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Describing the Dynamics of Meiobenthic Assemblages Regarding Factors of Environmental by Determining the Temporal Variations

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Abstract – Sandy intertidal zones were dissected for the nearness of meiofauna. The meiofauna (here characterized as metazoans which estimate go from 50 to 500 ìm) is a faunal gathering of high significance in the working of estuarine frameworks, particularly where soft bottoms prevail and the issue and energy fluxes start for the most part from the benthic detrital complex The present paper portrays the elements of meiobenthic collections in connection to natural factors along the shore of Thiruvananthapuram, Kerala on the southwest coast of India. Meiobenthic people group comprised of 11 taxa in which nematodes, foraminifers and copepods ruled. Impressive transient variations are recognizable for all meiofaunal taxa. The surrounding physico-chemical states of water and physical changes in sediment are in charge of the temporal distribution of meiobenthos. Vertically a descending movement of meiofauna has been seen in the sand section because of better waste, high atmospheric temperature and presentation.

Keywords: Meiofauna, Meiobenthic, Seasonal, Variation, Macrofauna, Interstitial, Vertical, Horizontal

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INTRODUCTION

The people group of meiofauna from soft base natural surroundings show prominent sketchiness in their temporal and spatial distribution. In contrast with other benthic gatherings (for example macrofauna, macroalgae, stony corals, wipes), meiofauna have a well-characterized three-dimensional distribution dependent on adjustments of their species to consume the spaces inside sediments up to a few centimeters top to bottom. The vertical distribution relies upon specific ecological procedures (for example oxygenation of pore water, interstitial dissemination, centralization of H_2S), still inadequately comprehended. In contrast with mild natural surroundings, the environment of meiofauna in tropical territories still should be generally investigated, especially the vertical distribution.

In biological systems, meiofauna guarantees a few noteworthy ecological roles, among which: i) the deterioration of rubbish and the reusing of nutrients; ii) the connection between natural issue and higher trophic dimensions and iii) an essentially commitment to benthic secondary production because of their fast turnover rate and high metabolic action.

The temporal distribution of meiofauna is very factor and scale-subordinate; subsequently the evaluation of the driving ecological components is uneasy. In mild environments, seasonal factors, for example, temperature and physical aggravation have been proposed to clarify the temporal variation of meiofaunal networks. Moreover, their spatial distribution in shallow living spaces is regularly determined by the grain size of sediment or by food availability. In tropical narrows, the ecological procedures drive meiofauna distribution examples ought to be basically the equivalent, however the scales and subtleties are to a great extent obscure and reliant on local conditions. Hence, an exhaustive and dependable depiction of the structure of meiofaunal networks and their changeability is basic for understanding the major ecological procedures happening in the sediments that are driving the working of these biological systems. We expect then changes in network structure following fluctuations in natural system, for the most part natural and residue/clay content and contamination load.

The meiofauna is horizontally and vertically factor and the middle grain estimate and the level of arranging of the sand grains decide the accessible space for the interstitial meiofauna. The vertical distribution indicates seasonal changes set apart by the shakiness of the physical and chemical conditions, complemented by the rhythms of drenching and emersion and it is controlled by the level of drainage and sediment oxygenation. Vertical developments of meiofauna have additionally been associated with unsettling influences by waves and rain.

The development and assorted variety of meiofauna might be animated by feeding on bacteria, which could expand the reusing of nutrients into the biological system and in this way be relied upon to have a more noteworthy productivity. Additionally, the meiofauna can give food to higher trophic dimensions, for example, fish and marine spineless creatures. The spatial examples of the structure of the meiofaunal community in sandy beaches of marine biological systems might be related with various environmental factors. Identified with this, the sediment granulometry, the natural issue source in coastal sediments, and lethal and anoxic conditions in the interstitial pore space have a crucial role in the richness and abundance of the benthic meiofauna.

In the intertidal zone of sandy beaches, temperature and salinity are very factor and can likewise impact the distribution and faunal organization. Benthic invertebrates are utilized broadly as a marker of estuarine environmental status Studies on benthic populaces have been generally acknowledged as an apparatus for evaluating the health of the earth as a result of certain one of a unique quality shown by benthic invertebrates. Being a significant connection in the food chain among bacteria and macrofauna of sediments, meiofauna populaces are most likely appropriate indicators of the benthic biological system balance. High affectability, fast turnover rate, snappy reaction, life cycles altogether spent in sediments and relative pollution steadiness makes meiofauna a legitimate instrument to evaluate the effect of environmental pressure. Checking of coastal environment is one of the key devices in logical administration of coastal assets.

