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Diversity and abundance of freshwater mollusc in lower Cauvery River

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Abstract

Molluscan species were collected from specific stations of Cauvery (Grand anaicut to Melaiyur) from December 2004 to December 2015. At six study sites 12 samples were taken and 24 molluscan species were recorded, of which 17 species were gastropods and 7 species bivalves. The gastropod species were grouped under 8 different families (Thiaridae and Viviparidae, Ampullaridae, Pleuroceridae, Lymnaeidae, Neritidae, Bithynidae and Planorbidae) the family Thiaridae (*Thiara scabra, Tarebia granifera, Melanoides tuberculata, Tarebia lineata*) was dominant group representing (26.34%) followed by Ampullariidae (15.86%) of the total Molluscan population. Bivalvia was represented by only 3 families in which Unionidae (24.87%) was dominant group. The greatest species richness occurred at Grand anaicut, Kabishtalam and Melaiyur while 12 molluscan species were present at all studied localities. Different biological indexes are used to findout the diversity, dominance, species richness and evenness of the observed moluscan fauna. The result priority to the importance of conserving the world's freshwater molluscan community, which are reducing at an alarming rate through habitat changes.

Key words: Freshwater Mollusc, Gastropoda, Bivalvia, River Cauvery

1. Introduction

Molluscs are most important community for freshwater biodiversity, and where abundant play a major role in ecological functioning (Wagmare &Kularni, 2015). These organism usually in habit benthic sediments for at the minimum part of their life cycle, and they are large enough to be retained by a mesh size of 0.2 mm to 0.5mm (Rosenberg & Resh 1993). After insects, Molluscan communities were the second largest invertebrate group on earth (Bouchet, 1992, Olofintoye & Olorunniyi, 2016). Hitherto the identified molluscan species has been increased from 80,000 (Boss, 1971) to 1, 35,000 (Abbott, 1989). The majority of molluscan species are also a standard biological indicator for paleoenvironments and pollution. According to their resistance power against utmost of Physico-chemical components of water (Edmondson *et al.,* 2010: Druart *et al.,* 2011, Raina *et al*., 2016).

The freshwater ecosystem in India harbor a rich diversity of molluscs, representing 203 species belongs to 59 genera, 29 sub genera under 26 families (Ramakrishna and Dey, 2007). According to reports from 1902 to till date, majority of the molluscan studies accomplished were for a little purpose of therapeutic values than anything else. Apart from this inference, few research analyses have also worked on this aspect with reference to parasites. Compared to numerous studies carried out in United States of America on the use of macro invertebrates in the biological monitoring and evaluation of water quality, very little analysis has been executed in India (Sivaramakrishnan *et al*., 1996). However, there are not any detailed taxonomic and spatial studies available to survey of species diversity, behavioral expression etc. that World highest the importance of preserving gastropod diversity (John Paul *et al.,* 2010).

Freshwater molluscs have faced a serious decline in diversity, abundance and distribution caused by manmade modification of habitats, deforestation, poor agricultural implementation, sand mining, pollution, the demolition of riparian area (Biggins *et al.,* 1995; Pimm *et al.,* 1995). Freshwater rivers and streams have been exposed to broad range of anthropogenic impacts (Savic *et al.,* 2016). In the last 300 years, enormous numbers of land and freshwater molluscs' extinction have been taken place (Groombridge, 1992; Aravind *et al.,*2011).

Most surveys have analysed streams and comparatively small rivers and there is an urgent requires to obtain ecological information on the large rivers many of which are pressure caused by increasing population and urbanization (Petts,

1993). The aim of current study exhibited about diversity and abundance of molluscan group in the selected sites of Cauvery. Therefore, the current work is a step ahead in surveying benthic mollusc group in lower Cauvery at specific objectives are to provide a species record of molluscan fauna at the study sites and determined the diversity.

2. Materials and Methods

The study on the molluscan community of the Cauvery River stretching from Grand anaicut to Poompuhar was executed for a period of year from December, 2014 - December, 2015. Six sampling stations were fixed in the river stretch (Fig.1).

