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ORIGINAL RESEARCH ARTICLE

A Study of a Marine Benthic Fauna with Special Reference to the Environmental Parameters, South East Coast of India

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ABSTRACT

A benthos is a bottom dweller and is organisms that live on the sea bed. The important food sources for many species are adapted to eating detritus and species that continually sift down to the sea floor from up above. The species found in the benthic zone are directly related to the specific kind of habitat. A number of factors control the distribution and diversity of benthic organisms. Totally 102 species were recorded and station I maximum species were recorded and station II minimum species were recorded. In its species maximum was recorded in muddy shores and minimum was recorded in sand beaches. In the present study clearly indicate that the polychaetes throughout year available when compare other species dominantly observed in all seasons. Physico-chemical and sedimentary factors are affect a species diversity and abundance.

Key words: Habitat, sediment, sand, mud, polychaetes, dominant.

INTRODUCTION

The benthic organisms have been widely used in assessing the health of marine ecosystem and bio investigation. The benthic zone provides many valuable products and ecological services. It is a play an important role in food chains and plays a critical role in the breakdown of organic substance [1]. They cycle nutrients through the sediments and serve as an important food source for bottom dwelling fish, larger surface dwelling invertebrates and many marine birds and mammals, including as food for humans. It can be provide information regarding the integrated effects of stress due to disturbances, if any and hence are good indicators of early warning of potential damage benthic fauna spatial and temporal distribution [2, 3, 4]. The abundance of benthic organisms those are important of fishery resources. Still, the differences in benthic organisms on a marine transect, in the coastal water zone, of a beach with different kinds of sediments. However, the benthic species diversity responds rapidly to changes in the aquatic environment particularly in relation to sediment and water nutrients [5]. This species distribution shows wide spatio temporal variations due to the different effect of hydrographical factors on individual species and they serve as good indicators of water quality and catches of fishes. An increase in fishes catch associated with an increase in benthic biomass and analysis of the landing report indicate the benthic production showed a good relationship with the demersal fish catch [6, 7]. Many factors reducing macro and meio benthic diversity may have direct detrimental effects on the amount and predictability of aquatic primary production. Earlier studies indicate the physico-chemical and sediment properties affect on the benthic species distribution [2, 3, 5, 8, 9] of marine environment. Hence the present study was carried out the physico-chemical and sedimentary parameters affect on the diversity of benthic organism from Chennai and Pondy coastal environment.

MATERIALS AND METHODS

The distributions of benthic organisms were investigated from different stations. The sampling period was one year from January 2009 to December 2009. The two different stations were Chennai (Station1) and Pondy (Station 2) from Indian coastal regions. The water and sediment

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samples were collected at monthly intervals. A hand cover with 4.3 cm inner diameter was used to collect samples at all stations, sieved and retained through 0.5Mm size sieve screen for macrobenthos, 45 mm sieve for meio and micro flora and preserved in 5% formalin. The animals were separated, counted, identified up to species level using standard references and expressed in No/cm^3 [10, 11]. Water and sediment samples were nutrient analysis by adopting standard procedure of [12]. The identification of species was referred standard manuals.

The atmospheric and water temperatures were measured using a digital centigrade thermometer. Salinity was estimated with the help of a hand refrectometer and pH was measured using an ELICO Grip pH meter. Dissolved oxygen was estimated by the modified Winkler's method [12]. For the analysis of nutrients, water and sediment samples were collected in clean polythene bottles and kept immediately in an icebox and transported to the laboratory. The water samples were than filtered using a Millipore filtering system and analyzed for dissolved nitrate, nitrite, total nitrogen and total phosphorus and sediment samples were ground to fine powder and dried in the hot plate at 110^{o}C to constant weight for an hour. Concentrations of sediment such as sand, silt, clay and nutrient viz., total organic carbon, cadmium, chromium, copper, ferric, manganes, nickel, lead and zinc were determined by the following method described by [12].

RESULTS

Table1: List and percentage composition of benthic species during January 2009- December 2009

S.No	Name of the species	Post-Monsoon		Summer		Pre-Monsoon		Monsoon	
	Polychaetes (%)								
1	*Ancistrosyllis constricta*	9.2	3.04	2.26	2.91	0.82	1.5	5.96	2.26
2	*Armandia longicaudata*	12.88	7.6	3.39	1.94	1.64	2.25	7.45	3.39
3	*Armandia intermedia*	11.04	6.08	0	0.97	0.82	1.5	2.98	1.13
4	*Brachiocapitta singularis*	7.36	4.56	2.26	3.88	2.46	0.75	1.49	2.26
5	*Capitella capitata*	12.88	7.6	4.52	2.91	0.82	1.5	10.43	5.65
6	*Chone collaris*	11.04	6.08	3.39	0.97	2.46	3	8.94	4.52
7	*Chone filicaudata*	7.36	4.56	2.26	0	0.82	1.5	4.47	2.26
8	*Chone concinnus*	9.2	3.04	3.39	1.94	0	2.25	2.98	1.13
9	*Cirratulus africanus*	5.52	6.08	4.52	2.91	1.64	0.75	4.47	2.26
10	*Cirratulus filiformis*	3.68	0	1.13	1.94	2.46	1.5	1.49	0
11	*Cirriformia* sp	9.2	4.56	5.65	3.88	3.28	0.75	2.98	3.39
12	*Cossura coasta*	11.04	7.6	2.26	2.91	0.82	1.5	11.92	7.91
13	*Cossura delta*	12.88	9.12	4.52	1.94	1.64	0.75	8.94	4.52
14	*Dorvillea gardineri*	9.2	6.08	3.39	0.97	2.46	0	4.47	2.26
15	*Drilonereis* sp	11.04	4.56	2.26	1.94	0.82	1.5	2.98	1.13
16	*Epidiopatra* sp	7.36	7.6	1.13	0	1.64	2.25	1.49	2.26
17	*Euclymene* sp	5.52	3.04	0	0.97	0.82	0.75	4.47	1.13
18	*Euclymene annandalei*	3.68	1.52	4.52	2.91	2.46	1.5	5.96	2.26
19	*Euclymene oerstedii*	0	3.04	1.13	1.94	0.82	0	0	1.13
20	*Eulalia bilineata*	5.52	0	2.26	0	1.64	0.75	2.98	0
21	*Eunice tubifex*	7.36	3.04	4.52	0.97	2.46	0.75	4.47	2.26
22	*Eunice indica*	5.52	7.6	1.13	1.94	0.82	1.5	2.98	4.52
23	*Exogone clavator*	1.84	4.56	2.26	2.91	1.64	0.75	0	3.39
24	*Eurythoe complanata*	7.36	3.04	1.13	1.94	0	1.5	2.98	4.52
25	*Fabricia filamentosa*	5.52	0	3.39	0.97	0.82	0.75	1.49	0
26	*Glycera alba*	12.88	9.12	2.26	3.88	1.64	0	8.94	5.65
27	*Goniada emerita*	7.36	12.16	1.13	1.94	3.28	2.25	2.98	4.52
28	*Goniadides falcigera*	9.2	1.52	2.26	2.91	1.64	0.75	7.45	3.39
29	*Hesione* sp	1.84	3.04	4.52	1.94	0.82	1.5	5.96	1.13
30	*Leanira hystricis*	3.68	4.56	3.39	0.97	1.64	0.75	2.98	3.39
31	*Lumbrineris* sp	9.2	6.08	2.26	1.94	0.82	2.25	4.47	2.26
32	*Nephtys dibranchis*	16.56	12.16	5.65	3.88	2.46	0.75	7.45	4.52
33	*Nephtys sphaerocirrata*	7.36	7.6	2.26	2.91	1.64	1.5	4.47	2.26
35	*Notomastus* sp	9.2	3.04	1.13	1.94	0.82	0	5.96	3.39
36	*Onuphis* sp	3.68	4.56	3.39	0.97	2.46	1.5	7.45	4.52
37	*Ophelia* sp	5.52	3.04	1.13	1.94	1.64	0.75	2.98	1.13
39	*Pisione galapagoensis*	3.68	4.56	0	0.97	0.82	0	5.96	3.39
40	*Pisionidens indica*	1.84	3.04	2.26	2.91	0	1.5	2.98	1.13
41	*Polydora ciliata*	9.2	4.56	4.52	1.94	0.82	0	4.47	2.26
42	*Prionospio pinnata*	7.36	3.04	2.26	0.97	1.64	1.5	7.45	3.39
43	*Prionospio capensis*	3.68	0	5.65	2.91	0	0.75	1.49	0
44	*Prionospio cirrifera*	1.84	3.04	3.39	1.94	0.82	1.5	0	2.26
45	*Scololepis squamata*	3.68	0	2.26	0.97	2.46	0.75	5.96	3.39
46	*Scoloplella capensis*	1.84	3.04	1.13	2.91	0	1.5	2.98	1.13
47	*Scoloplos* sp	3.68	4.56	1.13	1.94	2.46	0.75	4.47	2.26
48	*Syllis longocirrata*	5.52	0	3.39	0.97	1.64	2.25	1.49	0
49	*Syllis cornuta*	7.36	10.64	1.13	0	0.82	0	4.47	1.13
50	*Terebella ehrenbergi*	3.68	7.6	2.26	2.91	0	0.75	2.98	2.26
51	*Terebellides* sp	5.52	6.08	2.26	0.97	0.82	1.5	7.45	3.39

