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STUDY OF MACRO-BENTHIC (INVERTEBRATE) FAUNA AROUND DIGHA COAST

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INTRODUCTION

The organisms that live on, or in, the bottom of a water body with >1.0mm size are known as macrobenthic organisms which mainly consists of different invertebrates *viz.*, molluscs, cnidarians, crustaceans, sponges, worms, etc. Benthic invertebrates play an important role in transitional ecosystems, by filtering phytoplankton and then acting as a food source for larger organisms such as fish, thereby linking primary production with higher trophic levels. They also structure and oxygenate the bottom by reworking sediments and play a fundamental role in breaking down organic material before bacterial remineralization. In addition, a number of benthic invertebrates, particularly bivalves, are also consumed by humans and others, such as worms, are used for recreational purposes as fishing bait. They are often used as biological indicators because they can provide information on environmental conditions either due to the sensitivity of single species (indicator species) or because of some general feature that makes them integrate environmental signals over a long period of time. Due to habitat loss, overexploitation and impact of various anthropogenic pressures, the macrobenthic invertebrates are under continuous threats and which may impact on higher group of animals. Few studies on macro-benthic fauna of India are available (Ref). Many of these studies restricted to either few areas or few groups (Ref). However, there is no baseline information available for Digha coast in West Bengal. Few studies on marine biodiversity of Digha coast as well as surrounding coastal area were carried out in the past (Goswami, 1992, Subba Rao, *et al.*, 1992; Talukdar *et al.*, 1996, Ramkrishna *et al.*, 2003). Keeping view of these studies, the study was planned to evaluate the the recent population and distribution of macrobenthic invertebrates around Digha coast.

MATERIALS AND METHODS

The study area: Digha beach is situated close to the Gangetic mouths on the northern east coast of India where the sea is quite shallow with very little wave action and large intertidal expanses. Digha and the surrounding coastal area are with variable

Fig. 1. A map showing study locations around Digha coast.

habitats. The coastline, here, is straight and the beach is flat and compact. The beach is made up of sand grains mixed with variable proportions of silt and which makes it very compact. The different study locations in the present study were Talsari, Udaipore, Digha, Mohana & Shankarpur. These five locations are having different type of habitats which was represented through dominance of various species. The beach slope is shore is very gradual upto the low water mark.

Sampling: The study was carried out during August, 2008 to September, 2010 and the examples of benthic invertebrate representing various groups were collected from different habitats. Standard sampling techniques were employed at different study locations using line transects and quadrates in different zones. The sampling protocol were designed using the techniques of beach profiles by Emery, 1961. Generally, the collection of benthic animals were done at the time of low tide, however, fish catches at the time beach trawl operation were also monitored for the collection of sessile invertebrates. The macrobenthic fauna collections were preserved in 70% alcohol mixed with 3% of formalin.

RESULTS

Composition of marine benthic invertebrate groups: The overall comparison of all the marine benthic invertebrate groups recorded during the study at different study locations are represented in the Fig. 2. The comparison of benthic faunal group shows that the mollusc contributes the major part in the marine benthic fauna around Digha coast. Among molluscs, the bivalve shared 58 % and gastropods 21 %. The overall contribution of molluscs was 79 %. The phylum arthropods were second largest group with 14 % followed by Cnidaria with 4 %. However, Annelids, Brachiopods & Echinoderms contributes only 1% of total faunal composition. Among molluscs, the bivalve shared 58 % and gastropods 21 %. The overall contribution of molluscs was 79 %. The phylum arthropods were second largest group with 14 % followed by Cnidaria with 4 %. However, Annelids, Brachiopods & Echinoderms contributes only 1% of total faunal composition.

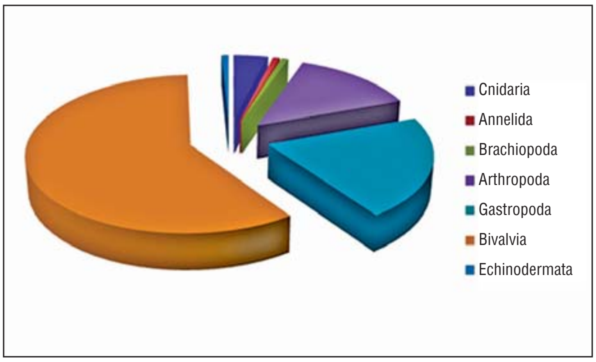

Fig. 2. Composition of major marine benthic invertebrate groups.

The diversity of macro-benthic fauna among all the study locations during the study period was given in Table 2. There were a total of 141 species under different groups were recorded from 88 genera and 52 families. The group-wise contribution shows that Phylum Mollusca was most abundant among all the study location. It has recorded 106 species from 32 families. The further division of this groups shows that Bivalvia contributes 79 species from 16 families and gastropods contributed 27 species from 16 families. Among the most abundant group i.e. bivalve, family Veneriidae was observed to be most diverse with 19 species from 10 genera. The other diverse families in bivalves were family Mactriidae with 13 species from 4 genera and family Tellinidae with 12 species from 4 genera. The second most abundant group among the benthic fauna during the study was observed as Phylum Arthropoda which contributed 21 species from 11 families. Further division of faunal composition was contributed by Phylum Cnidaria with 7 species from 4 families, Phylum Annelida with 4 species from 2 families, Phylum Echinodermata with 2 species from one family and Brachiopoda with one species only.

