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FISHERY AND BIOLOGY OF CLAMS AND COCKLES

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a) Meretrix meretrix (Linnaeus)

Exploitation and fishery: Rai (1932) estimated the production of this species and Katelysia coima in the erstwhile Bombay Presidency approximately at 8818 tonnes. Ranade (1964) stated that from Thana to Ratnagiri District about 3708 tonnes of the above two species are landed annually from 34 creeks. The most productive areas are the Kalbadevi estuary and Bhatia creek in Ratnagiri District. Tarkarli creek south of Malwan is also important. Clams are collected by men, women and children at low tide by hand picking. Canoes and rake nets are also used. Women market the clams at Bombay, Ratnagiri and Malwan and the last two places are important market centres for M. meretrix (Alagarwami and Narasimham, 1973).

In Goa, Tiracol, Chapora, Sal, Mandovi and Zuari rivers are important for clams in that order. This species is mainly fished at Siridao, Siolim and Ribander. About 400 to 500 persons are engaged in clam digging in Goa and fishing is throughout year except the monsoon (Alagarwami and Narasimham, 1973. Panaji and Mapura are important marketing centres.

In the North Kanara District Kalinadi estuary has rich clam beds of M. meretrix. Important clam fishing villages along the estuary are Kodibagh, Nandangadda, Sunkeri, Sadasivgarh and Kanasgiri. The above species is dominant on the bank side of the estuary. Here 300 to 400 persons are engaged in clam fishing and 50 canoes are deployed for the purpose. A clam net locally known as "Akhya" is used. The annual output of clams from Kalinadi is about 1000 tonnes of which about 50% is by M. meretrix (Alagarwami and Narasimham, 1973). Other important centres for this species along the North Kanara coast are Ankola, Moorba, Wadgoni creek, Mirjan, Horwada, Mudgian, Sanikatta, Tadri and Aghanasini. Here clams are fished throughout the year with a peak in March-June. Sanikatta and Ankola are important marketing centres for clams. In the extensive clam beds of the Sharawathi estuary M. meretrix is the dominant species. On both sides of the estuary about 100 persons regularly collect the clams.

In Tamil Nadu it is fished on a small-scale in the estuaries of Adyar, Courtalayar, Vellar and Cooum (Nayar and Mahadevan 1974). In the Kakinada Bay about 400 tonnes of this species are collected annually (Narasimham, 1973). It is also found in Pulicat lake and Chilka Lake.

Present status of utility: The flesh of the clams is tasty before they spawn and at this stage they are exploited indiscriminately (Nayar and Mahadevan, 1974). Apart from their use as food the shells are used in lime making at several places like Kodibagh, Sadasivagarh, Sunkeri and Nandwad.

Biology: Rai (1932) reported that the principal breeding season of M. meretrix on the Bombay coast lasts from March to June and under favourable conditions it may continue year round except during monsoon. On the east coast this clam spawns about the beginning of September and again in May (Hornell 1922). M. meretrix can withstand low salinity of 10.5% under laboratory conditions when the change is effected suddenly. On acclimatization to low salinity it can stand 5.0% salinity (Ranade and Kulkarni 1973) and this helps the clams to survive the low salinities prevalent during the monsoon.

b) Meretrix casta (Chemnitz)

Exploitation and fishery: In South Kanara this species is important in Coondapur, Silanadi, Malpe, Mulki, Gurpur and Netravati rivers (Alagarwami and Narasimhan, 1973). In the Mulki river canoes are employed to transport the women divers to pick the clams which are emptied into 'madi' (a piece of cloth folded like a bag) or in a bag net fastened to their waists. The clams are marketed at Malpe, Mangalore and Mulki.

Along the Kerala coast M. casta is one of the important clams in most of the estuaries and backwaters. At Kozhikode, Beypore, Vembanad lake and Quilon this species is fished for local consumption.

In the east coast M. casta beds occur in the estuaries of Athankarai, Pinnakayal, Vaigai, Vellar, Adyar, Cooum and Ennore backwaters. The species is known to exist at Pulicat lake and Chilka lake also. In the Adyar estuary, Ennore estuary and Pulicat lake each woman collects 300-400 clams a day and on thickly populated beds 2000-3000 clams may be picked up and taken home in baskets (Nayar and Mahadevan, 1974). The clams are not regularly sold in the markets and they are traded by barter system for commodities like paddy, sweets or pulses.

