban, Kundugal Point, Krusadai Islands and in Palk Bay, *G. pectinatum* (Linnaeus) in Pamban, Kundugal Point, Krusadai

and Shingle Islands and in Palk Bay and *G. divaricata* (Chemnitz) at Madras and Shingle Island. *Circe scripta* (Linnaeus) another cockle clam found sparsely distributed along with *G. tumidum* is also collected and eaten.

The true cockles are represented in Indian coasts by several large and handsome species chiefly *Cardium asiaticum* Bruguiere, a sandy coast inhabitant. The cockles are not commercially important as they do not appear to occur in thickly populated beds.

RAZOR SHELLS

The ark-shells *Arca tortuosa* Linnaeus and *A. inequivalvis* Bruguiere are marine species common in Palk Bay on the east coast where beds exist on a bottom of dirty muddy sand at depths upto ten metres. But the meat is not appreciated by the fisherfolk and therefore the bivalves are not exploited for the meat. Narasimham (1969) has studied the biology and fishery of *Anadara granosa* (Fig. 3 J) which is commercially important on the Kakinada coast. The ark shells are fished from 4 metres depth by fishermen who use them almost entirely for manufacture of lime. *A. granosa* grows to a length of 31.5 mm at the end of the first year and 49.5 mm at the end of the second year. The species appears to breed throughout the year in Kakinada Bay with peak spawning activity between January and April. *Arca (Anadara) granosa* has been reported by Hornell (1922b) and Rao (1941) to occur in the sandy backwaters of the east coast especially in Pulicat Lake. The meat of this cockle is tough and red and believed to be nutritious. The ark-shells are widely cultivated in Japan but they are not appreciated much by Indian people.

RAZOR CLAMS

The scabbard-shaped razor clams belonging to the genus *Solen* occur on sandy tidal flats where they live at depths of 2 cm to 20 cm below the surface at the low tide mark as well as in deeper waters. These clams do not form a regular fishery anywhere on our coasts except on the Ratnagiri coast. Rao *et. al.* (1962) have described the taxonomy and distribution of *Solen* spp. and studied the biology and fishery of the commercially important *S. kempi* Preston of Ratnagiri.

SOLENS KEMPI Preston

The shell is small, about six times as long as high, periostracum yellowish-brown and glossy; anterior region obliquely truncate, posterior region rounded (Fig. 3 K). Cardinal tooth in right valve with a shallow groove throughout its breadth; dorsal margin of soft body slightly concave in the anterior region and convex in the posterior region; siphon long and segmented; foot long, flattened and about half the length of body.

Solen kempfi occurs in Chilka Lake, Ennore (near Madras) and Ghakkadi (near Ratnagiri).

S. kempfi grows rapidly attaining a length of 37.5 mm in 6 months and 47.5–52.5 mm at the end of the first year. The largest size 66 mm is attained when the clams complete second year of their life. Gametogenesis takes place in September and spawning between late October and March. Sexual maturity is attained when the clams are 5 months old but spawning does not take place till they attain the age of one year.

The clam beds are found in regions where there is a good amount of silt deposited by the river enabling the shellfish to thrive well. The habitat is sandy in shallow waters from high water mark to a little beyond the low water mark. The main fishery is from February to May but extends up to September.

In Maharashtra fishing of these clams is done exclusively by women and girls of the community known as *bhandaris*. The clams are fished during low tide. The tell-tale openings of the burrows noticed on the beds during the low tide effecting little jets of water here and there indicate the retreat of the clams to the bottom of their burrows on feeling the vibrations caused by feet upon the flat. It is difficult to dig them out as they burrow and go down quickly. Even if one manages to catch hold of the posterior end it is hard to pull a large individual out. Hence they are dug out of their burrows by means of a broad bladed, strong steel knife which has a pointed free end. The digging is done deftly and in a flash as otherwise the animal will burrow deeper and deeper to escape capture. The catch is used for domestic consumption only and partly as fish bait for long-lining.