Concentrates on interstitial meiobenthic arrays in connection to environmental factors from the Indian beaches are scanty. Starting meiobenthic considers announced from the Indian coast were from the mud bank locale of Kerala coast. Following those a couple of more examinations on the distribution and abundance of meiobenthos have been made off the Indian coast. Thiruvananthapuram, the capital district of Kerala on the southwest coast of India, is the southernmost district of the state. Considering the role of meiobenthos as key indicators of environmental pressure, the present paper investigates the distribution of meiobenthos and its temporal variation in Thiruvananthapuram coast of Kerala in connection to the predominant environmental parameters as organizing components of interstitial meiofauna in the sandy beaches.

Distribution of Interstitial Fauna

Latitudinal variations in sandy beach interstitial meiofauna assorted variety and distribution have gotten little consideration. There is no motivation to expect that biodiversity will fluctuate from the standard pattern of increment toward the tropics and restricted information for nematodes bolsters this. Nonetheless, Kotwicki et al. (2005) couldn't show this for higher taxa of genuine meiofauna and possibly discovered such an example when little and adolescent macrofauna were incorporated. They discovered turbellarians progressively significant at higher scopes and nematodes at lower scopes. Lee and Riveros (2012) demonstrated that species richness of free-living marine nematodes from sandy beaches along the coast of Chile diminished with expanding latitude (diminishing temperature), while mean latitudinal range estimate for individual species expanded with latitude (Rapoport's Rule). Species ranges diminished toward the tropics with expanding species richness. They proposed that the nematode fauna of these beaches had been gotten from a low latitude fauna that had scattered to higher latitudes and that low temperatures were a constraint to dispersal further south. Accordingly, meiofauna may display the traditional latitudinal angle in species richness. This is a zone that warrants further examination, particularly for the interstitial nematodes and harpacticoids, however needs to incorporate thought of beach type.

Inside beaches, horizontal and vertical distribution demonstrates clear examples regardless of being sketchy. More extensive distribution of meiofauna is to a great extent controlled by the physical and chemical highlights of the interstitial environment, adjusted by sedimentological and hydrographical heterogeneity, though fine-scale distribution (cm) is increasingly identified with biotic communications, for example, fascination (e.g., for reproduction or feeding) and evasion of predation.

REVIEW OF LITERATURE

Geetha Priyalakshmi (2013) - A quantitative and subjective investigation of interstitial fauna and environmental factors was completed on five selected sandy beaches of the west coast of India. Types of nine interstitial taxa flourish the beaches. Nematodes, harpacticoid copepods, turbellarians, and polychaetes comprised the greater part of the populace. The accessible energy in the beaches extended from 0.2245 to 16.08 joules/mg and the grain size fluctuated from 0.93 to 2.88φ. Organic issue related fundamentally with coarse sand (Pearson connection r = 0.651; P < 0.01). Organic carbon, particle size, and broke down oxygen decided the abundance and distribution of interstitial fauna according to multivariate BIOENV examination. Shannon Wiener H diversity index was most extreme at Cherai (2.027) and least at

Sakthikulangara (1.144) beach. The estimation of nematode/copepod proportion (N $(2A)/C$ > 10) demonstrated at Sakthikulangara beach approves the expanded affectability of harpacticoids to environmental pressure.

Walter Traunspurger (2017) - Meiofauna characterize an assorted collection of moment invertebrates for the most part connected with the benthos, or base, of numerous streams and rivers. Meiofauna can be viewed as middle people among microorganisms and plainly visible life forms in stream food networks. In this section, we detail how to test, recognize, and evaluate these little creatures. Propelled techniques are additionally exhibited, handling the distribution designs, the life-history qualities, the reaction to toxicants, and the ecological role of meiofauna. We explicitly depict how characteristic arrays can be checked utilizing atomic methods, and how to keep up species in laboratory cultures for use in standard danger tests and for biomonitoring. We likewise address how the eating regimen and feeding conduct of meiofauna can be lit up in the laboratory and in natura. The techniques depicted here will cultivate inquire about on these intriguing creatures, which are as of now ignored in most ecological examinations of running waters.

RESEARCH METHODOLOGY

- **Area of the study**

The investigation was done along the Thiruvanandapuram coast of Kerala at two selected beaches, station I, situated at Poonthura coast and station II, at Adimalathura coast, lying between latitudes 8020'- 8030; North and longitudes 76055'-77003' east.

