1007 Clam resource in the Ashtamudi Lake, a tropical estuary in southern India: Management and conservation concerns

Clam resources form the livelihood of more than five hundred families in and around Ashtamudi Lake, situated between latitude 8°45' - 9°28' N and 76°28 - 77°17' E. The alarming increase in the exploitation of *Paphia malabarica* in the recent years forced the Government of Kerala to impose ban on the fishing activities during its breeding season based on the recommendations of CMFRI in 1993. In order to assess the present status of clam resources of Ashtamudi Lake, a survey was conducted from 2nd to 10th February 1996 by the Molluscan Fisheries Division of CMFRI, Cochin as part of the project on clam seed production and ranching' funded by the Marine Products Export Development Authority (MPEDA), Cochin, Government of India.

The study revealed that about 1200.78 ha in Ashtamudi Lake is rich in clam resources harbouring about 61255 t of commercially important clams. The ecological condition of the lake consisted of a marine zone in the bar mouth and adjacent areas, a middle estuarine zone followed by an extensive near-freshwater zone.

A. Ecology of clam bed:

The hydrographic parameters showed wide variation between stations. The hydrographic and sediment features recorded at the ten stations are given in table1.

The average depth of the clam bed was 1.72 m and average clarity 1.31 m. In general, water clarity was low in the first five stations (Fig.1) located near the bar mouth and high towards the upper reaches of the lake. The surface salinity of Ashtamudi Lake showed a gradual reduction from 33 ppt near the barmouth to 5 ppt in the upper reaches. While the surface salinities exhibited clear zonations of fresh to marine stations, the bottom water salinity variation was not pronounced. The dissolved oxygen content of the surface water was maximum of 2.79 ml/l in station IX and minimum of 1.17ml/l in station IV. The DO content of bottom water was highest of

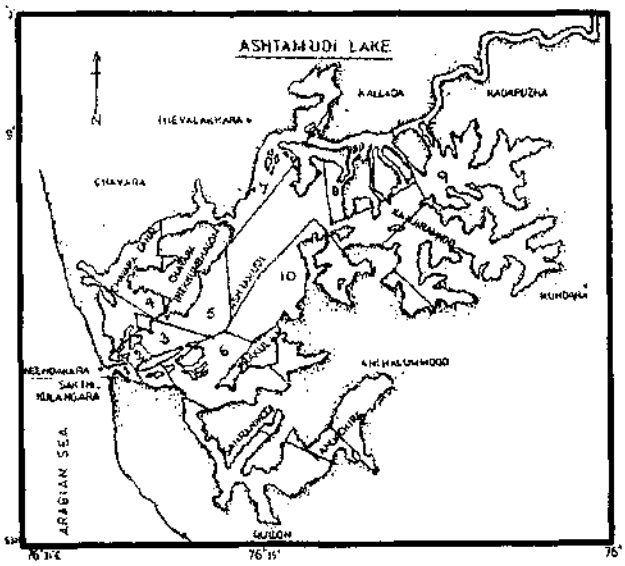

Fig.1. Map showing stations 1 to 10 in Ashtamudi Lake

2.7 ml/l in station VIII and lowest, 1.04 ml/l in station IV. The average gross productivity of the surface water in Ashtamudi Lake was estimated at 5.01 gC/m3/day. The average net productivity was 2.57 gC/m3/day. The productivity of bottom water was comparatively higher; the average gross and net values were 6.4 and 4.1 gC/m3/day respectively.

The soil composition was fine sandy and clayey in all stations. The percentage composition of each station showed a distinct pattern. At station I, fine sand was 41% and clay 59%, at station II, it was 58 and 42; at station III, 41 and 59; station IV, 43 and 57; station V, 49 and 45 respectively. This exhibits a distinct correlation in the distribution of the clam species with regard to the substrate preference. The soil texture of each station is indicated in table 1.

B: Clam Resource

The extent of clam bed in the Ashtamudi Lake was estimated at 1200.78 ha. The distribution of clams showed wide variation in terms of species composition, density and biomass in all the ten stations. However, clear zonation was seen in the distribution of dominant clam species like *Paphia*

Table 1. Hydrographic details of the surface and bottom water of the clam beds in Ashtamudi Lake

