Indian Journal of Marine Sciences
Vol. 34(1), March 2005, pp. 114-119

Polychaete diversity in Indian estuaries

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Received 1 April 2004; revised 21 September 2004

This paper provides a comprehensive account of the diversity of estuarine polychaetes of India. Information on polychaetes is available only from 8 estuaries out of 33 on the east coast and only from 4 out of 34 on the west coast. 153 species of polychaetes occur in Indian estuaries, representing about 37.46% of the total polychaetes present in Indian seas. While 119 species were found to occur only in east coast estuaries, 11 species were found only in the west coast estuaries. Twenty-three species were found to occur in the estuaries of both the coasts. Besides increasing the extent of coverage on the distribution of polychaetes from other Indian estuaries, there is also a strong need to understand the variations in their diversity in relation with environmental changes, especially in terms of pollution. This could become possible only with application of tools like genetic and biochemical make-up and improved statistical analyses to explain variability of diversity of polychaetes in space and time.

[**Key words:** Polychaetes, diversity, estuaries]

Introduction

Polychaetes (chaetopods) are the dominant macrofaunal taxa in all marine sediments from the intertidal area down to the deep sea. They constitute more to the total macrobenthic animals in terms of number of species and individuals. The majority of the species is quite small and short-lived exhibiting a high secondary production. Hence they are an important link in marine food webs and feature significantly in the diets of many bottom-feeding fishes. Being small-sized organisms, they play a crucial role in ecology and EIA (Environmental Impact Assessment) studies. As many of the polychaetes are sedentary in nature, changes in their abundance and diversity have been used in environmental monitoring particularly in assessing the health of the estuaries. As part of the Census of Marine Life (CoML) initiative to assess and explain the diversity and distribution of marine life, in this paper the distribution and diversity of polychaetes are discussed in view of their use in aquaculture as shrimp broodstock diet and in removing organic wastes from shrimp discharges, as toxicological test organisms and as indicator organisms of pollution. In view of these facts, distribution of polychaetes and their species diversity in the Indian estuaries are discussed in this paper.

Estuaries along Indian Coastline

The estuaries of India cover an area[1] of 2.14×10^6 ha, and are influenced by the semi-diurnal tides. Almost all the estuaries are used for the exploitation of marine and estuarine living resources, with the intensity of use ranging from moderate to heavy. Around metropolitan cities [Kolkata (Calcutta), Chennai (Madras), Kochi (Cochin), Mumbai (Bombay) etc.], the intensity of utilization is heaviest and may at times even exceed the carrying capacity of the estuaries. Industrial clusters and oil terminals also release effluents into the estuaries. Shrimp farms in all the maritime states discharge the used water containing organic matter and chemicals into the estuaries.

As many as 33 estuaries are flowing along the east coast of India (names of estuaries with intensity of use and major threats are given below). These are Hooghly—major open type estuary receiving domestic and industrial discharges in particular oil refineries (West Bengal); Rushikulya—major estuary influenced by chlor alkali released from an industry, Bahuda—minor estuary receiving agricultural run off, Mahanadi—major open type estuary receiving agricultural run off (Orissa); Godavari—Krishna—major open type estuaries receiving shrimp farm discharges, sewage and agricultural run off—Coringa mangroves present here is a reserve forest, Gosthani-minor estuary, Kandaleru—major estuary receiving shrimp farm discharges, Swarnamukhi and Konderu—minor estuaries (Andhra Pradesh);