- **Sample of the study**

Tests were taken month to month from the 2 stations up to a depth of 25 cm utilizing a graduated steel spread having a length of 25 cm and diameter 5.5 cm. The sediment center was then isolated into 5 cm and each portion was promptly expelled flawless into independent polythene packs. The samples were anesthetized with 7% MgCl and safeguarded in 4% buffered formalin 0.1% Rose Bengal was added to the example for proficient extraction of the fauna and was isolated by suspension decantation technique. Isolated benthic example was then prepared through a lot of two sieves with 500 mm and 42 mm mesh sizes for the partition of meiofauna. Meiobenthos was then depended on a higher ordered dimension utilizing a binocular microscope.

- **Data Analysis**

Perceptions of physic-chemical characteristic for sea water were made by standard strategies. Base sediment was exposed to the examination of geochemical factors temperature, pH, organic carbon and texture. Month to month estimations of all parameters investigated were pooled to acquire the seasonal qualities as pre monsoon (Feb-May), monsoon (June-Sep) and post monsoon (Oct-Jan).

RESULTS AND DISCUSSION

The interstices of sandy beaches are bountifully possessed by meiobenthic invertebrates which are of extraordinary ecological centrality. The taxonomic composition, density and distribution of meiobenthic fauna change extensively from space to space contingent upon a wide assortment of variables. Presentation, predation, competition, grain size, organic issue and oxygen to a great extent decide the distribution of meiofauna in Indian beaches. Numerically meiobenthic abundance fluctuated somewhat in the two beaches. The general density variation was from 1288 to 8386/100 cm^2 at the Poonthura coast and from 1151 to 10795/100 cm^2 at the Adimalathura coast (Table 1).

Faunal composition of meiobenthos acquired from the two sandy beaches of Thiruvananthapuram coast comprised of 11 taxa coprising foraminifera, Turbellaria, Kinorhyncha, Nematoda, oligochaeta, Polychaeta, Archiannelida, Ostracoda, Copepoda, Amphipoda and Arachnida. Over all abundance of meiobenthos has been in the order Nematoda, Copepoda, Foraminifera, Oligochaeta and Ostracoda at the Poonthura coast and in the order Nematoda, Foraminifera, Copepoda, Archiannelida and Oligochaeta at the Adimalathura coast (Figure 1). When all is said in done nematodes overwhelmed the meiobenthic community of Thiruvananthapuram coast. Nematodes are the most copious meiofaunal community of Indian beaches which frequently speaks to over 80% of benthic meiofauna.

Table 1: Temporal variations (No/100 cm^2) in meiofaunal density

Season	Poonthura coast	Adimalathura coast
Pre monsoon	Range 3465-6073	Range 2579-4631
	Mean 4945	Mean 3592
Monsoon	Range 1288-4590	Range 1511-5677
	Mean 2511	Mean 2508
Post monsoon	Range 1559-8386	Range 4540-10795
	Mean 6617	Mean 7884

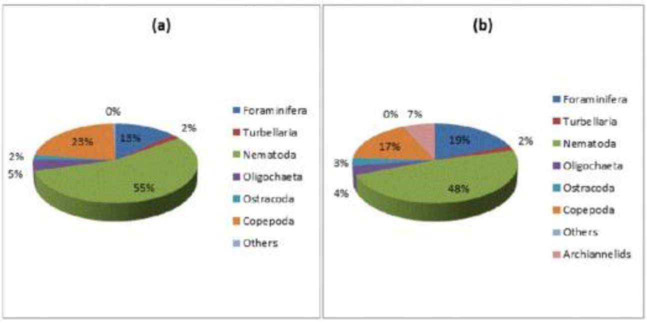

Figure 1: Composition of meiofauna in (a-Poonthura, b-Adimalathura) coast

The examination uncovered particular temporal variation in the interstitial meiofaunal segments along the coast of Thiruvananthapuram (Figure 2). Faunal abundance was higher amid the post monsoon period pursued by pre monsoon. A particular component of the Indian beaches is the impact of monsoon rains that unfavorably influence the density of the fauna. Amid the monsoon time frame (June-Sept) the beach configuration changes radically at short term intervals because of extreme erosion or heavy deposition. Solid wave activity amid the monsoon has the ability to totally expel or store the substratum. Amid the high choppiness time frame sediment particles get reworked influencing the interstitial spaces and the living space accessible for the creatures that get moved consistently. This wonder may evacuate the benthic fauna and open them to the danger of predation.