Station	Salinity (ppt)		Dissolved oxygen (ml/L)		Productivity (MgC/m3)				Depth (m)	Clarity (m)	Soil Texture
	Surface	Bottom	Surface	Bottom	Gross Surface	Gross Bottom	Net Surface	Net Bottom			
I	31	32	2.34	2.47	2.67	3.34	0.67	2.67	1.73	1.28	Clay
II	33	32	2.21	2.21	5.34	5.34	4.01	1.34	1.28	0.82	Clay
III	33	34	2.08	2.21	2.01	6.01	0.67	5.35	1.30	0.95	Sandy clay
IV	28	29	1.17	1.82	6.68	4.01	4.68	0.67	1.75	1.25	Clay
V	30	30	2.21	2.21	8.02	6.68	5.35	5.35	1.23	1.15	Clay
VI	29	30	1.69	1.04	4.01	7.35	3.34	6.68	1.68	1.55	Sandy clay
VII	23	26	2.21	1.17	5.35	7.35	1.34	5.35	2.16	2.00	Clay
VIII	17	27	2.47	2.73	8.02	10.02	1.34	8.69	1.80	1.00	Clay
IX	13	24	2.79	1.71	4.32	10.02	1.64	4.01	2.04	1.46	Clay
X	5	25	1.95	1.95	4.01	4.01	2.67	1.34	1.89	1.67	Clay
Average	24.2	25.9	2.11	1.95	5.01	6.4	2.57	4.1	1.72	1.31	

malabarica, Villorita cyprinoides and *Meretrix casta*. Apart from these three dominant clams, other bivalves like *Katelysia opima, Anadara granosa, Perna viridis, Modiolus sp., Crassostrea madrasensis* and *Saccostrea culcullata* contributed to bivalve biomass in varying magnitude.

i. Distribution of clams:

All the stations except IV was found to be rich in clam resources. Salinity of the station which was influenced by its proximity to the sea was the main ecological factor which contributed to the zonation or distribution pattern of clam. *Paphia malabarica* formed the single species population of the bivalve biomass in station I, II, III and V. These stations had almost marine conditions with high salinities ranging between 29 and 34 ppt. In the middle regions, mixed population of all the three species were noted but dominated by *Meretrix casta* contributing to 62% (stn. VI). These regions with salinity between 23 and 29 ppt had estuarine conditions. Figure 1 depicts the distribution of clam with respect to salinity and substrate. In upper regions of Ashtamudi lake where low saline conditions prevailed *Villorita cyprinoides* was the dominant species contributing to more than 95% of the biomass. The complete absence of *Villorita cyprinoides* in the marine station and *P. malabarica* in the upper reaches clearly highlighted the zonation of clams in Ashtamudi Lake. *Katelysia opima*, which was reported to be abundantly distributed in the middle station of the estuary during the early 1980's was found to be scarce and observed only in few number in station IV.

The specific substrate preference of each species was also distinctly evident. *Paphia malabarica* was more densely distributed in the lower station, i.e; stations II-III, showing a preference for sandy clay substrate, *Meretrix casta* in the middle to upper station, i.e; stations V-X and *Villorita cyprinoides* in the upper station, i.e. stations VII-X exhibiting a preference for clayey substrate.

ii. Density of clam bed:

Density of clams was highest with 3732 nos per sq.m in station II. High densities of 3480 and 1814 nos/sq.m were observed in station III and VII. *Paphia malabarica* was the single species contributing to high density in station II and III while in the station VII *Villorita cyprinoides* and *Meretrix casta* together formed dense beds. Density was as low as 59 and 74 nos per sq.m in stations VI and VIII, while in station IV, clams were completely absent. The average density of the commercially important species in the different stations is given in table 2.

iii. Biomass of clam bed:

The biomass denoted by the total weight per sq.m was highest in station II (18.8 kg). Similar high values were recorded in station III (14.6 kg)

Table 2. Average density (number/sq.m.) and average biomass (shell-on weight g/sq.m) of three dominant clam species in Ashtamudi Lake

Station	Average density (Number/sq.m)			Average biomass (Shell on weight g/sq.m.)		
	P.malabarica	*M.casta*	*V.cyprinoides*	*P.malabarica*	*M.casta*	*V.cyprinoides*
I.	344	nil	nil	1199	nil	nil
II.	3732	nil	nil	18840	nil	nil
III.	3480	3	nil	14619	12	nil
IV.	nil	nil	nil	nil	nil	nil
V.	59	nil	nil	600	nil	nil
VI.	200	26	3	1333	338	6
VII.	nil	688	1126	nil	5328	3436
VIII.	10	nil	64	20	nil	448
IX.	8	146	694	16	818	3648
X.	nil	378	483	nil	2688	2304

and VII (8.7 kg). The lowest biomass observed was 0.4 kg in station VIII. The average biomass of *P. malabarica, M. casta* and *V. cyprinoides* in different stations is given in table 2.

About 61255 t of clam was estimated as the standing stock of Ashtamudi Lake. *Villorita cyprinoides* with an estimated biomass of 36945 t was the dominant resource occupying approximately 1029.5 ha. *Paphia malabarica*, (22672 t) was the second followed by *Meretrix casta* (1638 t) contributing to 31% and 2.0% of the total clam biomass respectively.