Utility: At Ullal near Mangalore over 3000 tonnes of lime is produced valued over Rs. 5,00,000. The lime is used in manuring coffee plantations (Alagaraswami and Narasimham, 1973).

Growth: In the Adyar estuary it grows to a length of 48.7 mmⁱⁿ/about 18 months. Growth is retarded twice in a year (Abraham, 1953). It attains a size of 56.3 mm in about 3 years but nearly 90% of clams are fished before they reach 30 mm length. An average growth of 2.9 mm/month was reported by Harkantra (1975) from the Kali estuary during the first year and 2.7 mm/month by Parulekar et al (1973) from Goa. Dimensional relationships in this species were studied by Durve and Dharmaraja (1965) and Parulekar et al (1973). Durve (1975) observed change in the form of the shell during growth and suggested that it is essentially genotypic.

Condition factor: The percentage edibility (ratio of meat weight to the whole weight) of M. casta of Ennore backwaters varied from 7.62 to 15.75 (Venkataraman and Chari, 1951), and at Goa it ranged from 11.26 to 12.08 (Krishna Kumari et al., 1977).

Bio-chemical composition: The protein varied from 7.98 to 12.21%, fat 0.63 to 1.1% (Venkataraman and Chari, 1951). Their data show that the clams are rich in protein and minerals. The caloric value of M. casta was estimated as 3369 cal/g dry wt. (Sumitra Vijayaraghavan et al., 1975). Gopalakrishnan et al., (1977) observed a high protein content of 18.5% and gave the caloric value at 4755 cal/g.

Maturity: This species is reported to attain sexual maturity at 11 mm length and when one month old by Abraham (1953) and at 10-25 mm length by Harkantra (1975).

Spawning: In the Adyar estuary M. casta spawns throughout the year with peak activity in July-August, October-November and March-April (Abraham, 1953). Hornell (1922) stated that this species spawns twice in a year during April-May and in September. Durve (1964) recorded continuous spawning except for a break in late summer which related to hypersaline conditions in the marine fish farm at Mandapam. At Goa, continuous spawning throughout the year with a slight peak in March-April was observed by Krishna Kumari et al., (1977). Parulekar et al., (1973) also stated that this species at Banastim near Goa spawns throughout the year. Harkantra (1975) reported that it breeds throughout the year in the Kali estuary with a possible break in the winter.

Parasites: Silas and Alagarwami (1967) and Harkantra (1975) recorded the pea-crab Pinnotheres sp. in M. casta. They damage the gills, mantle, digestive gland and gonad. Durve (1964) observed that a few M. casta were parasitized by bucephalid cercaria.

c) Villorita cyprinoides (Gray)

The black clam is small and thick walled contributing to the clam fisheries along west coast. This species cannot withstand high salinities.

Exploitation and fishery: In Goa it is fished at Siridao, Savoi, Amonen and Naibag. In the Mangalore area also this species is fished and sold. Along the Kerala backwaters it is available in the Cochin area and at several places to its south (Alagarwami and Narasimham, 1973).

Utility: Apart from its value as food the shells are used in the cement manufacture. The Travancore Cements Ltd., Kottayam dredge annually about 60,000 tonnes of shells valued at Rs. 10,80,000 from the subfossil

deposits of the Vembanad lake. About 10,000 tonnes of white cement and 40,000 tonnes of grey cement are manufactured from these shells (Alagarwami and Narasimham, 1973). Nothing is known of the biology of the species.

d) Katelysia opima (Gmelin)

This species is of considerable importance in Maharashtra State.

Exploitation and fishery: This species accounts for half of clam production in the Ratnagiri District. It is extensively fished at the Kalbadevi creek near Ratnagiri and Tarkarli creek near Malwan. It is next in importance to M. casta on the east coast, especially at Adyar (Nayar and Mahadevan, 1974). It is never found in the interior of backwaters where the salinity is low.