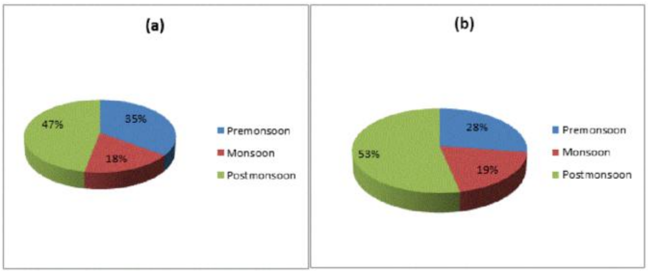

Figure 2: Seasonal variations in the distribution of meiofauna

The surrounding physico-chemical conditions and the physical change in the sediments are in charge of the temporal distribution of meiofauna. There were significant changes in the density of all taxa from month to month. Expanded temperature, high salinity, stable beach conditions and the likely more noteworthy food availability supported the rich post and pre monsoon populaces. Seasonal variations in hydrobiological and geographical factors are displayed in Tables 2 and 3 individually. The times of high density of interstitial meiobenthic community in the present investigation is matched with expanded water and sediment temperature, pH, dissolved oxygen and expanded organic carbon in the sediment together with higher extent of residue and clay. Seasonal rearing is characteristic of meiofauna and the expanded meiobenthic density is matching with extreme reproducing exercises of meiofauna amid the high temperature time frame. Temperature may likewise impact populace increment in a roundabout way by controlling supply of bacterial and diatom food. Size of sand grains was accounted for to be a main consideration affecting meiofaunal abundance. Interstitial fauna grows best in sands with medium diameter and moderate organic advancement. Sandy beaches of Kerala by and large have incredibly low organic issue in sediment. Faunal abundance was higher amid the post and pre monsoon months (Figure 2) with nematodes recording greatest abundance pursued by copepods in the Poontura beach and foraminifers at the Adimalathura beach. By and large nematode contributed 57.96% (pre-monsoon), 47.4% (monsoon) and 49.25% (post monsoon) of the total meiobenthic fauna. Predominance of nematode fauna in meiofaunal community of Indian beaches was accounted for before. Abundance of foraminifera in sandy substrata was likewise detailed from Indian beaches.

Table 2: Temporal variations (mean) in hydrological variables

Variable	Poonthura coast			Adimalathura coast		
	Pre monsoon	Monsoon	Post monsoon	Pre monsoon	Monsoon	Post monsoon
Temperature (°C)	30.30 ± 0.337	24.10 ± 0.447	28.20 ± 0.561	29.80 ± 0.719	23.80 ± 0.137	28.40 ± 0.666
pH	8.21 ± 0.088	7.642 ± 0.026	7.91 ± 0.018	8.21 ± 0.031	7.54 ± 0.073	8.14 ± 0.003
Salinity (S.10-3)	33.88 ± 0.113	32.14 ± 0.831	32.21 ± 0.192	34.24 ± 055	32.18 ± 0.512	33.90 ± 0.522
Dissolved oxygen (ml/l)	5.64 ± 0.696	4.32 ± 0.768	5.98 ± 0.632	5.72 ± 0.631	4.92 ± 0.731	6.01 ± 0.610
Nitrite-nitrogen (μmol/l)	0.211 ± 0.018	0.182 ± 0.016	0.202 ± 0.022	0.198 ± 0.022	0.21 ± 0.003	0.23 ± 0.061
Nitrate-nitrogen (μmol/l)	0.31 ± 0.086	0.23 ± 0.014	0.28 ± 0.136	0.33 ± 0.046	0.28 ± 0.029	0.31 ± 0.14
Phosphate-phosphorus (μmol/l)	0.21 ± 0.07	0.161 ± 0.072	0.27 ± 0.056	0.28 ± 0.008	0.21 ± 0.013	0.29 ± 0.017
Silicate-silicon (μmol/l)	0.23 ± 0.03	0.106 ± 0.008	0.181 ± 0.06	0.21 ± 0.061	0.091 ± 0.007	0.198 ± 0.012

