MOLLUSC DIVERSITY AT PULICAT LAGOON (INDIA)

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ABSTRACT

During our routine ecological survey conducted at Pulicat Lagoon, the most diverse class Gastropods comprised of 26 families with 34 species and Bivalvia with 13 families and 17 species were recorded. The most abundant molluscs species was *Crassostrea madrasensis*, captured between October 2013 – September 2015. Quite a good number of molluscs were washed ashore. The economic value of the shells in the field of cosmetics was raised high recently. Both in terms of aquaculture and market value the attention should be diverted towards their conservation. With few exceptions, the majority of these molluscs were ornamental.

RÉSUMÉ: La diversite des mollusques du lagon de Pulicat (India).

Durant notre étude écologique de routine effectuée dans le lagon de Pulicat, la classe la plus diversifiés des Gastropodes contient 34 espèces et 26 familles suivies par les Bivalves avec 17 espèces et 13 familles. Dans les prises d'Octobre 2013 – Septembre 2015, l'espèce la plus abondante a été la Crassostrea madrasensis. Un grand nombre de mollusques s'échouent sur les rives et récemment. La valeur économique des coquillages a augmenté de manière significative. En ce qui concerne l'aquaculture ainsi que la valeur de marché, l'attention devrait se porter plus vers leur conservation. A quelques exceptions près, la grande majorité sont des mollusques ornementaux.

REZUMAT: Diversitatea moluștelor din Laguna Pulicat (India).

În cadrul studiului nostru ecologic de rutină, efectuat în laguna Pulicat, s-au înregistrat 34 specii din 26 familii aparținând clasei Gastropoda, cea mai bine reprezentată, și 17 specii din 13 familii aparținând clasei Bivalvia. În capturile din Octombrie 2013 – Septembrie 2015, specia cea mai abundentă a fost *Crassostrea madrasensis*. Un mare număr de moluște au fost aduse pe țărm de valuri. Valoarea economică a cochiliilor cu aplicații cosmetice a crescut recent. Atât în termeni de acvacultură cât și de valoare de piață, atenția trebuie reorientată către conservarea acestor specii. Cu câteva excepții, majoritatea acestor moluște sunt ornamentale.

INTRODUCTION

The role of molluscs proved to be beneficial both cost-effectively as well as medicinally in the recent past (Wosu, 2003). They are important to humans as a source of food, jewellery, tools and even pets. Molluscs play a significant role in public and veterinary health (Supian and Ikhwanuddin, 2002). *Biomphalaria glabratus* caused with schistosomiasis (Richards, 1970).

In India 3,271 molluscs belong to 220 families and 591 genera, of which 1,900 are gastropods, 1,100 are bivalves (Venkatraman and Venkataraman, 2012). The studies on Indian molluscs were initiated by the Asiatic Society of Bengal and the Indian museum, Calcutta (Venkataraman and Wafar, 2005). Subba Rao and Dey (2000) reported 3,370 species of marine molluscs in India, out of which 1,282 species were from Andaman and Nicobar Islands. Subba Rao (2003) contributed in the field of mollusc's faunal diversity from Indian coastal regions.

Pulicat Lake is one of the most productive ecosystems in India. Chacko et al. (1953) gave the first exhaustive account of the biodiversity of the Pulicat Lake and it has been considered as a classical benchmark in the field biodiversity of the Pulicat Lake (Sanjeeva Raj, 2003, 2006). In previous studies, we have reported the Avifaunal diversity at Pulicat Lagoon (Govindan et al., 2015). The distribution of the mollusc's fauna in the Pulicat Lagoon has been reported by Thangavelu and Sanjeeva Raj (1985). They have also described the extensive mining of molluscs shells (Thangavelu and Sanjeeva Raj, 1985) in the northern regions of the Pulicat Lagoon. In order to update already existing data on mollusc's diversity we conducted a two year survey, which covered the entire area of Pulicat Lagoon.