Faunal diversity among study locations: Faunal diversity among different study location shown in Fig. 3. The maximum diversity of benthic fauna was recorded in Udaipur with 84 species from different groups which was followed by Talsari & Shankarpur with 77 species. Digha location was reported minimum diversity of benthic fauna with 55 species. However, Mohana was reported with 57 species. Group wise species composition at different localities shows that Talsari location was recorded maximum 39 species from 12 families of Bivalves, 10 species from 9 families of Gastropods and 15 species from 7 families of Arthropods. The group like Cnidaria, Brachiopod & Echinoderms were not recorded at Talsari and Annelids were reported only two species. Udaipur location although had maximum number of species diversity, shows same number of bivalve diversity as in Talsari i.e. 39 species from 14 families. Other fauna in Udaipur reported were the gastropods 15 species from 10 families, arthropods 21 species from 11 families, Cnidaria 6 species from 4 families and annelids 2 species from one family. The brachiopod were represented by only one species at Udaipur and echinoderm were totally absent during the sampling at this location. Digha was represented with 32 species of bivalves from 10 families, 9 species of gastropods from 8 families, 8 species of arthropods from 6 families and only one species of cnidaria. Annelida, Brachiopoda and echinodermata were totally absent in Digha.

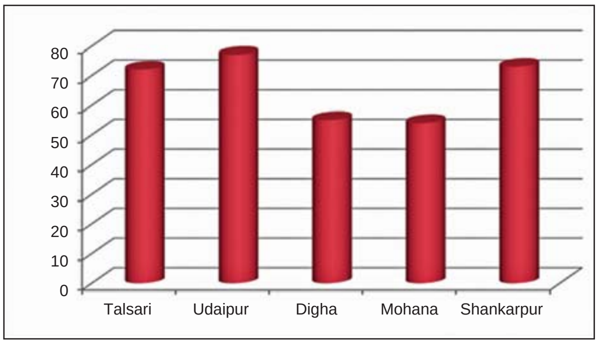

Fig. 3. Faunal diversity among study locations

Mohana benthic fauna comprised of 27 species of bivalves from 10 families, 7 species of gastropods from 5 families, 10 species of arthropods from 5 families, 2 species of annelids and 1 species each of cnidaria, brachiopod & echinodermata. Shankarpur represented with 45 species of bivalve from 13 families which was maximum number of bivalves among other study locations. Other benthic fauna of Shankarpur comprised of 11 species of gastropods from 9 families, 11 species of arthropods from 6 families, 2 species of annelids & echinoderms and 1 species of cnidaria. Brachiopods was also absent in this location.

Percentage species composition at different study locations: Percentage species composition of various benthic invertebrate groups at different study locations is shown in Fig. 4. At Talsari, the percentage of different faunal groups shows that the bivalve had maximum percentage with 60% composition which was followed by arthropods with 20% and gastropods with 15% composition among other fauna. Udaipur location observed bivalve composition 47%, arthropods 26%, gastropods 17%, cnidaria 6% & others 4%. The percentage composition at Digha location was 65% bivalve, 18% gastropods, 14% arthropods and 2% cnidaria and Mohana it was 59% bivalve, 21% arthropods, 15% gastropods and 2% each of cnidaria and other invertebrates. In Shankarpur, faunal composition consisted with 64% bivalve, 16% each of gastropods & arthropods and 3% other fauna. The overall comparison of faunal percentage composition shows that the bivalve contributed major part followed by Arthropoda and Gastropoda in the study locations.

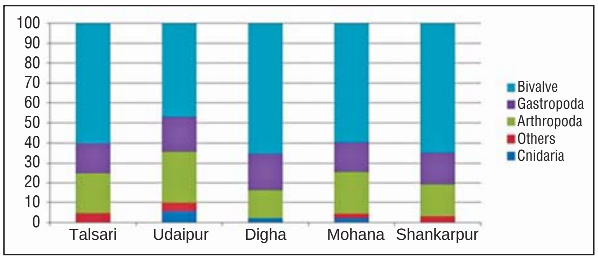

Fig. 4. Percentage species composition at different study locations

Species diversity index: Graphical representation of Shannon-Wiener index of species diversity of molluscan fauna which was one of the major component of benthic diversity among the study locations in different seasons is shown in Figure 5. The major dominant species are *Mactra cuneata* (Gmelin, 1791), *Mactra dissimilis* (Reeve, 1854), *Mactra luzonica* (Reeve, 1854), *Mactra mera* (Reeve), *Bernea candida* (Linnaeus, 1758) and majority of the species are distributed in the region but does not reflected its dominance throughout the sampling.