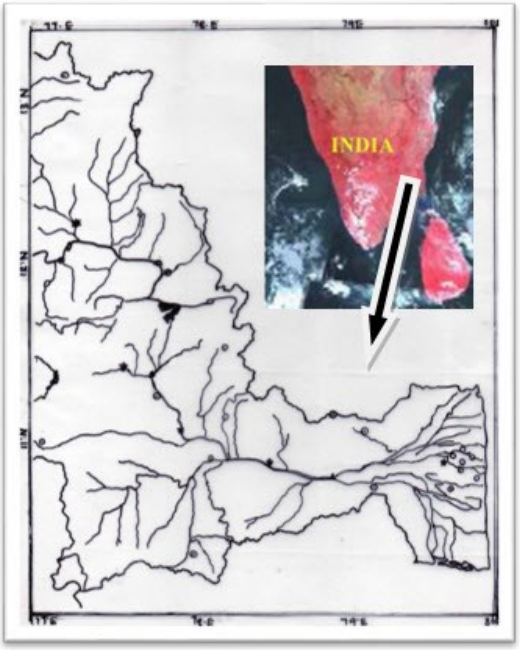

Fig.1: Location of the Cauvery river and sampling area.

Table 1 GPS Coordinates of the River stretches along the lower Cauvery

Site No	Name of the station	Longitude	Latitude	Location
1	Grand anaicut	E 78°49'22.2''	N 10°49'54.5''	Located at a span of 15 km from Tiruchirapalli, the dam was constructed by the Chola King Karikala (2nd century)
2	Kabisthalam	E 79°13'21.6"	N 10°55'55.2"	15 km down from Kallanai
3	Thiruvaiyar	E 79°06'24.37"	N 10°52'37.42"	1km down stream from Thiruvaiyar main Bridge
4	Kumbakonam	E 79°22'41.5"	N 10°58' 05.7"	2 km from Kumbakonam city
5	Moovalur	E 79°36'34.7"	N 11°05'28.4"	Up stream, 3 km from Mailaduthurai city
6	Melaiyur	E 79°48'18.8"	N 11°08'53.3"	Last check dam, 7 km above the Kaveripoompattinam

Description of sampling sites is presented in Table 1. The molluscs were collected by taking 3 kick nets samples from a unit area (mesh size 0.5mm); the contents of the nets were pooled and preserved in 70% ethanol. Diversity was determined by counting the sum of species per square meter for each sample. Molluscan species were identified by following standard literature (Subba Rao, 1989; Dey, 2007). We also discussed with ZSI/SRS Scientists of doubtful specimens. Identified specimens are deposited in Educational Museum, Zoology Department, Poompuhar College (Autonomous) Melaiyur, Nagapattinam, TamilNadu, India. Species richness and relative abundance of molluscan community were calculated. Shannon Wiener diversity index (H') was widely used for molluscan diversity studies and Shannon Index was calculated through the following equations.

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$H = -\sum (ni/N) \log 2 (ni/N)$

Where, n*i*= total no. of individuals of taxa, N=total no. of individuals of all taxa.

3. Result

In the current study, considerable changes in molluscan diversity was observed in the six sites of Cauvery River in 2014-2015. Total 24 species of molluscs be categorized to 11 families were observed (Table-1; Plate-1). Gastropods collected at the studied sites belong to 17 species within eight families. Two families were represented by four species (Thiaridae and Viviparidae) and three families were represented by two species (Ampullaridae, Pleuroceridae and Lymnaeidae) each. Three families were represented with a single species (Neritidae, Bithynidae and Planorbidae).