Araniar—major estuary receiving sewage and shrimp farm discharges, Ennore—major estuary polluted by industrial wastes and sewage, Cooum—bar built estuary worst affected by domestic sewage due lack of flushing, Adyar—major estuary polluted by domestic sewage, Muttukadu—bar built estuary having tourism and receiving aquaculture discharges and sewage, Edaiyur-Sadras estuarine complex—blind type estuary receiving agricultural run off and sewage, Uppanar (large open estuary heavily polluted by industrial wastes besides sewage and coir retting), Vellar—Coleroon (Kollidam) estuarine complex-open type estuaries receiving shrimp farm discharges and agricultural run off—Pitchavaram mangrove present here is a reserve forest, Cauveri -bar built estuary receiving shrimp farm discharges and agricultural run off, Agniar, Kallar, Pinnakayal, Pullavazhi, Athankarai, Kanjirangudi, Kottakkarai, Uppar, Vaigai and Kottakudy—all bar built estuaries receiving sewage and shrimp farm discharges), Thengapatanam—polluted by coconut retting and domestic sewage (Tamil Nadu); Ariankuppam—bar built estuary polluted much by domestic sewage, Sunnambar—bar built estuary having tourism and receiving agricultural run off (Pondicherry).

A total of 34 estuaries flow on the west coast of India. These are: Ashtamudi—major and open type receiving shrimp farm discharges and agricultural run off and used for retting, Kadinamkulam—minor bar built estuary with anoxic conditions due to coconut retting, Estuarine complex of Kochi (very large ecosystem receiving effluents from industrial clusters and shrimp farms, domestic sewage and agricultural run off—it has the Kumarakkam bird sanctuary, Korapuzha—open type estuary receiving agricultural run off, Beypore—major, polluted by effluents from Mavoor Gwalior Rayons, cargo handling and ship breaking unit, Olipuram Kadavu, Edava-nadayar-Paravur—coconut retting, Poonthura—domestic sewage, Puthuponnani, Chandragiri, Shiriya, Thotapally and Pozhikara—port activities (Kerala); Netravathi—Gurupur estuarine complex—port activities, Mulki-major open type estuary receiving sewage, Pavenje-increased sewage load due to urbanization, Gangolli—port activities including iron ore export, Kali—chemical weathering (Karnataka); Mandovi–Zuari estuarine complex—port activities, mining, tourism and sewage (Goa); Amba—port activities, Mahim—domestic and industrial wastes, Ulhas—industrial effluents, Waghotana and Vashishti—bar built estuaries (Maharashtra); Purna—bar built estuary receiving sewage, Mahi—receives industrial effluents from Baroda, Damaganga-Kolak and Par—receive Industrial effluents, Ambika-Kaveri-Kareira estuarine complex increased pollution load due to wastes from alcohol, paper, pulp and leather industries, Mindola—receives industrial wastes, Tapti receiving wastes from industries and domestic sewage, Narmada—receiving industrial wastes in particular from fertilizer plant and domestic sewage and Auranga receiving industrial wastes (Gujarat).

The Known

The studies carried out on estuarine polychaetes of the Indian estuaries are given below:

East coast estuaries

1) Hooghly—Macro and meiobenthos[2], macro invertebrates[3], polychaetes[4, 5]

2) Mahanadhi—Macro and meiobenthos[2]

3) Godavari—Macro and meiobenthos[2,] polychaetes[6, 7], benthic copepods[8]

4) Krishna—Macro and meiobenthos[2]

5) Vellar—Macrobenthos[9-12]

6) Coleroon—Macrobenthos[13-15],

West coast estuaries

1) Ashtamudi—Benthic ecology[16, 17]

2) Kochi—Benthos[18-21], Macrobenthos[22-26], polychaetes[27-29]

3) Beypore –Benthos[30]

4) Korapuzha—Benthos[30]

5) Mulki—Macrobenthos[31]

6) Kali—Benthos[32], macrobenthos[33]

7) Mandovi and Zuari—Benthos[34-36], benthic ecology[37], macrofauna[38]

8) Auranga—Benthos[39]

9) Narmada—Benthos[40]

Polychaetes of east coast of India

Of the 33 estuaries on the east coast of India, information on polychaete species is available only from 6 estuaries. Among these, maximum number of species was recorded in Vellar estuary (98 species) followed by Hoogli-Matla estuary (69 species), Vasista—Godavari estuary (44 species), Coleroon estuary (37 species), Mahanadhi estuary (33 species). The total number of polychaete species known from east coast estuaries is 142.