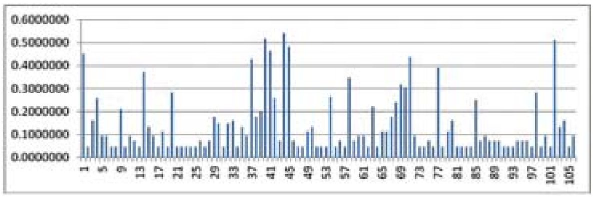

Fig. 5. Species diversity index.

(*Species name*: 1. *Umbonium vestiarium* (Linnaeus, 1758); 2. *Nerita (Ritena) grayana* (Recluz, 1843); 3. *Telescopium telescopium* (Montfort,); 4. *Amaea (Acrilla) acunimata* (Sowerby, 1844); 5. *Natica tigrina* (Roeding, 1798); 6. *Polinices (Glossaulox) didyma* (Roeding); 7. *Polinices trigona*; 8. *Sinum laevigatum*; 9. *Turritella attenuata* (Reeve, 1849); 10. *Turritella columnaris*; 11. *Lamellaria (Corvicella) indica* (Leach); 12. *Bursa (Bufonaria) rana*; 13. *Gyrinum natator*; 14. *Thais blanfordi* (Melvill, 1893); 15. *Thais lacera* (Born, 1778); 16. *Cronia konkanensis* (Melvill, 1893); 17. *Murex tribulus* (Linnaeus, 1758); 18. *Nassarius (Hima) stolatus* (Gmelin, 1791); 19. *Nassarius drsatus*; 20. *Amalda ampla* (Gmelin, 1791); 21. *Olivancilaria globosa*; 22. *Oliva olive*; 23. *Agaronia nebulosa*; 24. *Melo melo* (Solander, 1786); 25. *Turicula javana*; 26. *Pugilina (Hemifusus) cochlidium* (Linnaeus, 1758); 27. *Archectonica perspective* (Linnaeus, 1758); 28. *Anadara granosa* (Linnaeus, 1758); 29. *Anadara antiquata* (Linnaeus, 1758); 30. *Scapharca inaequivalvis* (Bruguiere, 1789); 31. *Scapharca indica* (Gmelin, 1791); 32. *Scapharca cornea*; 33. *Perna viridis* (Linnaeus, 1758); 34. *Modiolus undulates* (Dunker); 35. *Modiolus striatulus*; 36. *Atrina bicolor*; 37. *Saccostrea cucullata* (Born, 1778); 38. *Crassostrea cuttackensis* (Newton & Smith); 39. *Crassostrea graphoides*; 40. *Mactra luzonica* (Reeve, 1854); 41. *Mactra mera* (Reeve); 42. *Mactra violacea* (Gmelin, 1791); 43. *Mactra stultrum* (Linnaeus, 1758); 44. *Mactra cuneata* (Gmelin, 1791); 45. *Mactra dissimilis* (Reeve, 1854); 46. *Mactra parkensiana* (Hadley, 1902); 47. *Mactra echatina* (Holten, 1802); 48. *Mactra echinata*; 49. *Mactra symmetrica*; 50. *Roetella pulchella*; 51. *Roeta peliculla*; 52. *Spisula (Standella) annandalei*; 53. *Tellina angulosa* (Gmelin, 1791); 54. *Tellina (Tellinids) opalina*; 55. *Tellina (Homalina) myaeformis* (Sowerby); 56. *Tellina timorensis*; 57. *Tellina sinuate*; 58. *Macoma blairensis*; 59. *Macoma (Psammocoma) truncate*; 60. *Macoma birmanica*; 61. *Macoma truncate*; 62. *Macoma candida* (Lamarck, 1818); 63. *Apolymetis edentula*; 64. *Arcopagia remis* (Linnaeus); 65. *Donax pulchellus*; 66. *Donax incrnatus* (Gmelin, 1791); 67. *Donax compressus*; 68. *Donax deltoids* (Lamarck, 1818); 69. *Donax scortum* (Linnaeus, 1758); 70. *Sanguinolaria (Soletellina) acuminata* (Deshays); 71. *Mertrix meretrix*; 72. *Meretrix casta*. 73. *Circe scripta*; 74. *Pitar affinis*; 75. *Pitar morhuansis*; 76. *Pitar textile*; 77. *Mercia opima* (Gmelin, 1791); 78. *Paphia schnelliana*; 79. *Paphia semirugata*; 80. *Paphia gallus*; 81. *Pahia malabrica*; 82. *Paphia alapailiones* (Roeding); 83. *Sunetta (Sunetta) scripta*; 84. *Sunetta (Sunetta) meroi*; 85. *Pelecyrora trigona* (Reeve); 86. *Tapes belcheri*; 87. *Dosinia bruguiere*; 88. *Katelesiya japonica*; 89. *Katelesiya mermorata*; 90. *Diplodonta semiaspera* (Philippi, 1836); 91. *Diplodonta berhampurensis*; 92. *Trachycardium angulatum* (Lamarck, 1819); 93. *Laevicardium australis* (Sowerby); 94. *Plagiocardium pseudolatum* (Vosku & Unverwagt); 95. *Solen kempi* (Preston); 96. *Solen brevis*; 97. *Siliqua radiate*; 98. *Siliqua winteriana* (Dunker, 1852); 99. *Pharela javanica* (Lamarck, 1818); 100. *Glauconome sculpta*; 101. *Glauconome virens* (Linnaeus, 1767); 102. *Bernea candida* (Linnaeus, 1758); 103. *Pholas orientalis* (Gmelin, 1791); 104. *Laternula truncate* (Lamarck, 1818); 105. *Laternula anatine* & 106. *Placuna placenta* (Linnaeus, 1758))