GIANT CLAMS

TRIDACNA MAXIMA Roding

One species of giant clam of the genus *Tridacna*, *T. maxima* Roding occurs in the Andaman and Laccadive Islands. *T. maxima* is commonly known as *T. elongata* Lamarck but the specific name *maxima* has priority (Rosewater, 1965). In *T. maxima* represented in the Andaman and Laccadive Islands the valves are very inequilateral and the hinge is very much shorter than the ventral margin; primary radial sculpture consists of 6 to 12 broad, moderately convex rib-like folds of which 6 or 7 are very well developed, secondary radial sculpture consists of 10–20 evenly spaced riblets on folds and 3–7 in their narrow interstices; concentric sculpture consists of closely spaced undulate lines which produce low scales on primary folds (Fig. 3 L). The species has a wide distribution from East Africa to Polynesia with the exception of Hawaii. The flesh of *T. maxima* is used for food in the Laccadive and Nicobar Islands. The valves of *Tridacna* are used as benitiers in churches. So the clams are also called holy-water clams.

FAN SHELLS

PINNA BICOLOR Gmelin

Pinna spp. are utilized as food in Japan, Polynesia and other countries in the Indo-Pacific region (Rosewater, 1961). But *Pinna bicolor* Gmelin which occurs in good density at Pamban, Kundugal Point and near Mandapam is not made use of at present.

The shell of *P. bicolor* is broadly to attenuately triangular in shape, posterior margin truncate or convex-rounded, valves heavy and thick or rather thin and fragile; valves translucent and of light horn to dark purplish brown colour, 8 to 17 radiating ribs which are sometimes scarcely visible present. Spines almost absent except in the posterior region, fine concentric growth lines present, dorsal margin straight or slightly convex, interior of valves light smoky horn to dark purplish brown in colour, nacreous area iridescent (Fig. 3 M).

The species lives in sandy mud attached to the substratum by well developed byssus threads at depths of one to two fathoms. While the meat is edible the valves could be carved to form decorative articles.

From the foregoing account it is clear that clams and some other bivalves are sought after by considerable section of poorer classes of fisherfolk as a source of food. However, clams have not found favour with the vast majority of the population. With the prevailing indiscriminate fishing by most of the fishermen there are possibilities of the clam beds becoming depleted. This state of affairs caused by human agency can assume greater dimensions once natural mortality due to sludge deposition on account of floods in rivers, discharge of pollutants into rivers, deposition of ballast mud in the vicinity of the beds and the like also combine to make the ruin complete. As a first step to improve the edible clam fisheries certain aspects warrant our consideration in the interest of the future management of the clam fishery resources of the country.

In India at present there is no comprehensive work on the biology of the various species of clams that are edible except for a few studies mentioned. Investigations on the rate of growth, longevity, size at first maturity, periods of spawning, biotic and abiotic environmental factors influencing growth and breeding and suitability of different species of clams for being used as food that have not already been studied should be started. Resources survey of the area of availability, seasons of fishing, quantity fished and value of the fisheries are all yet to be properly assessed in the different maritime states of our country. These aspects should be given priority in the investigations. Side by side with these studies the edible values of the meat of the different species of clams from different places should also be investigated.

So far as the existing well-known clam beds are concerned steps should be initiated to clear the beds especially backwater mud flats, of stones and gravel during the low tide. Ploughing certain areas will enable the clams to burrow quickly in the soil. Restocking them with clams from other beds in the neighbouring localities should also be attempted. Transplantation experiments should also be tried in areas where clams are not available depending on the suitability of the places. Laying out beds for culture, one for seed clams and another for young clams to grow and a third for adult clams to serve as a breeding reserve, observance of short closed season for fishing during peak periods of spawning and elimination of predators and pests from the beds are some of the steps to be undertaken to counter the effects of overfishing and indiscriminate removal of clams.

In countries abroad in spite of enforcing numerous regulations for the conservation of very valuable clam beds they have been found to undergo gradual deterioration. In this context the culture of clams on scientific lines is the only possible solution to solve the problem. The available natural resources also should not be neglected.