Long-Term Changes in the Species Composition of Molluscs in Cochin Backwaters, Southwest Coast of India

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Abstract: *Cochin estuary is the second largest wetland system in India. Long-term changes in the diversity of benthic molluscs in Cochin estuary were investigated to assess overall health of the ecosystem. Sampling was done during the period July 2002- May 2004.Monthly and seasonal variations in the diversity of molluscs was studied. Results showed that estuary was poor in respect of molluscan fauna. Molluscs shows seasonal variation in occurrence. The molluscan fauna consisted 3 species of bivalves and one species of gastropod. The bivalve Muculista senhousia was found to a new invader to the system. It formed thick mat over the bottom, preventing the growth of other benthic animals. But their representation was occasional. It generally exhibited clumped distribution. Present data was compared with that of earlier investigators during the period 1974-2000. 17 species of molluscs, earlier reported from the estuary were found to be absent in the present survey. The ecology of these benthic molluscs may be adversely affected by changing physico-chemical parameters. The study emphasizes that estuary is affecting biodiversity degradation Judicious management is necessary for the survival of remaining fauna.*

***Keywords:*** *Cochin estuary, benthic fauna, long-term change, mollusca, pollution*

I. Introduction

Estuaries are the critical transition zones that link land, fresh water and the sea . They are biologically highly productive region. They act as critical reproductive and nursery ground for a variety of organisms. They are considered as hot spot of biodiversity. It supports a plethora of organisms. The benthos refers collectively to all aquatic organisms, which dwell, in, on or near the bottom of water bodies. Molluscs are common components of the benthic communities. They form the second largest phylum among the invertebrates . Majority of them are either suspension or deposit feeders. They are important component of many ecological communities. Marine molluscs have variety of substratum including rocky shores, coral reefs, mud flats and sandy beaches. They prove immensely beneficial both economically and medicinally (Wosu, 2003)[1]. They have been exploited worldwide for food, ornamentation and pearl production. However, molluscs are potentially at risk because of the impacts of human activities.

Many of the world's wetlands have polluted over the last century due to agricultural and urban development. The depletion of biodiversity may be due to introduction of exotic species, habitat loss or alteration and pollution of water. Benthic fauna are used in a variety of monitoring programmes to assess overall estuarine health and to follow long-term trends in estuarine communities related to anthropogenic impacts Joydas *et al.,*2012[2]. Molluscs are abundant, sedentary and easy to collect, which makes them ideal organisms in biomonitoring programmes (Bresler 2003)[3]. Bivalve and gastropod molluscs are among the most useful organisms for environmental monitoring (Boening, 1999)[4]. Present study investigates qualitative and quantitative distribution of benthic molluscs in Cochin estuary,India.

II. Materials And Methods

Cochin estuary the second largest wetland system in India is located in the tropical region between 09° 40' -10° 40' N and 76°00'-77°30'E. It is a bar-built estuary constituting a network of shallow canals and situated on the southwest coast of India.
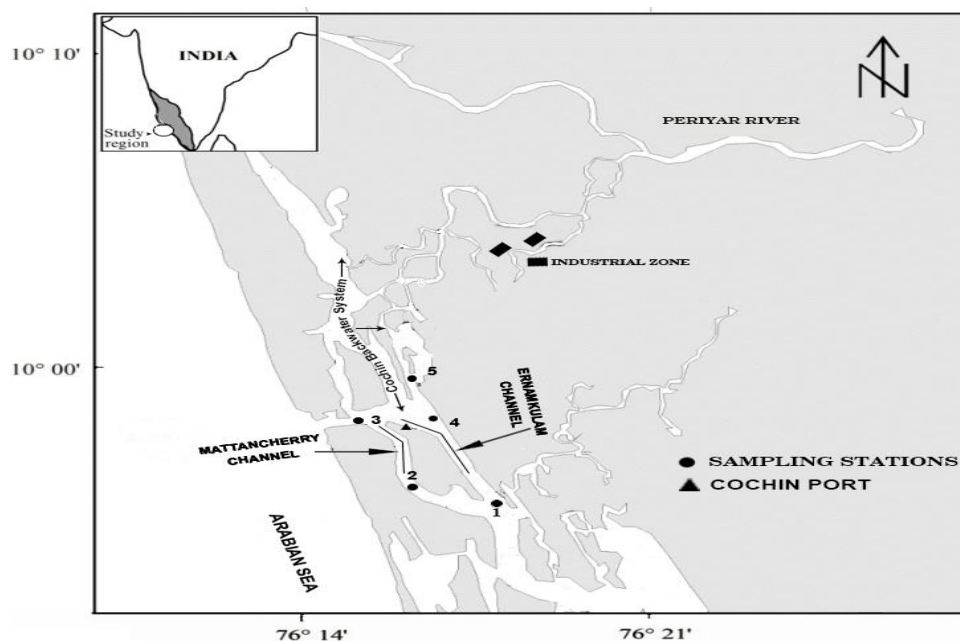
Figure: 1 Location of sampling stations in the cochin estuary