Number of occurrences of different species: The occurrence and relative occurrence of different species is presented in Figs. 6 & 7. The maximum occurrence for the species like *Amaea (Acrilla) acunimata, Saccostrea cucullata, Mactra cuneata, Mertrix meretrix, Mercia opima, Bernea candida* and most of the species reported form the region were from a single occurrence during the entire sampling period.

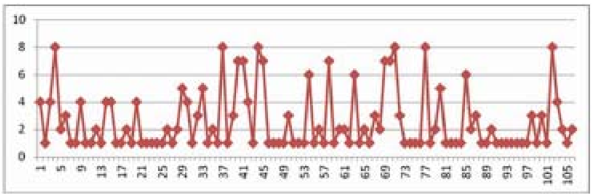

Fig. 6. Occurrences of different species.

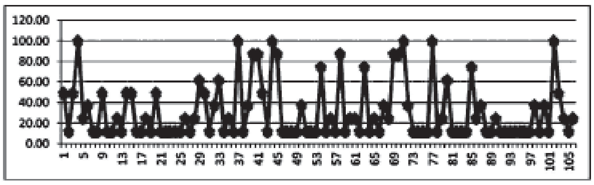

Fig. 7. Percentage occurrence of différent species.

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Abundance of different species: The abundance of different species is presented in Fig. 8. The species like *Umbonium vestiarium*, *Crassostrea graphoides*, *Mactra stultrum* were the most abundant species in the region followed by *Thais blanfordi*, *Mactra cuneata*, *Bernea candida*, *Mactra luzonica*. Most of the species were having single occurrence with single incidence during the entire sampling.

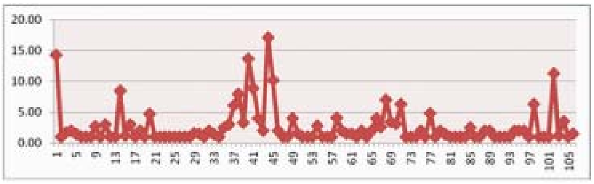

Fig. 8. Abundance of different species

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Monthly variation in species diversity: The monthly variation in species diverisity for two different years during the study is shown in Fig. 9. The monthly variation of species diversity in the sampling area suggested that the maximum species diversity was recorded during the post-monsoon and winter months (October-January) which highlights the recruitment and settlement of many species during the period and the minimum during the early summer months (March-April).

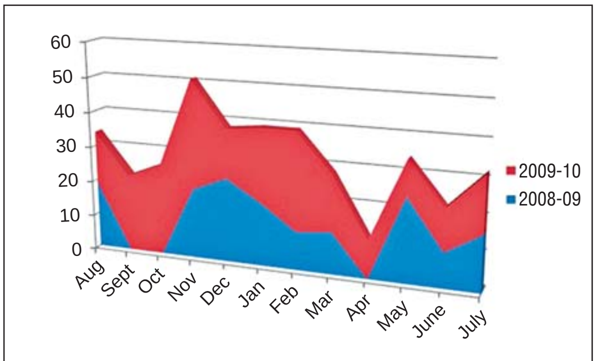

Fig. 9. Monthly variation in species diversity

DISCUSSION

The population studies of benthic invertebrates shows that the high species diversity at Udaipur and Talsari provides suitable substratum for macrobenthic invertebrate population. The habitat in these localities comprised of estuary with continuous flow of fresh water and regular tidal rhythm of inflow and outflow of water. It also shows that Talsari had little impact of anthropogenic activities as compare to Udaipur. None of the species showed abundant distribution in Mohana because of increasing fishing activities in the area. The lower species record and maximum number of species under abundant distribution at Shankarpur shows that the locality favors the species which preferred the sandy beach habitat. Old Digha with low species diversity shows many species in sparse distribution which may be due to increasing anthropogenic activity in the area. This location showed only two species with moderate distribution which was due to construction of wall and cement boulder around coast provided suitable substratum of the settlement of rock oyster. The earlier study by Ramakrishna *et al*. (2003) described 55 species of marine bivalves under the comprehensive study on marine invertebrates along Digha coast.

