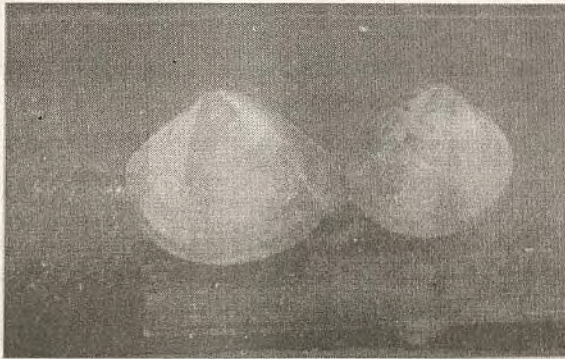




MOLLUSCAN CULTURE: CLAM

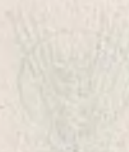


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Introduction

Molluscs contribute 18.1% to the total world aquaculture production, in which clams form 21.9%. China, Republic of Korea and Malaysia are the leading clam producing countries. In India, clams are the most important among the bivalve resources. They are distributed in the backwaters and estuaries along the Indian coast. Commercially exploited and cultivable clams are *Meretrix casta*, *M. meretrix*, *Paphia malabarica*, *Anadara granosa* and *Villorita cyprinoides* along the mainland. Good resources of giant clams are existing in Andaman and Nicobar Islands and Lakshadweep.

Species of clams

Meretrix casta (Chemnitz)

Shell thick, smooth, devoid of any sculpture and triangularly ovate. Outer surface pale yellowish brown tinted with dark grey posteriorly and very faintly rayed with grayish radial lines.

It occurs in great abundance in all estuaries and backwaters along the west coast. Rich beds of this species exist in Pulicate lake, Vellar, Athankarai and Pinnakayal estuaries along east coast. Fishing is done throughout the year and summer month during low tide is the best period. A fisher woman collects 300-400 clams per day and even 2000 – 3000 if the bed is dense.

The major spawning season is from September to March. The size at first maturity is 17 mm and the clam grows to 35-40 mm in length. Studies on age and growth indicated that it attains 36.5 mm in six months, 46.6 mm in one year and 56.5 mm in three years. Along east coast, spawning takes place twice a year, April-May and September. Natural spat settlement occurs during September-December and April-May.

The meat contains good amount of protein (7.98 to 12.29%) and minerals. The fat content varied from 0.57 – 1.07%. The injection of insulin led to increase of glycogen in digestive diverticula and foot, storehouses of carbohydrates. The saponification value of male clam was higher whereas iodine number was higher in the fat of females.

It is one of potential clams for culture. Good seed resources (197 t) are available in Kalinadi, Mulky and Gurpur estuaries. The CMFR Institute has standardized the technique for seed production through hatchery system. On day 9, settlement occurred at 181 μ m size and in one month, a maximum length of 1.2 mm was attained. During 1996-98, 3.03 million seeds of *M. casta* were produced with settlement percentage of 2.3 -16.3% from 15 spawnings in the hatchery.

Field culture experiments conducted in Mulky estuary showed that the clams had grown from 17.9 to 31.5 mm in 4 months with survival percentage of 48.2%. At Vellar estuary, 7.33 mm weighing 0.25 g had grown to 41.5 mm with 31.34 g in one year.

***Meretrix meretrix* (Linnaeus) (Great clam)**

The shell is triangularly ovate, thick, usually smooth sometimes weakly concentrically sculptured. The lunule is not well defined and the ligament is usually short. The hinge area is thick bearing 3 cardinal teeth.

This 'great clam' is distributed in large quantities in Kalleadevi and Bhatea creek in Maharashtra; Chaporal, Sal, Mandovi and Zuari estuaries in Goa; Kalinadi, Tadri and coondapur in Karnataka and in Tellicherry coastal area and Ashtamudi lake in Kerala. Along the east coast, it occurs in major estuaries of Tamil Nadu, Pulicat lake and Chilka lake on the seaward side.

Though the clams are fished throughout the year, they are indiscriminately exploited during August and April. The flesh is mainly used for local consumption. Since they are exploited before spawning, the meat is tastier.

The spawning period of the clam is September and May along the east coast. At Vellar estuary, the spawning extends from February – September, whereas at Tuticorin, two peak of spawnings are during January-February and September. The life span is estimated as 7-8 years with size range of 14.6 - 91 mm. The growth of tagged clams of size 14.6 to 88 mm registered a growth rate of 0.15 mm to 2.2 mm. Seeds of *M. meretrix* could not be collected from estuaries.

CMFR Institute succeeded in 1988 in evolving hatchery techniques for seed production. Spat settlement at 184 μ m occurred in the hatchery between 8th to 12th day after fertilization. Average size of 2.9 mm was attained on day 75 with survival rate ranging from 7.4 to 15.6% from initial larval stage. During 1996-97, 0.254 million seed were produced with percentage of seed production varying from 2.8 to 18.8%. The hatchery produced young clams of 7.8 mm had grown to 14.5 mm in 5 months.

