

An Updated Checklist of Benthic Polychaetes of Asia's Largest Brackish Water Coastal Lagoon -The Chilika Lake

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Abstract

Present study was carried out during the year 2007 to 2010, to describe the polychaete species in the Chilika lake after opening of a new lagoon inlet. A total of 45 polychaete species from the lake was observed. Among the dominant species *Nereis reducta*, *Capitella capitata*, *Heteromastus filliformis*, *Minuspio cirrifera* were conspicuous. Similarly, the taxa recorded first time in the lake were *Amphictene auricoma*, *Spiophanes bombyx*, *Mediomastus*, *Pomatoceros caeruleus*, *Hydroides elegans*, *Pisione remota*, *Hesione picta*, *Eteone picta*, *Eumida sanguine*, *Bipalponephtys cornuta*. These species were typical marine forms. This might be possible due to the opening of a new lagoon inlet. However, few indicator species like *Capitella* sp., and *Minuspio* sp. were observed from northern sector. From the entire study it was evidenced that sandy substratum of outer channel area appeared as the most suitable habitat for proliferation of benthic polychaete taxa.

Keywords: Benthic polychaetes; Outer channel area; Chilika lake

Introduction

During the recent periods, coastal ecosystems are much influenced by the natural and anthropogenic stresses. Some of the major stressors include sedimentation, eutrophication, heavy floods, tropical cyclones etc. These natural events can put moderate to severe impact upon macrobenthic community assemblage by altering the bottom sediment significantly [1,2]. This phenomenon is mostly seen in the shallow coastal ecosystems of tropical region [1,2]. The macrobenthos of tropical region is mostly dominant by polychaete [1,3]. Benthic polychaetes, because of the high level of adaptation, exhibited ubiquitous distribution in coastal and marine ecosystem. Certain features of polychaetes like limited mobility and ability to withstand in polluted conditions are tremendously helpful to the scientific community. Thus it has got virtual attention of different researchers and scientists worldwide, since they use it in eco-toxicological studies [4,5]. It is observed that under polluted conditions, the number of polychaetes may be high or low or complete impoverishment of taxa might be possible. But a higher level of species richness or diversity value of benthic polychaete may indicate a healthy condition of the ecosystem [6,7]. Besides this, it possess immense ecological functioning such as: (i) it is actively involved in the bio-geo-chemical cycling process [5,8,9], (ii) it acts as a coupling structure between meiofauna and macrofauna community in marine sediment [3], (iii) provides substantial contribution to the demersal fisheries of the tropical region [10], (iv) it interlinks the benthic community to the higher level trophic strata in the marine food chain [11].

Perusal of literatures revealed that, research on diversity and distribution of benthic polychaete on different coastal ecosystems of India has got maximum attention [3,12-21]. Although, research on benthic polychaetes in India was started from Chilika lake [22]. But recent study on this aspect was less. However, the lake is one of the most important ecosystems in the world enriched with biodiversity and vast destination for exploitable fishery resource. During the last couple of decades, the lake had faced many of the changes derived from natural and anthropogenic sources. Because of such events the lagoon inlet was closed. To revive the lake ecosystem from degradation a new mouth was dredged during the year 2000. Then, after couple of years the lagoon had

regained its pristine condition. Though, benthic polychaete is used as the indicator of environmental stress. But, in the context of Chilika lake very less information is available so far [20]. Thus, the present study was planned (i) to prepare a complete checklist of benthic polychaetes, (ii) to compare the present set of information with previously data set and (iii) to find out the occurrence of any pollution indicator species.

Materials and Methods

Study area-The Chilika Lake

Chilika lake is also called as a brackish water coastal lagoon. It is a shallow pear shaped ecosystem, provides enormous habitat support to a variety of flora and fauna. It appeared as an important destination for migratory birds and tourists. It is located between latitude 19° 28' and 19° 54' and longitude 85° 05' and 85° 38' of east coast of India adjoining to Bay of Bengal (Figure 1). The length of the lake is 64 km and width is varied from 2 to 20 km respectively. In summer the lake area shrink to 906 sq km from 1156 sq km in monsoon. It provides the socio-economic support to a population of 0.2 million residing in and around of it. They are mostly depended on fisheries and tourism sector. Every year almost a million of migratory birds often find their destination to Chilika lake. Mostly to the Nalabana bird Is. and Mangalajodi. It has vast exploitable fishery resource and thus provides immense socioeconomic support. Due to which the name of Chilika lake is included in the Ramsar site in 1981. Four ecological subdivisions were considered in the lake on the basis of salinity and composition of flora and fauna such as northern