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	Number of species	**184**	**152**	**113**	**97**	**82**	**75**	**149**	**113**
	Bivalves (%)								
1	*Arca sp*	4.04	9.81	1.3	0.54	1.86	0.98	0.54	2.04
2	*Anadara granosa*	7.07	5.45	1.3	0.54	0	0.49	0	1.02
3	*Anadara veligers*	9.09	13.08	0.65	0	0.62	0.98	1.08	0
4	*Bullia veliger*	1.01	8.72	0	0	0	0.49	0	0
5	*Cardium setosum*	14.14	10.9	1.3	0.54	1.86	1.96	2.7	2.04
6	*Cardium veligers*	17.17	14.17	3.9	2.7	2.48	2.45	3.24	3.57
7	*Crassostrea madrasensis*	10.1	5.45	1.3	2.16	1.24	1.47	4.32	1.53
8	*Donax cuneatus*	3.03	2.18	3.25	1.62	0.62	1.96	0	2.04
9	*Donax scortum*	7.07	3.27	3.9	2.7	2.48	0	1.08	1.53
10	*Donax veligers*	2.02	5.45	2.6	3.24	1.86	0.98	0.54	1.02
11	*Katelysia opima*	1.01	3.27	3.25	0.54	1.24	0.49	2.7	1.53
12	*Lucina ovum*	2.02	1.09	1.95	1.08	0	1.47	0	0.51
13	*Meretrix casta*	3.03	4.36	3.25	1.62	3.72	0.98	0.54	1.53
14	*Meretrix merretrix*	8.08	7.63	5.85	2.7	4.96	3.43	4.32	2.04
15	*Meretrix veligers*	4.04	6.54	1.3	1.62	4.34	1.47	2.7	1.02
16	*Paphia textile*	1.01	2.18	3.25	0.54	2.48	0.98	1.08	1.53
17	*Pecten* sp	2.02	5.45	0.65	2.16	3.1	0.98	1.62	0.51
18	*Placenta placenta*	4.04	5.45	1.3	1.62	3.72	0.49	0.54	1.02
19	*Perna viridis*	2.02	4.36	1.95	3.24	1.86	1.96	2.16	1.53
	Number of species	**24**	**17**	**19**	**17**	**13**	**12**	**23**	**18**
	Gastropods(%)								
1	*Bullia vitata*	1.59	2.1	1.16	0.93	1.5	1.62	2.17	1.9
2	*Cerethedia cingulata*	4.24	0.84	0.87	1.55	1.8	0.81	1.24	0.76
3	*Cerithium* sp	3.71	1.68	0.58	0.31	0.6	1.08	0.93	2.28
4	*Littorina scarba*	2.65	2.52	0.58	1.86	0.9	0.27	1.24	1.9
5	*Natica* sp	1.06	1.26	0.58	0.31	0.6	0.81	0.93	1.14
6	*Oliva nebulosa*	3.71	2.1	0.87	0.62	0	0.27	0	0.76
7	*Oliva veliger*	2.65	0.84	0.29	1.24	1.5	0.54	0.31	1.52
8	*Turritella attenuata*	2.12	2.52	1.45	1.24	0.3	1.35	0.62	1.14
9	*Umbonium vestiarium*	6.36	3.78	2.03	1.55	1.8	0.54	2.17	3.04
	Number of species	**53**	**31**	**29**	**24**	**30**	**23**	**31**	**27**
	Crustaceans (%)								
1	*Emerita asiatica*	1.2	1.14	0.75	0.39	0.13	0.002	0.63	0.9
2	*Eriopsia sp*	1.92	0.95	0.6	0.91	0.65	0.026	1.05	1.08
3	*Eurydice sp*	0.96	0.57	0.3	0.26	0.39	0.003	1.47	0.72
4	*Idunella sp*	1.68	0.95	0.6	0.13	0.52	0.026	1.26	0.54
	Number of species	**21**	**19**	**21**	**13**	**23**	**27**	**21**	**18**
	Amphipods (%)								
1	*Ampithoe romondi*	0.34	0.62	1.04	0.72	0.36	0.21	0.6	0.27
2	*Ampithoe* sp	2.04	1.55	0.78	0.24	0.9	0.42	0.9	0.54
3	*Corophium triaenonyx*	1.36	0.62	1.3	1.44	0.18	0.84	0.3	0.81
4	*Cheriphotes* sp	1.02	1.24	0.52	0.24	0.36	0.63	0.6	0.27
5	*Gammarus salinus*	1.7	0.93	0.26	0.48	0.18	0.21	0.3	0.54
6	*Grandidierella* sp	0.34	0.62	1.04	0.72	0.36	0.84	0.9	0.81
7	*Harpinia laevis*	1.02	1.24	0.26	0.24	0.54	0	0.3	0.54
8	*Pontharpinia* sp	1.7	0.93	0.52	0.48	0.18	0.21	1.8	1.62
9	*Urothoe* sp	1.36	1.55	0.26	0.72	0	0.42	2.1	1.35
10	*Vibilia* sp	0.68	0.31	0.78	0.48	0.18	0.63	1.2	0.54
	Number of species	**34**	**41**	**26**	**31**	**18**	**21**	**30**	**28**
	Sipunculida **Isopods** (%)								
1	*Angeliera phreaticola*	1.12	0.52	0.69	0.18	0.3	0.48	0.5	0.21
2	*Angliera* sp	1.4	0.26	0.46	0.54	0.15	0.32	0.75	0.84
3	*Cymodoce truncata*	0.56	1.04	1.15	0.36	0.45	0.32	1	0.63
4	*Eisiothistos* sp	0.84	0.52	0.23	0.54	0.15	0.16	1.25	0.21
5	*Mirocerberus* sp	2.24	1.3	0.92	0.36	0.15	0.32	0.75	0.42
6	*Paragnathia formica*	0.28	1.04	0.23	0.72	0.3	0.16	1	0.63
7	*Sphaeroma serratum*	0.84	1.3	0.69	0.18	0.3	0.48	0.75	1.05
8	*Sphaeroma* sp	0.56	0.78	0.92	0.36	0.45	0.32	0.25	0.42
	Number of species	**28**	**26**	**23**	**12**	**15**	**16**	**15**	**17**
	Branchiostomidae (%)								
1	*Branchiostomal lanceolatum*	2.85	4.56	2.28	3.42	2.85	4.56	5.13	6.84
	Number of species	**5**	**8**	**4**	**6**	**5**	**8**	**9**	**12**