Table -2: Relative abundance of molluscan species in 6 sites of Cauvery River

Sl.No	Class/Order/Family /Genus/Species Name	S 1	S2	S3	S4	S5	S6
	Phylum: Mollusca						
	Class: Gastropoda						
	Order: Mesogastropoda						
	Family: Neritidae						
1	*Septaria lineata* (Lamarck, 1816)	2.33	1.09	0.00	2.33	5.00	4.51
	Family: Viviparidae						
2	*Bellamya bengalensis Lamarck* form annandalei (Kobelt, 1908)	0.78	0.55	0.00	0.00	0.00	0.00
3	*Bellamya bengalensis* form *eburnea* (Annandale, 1921)	0.39	0.00	0.00	0.00	0.00	0.00
4	*Bellamya dissimilis* (Muller, 1974)	3.11	3.83	4.17	4.65	1.25	1.50
5	*Bellamya micron (*Annandale, 1921)	0.00	0.55	0.00	0.00	0.00	0.00
	Family: Ampullaridae						
6	*Pila globosa* (Swainson, 1822)	5.84	5.46	10.42	16.28	6.25	5.26
7	*Pila virens* (Lamarck 1822)	7.39	8.20	18.75	11.63	10.00	9.77
	Family: Bithynidae						
8	*Bithynia (Digoniostoma) pulchella* (Benson 1836)	0.78	1.64	0.00	0.00	0.00	0.00
	Family: Thiaridae						
9	*Thiara (Thiara) scabra* (Mueller, 1774)	10.89	9.84	8.33	13.95	27.50	18.80
10	*Melanoides tuberculata* (Mueller, 1774)	5.84	5.46	4.17	11.63	18.75	13.53
11	*Tarebia granifera* (Lamarck,1822)	3.11	2.73	0.00	0.00	0.00	0.00
12	*Tarebia lineata* (Gray,1828)	2.72	2.73	0.00	0.00	0.00	2.26
	Family: Pleuroceridae						
13	*Paludomus (Paludomus) annandalei (Preston, 1909)*	7.00	7.65	8.33	4.65	2.50	4.51
14	*Paludomus(Paludomus) transchauricus* (Gmelin,1771)	5.84	5.46	4.17	4.65	7.50	3.76
	Order: Basommatophora						
	Family: Lymnaeidae						
15	*Lymnaea (Pseudosuccinea)acuminata* form *typica* (Lamark, 1822)	0.78	0.00	0.00	0.00	0.00	0.00
16	*Lymnaea(Pseudosuccinea) luteola* form *typica* (Lamark,1822)	0.78	0.55	2.08	0.00	0.00	0.75
	Family: Planorbidae						
17	*Indoplanorbis exutus* (Deshayes, 1834)	7.00	7.10	10.42	4.65	6.25	3.76
	Class: Bivalvia						
	Order:Unionoidea						
	Family: Unionidae						
18	*Lamellidens consobrinus* (Lea, 1859)	2.72	2.73	0.00	0.00	1.25	2.26
19	*Lamellidens corrianus* (Lea, 1834)	7.00	6.56	2.08	4.65	2.50	1.50
20	*Lamellidens marginalis* (Lamarck,1819)	9.73	9.84	16.67	11.63	3.75	9.02
21	*Parreysia (Parreysia) corrugata* (Mueller, 1774)	7.00	9.84	6.25	4.65	2.50	11.28
22	*Parreysia (Parreysia) favidens* (Benson, 1862)	1.17	0.00	0.00	0.00	0.00	0.00
	Family: Corbiculidae						
23	*Corbicula striatella* (Deshayes, 1854)	5.45	6.56	4.17	4.65	5.00	3.76
	Family: Pisidiidae (Sphaeriidae)						
24	*Sphaerium indicum* (Deshayes, 1854)	2.33	1.64	0.00	0.00	0.00	3.76

S1- Grand anaicut, S2- Kabisthalam, S3-Thiurvaiyar, S4- Kumabkonam, S5-Moovalur,S6-Melaiyur

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Table -3: Species diversity indices of molluscan species in 6 sites of Cauvery River

Species diversity indices	S1	S2	S3	S4	S5	S6
Species Richness	23	21	13	13	14	17
Abundance	257	183	48	43	80	133
Dominance D	0.06	0.07	0.11	0.10	0.14	0.10
Shannon H	2.87	2.80	2.36	2.41	2.25	2.54
Simpson 1-D	0.94	0.93	0.89	0.90	0.86	0.90
Evenness e^H/S	0.77	0.78	0.82	0.85	0.68	0.74
Menhinick	1.44	1.55	1.88	1.98	1.57	1.47

Bellamyadissimilis

Bellamyabengalensis form *typica*

Bellamyabengalensis form *annandalei*

Paludomus annandalei

Bellamya micron

Bithynia pulchella

Thiara scabra

Paludomus transchauricus

Melanoides tuberculata

Tarebia lineata

Tarebia granifera

Lymnaea acuminate form *typica*

Indoplanorbis exustus

Lamellidens corrianus

Perreysia corrugata

Plate -1: Freshwater molluscan species

Among the Gastropoda group Thiaridae (*Thiara scabra, Melanoides tuberculata, Tarebia granifera, Tarebia lineata*) was dominant (26.34%) followed by Ampullariidae (15.86%), Pleuroceridae (11.56%), Planorbidae (6.45%), Viviparidae (3.63%), Neritidae (2.55%), Lymnaeidae (0.94%) and Bithynidae (0.67%) while three families(Unionidae (24.87%), Corbiculidae (5.24%) and Pisidiidae (1.88%)) of class Bivalvia was recorded (Fig.2). *Thiara scabra* and *Mellanoides tuberculata* is the commonest and most wide ranging member of the family Thiaridae, found dominant in

the lower stretch of Cauvery. *Thiara scabra* contributed 13.84% of the total number of species recorded, *L.acuminata* being a minor contributor forms only 0.13% of the overall density of molluscan fauna observed. Among bivalves *Lamellidens marginalis* forms 9.54% and thus dominates *Parreysia corrugata* (7.80%).