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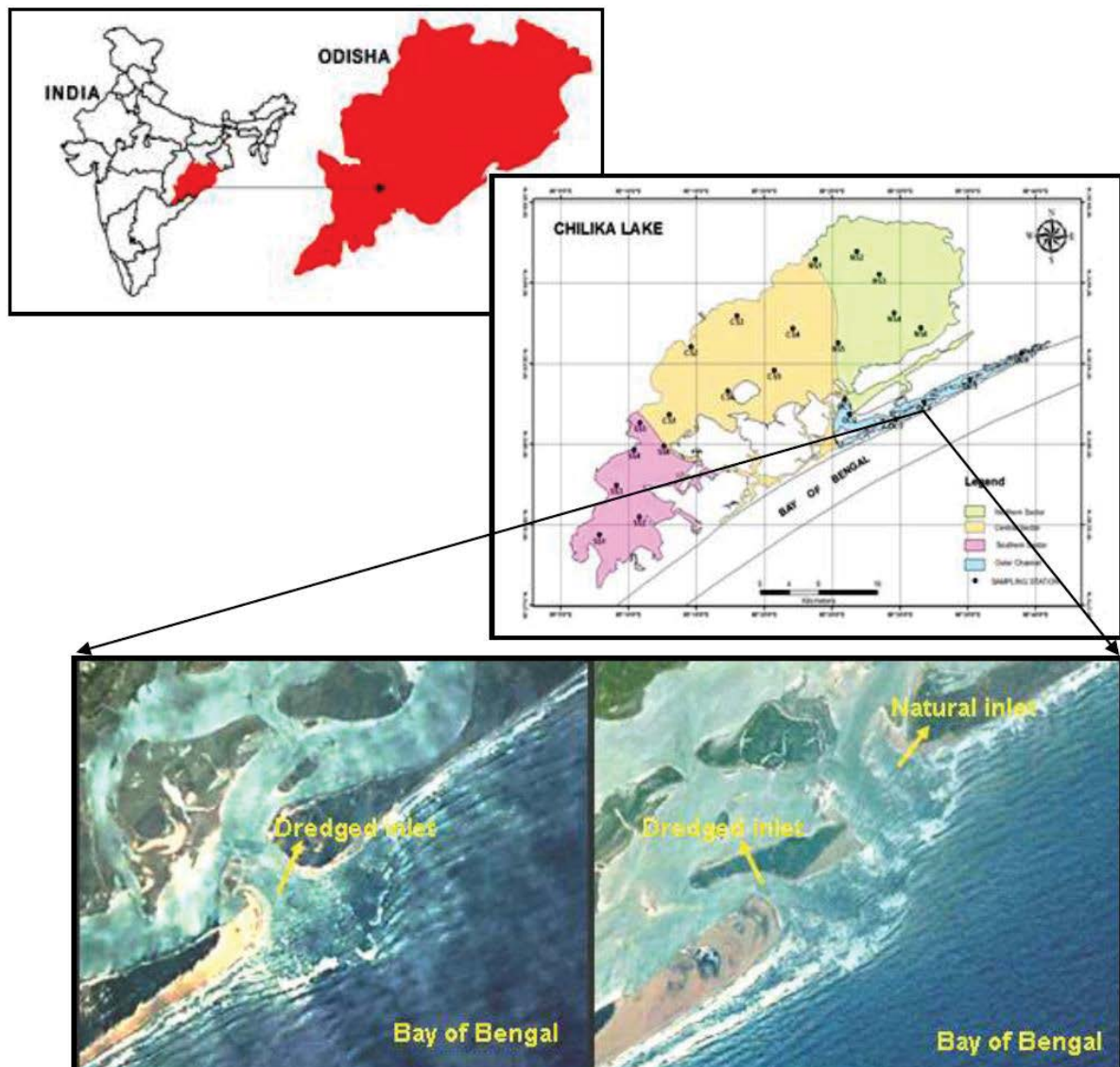