Station IX contributed to 97.4% of the total biomass of *Villorita cyprinoides*, while station I, II and III together contributed to 99.9% of *Paphia malabarica* biomass. 92.1% of *M. casta* biomass was recorded in station VII.

iv. Length composition of clams:

Paphia malabarica of 5 to 46 mm length were observed in the population. In the first station the mode was observed in 24-26 mm, while in station II, the mode was in 26-28 and 28-30 mm length range. In station III, V and VI larger clams were dominant with the modes in 32 to 34 mm length range.

Seed clams (below 15 mm) formed 5.4 and 2.29% of the population in station I and II respectively, while in station III their contribution was as high as 16%. In station V seed clams were completely absent, while in station VII and IX, where only stray (3 and 5 nos/sq.m) occurence of *Paphia malabarica* was recorded, 100% and 80% of clams, respectively, were below 15mm.

Villorita cyprinoides of 5 to 36 mm length were observed in the population. In station VII all the length groups were represented with mode in 20-22 mm length range. In station VIII clams of 5 to 34 mm of length were recorded with mode at 20-22 mm. In station X slightly larger clams of 24-26 mm were dominant.

Though clams of 5 to 36 mm length were noted in the beds of *M. casta* in Ashtamudi Lake, almost entire population was contributed by clams above 15 mm. Seed clams were present only in negligible quantity. In all the stations where *M. casta* was available, 26-28 mm was the modal length group except in station X where the mode was at 28 to 30 mm.

C. Clam fishery:

Fishery for *Paphia malabarica* was observed in the first three stations during low tide. Fishery methods were mainly had picking and hand dredging with scoop nets. In this area, small clams were not observed in the fishery since the fishery was mainly targeted at export market. The catch per canoe varied from 200 to 400 kg. In the

middle and upper reaches of the estuary indiscriminate fishing, of *Meretrix casta* and *Villorita cyprinoides* was observed.

The fishery for *Paphia* commences by February, every year. Four types of fishing methods were observed for *Paphia*, the hand dredge operated from a dugout canoe, two divers collecting clams from a canoe by alternate diving, canoe with one diver and collection by hand picking from shallow water. The first method is widely practised in Ashtamudi, which gives the maximum yield. 300-450 canoes with hand dredges are operated during peak fishing season (February to may). For *Villorita* fishing, diving and scooping the clam bed is being pacticed in most of the stations. Diving is done in deeper waters and hand picking in shallow areas.

In 1981, when clam fishery was initiated for export trade, only 200 t were landed for one year period in Ashtamudi. In 1982, it rose to 5,436 t. The average annual landing from 1982 to 1992 was 6,800 t with peak of 10,000 t in 1991. The production declined drastically in 1993 to 5,000 t. This created concern among the fishermen and they demanded action against indiscriminate fishing in the estuary especially during spawning season.

Utilization: Meat of *Meretrix casta* and *Villorita cyprinoides* are extracted and sold in the market. Bulk of *P. malabarica* landed is taken to the processing plant where they are subjected to depuration, grading and shucking. Frozen meat is exported.

Remarks: Clams have been exploited for the past one and half decade and the fishery has shown wide fluctuations during this period. The survey has thrown light on the present status of the clam resources of Ashtamudi estuary and also raised several management concerns. The following recommendations have been made for the judicious exploitation, regulation of fishing and conservation of the clam resources of the estuary to ensure a sustainable fishery.

The regulatory measures to be enforced include:

- Restriction on mesh size for clam fishing (the bag net of the hand dredge used for clam fishing should be larger than 30 mm) and ban on fishing of juveniles.
- Ban on fishing during peak spawning season (October to January)
- Strict vigilance at the check posts to restrict large-scale movement of under-sized clams for use in the carbide industry.
- Restriction on export grade size of frozen clam meat to below 1400 numbers/kg.

Mariculture practices such as transplantation / relaying / semiculture of clam seeds for increasing production. Sea ranching programmes to reduce fishing pressure on the juvenile stock.

Stock enhancement programmes for the overexploited stock and other potential species such as *Katelysia opima* which is a potential clam resource in the Ashtamudi Lake, having excellent export potential. However, the stock which was present in the middle zone of the estuary in the early 80's has been wiped out due to increase in salinity with the closure of freshwater flow from the Kallada river and subsequent change in the nature of the bottom substrate. This stock can be revived, through joint R&D efforts by the CMFRI and other Central and State fisheries development agencies.

Optimum utilisation of clam meat of all the species through value addition (cocktail shellfish meat, pickles smoked clam meat, clam meat curry) and market promotion (at both domestic and international levels) by collaborative research by the fisheries technology institutes and export promotion agencies.

While regulatory measures have been implemented to revive the *Paphia* fishery, concerted efforts are necessary for the long-term sustained development and management of fishery of other clam species in this dynamic tropical estuary.

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