The relationship between energy budgets, habitat structure, physiological parameters and population diversity has been investigated most extensively in marine bivalves by several workers (Hoarding, 1949; Kuenzler, 1961; Hancock, 1965; Dame, 1972; Dare, 1976; Rodhouse, 1979; Bayne *et al*., 1983; Lee, 1985; Huang *et al*., 1985; Cheung, 1991; 1993). Nevertheless, structural complexity of the environment has often been considered an important determinant of biotic diversity and the assumption that increased habitat complexity provides more ways for feeding strategies to differ has been a common thread running through many studies (Smith, 1972). This study of natural population of *Meretrix* sp., *Paphia* sp., *Donax* sp., *Mactra* sp., *Saccostrea* sp. & *Macoma* sp. at five study localities reveals several points of interest with respect to sustainability of the species in the different geographically separate areas as well as impact of different levels of anthropogenic activities in the area.

As a common tropical and sub tropical marine bivalves, high densities of these species occur in the zone of inter tidal and sub tidal regions of coastal water, estuaries and backwaters on the coast of India (Subba Rao *et al.*, 1991). High population density of marine bivalves in Shankarpur and Talsari in summer (May) was partly maintained by a heavy recruitment occurred in winter. This is supported by the reproductive events of gonadal cycles in case of *Saccostrea cucullata* (Born) (Yennawar, 1997). Besides the dominance of these species over other inter tidal bivalves reported in these localities, can possibly be attributed to a higher tolerance to environmental stress like atmospheric exposure, fluctuation in salinity due to influx of fresh water, pressure induced by pollution, etc. and particularly in Mohana & Talsari pollution effects like fishing boat discharge, sewage and land drain.

In the present study, population density of marine benthic groups was comparatively more at Talsari & Mohana. Qasim *et al*. (1972) observed that in an estuarine environments where changes in salinity are very large, maximum abundance of many organisms occur at exceptionally low salinities. In Digha, though the oysters inhabit in sub tidal region thereby remain submerged even in low tide hours, the water is mostly turbid. Due to such environment there is possible effect on the number of gametes formed, released and also survival of new recruits (Yennawar, 1997). Such situation may be attributed to enhanced by pure, eutrophic, environmental conditions prevailing in monsoon which gave great decrease in the population density in case of *Donax* sp. at all the localities. The decrease of population was considerably less in the other location in respect to seasons which reveals suitability of the habitats.

Difference between populations at different locations may represent the response to different levels of stress. Lee (1985) attributed the reproductive strategy adopted by *P. viridis* in Victoria Harbor, Hong Kong to the need for the population to maximize adult survival and successful production of offspring by ensuring that a considerable number of larvae successfully settle as new recruits to the parent population over a restricted period limited by pollution stress. The differences in the densities can be accounted to the greater number of younger individuals settled and grown. Such differences of the reproductive success is common in species that use an indirect mode of reproduction and several biotic and abiotic factors can be responsible.

Spatial and temporal variability of the beginning of the shell-growing season of *Macoma balthica* had been documented by study of Beukema *et al.* (1985) and Vincent *et al.* (1987). Both suggested that the temperature was principal factor controlling the onset of shell growth. Further, in the view of density and size distribution of the marine bivalves, the differences in the start of the growing season observed between younger and older generations can probably be related to the presence or absence of reproductive activity and to energy allocation (Harvey and Vincent, 1989). In the study of *M. balthica* at St. Lawrence estuary, Canada, temperature and food conditions were favorable for growth. In those individuals which had not built up sexual products during the period would begin to grow earlier than those which had invested energy in reproduction (Harvey and Vincent, 1989). The differences in the population densities at different locations under the present study can also probably be related to the presence or absence of reproductive activity and to energy allocation.

Growth trajectories of shell and soft tissue in marine bivalves have already been compared but presence of three distinguishable phases of growth has never been observed (Beukema *et al.*, 1985; Craunford *et al.*, 1985). It is pertinent to mention here that Hilbish (1986) showed that rates of growth preceded the growth of soft tissue. However, Peterson and Fegley (1986) found that there was little tendency for *Mercenaria mercenaria* to grow simultaneously in shell volume, somatic mass and gonadal mass. Uncoupled growth patterns of shell and soft tissue seem to be a general phenomenon in marine bivalve populations (Hilbish, 1986; Peterson & Fegley, 1986). Mechanisms by which shell and soft tissue growth may be uncoupled are (1) different growth rates of both components, (2) loss of weight due to spawning, and (3) loss of tissue weight due to periods of negative energy balance. In the study on condition index conducted on *S. cucullata* from Kalbadevi estuary in summer at both localities focused the above mechanisms (Yennawar, 1997). In the present study, the population shows startled growth and variations in distribution in different locations because of elevation pollution levels and exploitation by local fishermen.

Table 2. Distribution of macro benthic fauna in different study locations.