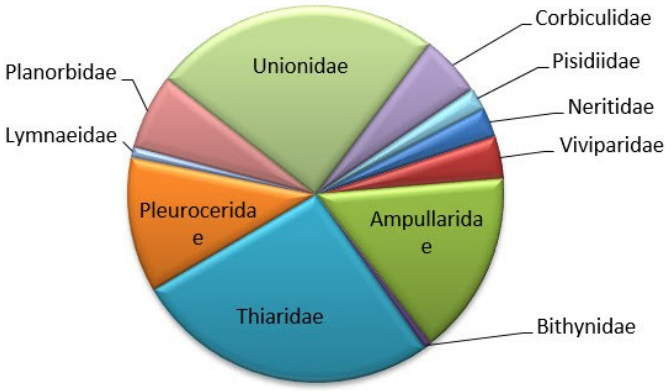

Fig.2 Percentage of molluscan species composition in 6 sites of Cauvery River

High Shannon-Wiener indices were recorded, varying between H=2.249 to H=2.874. Species dominance index i.e. Simpson's index varied between (d_{Simp}=0.890 to d_{Simp}=0.936) (Table 3). The greatest species richness occurred at localities 1, 2 and 6 (23,21, and 17 species respectively). Species like *Thiara tuberculata, Lymnaea luteola, Indoplanorbis exutus* are all common, even occurring in polluted waters. The species *Parreysia favidens* and *Lymnaea acuminata* was found at only one locality, while 12 species of mollusc were present at all studied localities.

4. DISCUSSION

Distribution data for freshwater Mollusca of the Cauvery River has been expanded by an additional 100km, resulting in 13 more species containing sites being documented. Molluscan diversity has been shown to directly proportional to the drainage area of water *resources* (Watters, 1992) The lower Cauvery exhibits a higher molluscan diversity compared to other Indian rivers. Earlier study, Narmatha River, which has a species richness of 19 (Kumar and Vyas, 2012). High molluscan species in river Barak and its branches in Assam were described and it was noticed that gastropods were in greater state than bivalves and recorded 16 molluscan species to be classified by two classes (Roy and Gupta, 2010). Similar observations were acquired in River Nile (Fishar and Williams, 2006) and in the Murrumbidee River in Australia (Harrison *et al.,* 2008). To the best of our knowledge, previous studies on lower cauvery molluscs showed lower species numbers than the present investigation. Amanullah and Hameed (1996) revealed the occurrence of 12 species of freshwater molluscs belonging to 5 families of Gastropoda in the Tamilnadu part of lower Cauvery. Dhanalakshmi *et al.,* (2013) recorded thirteen species in lower anaicut. All of lower anaicut species were witnessed in the current study. Higher number of molluscan species were collected from the study area may be caused by the successive collection of the current work.

Freshwater biodiversity patterns are closely associated to local geographic features and physiochemical habitat structure, in combination with biological effects. (Malm *et al.,* 2005). In the current study Thiara *scabra, Pila virens* and *Lamellidens marginalis* dominated the molluscan fauna and are distributed from the shore line to 3m depth in all types of sediments. Plant species like *Eichhornia sp*., *Ipomea sp*., *Pistia sp*. and *Salvinia sp*. are prevalent in most of the pool habitat in this region. Among the gastropod species, *Indoplanorbis exutus*, *Lymnaea luteola, Pila virens* and *B.dissimilis* were related with aquatic weeds which provided food and shelter for those organisms. When the weeds are expired and deteriorate leads to increase the turbidity level of water and cause an anomic environmental condition. These changes in states are likely to have a severe impact upon freshwater molluscan fauna. There is a limited research into the effects of these aquatic weeds in the aquatic ecosystems on the freshwater molluscan fauna.

The percentage of frequency of each species composition (species richness) to the total samples was calculated. The species constitution of the community ranged from thirteen to twenty three species. The species constitution of molluscan group ranged between 13 species at Kumbakonam and Thiruvaiyar and 23 species at Grand anicut. Lower stretch of Cauvery except site 1 and 2, are increasingly vulnerable due to a variety of anthropogenic activities. Species such as *Thiara tuberculata, Lymnaea luteola* and *Indoplanorbis exutus* are all common, even occurring in polluted waters (Arvind *et al*., 2011). Through this study the crucial threats to lower Cauvery molluscs have been identified as agricultural and urban water pollution, overharvesting, dams, urban development and mining. In the river course, there are no studies that have addressed the impact of sand mining on freshwater molluscs. Hence, there is pressing need to study the impact of sand mining on mollusc biodiversity. Pennak (2004) reported that the dissolved oxygen is the restricting factor for the distribution of molluscs, absence of molluscan population in shallow strata of the Thiruvaiyar and Kumbakonam region indicates that the dissolved oxygen is a chief environment in limiting their distribution.

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