MATERIAL AND METHODS

Pulicat Lagoon is the second largest brackish water, lying partly in Tamil Nadu and Andhra Pradesh. In Tamil Nadu, the Pulicat Lagoon is located in Pulicat Vvillage in Thiruvallur District. It is connected with the Bay of Bengal through a deep opening of about 0.8 km width situated about 1.6 km north of the Pulicat light house. Five sampling stations, namely Barmouth (S1), Kunankuppam (S2), Light house kuppam (S3), Sattankuppam (S4) and Jameelabad (S5) (Fig. 1) were selected at Pulicat Lagoon.



Figure 1: Sampling locations in Pulicat Lagoon.

The mollusc's shells were collected by hand picking, scraping method and through laboratory. The shells were washed with water to remove adhering debris without damaging and then dried. The collected molluscs were identified with morphological characters. The gastropods were mainly identified based on the spire length and shape, mouth opening, opercular, umbilicus, colour and ornamentation and bivalves on the hinge, interlocking dentition, with referred to elsewhere Richards (1970), Vannucci (2002), Subba Rao (2003), Ramakrishna and Dey (2010), Venkatraman and Venkatraman (2012).

The specific shell characters like spire shape and length, opercular, umbilicus, mouth cavity, colour and ornamentation, were used primarily for the recognition of studied gastropods. The studied bivalves were recognized principally based on the shell morphology and the two valves. The external surface may be striated and the two valves held together by a ligament and a scar on the hinge.

1. The Shannon-Wiener diversity index, Simpson's index and Margalef's richness index were calculated for estimating mollusc's diversity. The data were subjected to diversity indices and cluster analysis using PAST Software, Margalef index (Margalef, 1958).

Margalef's index was used as a simple measure of species richness

Margalef's index = (S - 1)/In N

S = total number of species

- N = total number of individuals in the sample
- In = natural logarithm (Margalef, 1958)
- Shannon Diversity Index "H" H = -Σ [(ni/N) x (lnni/N)] H: Shannon Diversity Index ni: Individuals number associated to i species N: Individuals total number (Magurran, 2004)
 Simpson Diversity Index "D"
- Simpson Diversity index D Simpson's index of dominance: $D = \Sigma$ ni (ni-1)/N (N-1) Where, ni = the total number of individuals of a particular species. N = the total number of individuals of all species (Magurran, 2003)
- 4. Pielou Evenness Index "J" (Pielou, 1966) J = H/Hmax J: Pielou evenness index H The observed value of Shannon Shannon index Hmax: lnS S: Total number of species (Pielou, 1966)

RESULTS AND DISCUSSION

Gastropods and bivalves are the two major classes of phylum mollusc contributed by 39 families belonging to 51 species. The most diverse class: Gastropod has 26 families belonging to 29 genera, 34 species (Fig. 2; Tab. 1) and Bivalve included 13 families, 15 genera and 17 species (Fig. 3; Tab. 2). 39 family, 51 species were located at Barmouth (S1), 39 family, 50 species were located at Kunankuppam (S2), 29 family 35 species were located at Light house kuppam (S3), 27 family 23 species were located at Sattankuppam (S4) and at Jameelabad (S5) 25 family, 30 species were located (Tab. 1). The Conidae were found to be the dominant family in Pulicat Lagoon.

Gastropods and bivalves are generally benthic organisms and they are frequently used as bio indicators of aquatic health. A similar study was conducted at a few localities from the Raigad District the Maharashtra West Coast of India. Nearby 22% bivalves and 78% gastropods were recorded throughout October 2010 to September 2011 (Khade and Mane, 2012). In total 55 species of molluscs representing 13 orders, 30 families and 39 genera were recorded from the mangroves of Uran, Maharashtra (Pawar, 2012). An analogous study was carried out at Dadar and Juhu beach in Mumbai that revealed the availability of 19 genera and 14 families collectively on both coast lines. Most number of Bivalves belonged to the Cardidae while maximum Gastropods were from Trochidae family (Joshi et al., 2013). The study revealed that there is a good diversity of molluscs.



Figure 2: Distribution of Gastropods in Pulicat Lagoon.



Figure 3: Distribution of Gastropods in Pulicat Lagoon.