Table 2: Macrofauna evenness, diversity, richness and index

Index	Polychaetes		Bivalves		Gastropods		Amphipods		Isopods		Crustaceans		Branchiostomidae	
Stations	I	II	I	II	I	II	I	II	I	II	I	II	I	II
Pielou's evenness J	0.895	0.746	0.679	0.582	0.478	0.567	0.548	0.681	0.432	0.428	0.347	0.392	0.214	0.231
Shannon -Wienner's diversity(H)	0.421	0.172	4.917	4.152	3.354	3.823	3.912	3.541	2.145	2.317	2.143	2.054	1.782	1.63
Margalef's(D)iversity index	4.574	3.789	3.3177	2.984	2.523	2.154	1.961	1.464	2.039	1.678	1.421	1.432	1.347	1.358
Margalef's(D) Species Richness(SR)	7.085	7.195	2.506	3.152	1.412	1.971	1.214	1.924	1.329	1.477	1.436	1.423	1.356	1.321
Simpson's Index(D)	0.857	0.749	0.823	0.835	0.879	0.765	0.743	0.756	0.714	0.716	0.678	0.697	0.678	0.654

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The recorded benthic organisms were grouped into seven categories namely Polychaetes, Bivalves, Gastropods, Crustaceans, Amphipods, Isopods and Branchiostomidae. The species composition of the macrofauna in the present study showed that Polychaetes are predominant, followed by Bivalves, Gastropods, Amphipods, Isopods, Crustaceans and Branchiostomidae. The study period totally 102 species was recorded in different stations following them, Polychaetes (51), Bivalves (19), Gastropods (9), Crustaceans (4), Amphipods (10), Isopods (8) and Branchiostomidae (1). The post monsoon season maximum and minimum species was recorded in station I, the following order; Polychaetes (184) > Gastropods (53) > Amphipods (34) > Isopods (28) > Bivalves (24) > Crustaceans (21)> Branchiostomidae (5) and the benthic organisms was observed similarly in station II; Polychaetes (152) > Amphipods (42) > Gastropods (31) > Isopods (26) > Crustaceans (19) >Bivalves (17) > Branchiostomidae (8). The summer season maximum and minimum species was recorded in station I, the order of Polychaetes (113) > Gastropods (29) > Amphipods (26) >Isopods (23) > Crustaceans (21) > Bivalves (19) > Branchiostomidae (4) and similar as followed the benthic organisms was recorded in station II: Polychaetes (97) > Amphipods (31) > Gastropods (24) > Bivalves (17) > Crustaceans (13) >Isopods (12) > Branchiostomidae (6). The premonsoon season maximum and minimum was recorded in the following order, station I; Polychaetes (82) > Gastropods (30) > Crustaceans (21) > Amphipods (18) > Isopods (15) >Bivalves (13) > Branchiostomidae (5) and similarly the benthic organisms was observed in station II; Polychaetes (75) > Crustaceans (23) >Gastropods (27) > Amphipods (21) > Isopods(16) > Bivalves (12) > Branchiostomidae (8) and the monsoon season maximum and minimum was recorded in the following order, station I; Polychaetes (149) > Gastropods (31) > Amphipods (30) >Bivalves (21) > Crustaceans (21) > Isopods (15) > Branchiostomidae (9) and similarly the benthic organism was recorded in station II; Polychaetes (113) > Amphipods (28) > Gastropods (27) >Bivalves (23) > Crustaceans (18) >Isopods (17) > Branchiostomidae (12) (**Table 1**).

The data were analysed by Margalef's species richness (*d'*), Shannon-Weiner diversity function (*H'*), Pielou's evenness (*J'*) and Simpson's dominance ($1\text{-}\lambda'$). The species richness and diversity of macrofauna was dominated by polychaetes at two sampling stations were determined by using Pielous evenness shown that highest at the station1 (0.895) and lowest at the station 2 (0.746) than other groups. Both Shannon and Simpson indices were highest at the station1 (0.857) (**Table 2**).

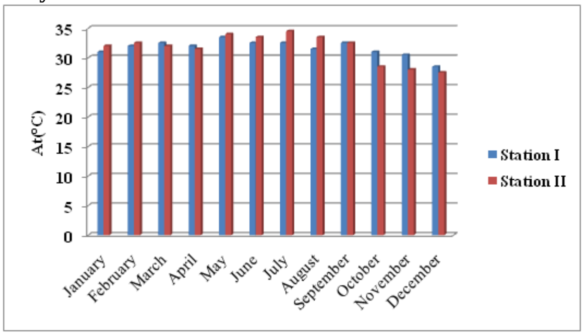
Rainfall:

Total rainfall recorded from the study area was 1025 mm to 1170 mm. There was no rainfall during February and April. Maximum rainfall was recorded during the month of November (381.5 mm). A cyclonic storm during the monsoon season accounted for the highest total rainfall recorded during the first phase than the latter.

Atmospheric temperature At (°C):

The atmospheric temperature minimum was recorded 28.5°C and 27.5°C during the monsoon period in the month of December at station-I and station-II and maximum was recorded 33.5°C and 34.0°C during summer in the month of May at station-I and station-II respectively and the variation of atmospheric temperature in different months of the year is shown in (**Fig 1**).

Fig 1: Atmospheric temperature (°C) in different stations from January-2009 to December- 2010



Water temperature:

The water temperature minimum was recorded 27.5 °C and 27.0°C during the monsoon period in the month of December at station-I and station-II and maximum was recorded 33.5°C and 32.5°C during summer in the month of May at station-I and station-II respectively and the variation of water temperature in different months of the year is shown in (**Fig 2**).