Figure 1: Map of Chilika lake showing sampling points and four ecological sectors and its neighbourhood.

sector having fresh water, central sector having brackish water, southern sector having brackish cum marine water and outer channel as the marine region [23,24]. On hydrological front, the lake is connected by three hydrological regimes such as (i) marine incursion from bay Bengal in the east, (ii) Mahanadi distributaries in the northern side and catchment influx from western catchment area, (iii) Palur channel in the south. There is a 16 km long canal that connects the southern tip of the Chilika lake to the Rushikulya estuary called as the "Palur channel". There are 52 number of river and rivulets bring silt borne fresh water during monsoon which is further out fluxed through the inlets to the Bay of Bengal. During the end period of 20th century, the lagoon inlet was closed due to which the lagoon-sea interaction was disturbed drastically with the sharp declination of salinity. As a consequence, the lagoon had undergone severe ecological degradation with sharp depletion of water quality followed by fisheries output. To revive the lagoon from such destructive condition, a new inlet was dredged at the

"Shipakuda" region of outer channel area during 23rd September 2000. During 1st of August 2008 another mouth was opened at 1 km northeast of the dredged mouth by natural process [25].

Sample collection and analysis

In order to get the macrobenthic polychaetes, multiple sediment samples were collected from all the four sectors (Figure 1) of the lake area during 2007 to 2010 by using a Van Veen type of grab sampler having the surface area of 250 cm². The sediment samples were washed through a sieve of 500 micron. Then the remaining residues over the sieve were collected carefully to plastic containers and preserved in 5% formaldehyde in sea water containing Rose Bengal solution. Then after, the entire samples were transferred in to the laboratory and washed repeatedly to remove the attached sediment and debris. After that, the polychaetes samples were removed from the group of other macrobenthic fauna. Standard procedure was followed regarding

polychaetes identification up to species level by using a stereo zoom microscope, followed by available identification keys [26,27].

Results and Discussion

During the present study a total of forty five species of polychaete taxa belonging to 23 families and 10 orders were reported (Table 1). Spatial distribution of taxa revealed that northern sector had the lowest number having 20 species, while central sector with 27 sp. and 25 species from southern sector was reported. But, outer channel area comprised with 39 species. Some of the newly occurred species reported after the

opening of new lagoon inlet during the year 2008 were *Amphictene auricoma*, *Spiophanes bombyx*, *Mediomastus*, *Pomatoceros caeruleus*, *Hydroides elegans*, *Pisione remota*, *Hesione picta*, *Eteone picta*, *Eumida sanguinea*, *Bipalponephthys cornuta* etc. Representatives of the families like Capitellidae and Neredidae were widely distributed in the lake sediment such as *Nereis reducta*, *Namalycastis indica*, *Neanthes chilkenis* *Capitella capitata* and *Heteromastus filliformis*. Some of the common representatives were those of *Sigambra constricta*, *Nephtys polybranchia*, *Nephtys oligobranchia*, *Goniadopsis longicirrata*, *Myriochele picta*, *Cossura coasta*, *Heteromastus filiformis* *Lumbrineris polydesma*