Although the estuary has openings at Cochin and Azhikode, the former inlet is wider (450 m) and forms the main entrance to the Arabian Sea. It is unique in-terms of geology, climate, hydrology, land use and flora and fauna. At the same time it receives a lots of pollutants (Menon *et al.,* 2000)[5]. This estuary experiences natural stress from the annual rainfall regime. During the monsoon period (June-September) heavy rainfall results in higher river discharge, making a freshwater condition in the estuary.

Sampling was conducted from 5 stations of Cochin estuary during the period 2002 – 2004(fig:1 and Table 1). Four $0.05m^2$ van Veen Grab hauls were taken from each station. Altogether 60 grab hauls were taken. The sediment samples were sieved through 0.5 mm mesh and fixed in 5% neutral formalin. Mollusc were sorted to species level, followed by counting of individuals.

Table: 1 Details of stations

Stn No.	Name	Latitude	Longitude
1	Thevara	Lat 9^0 55' 35 N	76^0 17' 53 E
2	Mattancherry	Lat 9^0 56' 47 N	76^0 15' 52 E
3	Barmouth	Lat 9^0 58' 26 N	76^0 14' 39 E
4	Marine Science Jetty	Lat 9^0 57' 39 N	76^0 16' 40 E
5	Bolghatty	Lat 9^0 58' 52 N	76^0 15' 50 E

The survey period consisted of two phases. During the first phase (July 2002-June 2003) monthly collection of samples were done. In the second phase (July 2003-May 2004) seasonal sampling was carried out. Altogether 15 collections were done. For the sake of interpretation, the data collected were pooled together based on the seasons and subjected to further analyses. A calendar year was divided into 3 distinct seasons viz.,Monsoon (June- September),Post-monsoon (October -January) and Pre-monsoon (February -May).

III. Result And Discussion

Table 2 shows spatial and temporal variation of molluscs in the study area .Generally the estuary was poor in respect of molluscan fauna. The molluscan fauna includes 3 species of bivalves (*Katalysia* sp, *Paphia* sp & *Muculista senhousia)* and one species of gastropod *(Thais* sp*)*. Out of these *Muculista senhousia* was the only dominant group that gave fair contribution to population density. But their representation was occasional. All the other species had rare incidence.

Table: 2 Population density of Mollusc (no/0.1 sq.m) at station 1-5 during the period July 2002 to May 2004

Station	Jyo2	Aug	Spt	Oct	Nov	Dec	Jano3	Feb	Mar	Apr	May	Jun	Jy	Nov	My04
1	6	4	0	0	0	2	2	2	30	8	2	4	4	4	8
2	0	2	0	0	2	2	2	0	2	0	0	0	26	0	0
3	16	54	0	0	0	0	0	4	52	82	50	50	0	0	2
4	0	0	0	0	0	2	2	8	230	290	40	8	0	0	0
5	0	0	0	0	0	2	10	0	0	2	0	0	0	0

At station 1 the number varied from (0-30)/0.1 sq.m. With respect to station 2 it varied from (0 – 26)/0.1 sq.m. As far as station 3 is considered it varied from (0-82)/0.1 sq.m. At station 4 it varied from 0 – 290/0.1 sq.m. With respect to station 5 it varied from (0-10)/0.1 sq.m. Nil occurrence of species was also reported from different stations in a number of collections .The major share of the density was given by *Muculista senhousia* at all stations. From table 2 it is clear that the molluscs show seasonal variation in occurrence. Maximum density of molluscs occurred during pre-monsoon season.