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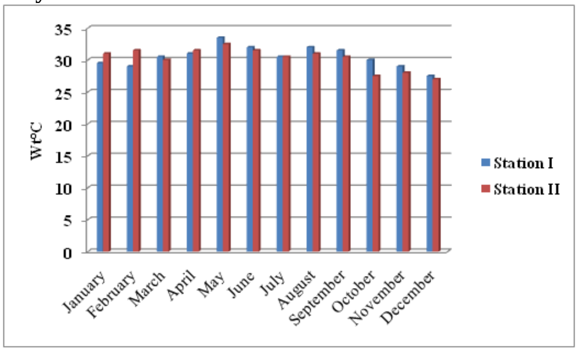
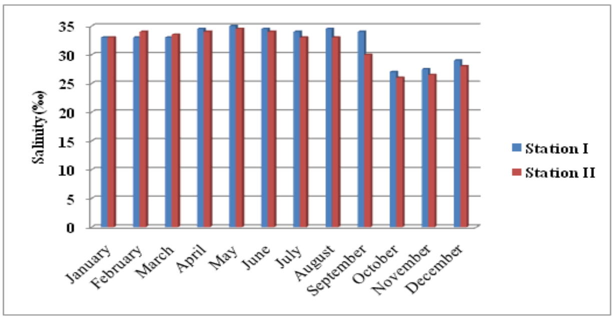
Fig 2: Water temperature (°C) in different stations from January-2009 to December- 2010



Salinity:

The salinity minimum 27.5ppt and 26.5 was recorded during the monsoon in the month of November at station-I and station-II and maximum 35.0 ppt and 32.0 ppt salinity was recorded during summer in the month of April at station-I and station-II respectively. Both the station showed similar seasonal pattern in salinity distribution and recorded low values during the monsoon season and high during the summer season (**Fig 3**).

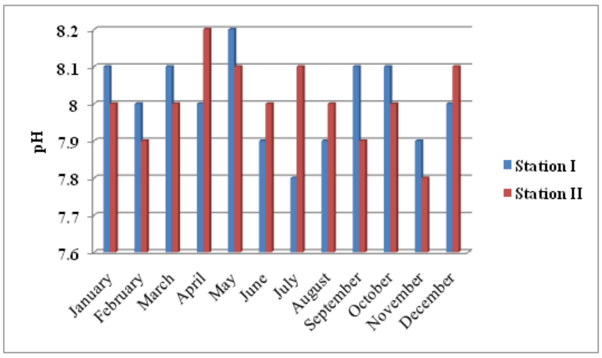
Fig 3: Salinity (ppt) in different stations from January-2009 to December- 2009



pH:

The pH minimum was recorded 7.8 and 7.9 during the monsoon season in the months of November at station-I and station-II and maximum was recorded 8.2 and 8.1 during summer in the month of April at station-I and station-II respectively and the variation of pH in different months of the year is shown in (**Fig 4**).

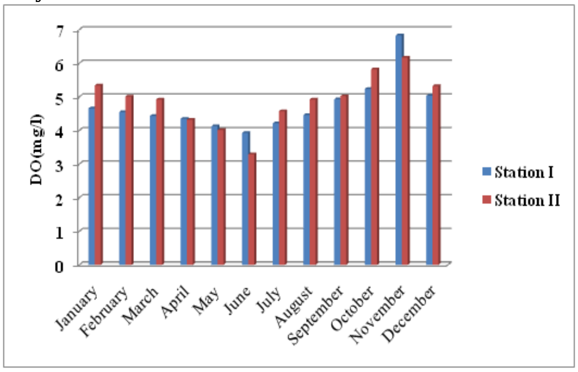
Fig 4: pH in different stations from January-2009 to December- 2009



Dissolved oxygen:

The dissolved oxygen minimum was recorded 3.926 mg1/l and 3.29 mg1/l during the summer season in the month of June at station-I and station-II and maximum was recorded 6.827 mg1/l and 6.17 mg1/l during the monsoon season in the month of November at station-I and station-II respectively and the variation of dissolved oxygen in different months of the year is shown in (**Fig 5**).

Fig 5: Dissolved oxygen (mg1/l) in different stations from January-2009 to December- 2009

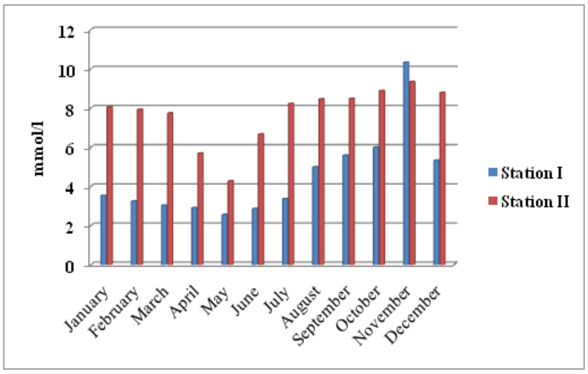


Nutrients:

Nitrate

The nitrate minimum was recorded 2.554 mmol/l and 4.267 mmol/l during the summer season in the month of May at station-I and station-II, maximum was recorded 10.321 mmol/l and 9.337 mmol/l monsoon season in the month of November at station-I and station-II respectively and the variation of nitrate in different months of the year is shown in (**Fig 6**).

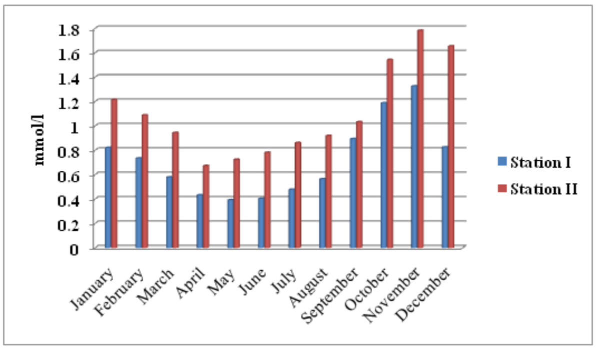
Fig 6: Nitrate (mmol/l) in different stations from January-2009 to December- 2009



Nitrite:

The nitrite minimum was recorded 0.392 mmol/l and 0.672 mmol/l during the summer period in the months of May and April at station-I and station-II and maximum was recorded 1.325 mmol/l and 1.782 mmol/l during the monsoon season in the month of November at station-I and station-II respectively and the variation of nitrite in different months of the year is shown in (**Fig 7**).

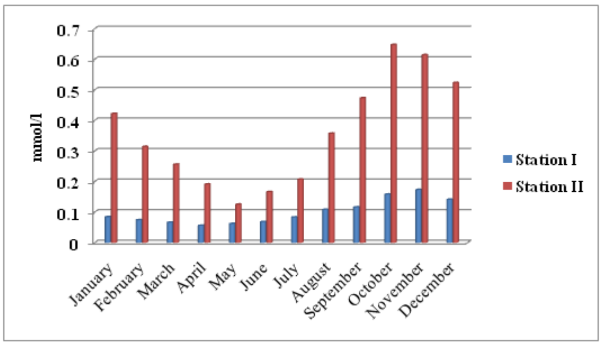
Fig 7: Nitrite (mmol/l) in different stations from January-2009 to December- 2009



Ammonia:

The ammonia minimum was recorded 0.056 mmol/l and 0.125 mmol/l during summer period in the month of April and May at station-I and station-II and maximum was recorded 0.173 mmol/l and 0.614 mmol/l during monsoon in the month of November at station-I and station-II respectively and the variation of ammonia in different months of the year is shown in (**Fig 8**).