Family	Name of the species	S1	S2	S 3	S 4	S5
1. Architectonicidae	Architectonica perspectiva		+	+	1	-
2. Babyloniidae	Babylonia zeylanica		+	+	١	_
3. Buccinidae	Cantharus tranquebaricus	+ + +		+	١	+
4. Bullidae	Bulla ampulla	+	+	1	١	_
5. Bursidae	Bufonaria echinata	+	+	1	١	_
6. Cassidae	Phalium glaucum	+	+	+	+	+
7. Cerithiidae	Rhinoclavis sordidula		+	+	+	+
8. Chilodontidae	Euchelus asper		+	+	+	+
	Conus amadis	+	+	_	-	_
0 Caridaa	Conus betulinus	+	+	+	+	+
9. Conidae	Conus lentiginosus	+	+	+	+	+
	Conus virgo	+	+	1	١	_
10. Fasciolariidae	Fusinus colus	+	+	+	+	+
11. Ficidae	Ficus variegata	+	+	+	+	_
12. Harpidae	Harpa major	+	+	+	+	+
13. Melongenidae	Pugilina conchlidium	+	+	+	+	+
14. Muricidae	Chicoreus virgineus	+	+	+	١	_
	Murex carbonnieri	+	+	+	-	+
15. Naticidae	Eunaticina papilla	+	+	+	-	-
	Natica lineata	+	+	Ι	-	-
	Natica vitellus	+	+	+	+	+
16. Olividae	Agaronia nebulosa	+	+	Ι	-	-
	Oliva caerulea	+	+	+	+	+
	Oliva oliva	+	-	Ι	-	+
17. Potamididae	Telescopium telescopium	+	+	+	+	+
18. Strombidae	Strombus marginatus succinctus	+	+	+	+	+
19. Terebridae	Hastula inconstans	+	+	+	+	+
20. Tonnidae	Tonna cumingi	+	+	+	-	-
21. Trochidae	Umbonium vestiarium	+	+	—	-	_
22. Turbinellidae	Turbinella pyrum	+	+	—	_	+
23. Turridae	Gemmula unedo	+	+	+	+	+
24. Turritellidae	Turritella attenuata	+	+	_	-	_
25. Volutidae	Melo melo	+	+	+	+	+
26. Xenophoridae	Xenophora solariformis	+	+	_	_	_

Table 1: List of gastropod identified from Pulicat Lagoon.





Figure 4: Distribution of Biavalve in Pulicat Lagoon.

Family	Name of the species	S1 S2 S3 S			S4	S5
	Anadara antiquate	+ + +			+	+
Arcidae	Anadara granosa	+	+	+	+	+
Cardiidae	Vasticardium flavum flavum	ıvum flavum + +				_
Carditidae	Cardita antiquata	uata + +		+	_	+
Cucullaeidae	Cucullaea labiata	ta + +		+	+	_
Donacidae	Donax cuneatus	+	+	+	+	+
Mactridae	Mactra antiquata	+	+	+	+	+
Mytilidae	Perna viridis	+	+	_	_	_
Ostreidae	Crassostrea madrasensis	+	+	+	+	+
Placunidae	Placuna placenta	+	+	_	_	_
Pinnidae	Atrina (Atrina) vexillum	+	+	+	+	+
	Pinna bicolor	+	+	_	_	_
Tellinidae	Tellina cancellata	+	+	+	+	+
Veneridae	Gafrarium tumidum	+	+	+	+	+
	Paphia malabarica	+	+	+	+	+
	Paphia textile	+	+	+	+	+
Pteriidae	Pinctada margaritifera	+	+	_	_	_