The growth of 2 mm seed exposed to salinities 6.7 to 33.5 ppt indicated that high growth rate (189.65%) was obtained in 20 ppt.

Marcia opima Gmelin (Baby clam)

The shell is more or less elongately ovate with the umbone inclined forwards. The surface is either smooth or finely concentrically striated. The lunule and the area are clearly defined. The hinge margin bears three thick diverging teeth. The outer surface of shell polished pale yellowish brown or straw coloured and rayed with purplish grey markings. The photograph is given in cover page

It occurs in great abundance along the estuaries and backwaters of South India. It prefers river-mouth and is found burrowing in mudflats of Gulf of Mannar, Ashtamudi Lake, Ratnagiri, North Kanara, Bombay and Chennai coasts. The estimated resource in Ashtamudi Lake was 6000-6500 t. Clam fishing is done throughout the year with peak in February-March. The methods of fishing are handpicking, scoop net and dredging. A canoe with 2 fishermen takes about 200-300 kg of clams per day. Good fishery also exists in Batya creek and Kalbadevi creek in Ratnagiri. The size of the clams ranged from 5-44 mm. It grows to 26-33.8 mm in one year and the life span is about 3 years. Sexual maturity is observed in the size 11-12 mm of 3 months old. Spawning season is December to February.

Five percent of the total clam production is consumed locally and the rest are exported. The shells are utilized for calcium carbide industry. Considering the vast resources and its export value, the seed production through hatchery system was evolved by CMFR Institute. Spat settlement occurred on day 9 at 273 μ m. On day 29, the mean size was 2 mm which increased to 2.38 mm on 45th day. The clam seed reared further in nursery attained a size of 11.5 mm in 4 months. Through 7 spawnings, totally 5.4 lakhs spat were produced and the percentage of settlement varied from 13.9 to 56.2.

Paphia malabarica Chemnitz



The shell is more or less elongate, smooth or concentrically sculptured with narrow and elongated lunule. The hinge

area is short with narrowly diverging teeth. The pallial sinus is moderately deep and 'U' shaped.

Good fishery exists in Karwar, north Kanara and Ashtamudi lake in Kerala. It usually occurs in depths upto 4 metres in sandy mud. The fishery extends throughout the year with a peak between January and July. During lowtide fishermen take small scoop nets in one hand against the current and the clams are pushed into the net with the other hand. Good quantities are collected during full and new moon days. Each individual collects 40 kg/day and about 1000 kg are landed in a centre daily.

The size at first maturity is 20 mm. The peak spawning period is from October to February. This species attains a length of 36.3 mm in 6 months and 48.1 mm in one year. Seeds of this clam could not be collected in natural beds. Hence seeds were successfully produced in the hatchery. Settlement occurred on day 9 and completed on day 12 at 286 μ m. In 3 months, the seed had grown to a mean length of 2.9 mm with a maximum length of 4.2 mm. The higher growth rate (305%) of this clam was observed in 28 ppt salinity.

***Villorita cyprinoids* (Gray) (Black-clam)**

Shell thick, ovately triangular with strong concentric ridges, umbones prominent, well elevated, hinge margin short and thick with three oblique cardinal teeth. Pallial sinus small, lunule narrow and ligament large. Periostracum dark olive brown to blackish brown.

In the northern region it occurs in Siridavo, Savoi, Amonen and Naibag in Goa. Majority of the stock is from Kalinadi, Aghnashiri and Gurupur estuaries in Karnataka, Vembanad, Ashtamudi and Kodungathiore lakes in Kerala. In Vembanad lake, the resource was estimated as 21,490 – 27,000 t. At Ashtamudi, Kumbalattu kayal is very rich with this clam. The annual production is estimated as 6000 t and the present stock in Kayal is 12,000 t in a bed covering 50 ha. The fishing season is from February to April. 75-90 canoes are employed every day. Further 82.1 t of seed resources is available in Kalinadi, Mulky and Gurpur estuaries in Karnataka.

In Cochin, the spawning occurs twice a year i.e. May-September and January – March. It attains sexual maturity at 11-15 mm size. In nature, it grows to 30 mm length in one year. In Nethravathi estuary, the spawning season is from October to May. Vast beds occur in the farthest ends of backwaters where salinity is below 15 ppt. Young clams of 15-20 mm tolerate 0.87 to 29.8 ppt whereas 40-50 mm clams tolerate 4.73 to 27.1 ppt. However it survives in freshwater in Kerala and Karnataka estuaries.

The protein content of the meat is 10.09%, fat 2.52% and glycogen 6.68%. *V. cyprinoides* was also induced to spawn in the laboratory and spat settlement occurred on 11th day in experimental rearing. This observation indicated that large scale seed production is possible through hatchery system like in other clams.