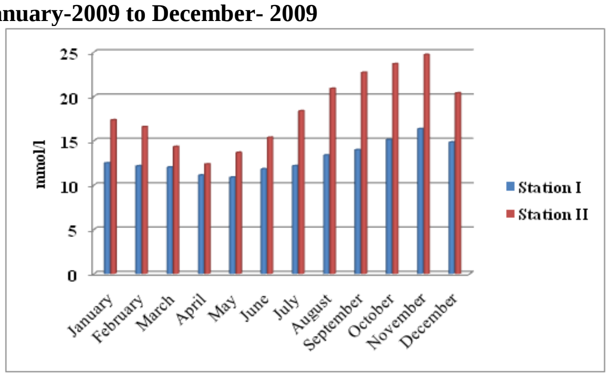
Fig 8: Ammonia (mmol/l) in different stations from January-2009 to December- 2009



Total Nitrogen:

The total nitrogen minimum was recorded 10.871 mmol/l and 12.356 mmol/l during summer period in the months of May and April at station-I and station-II and maximum was recorded 16.328 mmol/l and 24.698 mmol/l during monsoon in the month of November at station-I and station-II respectively and the variation of nitrogen in different months of the year is shown in (**Fig 9**).

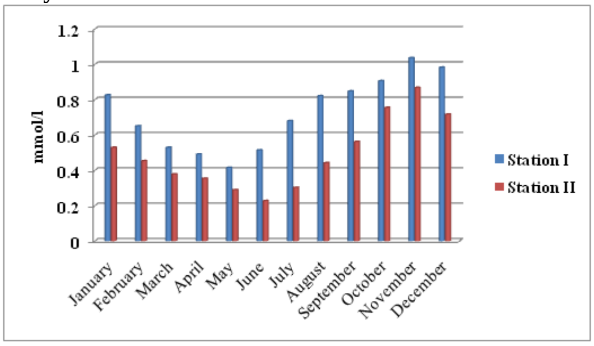
Fig 9: Total nitrogen (mmol/l) in different stations from January-2009 to December- 2009



Inorganic phosphate:

The inorganic phosphate minimum was recorded 0.415 mmol/l and 0.227 mmol/l during summer seasons in the month of May and June at station-I and station-II and maximum was recorded 1.036 mmol/l and 0.868 mmol/l during monsoon in the month of November at station-I and station-II respectively and the variation of inorganic phosphate in different months of the year is shown in (**Fig 10**).

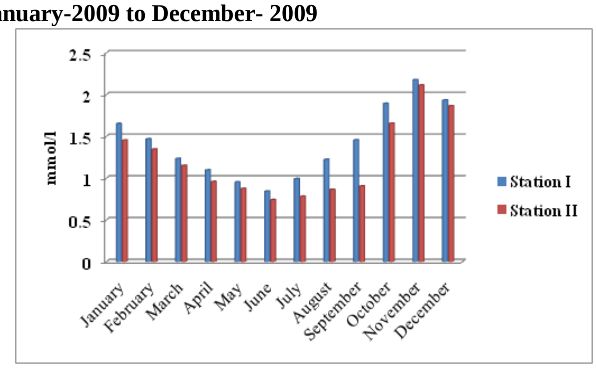
Fig 10: Inorganic phosphate (mmol/l) in different stations from January-2009 to December- 2009



Total Phosphorous:

The total phosphorous minimum was recorded 0.841 mmol/l and 0.740 mmol/l during summer period in the month of May at station-I and station-II and maximum was recorded 2.176 mmol/l and 2.112 mmol/l during monsoon in the month of November at station-I and station-II respectively and the variation of total phosphorous in different months of the year is shown in (**Fig 11**).

Fig 12: Total phosphorous (mmol/l) in different stations from January-2009 to December- 2009



Reactive silicate

The reactive silicate minimum was recorded 12.130 mmol/l and 10.258 mmol/l during summer period in the month of May at station-I and station-II and maximum was recorded 18.778 mmol/l and 21.998 mmol/l during monsoon in the month of October and November at station-I and station-II respectively and the variation of reactive silicate in different months of the year is shown in (**Fig 13**).

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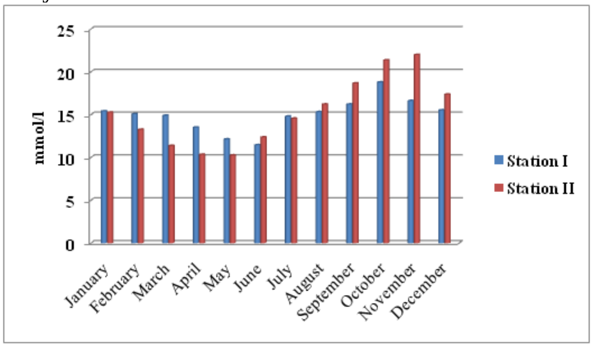
Fig 13: Reactive silicate (mmol/l) in different stations from January-2009 to December- 2009

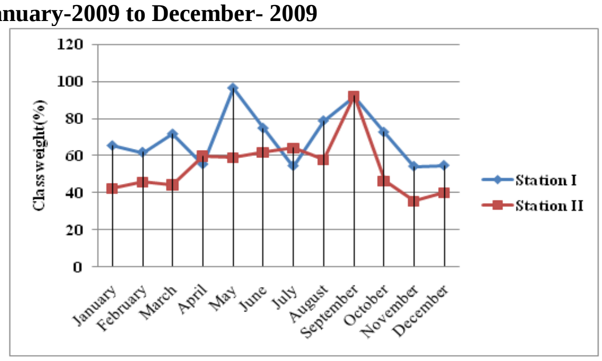


Sediment analysis:

Sand

The sand minimum was recorded 96.55% and 58.76% during summer seasons in the month of May at station-I and station-II and maximum was recorded 54.15% and 35.46% during monsoon in the month of November at station-I and station-II respectively and the variation of sand in different months of the year is shown in (**Fig 14**).

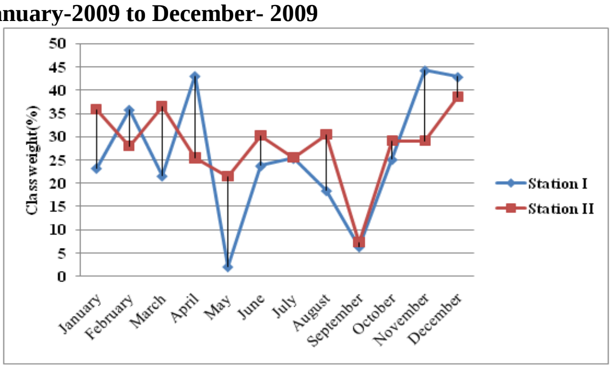
Fig 14: Properties on sand (%) in different stations from January-2009 to December- 2009



Silt:

The silt minimum was recorded 2.09 % and 21.46 % during summer seasons in the month of May at station-I and station-II and maximum was recorded 44.24 % and 29.07 % during monsoon in the month of November at station-I and station-II respectively and the variation of silt in different months of the year is shown in (**Fig 15**).