Class	Order	Family		Genus/species	OC	SS	CS	NS		
Polychaete	Phyllodocida	Nereididae	1	<i>Nereis reducta</i> Southern, 1921	+	+	+	+		
			2	<i>Neanthes chilkenis</i> Southern, 1921	+	+	+	+		
			3	<i>Neanthes glandicincta</i> Southern, 1921	+	+	+	+		
			4	<i>Namalycastis indica</i> Southern, 1921	+	+	+	+		
		5	<i>Perinereis nigropunctata</i> Horst, 1889	+	+	+	-			
		Nephtyidae	6	<i>Bipalponephthys cornuta</i> Southern, 1921	+	+	+	+		
			7	<i>Nephtys polybranchia</i> Southern, 1921	+	+	+	+		
			8	<i>Nephtys oligobranchia</i> Southern, 1921	-	+	+	+		
		Hesionidae	9	<i>Oxydromus fasciatus</i> Grube, 1855	+	+	+	-		
			10	<i>Hesione picta</i> Müller in Grube, 1858	+	+	+	-		
		Pilargidae	11	<i>Sigambra constricta</i> Southern, 1921	+	+	+	+		
			Phyllodocidae	12	<i>Eulalia viridis</i> Linnaeus, 1767	+	-	-	-	
		13		<i>Eteone picta</i> Quatrefages, 1866	+	+	-	-		
		14		<i>Eumida sanguinea</i> Örsted, 1843	-	+	-	-		
		Goniadidae	15	<i>Glycinde oligodon</i> Southern, 1921	+	+	+	+		
			16	<i>Goniadopsis longicirrata</i> Arwindsson, 1899	+	+	+	+		
		Glyceridae	17	<i>Glycera alba</i> Southern, 1921	+	-	-	-		
			Sigalionidae	18	<i>Pisione remota</i> Southern, 1914	+	-	-	-	
		Sabellida	Maldanidae	19	<i>Euclymene annandalei</i> , Southern, 1921	+	+	+	-	
				20	<i>Axiiothella obockensis</i> Gravier, 1905	+	+	+	+	
			Fabriciidae	21	<i>Fabricia spongicola</i> , Southern, 1921	+	-	+	-	
				Oweniidae	22	<i>Owenia fusiformis</i> Delle Chiaje, 1844	+	+	+	-
			23	<i>Myriochele picta</i> Southern, 1921	+	+	+	+		
			Sabellidae	24	<i>Chone fauveli</i> McIntosh, 1916	+	+	+	+	
			Serpulidae	25	<i>Pomatoceros caeruleus</i> Fauvel, 1933	+	-	-	-	
				26	<i>Hydroides elegans</i> Haswell, 1883	+	-	-	-	
			not assigned	Capitellidae	27	<i>Capitella capitata</i> Fabricius, 1780	+	+	+	+
					28	<i>Notomastus latericus</i> Sars, 1851	-	+	-	+
		29			<i>Heteromastus filliformis</i> Claparède, 1864	+	+	+	+	
		30			<i>Mediomastus</i> sp., Hartman, 1969	+	-	+	+	
		31			<i>Heteromastus similis</i> Southern, 1921	-	-	+	+	
		32			<i>Pullioella armata</i> Fauvel, 1929	-	-	-	+	
		33			<i>Cossura coasta</i> Kitamori, 1960	+	+	+	-	
		Eunicida	Onuphidae	34	<i>Diopatra neapolitana</i> Delle Chiaje 1844	+	-	+	-	
			Lumbrineridae	35	<i>Lumbrineris polydesma</i> Southern, 1921	+	+	+	+	
		Spionida	Eunicidae	36	<i>Lumbriconereis simplex</i> Southern, 1921	-	+	-	+	
				37	<i>Marphysa gravelyi</i> Southern, 1921	+	+	+	+	
				38	<i>Paraprionospio pinnata</i> Ehlers 1901	+	+	+	+	
				39	<i>Minuspio cirrifera</i> Wirén 1883	+	+	+	+	
		Scoleisida	Orbiniidae	40	<i>Spiophanes bombyx</i> Claparède 1870	+	-	+	-	
				41	<i>Polydora hornelli</i> Willey, 1905	+	-	-	-	
		Paraonida	Pilargidae	42	<i>Scoloplos marsupialis</i> Southern, 1921	+	+	+	+	
		Terebellida	Pectinariidae	43	<i>Aricidea lopezi</i> Berkeley and Berkeley, 1956	+	+	+	+	
		Eunicida	Onuphidae	44	<i>Amphictene auricoma</i> Müller, 1776	+	-	-	-	
				45	<i>Onuphis eremita</i> Audouin and Milne Edwards, 1833	+	-	-	-	
Total				45	39	25	27	20		

Table 1: Checklist of benthic polychaetes of Chilika lake collected during 2007 to 2010.