Table 2: List of gastropod identified from Pulicat Lago

Margalef index was minimum 1.329 during post monsoon 2014 at the Jameelabad (S5) and maximum 8.834 at monsoon 2014 were recorded in the Barmouth (S1) (Tab. 3). Margalef Diversity Index "Ma" has no limit value and it showed variation depending upon the number of species. Thus, it is used for comparison between the sites (Hazarika, 2013). The noticed value was 7.78 which was also at the inferior limit of the scale. Simson index was minimum 1.952 at the Jameelabad station (S5) in the time of post monsoon 2014 and maximum 27.118 at the Barmouth (S1) during the post monsoon 2015 was noticed (Tab. 3). Simpson index was closer to one pointed out almost acceptable diversity status of the Pulicat Lagoon. Shanon Wienerindex was minimum 1.040 in Jameelabad (S5) in the time of post monsoon 2014 and maximum 3.459 at Barmouth (S1) during the summer 2014 (Tab. 3). Diversity indices of mollusc's communities showed that Shannon index value (H) was 0.50, which was not at all satisfactory as "H" value above three indicating better balance and stable habitat condition (Mandaville, 2002). Pielou index "J" showed that molluscs species found minimum 0.580 at the Jameelabad (S5) during the post monsoon 2014 and maximum 0.971 during the monsoon 2014 at Sattankuppam (S4) (Tab. 3). Pielou index "J" showed that molluscs species reported area in the studied area almost evenly distributed because our calculated values were closer to one (Mandaville, 2002).

Study	Seasons	Stations	5 Diversity Indices				
period			Margalef's (M)	Simpson's (1/D)	Shannon wiener (H)	Pielous's index	
		S1	8.834	23.297	3.406	0.875	
2013		S2	6.930	20.280	3.245	0.920	
	Monsoon	S3	4.013	7.538	2.436	0.879	
		S4	2.216	5.769	1.841	0.946	
		S5	1.747	3.396	1.536	0.790	
		S1	7.112	26.793	3.438	0.914	
		S2	6.740	16.788	3.087	0.861	
	Post	S3	3.852	12.651	2.700	0.917	
	monsoon	S4	1.953	5.063	1.853	0.891	
		S5	1.329	1.952	1.040	0.580	
2014		S1	8.121	25.979	3.459	0.904	
		S2	7.062	18.862	3.186	0.904	
	Summer	S3	3.875	6.000	2.232	0.805	
		S4	1.846	4.091	1.587	0.886	
		S5	1.535	3.558	1.505	0.840	
		S1	7.494	23.693	3.379	0.910	
	Premonsoon	S2	5.868	13.674	2.906	0.882	
		S3	3.267	6.050	2.155	0.867	
		S4	2.164	5.333	1.787	0.918	
		S5	1.765	3.322	1.447	0.808	
		S1	6.795	26.049	3.409	0.924	
	Monsoon	S2	6.792	18.978	3.204	0.894	
		S3	4.973	13.984	2.901	0.913	
		S4	5.049	15.291	2.805	0.971	
		S5	4.010	11.700	2.676	0.909	
-	Post	S1	6.937	27.118	3.448	0.917	
	monsoon	S2	5.985	20.806	3.205	0.909	
		S3	5.016	18.250	3.061	0.940	
		S4	3.940	7.759	2.405	0.867	
		S5	3.168	7.496	2.327	0.859	
		S1	6.691	26.661	3.427	0.929	
2015	Summer	S2	6.123	21.486	3.232	0.909	
		S3	4.275	13.501	2.797	0.905	
		S4	3.244	8.426	2.369	0.898	
		S5	4.200	12.524	2.732	0.897	
		S1	7.112	26.032	3.432	0.918	
	Premonsoon	S2	5.932	18.441	3.142	0.907	
		S3	4.809	13.898	2.858	0.911	
		S4	3.478	11.025	2.510	0.951	
		S5	3.981	12.411	2.697	0.916	

Table 3: Molluscs fauna diversity indices of seasonal variations in 2013-2015.

CONCLUSIONS

The present investigation on molluscs species diversity associated with the lagoon ecosystems along Pulicat Lagoon, revealed the distribution of 34 gastropods and 17 bivalves, totalling to 51 molluscs species with one species of gastropod was dominant, namely *C. madrasensis*. It might, therefore, be useful and rewarding to further investigate the contributions of these macroinvertebrates towards nutrient processing and survey their role as biomonitors.

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