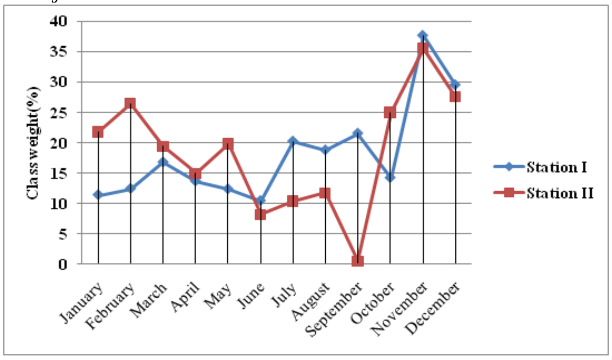
Fig 15: Properties on silt (%) in different stations from January-2009 to December- 2009



Clay

The clay minimum was recorded 1.34% and 19.77 % during summer seasons in the month of May at station-I and station-II and maximum was recorded 37.62% and 35.46% during monsoon in the month of November at station-I and station-II respectively and the variation of clay in different months of the year is shown in (**Fig 16**).

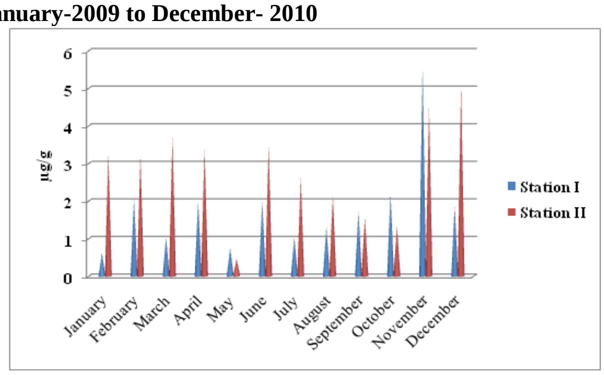
Fig 16: Properties on clay (%) in different stations from January-2009 to December- 2009



Total organic carbon:

The total organic carbon minimum was recorded 0.756 µg/g and 0.471 µg/g during summer seasons in the months of May and June at station-I and station-II and maximum was recorded 5.586 µg/g and 4.504 µg/g during monsoon in the month of November at station-I and station-II respectively and the variation of total organic carbon in different months of the year is shown in (**Fig 17**).

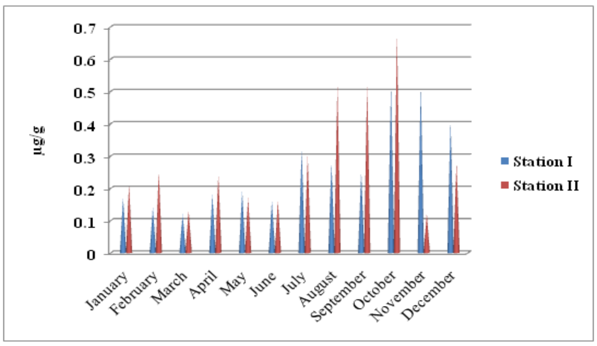
Fig 17: Total organic carbon (µg/g) in different stations from January-2009 to December- 2010



Cadmium:

The cadmium minimum was recorded 0.12 µg/g and 0.13 µg/g during post monsoon period in the month of March at station-I and station-II and maximum was recorded 0.52 µg/g and 0.68 µg/g during premonsoon in the month of October at station-I and station-II respectively and the variation of cadmium in different months of the year is shown in (**Fig 18**).

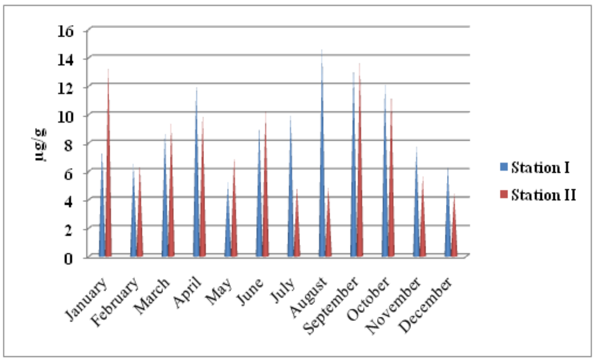
Fig 18: Cadmium (µg/g) in different stations from January-2009 to December- 2010



Chromium

The chromium minimum was recorded 5.16 µg/g and 7.041 µg/g during summer seasons in the month of May at station-I and station-II and maximum was recorded 12.24 µg/g and 11.56 µg/g during premonsoon in the month of October at station-I and station-II respectively and the variation of chromium in different months of the year is shown in (**Fig 19**).

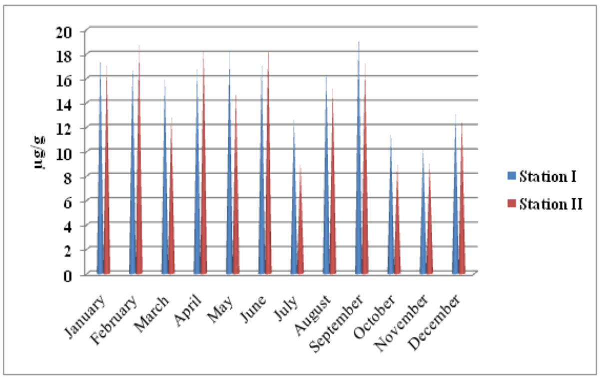
Fig 19: Chromium (µg/g) in different stations from January-2009 to December- 2009



Copper

The copper minimum was recorded 16.2 µg/g and 12.92 µg/g during postmonsoon seasons in the months of March at station-I and station-II and maximum was recorded 19.72 µg/g and 17.2 µg/g during premonsoon in the month of September at station-I and station-II respectively and the variation of copper in different months of the year is shown in (**Fig 20**).

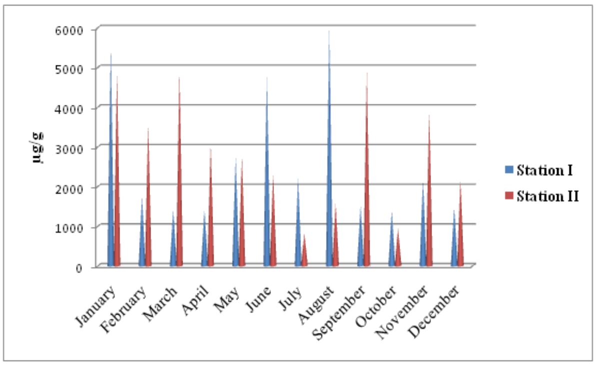
Fig 20: Copper (µg/g) in different stations from January-2009 to December- 2009



Ferric:

The ferric minimum was recorded 2201 µg/g and 815.2 µg/g during post monsoon period in the month of July at station-I and station-II and maximum was recorded 2165.6 µg/g and 3878.4 µg/g during premonsoon in the month of October at station-I and station-II respectively and the variation of ferric in different months of the year is shown in (**Fig 21**)..