Many scholars have produced clear evidences to indicate the nature of evolving resource crisis and environmental degradation in Cochin backwaters (Balachandran *et al*., 2006[6]; Martin *et al*., 2008[7]). The community structures of molluscs in Cochin backwaters were well documented earlier (Pillai,1978[8]; Batcha,1984[9]; Sarala,1986[10] and Sheeba,2000[11]) . The present investigation was a resurvey of five selected stations of Cochin backwaters to trace the molluscan diversity change that might have occurred over the period 1974-2004.

From the table 3 it is clear that 21 species of mollusc were reported from station 1-5 during the period 1974-2004. The following 17 species of molluscs may be disappeared from the selected study area of the estuary which include *Arca bistrigata, Arca sp, Cardium sp,Dendrophylax sp, Dentalium sp, Dosinia sp, Littorina sp, Meretrix casta, Modiolus metacalfei, M.striatula, M.undulatus, Naculana* sp, *Solen* sp, *Standella* sp,*Suneta scriptta, Tellina* sp,and *Villorita* sp.

Table 3. Long term changes in the species composition of molluscs in the Cochin Estuary - (+++) - abundant, (++) - frequent , (+) -rare ,(---) - absent.)

		1974-76	1977-78	1981	1996-97	2002-04
1	Arca bistrigata	+	---	---	---	---
2	Arca sp	+	---	+	---	---
3	Cardium sp	---	---	---	+	---
4	Tellina sp	+	---	---	---	---
5	Dendrophylax	+	+	+	+	---
6	Dentalium	---	---	---	+	---
7	Dosinia	---	+	---	+	---
8	Katalysia	---	---	---	---	+
9	Littorina sp	---	---	+++	---	---
10	Meretrix casta	---	---	+	+	---
11	Modiolus metcalfei	+	+	--	---	---
12	M.striatula	---	---	+++	+	---
13	M.undulatus	++	++	+	+	---
14	Musculista senhousia	---	---	---	---	++
15	Naculana sp	+	+	---	+	---
16	Phaphia sp	+	+	+	+	+
17	Standella sp	+	---	---	---	---
18	Suneta scriptta	---	+	---	---	---
19	Thais sp	---	---	---	---	+
20	Solen sp	+	---	---	---	---
21	Villorita sp	---	---	---	+	---
	Total No of species	10	7	7	10	4

(Sources : 1974-76- Pillai ,1978; 1977-78-Batcha ;1984 1981- Saraladevi ,1986; 1996-97 Sheeba, 2000; 2002-2004- Present study)

Vast volumes of ballast water are discharged into the estuary by overseas shipping. Different organisms can be transferred around the world in ballast water. In many estuaries the exotic organisms are known to be brought as fouling on barges, drilling platforms and other structures(Willan 1985)[12]. The bivalve *Musculista senhousia,* which is a new invader to the system, became the prevailing species in the present study(2002-2004). Its byssus threads, which were forming a thick mat over the estuarine bottom, prevent the growth of other benthos. Out of the 3 species of bivalves of present survey the mussel *Musculista senhousia*, settles in aggregates and dominate itself in the benthic community. In the southern limb of the estuary it potentially excludes native species by suppressing the growth of other benthos in the same habitat. Its success in the estuary is probably due the absence of predators and its high adaptability in the disturbed environment.

The southern area of the estuary has several paddy fields and there were uses of organochlorines like hexachlorocyclohexane (HCH) and its isomers, and Endosulfan; organophosphates like malathion and methyl parathion to raise high yielding paddy varieties (Menon et al., 2000[5]). The ecology of molluscs is considered to be affected by environmental factors like physico-chemical parameters (Garg et al., 2009[13]). Decreasing the abundance of molluscs may be linked to nutrient loading and construction and operation of the water-controlled structures like 'Thannermukham bund' in the estuary. Since this act as a barrier between the fresh water and saline water habitats the estuary may no longer serve as nursery grounds for the larvae of molluscs, as it did earlier.

IV. Conclusion

Cochin estuary, one of the largest tropical estuaries of India, supports high levels of human pressure throughout the year . The different species showed clear seasonal and spatial variation in distribution. Pre-monsoon showed high density of individuals. The study showed that the molluscs are very sensitive to pollution and their species diversity is alarmingly decreasing. The deterioration of mollusc in Cochin estuary may be a result of pollution and habitat destruction. This study underlined that the threats are many; increasing in magnitude and the estuary is moving towards degradation. The study underscores the need for greater sensitivity and vision on the part of planners and decision makers towards conservation and sustainable management of pristine and productive ecosystems.

Acknowledgements

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