Of the 34 estuaries on the west coast of India, information on polychaete species is available only from 4 estuaries, while in the 6 other estuaries, studies were done only at the group level. Among these the maximum number of species was recorded in Cochin estuary (19 species) followed by Mandovi and Zuari estuarine complex (10 species), Ashtamudi estuary (7 species) and Mulki estuary (5 species).

Of the 152 species of polychaetes recorded in the Indian estuaries, 119 species were recorded to occur only in the east coast, 10 species in the west coast, and 23 species were found both in the east and west coasts (among the 152 species of polychaetes listed below species marked with single asterisk (*) occur in the west coast estuaries also and those marked with two asterisks (**) occur only in the west coast estuaries). The number of polychaete species recorded in Indian estuaries represents about 38% of those known from Indian seas[41]. Due to proximity of estuaries with the neritic realm and the larval phase in the life history of polychaetes which are very much carried from the estuaries to the sea and back, polychaete species endemic to the estuaries are not known.

List of polychaete species occurring in Indian estuaries

Class: Polychaeta

Group: Errantia

Family Polynoidae: *Hololepidella maculata* Day 1967*;* Family Aphroditidae *Panthalis oerstedi* McIntosh 1925, *Polynoe* sp. Savigny 1818, *Polydontes melanonotus* (Grube 1876), *Polydontes* sp. Renier 1832, *Sigalion* sp. Audouin and Milne Edwards 1832, *Sthenelais boa*** *(*Johnston 1839*), Lepidonotus tenuisetosus*** *(*Gravier 1901*)*; Family Amphinomidae: *Amphinome rostrata* (Pallas 1766); Family Pisionidae: *Pisionidens indica* (Aiyar and Alikunhi 1940); Family Phyllodocidae: *Eulalia sanguinea* Oersted 1843, *Pelagobia longicirrata* Greef 1879, *Phyllodoce malmgreni* Gravier 1900, *P. zeylanica* Willey 1905, *P. tenussima* Fauvel 1932; *Phyllodoce* sp., *Mystides southerni* Theel 1879*;* Family Iospilidae: *Phalacrophorus pictus* Greef 1879; Family Alciopidae: *Alciopina parasitica* Claparede and Panceri 1867; Family Tomopteridae: *Tomopteris helgolandica* Greef 1879; Family Typhloscolecidae: *Travisiopsis lobifera* Levinsen 1885; Family Pilargidae: *Ancistrosyllis constricta** Southern 1921, *A. groenlandica* McIntosh 1879, *A. parva* Day 1963, *Talehsapia annandalei* Fauvel 1932; Family Hesionidae: *Leocrates claparedii* (Costa 1868), *Gyptis* sp., *Ophiodromous* sp.* Sars 1861; Family Syllidae: *Autolytus* sp., *Opisthosyllis sp.***, *Exogone* sp.***;* Family Nereidae: *Ceratonereis costae* (Grube 1840), *C. burmensis* Monro 1937, *Ceratonereis* sp., *Micronereis* sp., *Dendronereis aestuarina** Southern 1921, *Dendronereis arborifera** Peters 1854, *D.heteropoda* Southern 1921, *Dendronereis* sp.**, *Pereneris cultrifera* (Grube 1840), *P. cavifrons*** Ehlers 1920, *Leonates* sp., *Lycastis indica** Southern 1921, *Nereis chilkaensis* Southern 1921, *N. kauderni* Fauvel 1921, *N. lamellose* Fauvel 1936, *N. (Neanthes) capensis* Willey 1904, *N.(Neanthes) chingrighattensis* Fauvel 1932, *Nereis* sp.*, *Pseudonereis* sp., *Tylonereis fauveli* Southern 1921, *Namalycastis indica* (Southern 1921), *Nectoneanthes ijimai* Kinberg 1857, *N. irrota* Kinberg 1910*; Nephtys polybranchia** Southern 1921; *N. oligobranchia** Southern 1921; Family Nephtyidae: *Nephtys* sp. Cuvier 1817; Family Glyceridae: *Glycera alba** (Muller 1788), *G. tesselata* Grube 1863, *G.longipinnis*** Grube 1878, *Glycera* sp.*, *Glycinde oligodon* Southern 1921, *Glycinde* sp., *Goniada incerta* Fauvel 1932, *Goniada* sp., Family Eunicidae: *Diopatra neapolitana** Dellechiaje 1841, *D. cuprea cuprea* (Bosc 1802), *Diopatra* sp.**, *Dorvillea neglecta* (Fauvel 1923), *D. incertus* Parfitt 1866, *Eunice tubifex* Crossland 1904, *E. gracilis* Fauvel 1932, *Eunice* sp., *Lumbrineris latreilli* Audouin and Milne Edwards 1834, *L. impatiens* Monro 1937, *L. polydesma** Southern 1921, *L. pseudobifilaris* Fauvel 1932, *L. simplex** Southern 1921, *L. heteropoda* Marenzeller 1879, *Lumbrineris* sp.* Blainville 1828, *Marphysa sunguinea** Fauvel 1923, *M. gravelyi* Southern 1921, *Ophryotrocha* sp.