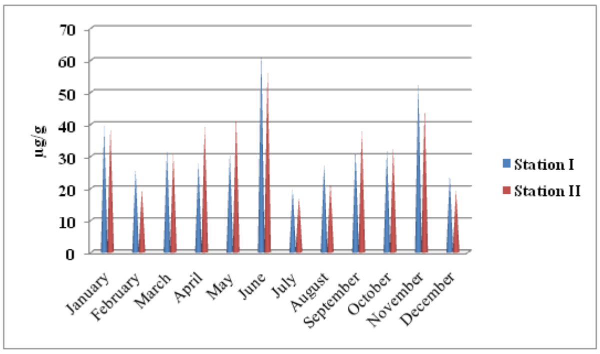
Fig 21: Ferric (µg/g) in different stations from January-2009 to December- 2009



Manganes

The manganes minimum was recorded 30.87 µg/g and 39.4 µg/g during summer seasons in the months of May and July at station-I and station-II and maximum was recorded 52.96 µg/g and 45.17 µg/g during monsoon in the month of November at station-I and station-II respectively and the variation of manganes in different months of the year is shown in (**Fig 22**).

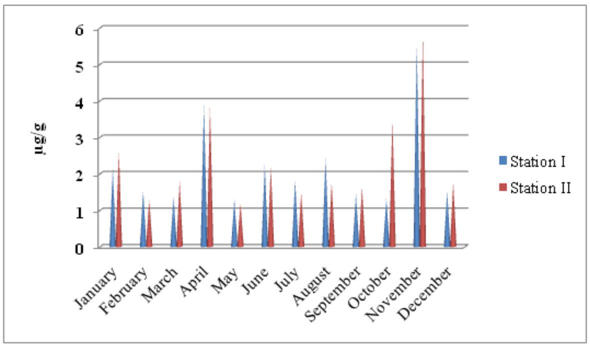
Fig 22: Manganese (µg/g) in different stations from January-2009 to December- 2009



Nickel:

The nickel minimum was recorded 1.28 µg/g and 1.19 µg/g during summer seasons in the month of May at station-I and station-II and maximum was recorded 5.56 µg/g and 5.85 µg/g during monsoon in the month of November at station-I and station-II respectively and the variation of nickel in different months of the year is shown in (**Fig 23**).

Fig 23: Nickel (µg/g) in different stations from January-2009 to December- 2009



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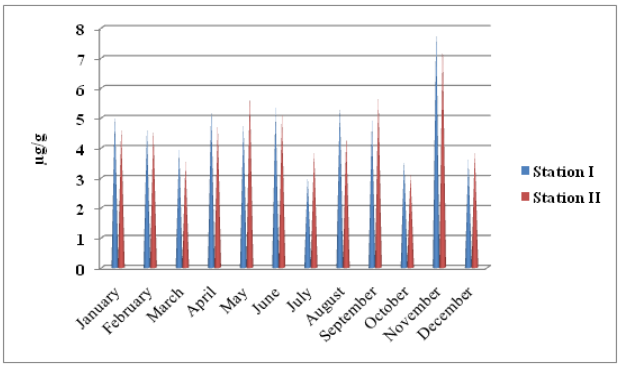
Lead

The lead minimum was recorded 4.84 µg/g and 5.8 µg/g during summer seasons in the month of May at station-I and station-II and maximum was recorded 7.96 µg/g and 7.42 µg/g during monsoon in the month of November at station-I and station-II respectively and the variation of lead in different months of the year is shown in (**Fig 24**).

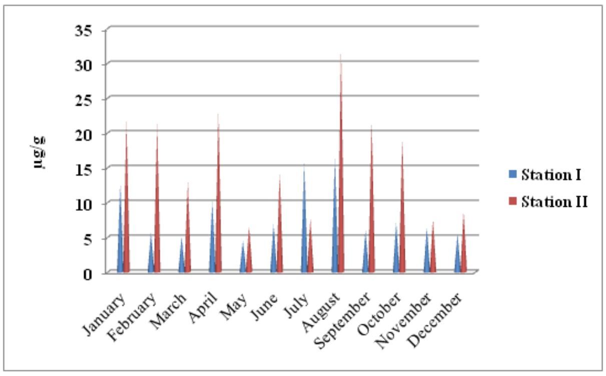
Fig 24: Lead (µg/g) in different stations from January-2009 to December- 2009



Zinc

The zinc minimum was recorded 4.52 µg/g and 6.58 µg/g during summer seasons in the month of May at station-I and station-II and maximum was recorded 16.28 µg/g and 32.0 µg/g during premonsoon in the month of August at station-I and station-II respectively and the variation of zinc in different months of the year is shown in (**Fig 25**).

Fig 25: Zinc (µg/g) in different stations from January-2009 to December- 2009



DISCUSSION

The benthic fauna and flora have adapted many different styles that influence their exposure to sediment contaminants. Most upon the species live on the deposit surface and feed in the water column, others live on the sediment surface in tubes and feed on detrital materials that are at the surface of the sediment and suspended in the water column. Other organisms live within mucous lined burrows within the sediment and obtain their food supplies from the surface of the sediment adjacent to the burrows [6]. The species of benthic organisms for which have the most information are those that value as a food source. The main food sources for the benthos are algae and organic runoff from land [13, 14]. The depth of water, temperature and salinity and type of local substrate all affect what benthos is present. The coastal waters and other places mostly formed environmental disturbances rapidly, due to the benthic organisms can proliferate. The organisms found here represent only a few taxa in large numbers suggesting poor water quality. Most upon the benthic organisms have a high rate of fecundity. A high rate of fecundity enables many species to recover from environmental turbulence rapidly and to colonize new habitats quickly and in high numbers. They generally live in close relationship with the substrate bottom many such organisms are permanently attached to the bottom others are attached to stones and even other organisms. It is also primarily because the bottom offers many more types of habitats that organisms can adapt to than the other environment. There are spatial variability has been inferred to be related to inhabitant availability, sediment structure and point sources of organic substance [13].

In the present study totally 102 species were recorded. Maximum species were recorded station I and minimum species were recorded in station II (Table1). When compare other species the polychaetes were predominate in all seasons. Still, the species density and abundance are seasonally varied. The dominance of the polychaetes throughout the year was observed in the present study and such a condition was also reported by [7, 15, 16, 17] from the southwest coast of India. [18] from the North Eastern Bay of Bengal. [19] from the Kakinada Bay and Back water, [9] from the Arabian Sea. [20] from the central Indian Ocean basin. [5] from the coromandal coast of Tamilnadu. The postmonsoon rise in polychaetes density followed by fall during increased salinity and temperature in summer as obtained in the present study. The monsoon season at both the stations indicated helpful adaptation of organic wastes. The plankton and other organisms detritus accumulated in the sediments during the postmonsoon and that the macro, meio and micro fauna and flora responded to this store of food when temperatures rose rapidly in the summer and summer ends the stored detritus was an exhausted and the benthic organism declined, such as, the premonsoon seasons the species abundance and density is very low. Similar findings were observed by [1] from the

Cochin backwater, [2] from the Kerala coast, [3] from the west coast of India, [21] from the Goa , [4] from the shallow and tropical coastal area, [5] from the coromandal coast of Tamilnadu.