Utility: They are generally eaten by poorer classes people and the shell is used in the preparation of lime.

Growth: According to Rao (1951) the life span is 3 years and clams of the size 26-33.8 mm in length are over one year old. Similarly 38.8 to 43.5 mm length are two year old clams. Growth is arrested during August-December period when there is a fall in salinity.

In the Kalbadevi estuary it attains a length of 22 mm, 31 mm and 43 mm by the end of 1, 2 and 3rd year respectively (Mane, 1974a). The growth rate is not uniform throughout the year and it is rapid from September to January, moderate from February to May and poor during June-September. The retarded growth during the monsoon is correlated with low salinity and the disturbance rings formed at this time were made use in age determination (Mane, 1974a).

Maturity: In the Adyar estuary first indication of sexual maturity is observed in 11-12 mm clams when they are 3 months old (Rao 1951). In Kalbadevi it attains sexual maturity at a size of 12 mm in males and 13 mm in females (Mane, 1974 a).

Spawning: Spawning begins in December in the Adyar estuary when the river is in communication with the sea and lasts about a month (Rao 1951). In the Kalbadevi estuary the clams spawn twice a year; major spawning takes place in October-November and a minor one confined to March-April period (Mane 1975). The spawning in October is attributed to salinity and temperature rise.

Physiology: Ranade and Kulkarni (1973) stated that K. opima tolerates a low salinity of 14.0‰ under laboratory conditions when the transfer to low salinity is sudden. On acclimatization to low salinity its tolerance limit comes down to 7.5‰. Comparable results on salinity tolerance were obtained by Mane (1974b). Thus acclimatization has survival value during monsoon when the estuarine salinities are low.

e) Paphia spp.

Paphia malabarica, P. laterisulca, P. textile and P. marmorata are the common species exploited along the Maharashtra, Goa and North Kanara coasts. Paphia occurs along the Malabar coast and east coast of India but not in abundance.

Exploitation and fishery: P. laterisulca occurs in Mahim Bay and is found in most of the estuaries along the Maharashtra coast. In Ratnagiri District about 10% of the clam production is accounted by Paphia. In Goa it occurs in Siolim, Siridao and Ribander. Near Karwar in Kalinadi P. malabarica is abundant (Alagaraswami and Narasimham 1973). It occurs in depths upto 4 metres in sandy mud. 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. They are fished throughout the year with a peak between January and July. During peak fishing each individual collects 40 kg per day and about a tonne are landed daily in each centre (Nayar and Mahadevan, 1974).

Biology of *P. laterisulca*: Mane (1979) studied its biology from the Kalbadevi estuary. The clam grows to a length of 23, 38, 47 and 50 mm at the end of 1, 2, 3 and 3.5 years respectively. The retardation of growth in the monsoon is attributed to low salinity and monsoon checks in the form of annual rings are formed. These were also used in age determination. Sexual maturity is attained at 16-18 mm, spawning takes place from September to March with 2 peaks in November and March.

f) *Donax* spp.

Donax spp. are called wedge clams or bean clams and are widely distributed along the exposed sandy shores of our coast line.

Exploitation and fishery: *D. incarnatus* Gmelin is common along the Bombay coast, Goa, a number of Bays around Karwar and Cochin. *D. cuneatus* Linnaeus and *D. faba* Gmelin are widely distributed both along the east and west coasts. *D. scortum* Linnaeus is fairly abundant along the Palk Bay and Gulf of Mannar (Alagaraswami and Narasimham, 1973). Though they are abundant, at present there is no regular fishery for these clams as food or any organised lime making industry with the result the resource is neglected (Nayar and Mahadevan, 1974).

Biology of *D. cuneatus*: At Palk Bay it grows to a size of 13-14 mm in 11 months. The life span is two years and it grows upto 19 mm. Ring formation due to cessation of growth in November-December was observed (Nayar (1955)). At Ratnagiri it grows to a size of 13-14 mm, 21-22 and 22 to 23 mm within 1, 2 and 2.5 years respectively. Growth was moderate during December-January, rapid during February-June and poor in July-November. Fast growth in February-June is correlated with rising salinity and the retarded growth during monsoon and winter with low salinity (Talikhedkar et al., 1978).