Group: Sedentaria

Family Spionidae: *Malacoceros indicus* (Fauvel 1928), *Nerine cirratulus* Fauvel 1927, *Prionospio pinnata** Ehlers 1901, *P. cirrobranchiata* Day 1961, *P. malmgreni* Claparede 1870, *P. cirrifera* Wiren 1883, P. polybranchiata* Fauvel 1929, *P. granii* Malmgren 1865, *Prionospio* sp., *Polydora armata* Langerhans 1880, *P. ciliata** Fauvel 1927, *Polydora* sp., *Pseudopolydora kempi* Day 1957, *Scolelepis squamata* (Muller 1806), *Spio bengalensis* Willey 1905, *Nerinides* sp.; Family Magelonidae:*Magelona papillicornis* Fauvel 1927, *M. cincta* Wilson 1958, *Magelona* sp.; Family Cirratulidae: *Cirratulus*

cirratus Fauvel 1927, *Cirratulus* sp., *Chaetozone* sp.; Family Cossuridae: *Cossura delta* Reish 1960; Family Chaetopteridae: *Phyllochaetopterus* sp., *Spiochaetopterus costarum* (Claparede 1870); Family Orbiniidae: *Scoloplos marsupialis* Southern 1921, *Scoloplos* sp.; Family Opheliidae: *Ammotrypane aulogaster* Rathke 1843, *Armandia lanceolata* Willey 1905; Family Capitellidae: *Branchiocapitella singularis** Fauvel 1932, *Capitellethus dispar* Chamberlin 1919, *Capitella capitata* Fauvel 1927, *Capitella* sp., *Heteromastus similis* Southern 1921, *Mastobranchus indicus* Southern 1921, *Notomastus latericeus* Sars 1851, *Notomastus* sp., *Paraheteromastus tenuis** Monro 1937, *Scyphoproctus djiboutiensis** Gravier 1906, *Pulliella armata*** Fauvel 1927; Family Chaetopteridae: *Poecilochaetus serpens* Allen 1904, *P. johnsoni* Southern 1921, *Trochochaetus* sp.; Family Maldanidae: *Axiothella obockensis* Fauvel 1932; *Axiothella* sp., *Euclymene annandalei* Southern 1921; Family Oweniidae: *Owenia* sp.**; Family Sternaspidae: *Sternaspis scutata* Fauvel 1927, *Sternaspis* sp.; Family Flabelligeridae: *Stylarioides* sp., Family Sabellaridae: *Sabellaria cementarium** Moore 1906; Family Pectinariidae: *Pectinaria crassa* Fauvel 1932, *Pectinaria* sp.; Family Ampharetidae: *Amphicteis posterobranchiata* Fauvel 1932, *Amphicteis* sp., *Isolda pulchella* Augener 1918, *Auchenoplax* sp., *Melinna* sp., *Samytha* sp.; Family Terebellidae: *Loimia medusa* Fauvel 1953, *Polymnia* sp., *Terebellides stroemi* Sars 1835; Family Sabellidae: *Chone* sp., *Dasychone cingulata* Fauvel 1932, *Laonome indica* Southern 1921, *Sabella melanostigma* Fauvel 1939; Family Serpulidae: *Mercierella enigmatica** Fauvel 1923, *Pomatoceros caeruleus* (Schmarda 1861), *Serpula vermicularis* Fauvel 1927.