In the present investigations clearly indicate that, the marine environment consists of constantly changing conditions, caused by the forces of wind, waves, currents and tides. The coastal are composed of sediment of various sizes, from large boulders to fine sand or mud. Most of the ocean floor is, however, not covered with hard substrate, but is sandy or muddy. The marine sediment structure indicated a diverse nature of the benthic substratum along the study area. Granule size is thus a vital factor determining faunal distribution and abundance, the grain size contains is influenced by many environmental factors [9, 22]. The prominent benthic organisms often sessile and animals are not common there and in fact these habitats may at first look quite lifeless. This, however, is a deceptive impression as most of the benthic animals in these habitats live buried in the bottom. Many large polychaeta worms and bivalves occur there as well as a myriad of smaller species. There are many barriers which the pelagic larvae of macrobenthic animals have to cross before they finally settle on the bottom and that each type of bottom deposit will attract a very limited and selected set of species. Such biotic interactions coupled with the extreme variability of environmental factors resulted in the evolution of benthic fauna. In the present study at sampling station 1 mostly the muddy shores are restricted to intertidal areas completely protected from open ocean wave activity. The muddy shores are best developed where there is a source of fine grained sediment particles. In these areas developed where water movements is minimal the slope of mud shores tends to be much flatter observed for sand beaches, organic films and bacterial composition are clearly less likely to play a role in attracting settlement on high energy sandy beaches, because benthic communities are permanent residents of the coastal and they are highly sensitive to poor water and sediment quality [9]. The muddy shores are limited mobility of species and cannot migrate to avoid stressful situations; several benthic groups have been used as indicators of stress conditions. The productivity of benthos is presumably related to the primary productivity of the overlying water column. Settling of products of primary production which are not consumed by pelagic herbivorous zooplankton could enhance benthic secondary production in sediment directly. In this newly excavated mud it was noted that primary productivity value increased as mud area grew older along with increases in total benthic population. At sampling station 2 mostly sand beaches occur only where wave action is light coarse ones where it is heavy is that, in heavy wave action, the smaller particles remain suspension so long that they are carried away from the beach. It can be providing as a habitat, food, serving as resting area, breeding grounds and nursery for a number of animals. In the open sand beaches tent to have lesser amount of organic debris from various sources finds its way to the beach to be a reliable source of food for certain organism [15,17]. Since these detritus materials is often carried up and down the beach suspended in the wave wash rather than being deposited on the bottom, therefore, the burrowing benthic organisms clearly observed in higher animals for feeding as a major problems of the benthic organism can be destroyed and migration of inhabitant. For high benthic biomass the relative importance of the bottom composition appears to be silt, clay and sand, out of which silt and clay compositions were found to play a decisive role in supporting the rich benthic biomass. Here it would be concluded that, the diversity and abundance of benthic community is high station I, when compare station II. Since, the benthic organisms are much more abundant in the muddy waters off the coast. In the shallow water the dead food material is more abundant because there is a higher population of organisms near the surface in this area. In these waters food also arrives from river sediments. The high faunal abundances may have also occurred because of organic detritus settle on sediments were a food rich environment. Once food has reached the sea floor, currents carry this food and organisms filter it without having to use their own energy to go and get food. Similar observations were reported by [2] from the Kerala coast, [3] from the west coast of India, [21] from the Goa, [4] from the shallow and tropical coastal area, [5] from the coromandal coast.

The results discussed so far clearly demonstrate that, the sediment and water nutrients are important parameters in the aquatic environment by influencing the inhabitants activities such as growth, movement, development, metabolic, reproduction, survival and existence [17, 22, 23]. The temperature is one of the most important factors among the external factors which influence the benthic production. Increased or decreased temperatures and future changes in water currents may severely affect benthic life and their ability to recover from extreme climatic events. As result of the increase in water temperature, since this effects the food supply of the benthic organisms besides its effect on its metabolism. The salinity remains one of the most important benthic community structuring forces. Its effect on the population growth under favorable environment conditions rather than from a sudden change in growth rate and its need reproduction of dominant species and period of exposure of inhabitant area to light, are largely responsible for the growth of benthic organisms. The pH is a significant factor of benthic species growth, larval development, feeding capability and metabolic activities. The phosphorus is not toxic to benthic animals and rich in phosphorus, results in excess amount of decayed materials, due to the microbes breakdown of decayed materials can cause oxygen deficiencies effect on inhabitant species is able to stress and movement, survival and existence [17, 22]. The sediment strata serve as a significant habitat for the benthic organisms which metabolic activities contribute to aquatic productivity. Most upon the benthic organisms normally have a range of total organic carbons tolerance, above and below determined the population and migration of species. In benthic communities, it is generally expected that increases concentrations of total organic carbon in sediment will result in increases abundance and productivity, with decreased species richness and diversity in changes to benthic communities structure and possibly to functions. The high amount of ammonia in water causes different problems in benthic species which is harmful to the respiration, abnormal growth and metabolic activities. Nitrate and nitrite is a vital nutrient but at high concentration, is becomes toxic to inhabitants species and are capable of disturbing the aquatic environment, the species migrated very long ones. However, the rapidly increasing sediment temperatures during this time may also strongly affect benthic communities. The bottom sediments of water bodies originating from soil erosion and precipitation from chemical and biological processes play a very important role in maintaining the characteristics of aquatic ecosystems. Keeping this mind, the present study was conceived to analyses the sediment properties of viz., N_2, $P_,$ Cd, Cu, Cr, Fe, Mg, Ni, Pb, Zg and organic carbon into coastal ecosystems. The marine sedimentary habitats are not only the most common habitats and need a better understanding for examining the relationship between functional of species diversity and ecosystem status [24, 25]. The coastal differentially formed in sediment of sand, silt and clay, characteristics very important ones, since the benthic species that are not able to tolerate the toxic contaminants that are found in some sediment simply die, reducing the variety of organisms in the affected environment and concern with contaminated sediments stems from the threat animals that survive exposure to may develop serious health problems and the environment, this contamination releases from a variety of point and nonpoint sources including day to day releases from industry, sewerage treatment plants, urban runoff, rivers, shoreline erosion, federal facilities, atmospheric sources and periodic spills from the vessels, pipeline and shore side facilities. In the present study indicated that, a number of biotic and abiotic factors, can affect biodiversity and the biomonitoring is the systematic use of living organisms and their responses to determine the quality of the environment.

CONCLUSION

The biodiversity refers to a wide variety of life forms and is becoming an important area of scientific studies over the past two decades and relentless efforts are going on for its prevention by research and public awareness which has pointed out the necessity of its maintenance for the welfare of benthic and other living organisms. The anthropogenic disturbance of the overexploitation of many species, destructive fishing practices and habitat fatalities are the main causes of declining levels of biodiversity in marine environments and valuable aquatic resources are becoming increasingly susceptible to both natural and human caused environmental changes. Marine researchers have long believed that the area with the highest diversity of benthic organisms. The anthropogenic disturbances include pollution, coastal development and the introduction of non native species to an area. Both natural and anthropogenic sources of disturbance act together in affecting benthic inhabitants characteristics and species distribution. The description of such spatial variability is required to understand the ecological processes behind them. So these kinds of problems should take action and conserve the benthic species diversity.

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