The size at sexual maturity at Palk Bay is 10-13 mm when the clams are 10 months old. They spawn for the first time from January

to April when they are one year old and do not spawn more than twice during their life time (Nayar, 1955). Spawning has been reported from December to June at Madras (Rao 1967), and October to January at Ratnagiri (Nagabhushanam and Talikhedkar 1977a). The protein content varied from 56.59 to 68.31%, glycogen 11.14 to 25.85% and fat in 56 to 7.15% (Nagabhushanam and Talikhedkar, 1977b).

Biology of *D. faba*: It grows to a length of 19.5 mm in the first year and 23.5 mm at the end of second year at Mandapam. The life span does not seem to exceed 3 years. The clams reach sexual maturity at 13-14 mm length. Spawning is prolonged, extending from November to June with two spawning peaks in November- December and May-June. The average percentage edibility values ranged from 7.25 to 11.98 during different months and *D. faba* appears to be in the best condition during August-October and March-May period (Alagarwami, 1966).

Biology of *D. incarnatus*: At Goa spat that settled in April grew rapidly and continuously for 8 months reaching 21-22 mm length by December. Growth was slow for the next 12 months and few clams survived to reach this age (Ansell et al., 1972). The same authors obtained slightly slower growth for the same species at Cochin. Ayyappan Nair et al (1978) recorded a growth rate of 2.2/mm/month for the same species at Goa and observed that growth was influenced by availability of particulate organic carbon and chlorophyll a in the surf water. Bio-chemical studies on this clam from Goa showed that fat varied from 7.08 to 11.56%, carbohydrate 4.43 to 14.12% and protein 60.56 to 66.94% on dry weight basis (Ansell et al 1973). The average caloric value given by the same authors is 4650 cal/g dry weight.

Anadara granosa (Linnaeus)

Members of the genus Anadara are popularly called as ark shells, blood clams and cockles. A. granosa is widely distributed along the east and west coasts of our country. It grows upto 70 mm in

length. It forms a fishery second only to the windowpane oyster in the Kakinada Bay.

Exploitation and fishery: A. granosa thrives well in soft muddy bottom with good amount of silt. In the Kakinada Bay this clam is fished in the region from the intertidal upto 4 m depth waters. Fishermen from 15 villages around Kakinada fish for the clams throughout the year with a peak in March-May. Annual production is estimated at 1000 tonnes valued at Rs. 50,000 (Narasimham, 1973).

Present status of utility: They are eaten locally to a limited extent and occasionally used as medicine. Shells are mostly burnt into lime in kilns locally known as batties with the meat intact.

Biology: It grows to a length of 31.5 mm 49.5 mm at the end of 1st and 2nd year of life respectively. The commercial catches chiefly consisted of clams below 2 years old. It attains sexual maturity at 21 mm length when 7 months old and appears to spawn throughout the year with peak activity in January-April period (Narasimham, 1969).

In addition to the clams dealt in the foregoing account there are a few other species along our coasts which are fished to a lesser extent or practically unexploited but with a potential, mention may be made of the following.

Meretrix casta var ovum (Hanley): It grows to a length of 35-40 mm and is fished along the Kerala coast. /along

Tellina pinguis Hanley: It is a brackish water form and is among the important commercial clams on the Bombay coast.

Mesodesma glabratum (Lamarck): It is common on the coarse sandy beaches of the islands of Gulf of Mannar and is seldom fished.

Gafrarium tumidum Roding: Nearly 5 tonnes of this cockle clam are fished annually at Pamban and Rameswaram (Alagarwami and Narasimham, 1973).

Solen Kempti Preston: This has commercial importance near Ratnagiri where over 3 tonnes valued at Rs.2000/- are annually landed. It grows to a length of 52.5 mm at the end of first year. Spawning takes place between late October and March. Sexual maturity is attained when the clams are 5 months old. Diatoms and detritus form the bulk of its food (Rao et al., 1962).

Cardium spp.

The true cockles belonging to the genus Cardium are not abundant in our waters. We have a few species like C. asiaticum. Bruguiere and C. assimile Reeve distributed at several places but they do not constitute fishery.