Minuspio cirrifera, *Scoloplos marsupialis*, *Paraprionospio pinnata*, *Capitella capitata* (Figure 2). All the representatives of Capitellidae observed during the present study were deposit feeders. But, Nereididae representatives were belonged to suspension feeders. Available information revealed that the northern sector contained with soft mud enriched with organic matter. Southern sector, Nalabana bird Is., and outer channel region is comprised with sandy sediment [25]. Presence

of 39 polychaete species in outer channel region in contrast of 20 species from northern sector revealed that most of the observed taxa favoured to live in sandy sediment than the soft mud. Similar observations were made earlier in different parts [21,28,29]. This is because of the clogging in the feeding apparatus of the filter feeders by the fine clay sediment. In fact, filter feeders feed upon the suspended planktonic matter present in the water column. But deposit feeders conversely

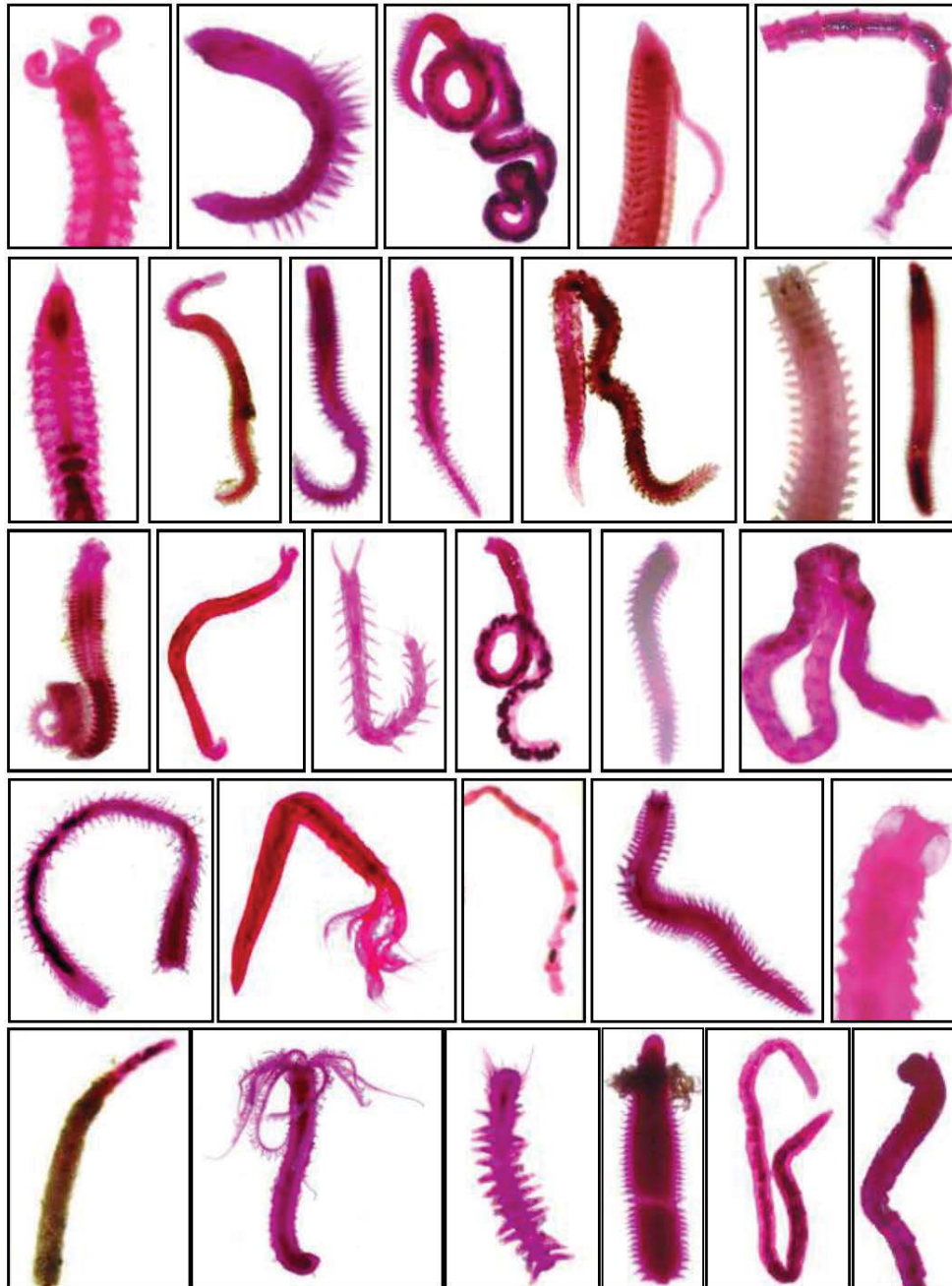


Figure 2: Benthic polychaetes of Chilika lake. From left to right *Polydora hornelii*, *Prionospio pinnata*, *Minuspio cirrifera*, *Cossura coasta*, *Axiothella obockensis*, *Aricidia* sp., *Glycinde oligodon*, *Nephtys oligobranchia*, *Nephtys cornuta*, *Nemalycastis indica*, *Perinereis nigropunctata*, *Drilonereis*, *S. constricta*, *Goniada*, *Pissione*, *Heteromastus similis*, *Ophiodrumus*, *Mediomastus*, *Eteone*, *Chon fauveli*, *Eucliyemene annandeli*, *Nereis reducta*, *Marphyssa falax*, *Myriochele picta*, *Fabricia spongicola*, *Hesione*, *Lumbrinereis polydesma*, *Capitella capitata*, *Heteromastus filliformis*.

Genus/species	Present study	ZSI 1995	Southern 1921
<i>Nereis reducta</i> Southern, 1921	+	+	+
<i>Neanthes chilkenis</i> Southern, 1921	+	+	+
<i>Neanthes glandicincta</i> Southern, 1921	+	+	-
<i>Namalycastis indica</i> Southern, 1921	+	+	-
<i>Perinereis nigropunctata</i> Horst 1889	+	+	+