Sl. No.		**Talsari**	**Udaipur**	**Digha**	**Mohana**	**Shankarpur**
	Phylum: CNIDARIA					
	Class: ANTHOZOA					
	Order: ACTINIARIA					
	Family: ACTINIIDAE					
1	*Paracondylactis indicus* (Dave, 1957)		√			
	Family: HALIACTIIDAE					
2	*Pelocoetes exul* (Annandale, 1915)			√		
3	*Pelocoetes* sp.		√			√
	Order: PENNATULACEA					
	Family: VERTILLIDAE					
4	*Cavernularia elegans* (Herklots, 1858)		√			
5	*Cavernularia malabrica* (Flower, 1894)		√			
	Family: VIRGULARIDAE					
6	*Virgularia* sp.		√		√	
	Class: HYDROZOA					
	Family: PORPITIDAE					
7	*Porpita porpita* (Linnaeus, 1758)		√			
	Phylum: ANNELIDA					
	Class: POLYCHAETA					
	Family: ONUPHIDAE					
8	*Dioptera cuprea* (Bosc, 1802)	√			√	√
	Family: AMPHINOMIIDAE					
9	*Chloeia parva* Baird, 1868	√			√	√
10	*Nereis chilkansis* Southern, 1921		√			
11	*Perinereis nunntia* (Saviguy in Lamarck, 1818)		√			
	Phylum: BRACHIOPODA					
	Class: LINGULATA					
	Family: LINGULIDAE					
12	*Lingula anatina* (Lamarck, 1801)		√		√	
	Phylum: **ARTHROPODA**					
	Class: CRUSTACEA					
	SUB Class: CIRRIPEDIA					
	Order: THORACICA					
	Family: BALANIDAE					
13	*Balanus amphitrite* (Darwin, 1854)	√	√	√		√
	Family: CHTHAMALIDAE					
14	*Chthalamus stellatus* (Poli, 1795)		√	√		

Table 2. contd.

Sl. No.		Talsari	**Udaipur**	**Digha**	**Mohana**	**Shankarpur**
	Subclass: MALACOSTRACA					
	Order: STOMATOPODA					
	Family: SQUILLIDAE					
15	*Squilla nepa* Latreille, 1828	√	√	√	√	√
	Order: DECAPODA					
	Family: PALINURIDAE					
16	*Panulirus polyphagus* (Herbst, 1793)	√	√	√	√	√
17	*Panulirus ornatus* (Fabricius, 1798)	√	√	√	√	√
	Family: MATUTIDAE					
18	*Matuta victor* (Fabricius, 1781)	√	√	√	√	√
19	*Matuta planips* Fabricius, 1798	√	√	√	√	√
	Family: PORTUNIDAE					
20	*Portunus pelagicus* (Linnaeus, 1758)	√	√			
21	*Portunus sanguinolentus* Herbst, 1868	√	√		√	
22	*Charybdis feriata* (Linnaeus, 1758)	√	√	√	√	√
23	*Charybdis granulata* (de Haan, 1833)	√	√		√	√
24	*Scylla serrata* (Forskal, 1775)	√	√		√	√
	Family: PAGUNIDAE					
25	*Diogenes custus* (Fabricius, 1798)	√	√			
26	*Diogenes miles* (Fabricius, 1787)	√	√		√	
	Family: MAIIDAE					
27	*Doclea ovis* (Fabricius, 1787)		√			
28	*Doclea canalifera* Stimpson, 1857		√			
	Family: PARATHENOPIDAE					
29	*Lambrush (Platylambrush) prensor* Herbst		√			
	Family: OCYPODIDAE					
30	*Oceypoda macrocera* H. Milne-Edwards, 1852		√			√
31	*Uca triangularis* (A.Milne-Edwards, 1873)		√			√
	Class: MEROSTOMATA					
	Order: XIPHOSURIDA					
	Family: XIPHOSURIDAE					
32	*Tachypleus gigas* (Muller, 1785)	√	√			
33	*Carcinoscorpius rotundicauda* (Latreille, 1802)	√	√			
	Phylum: MOLLUSCA					
	Class: GASTROPODA					
	Order: ARCHAEOGASTROPODA					
	Family: TROCHIDAE					
34	*Umbonium vestiarium* (Linnaeus, 1758)	√	√	√		√
	Family: NERITIDAE					
35	*Nerita (Ritena) grayana* Recluz, 1843		√			

Table 2. contd.