Polychaetes serve as very good indicators of pollution. In unpolluted conditions conservative polychaete species thrive well and species diversity is greatest. Conservative species have relatively long life span, long development time to reach reproductive maturity, one or two reproductive periods and low death rate. Those species, which could not stand polluted conditions, give way to opportunistic small-bodied species, which have short life span, rapid development to reach reproductive maturity, prolific spawning and high death rate. Such few number of opportunistic species show higher abundance. The species recorded with high abundance in polluted parts of estuary around metropolitan areas include *Prionospio polybranchiata, Paraheteromastus tenuis, Lycastis indica, Dendronereis aestuarina* and *Scyphoproctus djiboutensis.* Species found in moderately polluted parts include *Nephtys polybranchia, N. oligobranchia, Lumbrinereis polydesma* and *L. simplex*. Polychaete species, which were not found in the polluted part, include *Diapatra neapolitana, Sthenelais boa* and *Lepidonotus tenuisetosus*.

Unknown

The polychaete diversity has been studied only in a few estuaries along coasts of India. No information is available on polychaete distribution and diversity for other 51 estuaries. To make this problem worse, there is a great shortage of taxonomic information—no update or replacement for Day's[42] monograph in printed form accessible to the investigators. Neither computerized online nor offline taxonomic keys are available.

Compared to the studies carried out in other parts of the world, especially in the Western hemisphere, the following aspects on biodiversity of polychaetes need to be given more focus:

- Long term monitoring and spatial variability, larval stages for many polychaetes.
- The extent of their utility in assessing habitat deterioration, especially in situations of intense human intervention as in Hooghly estuary (harbor activity etc.), Ennore estuary (industries), Cooum and Adyar estuaries (sewage discharge), Ariyankuppam estuary (sewage etc.), Uppanar estuary (industrial effluents), Cochin estuary (harbor and industrial activities and sewage), Kali estuary (industrial effluents), Mandovi and Zuari estuaries (harbor, mining, sewage etc.), Amba, Mahim and Ulhas estuaries (all types of pressures)**.**
- Impact of shrimp farming on diversity of estuarine polychaetes.
- Information on the opportunistic species (**r**—selected) and moderately tolerant species (**t**—selected) from intensively used estuaries.
- Taxonomic sufficiency has not been attempted through environmental monitoring studies.
- Co-variations in polychaete diversity with that of other groups like amphipods and their use in assessing health of estuaries.

- Genetic diversity of polychaetes.
- The biochemical make-up of polychaetes, especially in view of their usefulness as maturation diet for shrimp brood stock.

Polychaetes constitute an important group known for their rich diversity, species richness and numerical dominance in the benthic realm. Besides their use in assessing the health of the marine environment in particular the estuaries, they also have commercial prospects in the aquaculture industry. They occur in all the Indian estuaries. But unfortunately they have not been studied in most of the estuaries. In the estuaries situated around metropolitan cities and other intensively used estuaries, continuous monitoring using polychaetes could be undertaken advantageously. For polychaetes an updated electronic identification key besides investigations on aspects listed under unknown are the need of the hour.

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