<i>Bipalponephtys cornuta</i> Southern, 1921	+	-	-
<i>Nephtys polybranchia</i> Southern, 1921	+	+	+
<i>Nephtys oligobranchia</i> Southern, 1921	+	+	+
<i>Oxydromus fasciatus</i> Grube, 1855	+	-	-
<i>Hesione picta</i> Müller in Grube, 1858	+	+	-
<i>Sigambra constricta</i> Southern, 1921	+	+	-
<i>Eulalia viridis</i> Linnaeus, 1767	+	-	-
<i>Eteone picta</i> Quatrefages, 1866	+	+	+
<i>Eumida sanguinea</i> Örsted, 1843	+	-	-
<i>Glycinde oligodon</i> Southern, 1921	+	-	+
<i>Goniadopsis longicirrata</i> Arwindsson, 1899	+	+	-
<i>Glycera alba</i> Southern, 1921	+	-	<i>Tylonereis fauveli</i> ,
<i>Pisione remota</i> Southern, 1914	+	-	<i>Sternaspis costata</i>
<i>Euclymene annandalei</i> , Southern, 1921	+	-	+
<i>Axiiothella obockensis</i> Gravier, 1905	+	-	<i>Laonome indica</i>
<i>Fabricia spongicola</i> , Southern, 1921	+	-	+
<i>Owenia fusiformis</i> Delle Chiaje, 1844	+	+	-
<i>Myriochele picta</i> Southern, 1921	+	+	+
<i>Chone fauveli</i> McIntosh, 1916	+	-	-
<i>Pomatoceros caeruleus</i> Fauvel, 1933	+	+	-
<i>Hydroides elegans</i> Haswell, 1883	+	+	-
<i>Capitella capitata</i> Fabricius, 1780	+	+	-
<i>Notomastus latericus</i> Sars, 1851	+	+	-
<i>Heteromastus filiformis</i> Claparède, 1864	+	-	-
<i>Mediomastus</i> sp., Hartman, 1969	+	-	-
<i>Heteromastus similis</i> Southern, 1921	+	-	+
<i>Pulliella armata</i> Fauvel 1929	+	-	-
<i>Cossura coasta</i> Kitamori 1960	+	-	-
<i>Diopatra neapolitana</i> Delle Chiaje 1844	+	+	+
<i>Lumbrineris polydesma</i> Southern, 1921	+	+	+
<i>Lumbriconereis simplex</i> Southern, 1921	+	+	+
<i>Marphysa gravelyi</i> Southern, 1921	+	+	+
<i>Paraprionospio pinnata</i> Ehlers 1901	+	-	-
<i>Minusprio cirrifer</i> Wirén 1883	+	+	-
<i>Spiophanes bombyx</i> Claparède 1870	+	+	-
<i>Polydora hornelli</i> Willey 1905	+	-	+
<i>Scoloplos marsupialis</i> Southern, 1921	+	-	+
<i>Aricidea lopezi</i> Berkeley & Berkeley 1956	+	-	-
<i>Amphictene auricoma</i> Müller 1776	+	-	-
<i>Onuphis eremita</i> Audouin & Milne Edwards, 1833	+	-	-