Sl. No.		Talsari	Udaipur	Digha	Mohana	Shankarpur
	Order: MESOGASTROPODA					
	Family: POTAMIDIDAE					
36	*Telescopium telescopium* (Linnaeus, 1758)	√	√		√	√
	Family: EPITONIIDAE					
37	*Amaea (Acrilla) acunimata* (Sowerby, 1844)	√	√	√	√	√
	Family: NATICIDAE					
38	*Natica tigrina* (Roeding, 1798)	√	√			
39	*Polinices (Glossaulox) didyma* (Roeding, 1798)		√	√	√	
40	*Polinices tumidus* (Swainson, 1840)	√				
41	*Sinum neritoiderum* (Linnaeus, 1767)		√			
	Family: TURRITELLIDAE					
42	*Turritella attenuata* Reeve, 1849	√	√	√		√
43	*Turritella columnaris* Kiener, 1843					√
	Family: LAMELLARIIDAE					
44	*Lamellaria (Corvicella) indica* Leach, 1867	√				√
	Family: BURSIDAE					
45	*Bursa (Bufonaria) rana* (Linnaeus, 1758)			√		√
	Family: RENELLIDAE					
46	*Gyrinum natator* (Roding, 1798)			√		
	Order: NEOGASTROPODA					
	Family: MURICIDAE					
47	*Thais blanfordi* (Melvill, 1893)		√	√	√	
48	*Thais lacera* (Born, 1778)	√	√	√		
49	*Seminricinula konkanensis* (Melvill, 1893)				√	
50	*Murex tribulus* (Linnaeus, 1758)		√			
	Family: NASSARIDAE					
51	*Nassarius (Hima) stolatus* (Gmelin, 1791)	√				
52	*Nassarius dorsatus* (Roeding, 1798)					√
	Family: OLIVIDAE					
53	*Ancilla ampla* (Gmelin, 1791)	√	√		√	√
54	*Olivancilaria gibbosa* Born, 1778				√	
55	*Oliva oliva* (Linnaeus, 1758)			√		
56	*Agaronia nebulosa* (Lamarck, 1811)		√			
	Family: VOLUTIDAE					
	SUB Family: CYMBIINAE					
57	*Melo melo* (Solander, 1786)		√			
	Family: TURIIDAE					
	SUB Family: TURRICULINAE					
58	*Turicula javana* (Lamarck, 1816)					√
	Family: MELONGENIDAE					
59	*Pugilina cochlidium* (Linnaeus, 1758)		√			

Table 2. contd.

Sl. No.		Talsari	Udaipur	Digha	Mohana	Shankarpur
	SUB Class: HETEROBRANCHIA					
	SUPER Order: ALLOGASTROPODA					
	Family: ARCHECTONIDAE					
60	*Archectonica perspective* (Linnaeus, 1758)					√
	Class: BIVALVIA					
	Order: ARCOIDA					
	Family: ARCIDAE					
61	*Anadara granosa* (Linnaeus, 1758)				√	
62	*Anadara antiquata* (Linnaeus, 1758)	√	√	√	√	√
63	*Scapharca inaequivalvis* (Bruguiere, 1789)		√	√		√
64	*Anadara indica* (Gmelin, 1791)					√
65	*Scapharca cornea* (Reeve, 1844)	√	√	√		√
	Order: MYTILOIDA					
	Family: MYTILIDAE					
66	*Perna viridis* (Linnaeus, 1758)	√	√	√	√	√
67	*Modiolus undulates* (Dunker, 1856)		√			
68	*Modiolus striatulus* (Hanley, 1844)			√	√	
	Order: PTERIOMORPHA					
	Family: PINNIDAE					
69	*Pinna bicolor* Gmelin, 1791		√			
	Order: OSTEROIDA					
	Family: OSTREIDAE					
70	*Saccostrea cucullata* (Born, 1778)	√	√	√	√	√
71	*Crassostrea cuttackensis* (Newton & Smith, 1912)	√				√
72	*Crassostrea graphoides* (Scholtheim, 1813)			√	√	
	Order: VENEROIDA					
	Family: MACTRIDAE					
73	*Mactra luzonica* (Reeve, 1854)	√	√	√	√	√
74	*Mactra mera* (Reeve,)	√	√	√	√	√
75	*Mactra violacea* (Gmelin, 1791)	√	√	√		√
76	*Mactra stultrum* (Linnaeus, 1758)		√			
77	*Mactra cuneata* (Gmelin, 1791)	√	√	√	√	√
78	*Mactra dissimilis* (Reeve, 1854)	√	√	√	√	√
79	*Mactra turgida* Gmelin, 1791	√				
80	*Mactra achatina* (Holten, 1802)	√				
81	*Standella nicobarica* Gmelin, 1790	√				
82	*Mactra symmetrica* Deshayes, 1853					√
83	*Roeta pulchella* (Reeve, 1850)		√	√		√
84	*Roeta pelicull**a*** (Reeve, 1854)		√			

Table 2. contd.