Anadara granosa(Linnaeus) Blood clam

Shell of this species thick and attains large size. The shell is strongly ridged. It occurs in abundance in Kakinada bay, at 4 m depth. The beds exist on a bottom of muddy sand and also sandy backwaters of the east coast. At Kakinada, heavy catches were reported in March – April and August – September. The catch per unit effort varied from 14.7 to 40.4 kg. The length of the clams varied from 15 – 71.2 mm. The total catch varied from 104 to 222 t, in the natural bed covering an area of 44 km² in Andhra coast. Total annual production was estimated as 2000 t of which 10 % is used for human food. Fishing is by handpicking.

It breeds throughout the year with peak spawning from January to April. It grows to a length of 31.5 mm in 1st year and 49.5 mm in 2nd year.

Field culture experiments were carried out with 24.3 mm size seed collected from nature. The production rate ranged from 38 to 42 t/ha. The survival rate was 88.6% with flesh weighing 20%.

In 1988, through hatchery system, 8090 seed of blood clam were successfully produced. Settlement

occurred on 16th day. The 2.4 mm young clams (2 months old) reared in cages grew to 20 mm in 5 months with 72% survival. Higher growth rate of 419.2% was observed in the juveniles reared in 25 ppt salinity.

Clam fishery

Totally 45,412t of clams are landed annually and only 5 -10% is utilized for human consumption. The shells ,a by-product of clam fishery are sold to carbide, cement and lime industries. Apart from shells of live clams, subfossil deposits of clam shells to the tune of 41,445 to 69,306 tons are being regularly exploited in Vembanad lake. The shells are also used in paper, leather, tiles and rayon industries and as shellgrit for poultry.

From 1981, clam meat is exported as frozen, canned and as pickles to Japan, Oman and UAE. The quantity of export of clam meat varied from 371 to 1396 t.

Three incidences of paralytic shellfish poisoning has been reported due to consumption of clams collected from polluted areas. Hence proper monitoring of the clam beds and sanitary measures have to be implemented for arresting the pollution of the clam beds. This will make the clams safe for human consumption.

Clams, being filter feeders, harbour pathogenic and faecal coliforms. The intestine contains mud and sand imparting muddy flavour and grittiness to the meat . In depuration process, the harvested clam is cleaned in filtered seawater for 18- 24 hours followed by chlorination (5 ppm) and maintained for 2hrs. This led to the removal of pathogenic bacteria and sand to negligible levels. Hence depuration has to be made a mandatory requirement before marketing.

Proper Indian standards have to be also evolved for processing and canning the clam meat since there is no Indian standard for canning of clams.

The exploited size group of these clams is below 20 mm. Due to the export of clam meat, there is indiscriminate fishing for small clams. Over 1000 numbers of small clams of 25-30 mm are required for 1 kg of meat whereas the same could be obtained from 460 numbers of 35 - 40 mm clams. Thus the exploitation of small size clams adversely affects the future resources and production. So mesh size of hand dredge to 30 mm has to be regulated to prevent the exploitation of smaller clams. In the pretext of mining the sub-fossil deposits, nearly live clam beds are also dredged. Hence the beds of live clam have to be excluded from mining. Licensing system for clam fishing has to be adopted along the maritime states, as followed in Vembanad lake, so as to have sustainable yield. For each area fishing season has to be adhered to rather than fishing throughout the year.

Clam culture

Seed is one of the prime requisites for culture. In India, seed resource of 197 t and 82.1 t has been estimated for *Meretrix casta* and *Villoritta cyprinoides* respectively. But seed of *M. meretrix*, *Marcia opima* and *Paphia malabarica* could not be recorded in natural beds. Considering this, the CMFR Institute has developed suitable techniques for mass seed production through shellfish hatchery at Tuticorin, with annual production capacity of 2 to 3 million clam seeds. Many of the European countries are mainly depending on the seed supply from hatcheries. In the Southeast Asian countries, seed required for culture is met from natural resources. Recently, because of raising demand in Taiwan, 15 hatcheries have been established to supply seed of *Meretrix lusoria*.

In Malaysia, Thailand and China wild seeds of blood clams are used for farming in pens erected in intertidal mud flats with average production of 40t/ha. The production rate

of *A. granosa* in the Kakinada bay compares well with those reported from Malaysia and Thailand. The Venerid clams are amenable candidate species for farming. In France, culture of Manila clam (*Ruditapes philippinarum*) is being carried out in intertidal enclosures. The annual production is 300 t. Of recent *Meretrix lusoria* is intensively cultured in ponds used for shrimp culture. Thus the technical feasibility of culture of *M. casta* has been established through experimental trials. In India, vast intertidal areas as well as ponds used for shrimp farming could be effectively used for clam culture. Pilot projects have to be undertaken by the Fisheries Departments of maritime states to demonstrate the economic feasibility of clam culture.

There is great demand for dried adductor muscle of giant clams apart from the edibility of the meat. In Papua New Guinea and Australia attempts are being made to produce seed and culture of giant clam. Having the potential resources and area for culture, major thrust has to be given for the seed production and culture of giant clam in India.