Table 2: Comparison of species composition of benthic polychaetes with previous studies.

seen in muddy sediment and feed up on decomposed organic matter [28,29]. Thus sediment composition played a significant role in the distribution of benthic animal. This is well corroborated with findings of Sanders [30] who proposed regarding animal-sediment relationship. Similar observations were also documented by Palacin et al. [31] while working on Mediterranean Bay. Chilika lake has large expansion of sea grass meadow mostly at southern sector, Nalabana bird Is. and outer channel area. It was appeared as the best habitat for colonising the benthic polychaetes. The present study documented some of that genus such as Chone, Axiiothella, Aricidea, Scoloplos, Paraprionospio,

Polydora, Clymenella, Fabricia, Capitella, Mediomastus, Heteromastus, Notomastus, Sigambra, Glycinde, Goniada, Marphysa, Lumbrineris, Amphictene. Similar observations were made in the region of Southeast Brazil [32].

The observations made in the present study regarding the species composition of benthic polychaete can be comparable with earlier findings from this ecosystem. In the Table 2 comparison was made with the findings of ZSI [33] and Southern [22] reported 31 and 20 number respectively. However, 74 % of polychaetes from 1995 data set and 85% of the polychaetes from 1921 data set was found almost similar with

the present study. It is noteworthy to mention here that during 1995 most of the brackish water species were prevailed in the lake ecosystem. The average salinity of the lake at that period was 5 ppt [33]. But, polychaetes species observed by Sewell and Annandale [34,35] were of typical marine forms and high salinity was also reported. Hence, it is established that higher salinity favours more marine forms rather than the brackish water species. This is in congruence with the findings of Mahapatro et al. [20].

Species composition of the present study virtually compared with other ecosystem of India. Studies made in south east coast of India by Musale and Desai [3] from the polluted regions of Mumbai harbour reported 63 polychaeta species. Similarly, Sukumaran and Saraladevi [15] reported 84 polychaete species whereas 71 polychaeta species were documented from polluted estuarine system of Zuari estuary reported by Sivadas et al. [17]. Subsequently, Mandal and Harkantra [19] found 31 polychaete species while working on Mumbai port. But, recently Mahapatro et al. [20] reported 39 polychaetes species along the outer channel area of Chilika lake. Interestingly, the species composition of benthic polychaete appeared in the different coastal ecosystems of India was apparently same with species compositions documented during this study.

Pollution indicator species

Many families of polychaetes were well reported as pollution indicators. However considering any species as indicator of pollution, there are certain criterions as described by Gaufin and Tarzwell [36] such as (i) high numerical density, (ii) few species in the fauna, (iii) feeding habit must be of scavenger type and (iv) tolerance or adaptation for low dissolved oxygen. Again, its presence should be negligible in high diversity rich areas or unpolluted regions. Under such condition certain polychaete taxa fall on this category. Most of them are belonging to the family Spionidae, Capitellidae, Pilargidae etc. Dominant representatives were those of *Capitella capitata*, *Minuspio cirrifera* and *S. constricta* [15]. Polychaetes like *Capitella capitata*, *Minuspio cirrifera* can able to tolerate the hypoxic conditions [6,15]. According to Musale and Desai [3], the deposit feeders *Capitella* and *P. pinnata* were found in the sediment which is enriched with organic sewage. Similarly, Martin et al. [18] observed *Minuspio cirrifera* and *C. capitata* as a dominant species in organically enriched regions of Cochin backwater. In Chilika lake, such indicator species were observed in the northern and central sector region. These regions were much influenced by the organic matter because of the huge decomposition of macrophytes [23].

Conclusion

In the present study, the obtained polychaetes taxa were similar with other coastal ecosystems of India. Preponderance of 45 polychaete species from the lake sediment exhibited healthy condition of the study area. But dominance of *Capitella* sp., and *Minuspio* sp., in the northern sector of the lake indicated the occurrence of organic enrichment. However, many of the species occurred for the first time in this system were belonging to marine habitat. This might be corroborated as the opening of new lagoon inlet. Since, very less information is gathered regarding the benthic polychaete taxa of the Chilika lake. Thus providing any of the conclusive remark is found difficult. The present findings may be considered as the baseline information for further investigation.

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