Sl. No.		Talsari	Udaipur	Digha	Mohana	Shankarpur
85	*Spisula (Standella) annandalei*	√				
	Family: TELLINIDAE					
86	*Tellina angulata* Chemitz		√			
87	*Tellina (Tellinids)opalina* Chemitz, 1788	√	√	√	√	√
88	*Tellina (Homalina) myaeformis* (Sowerby)	√				
89	*Tellina timorensis* (Lamarck, 1818)	√	√			
90	*Strigilla splendid* (Anton)	√				
91	*Macoma blairensis*	√	√	√	√	√
92	*Macoma (Psammocoma) truncata* (Jonas)	√				√
93	*Macoma birmanica* Philippi, 1949	√	√			
94	*Macoma truncate*		√			√
95	*Macoma candida* (Lamarck, 1818)	√				
96	*Apolymetis edentula* Spengler, 1782	√	√	√	√	√
97	*Tellina remies* (Linnaeus, 1758)			√		
	Family: DONACIDAE					
98	*Donax pulchellus* Hanley, 1843	√				
99	*Donax incrnatus* Gmelin, 1791					√
100	*Donax compressus* Lamarck, 1800			√	√	√
101	*Donax deltoids* (Lamarck, 1818)	√	√	√		√
102	*Donax scortum* (Linnaeus, 1758)	√	√	√	√	√
	Family: PSAMMOBIIDAE					
103	*Sanguinolaria acuminata* (Deshays)	√	√	√		√
	Family: VENERIDAE					
104	*Mertrix meretrix* (Linnaeus, 1758)	√	√	√	√	√
105	*Meretrix casta* (Gmelin, 1791)			√	√	√
106	*Circe scripta* (Linnaeus, 1758)				√	
107	*Pitar albastrum* (Reeve, 1863)		√			√
108	*Pitar morhuansis* (Dall, 1902)		√			
109	*Pitar textile* (Gmelin, 1791)	√				
110	*Katelysia opima* (Gmelin, 1791)	√	√	√	√	√
111	*Paphia textile* Gmelin, 1791					√
112	*Paphia semirugata*			√	√	√
113	*Paphia gallus* (Gmelin, 1791)	√			√	√
114	*Paphia malabrica* (Chemnitz, 1782)	√				
115	*Paphia alapailiones* Roeding				√	
116	*Sunetta (Sunetta) scripta* (Linnaeus, 1758)		√			
117	*Sunetta (Sunetta) meroi* (Linnaeus)		√			
118	*Pelecyrora trigona* (Reeve, 1850)	√	√	√	√	√
119	*Tapes belcheri* Sowerby, 1852	√				√
120	*Dosinia trigona* Schroter				√	√
121	*Katelesiya japonica* (Gmelin, 1791)		√			√

Table 2. contd.

Sl. No.		Talsari	Udaipur	Digha	Mohana	Shankarpur
122	*Katelesiya mermorata* (Lamarck, 1818)					√
	Family: UNGULINIDAE					
123	*Diplodonta bullata* (Dunker, 1865)					√
124	*Diplodonta berhampurensis* Preston					√
	Family: CARDIIDAE					
125	*Trachycardium asiaticum* Brugierra, 1794		√			
126	*Laevicardium apertom* (Brugierra)	√				
127	*Acanthocardia coronata* (Schroter, 1786)	√				
	Order: ADAPENDOTA					
	Family: SOLENIDAE					
128	*Solen kempi* (Preston, 1915)			√		
129	*Solen brevis* Gray, 1842					√
130	*Siliqua radiate* (Linnaeus, 1758)		√			
131	*Siliqua winteriana* (Dunker, 1852)	√	√	√	√	√
132	*Pharela javanica* (Lamarck, 1818)					√
	Family: GLAUCONOMIDAE					
133	*Glauconome sculpta* Sowerby, 1894		√	√	√	
134	*Glauconome virens* (Linnaeus, 1767)			√		
	Order: MYOIDA					
	Family: PHOLADIDAE					
135	*Bernea candida* (Linnaeus, 1758)	√	√	√	√	√
136	*Pholas orientalis* (Gmelin, 1791)			√	√	√
	Family: LATERNULIDAE					
137	*Laternula truncate* (Lamarck, 1818)	√	√			√
138	*Laternula anatina* (Linnaeus, 1758)					√
	Family: PLACUNIDAE					
139	*Placuna placenta* (Linnaeus, 1758)					√
	Phylum: ECHINODERMATA					
	Class: ASTEROIDEA					
	Order: PAXILLOSIDA					
	Family: ASTEROPECTINIDAE					
140	*Astropecten euracanthus* (Luetken, 1871)					√
141	*Astropecten indicus* (Doederlein, 1872)		√		√	√

CONCLUSION

The variation of population size of different species at different location in different seasons reflects the suitability of habitat, environ & pressure to the marine bivalves. Overall, Talsari, Udaipur & Shankarpur was observed to be most suitable location of marine benthic population. However, Digha & Mohana was under pressure due to increasing tourism and other anthropogenic activities. The species diversity was recorded maximum during the months of October-January and minimum during March-April, which suggested that the recruitment and settlement of the fauna are maximum during the post-monsoon to winter. The major dominant species are *Mactra cuneata* (Gmelin, 1791), *Mactra dissimilis* (Reeve, 1854), *Mactra luzonica* (Reeve, 1854), *Mactra mera* (Reeve), *Bernea candida* (Linnaeus, 1758) and majority of the species are distributed in the region but does not reflected its dominance throughout the sampling. The population shows startled growth and variations in distribution in different locations because of elevation pollution levels and exploitation by local fishermen. Generally, the marine benthic invertebrates occur in areas of wide range of coastal zonation, some live where the salinity is high and many favors backwaters and estuaries where the flow of freshwater is regular and moderate salinities are prevail.

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