Table 3: Temporal variations (mean) in geological parameters

Parameter	Poonthura coast			Adimalathura coast		
	Pre monsoon	Monsoon	Post monsoon	Pre monsoon	Monsoon	Post monsoon
Temperature (°C)	30.00 ± 0.61	25.10 ± 0.88	29.10 ± 0.58	29.70 ± 0.701	24.2 ± 0.515	29.50 ± 0.412
Organic carbon (%)	0.31 ± 0.28	0.23 ± 015	0.56 ± 0.13	0.70 ± 0.14	0.45 ± 0.09	0.64 ± 0.09
Sand (%)	77.76 ± 5.03	96.45 ± 3.65	96.62 ± 4.32	73.61 ± 3.12	98.75 ±1.01	84.86 ± 6.15
Silt (%)	14.16 ± 2.92	2.76 ± 1.22	1.33 ± 0.92	16.1 ± 4.46	0.62 ± 03	3.51 ± 1.25
Clay (%)	8.08 ± 3.30	0.79 ± 0.63	2.05 ± 1.16	10.29 ± 3.50	0.62 ± 0.03	11.63 ± 1.25

Vertically, most of meiobenthic life forms are bound to the upper 10 cm depth (Figure 3). Generally, nematodes are found to enter the deep layers and found in the whole 25 cm depth. Foraminifera are the other gathering in the deeper layers of the sediment. 21% of foraminifera and 25% nematoda enter the deeper (in excess of 10 cm) layer. Of the various gatherings just oligochaeta and archiannelida were recorded from the deepest (20-25 cm) layer. Lessening in faunal density in the deeper layers has been ascribed to the decrease in interstitial space, oxygen content and food material. One reason for the fruitful entrance of nematodes into deeper layers could be credited to their ability of anaerobic presence. Seasonal variations were clear in the vertical distribution meiobenthos with most astounding density in the surface area (0-5 cm) amid the monsoon time frame at both the beaches and greatest density in the 5-10 cm layer amid different seasons (Figures 4 and 5). Meiofauna in sandy sediments by and large have all the earmarks of being assembled at those dimensions where parching isn't excessively extreme and oxygen availability isn't excessively low. As a result of better drainage of sand and higher temperature at the surface layer the fauna discovered entered to the deeper layer amid pre and post monsoon seasons.

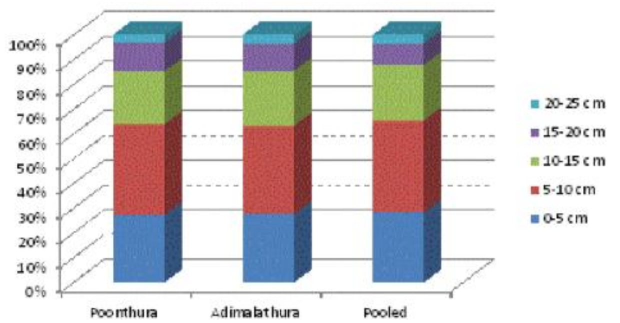

Figure 3: Vertical distribution of meiofauna (annual%)

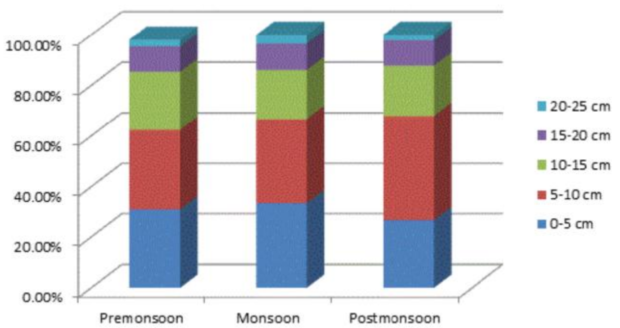

Figure 4: Seasonal variation in the vertical distribution of meiofauna

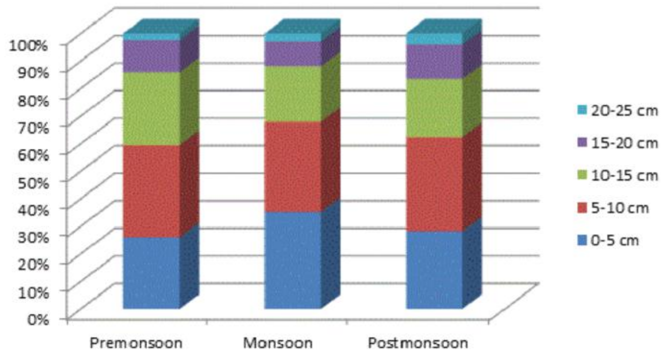

Figure 5: Seasonal variations in the vertical distribution of meiofauna

CONCLUSION

Natural elements are known to assume a key role in the foundation and upkeep of macrofauna zonation on rocky shores, with enrollment, predation and competition all assuming principle roles. Subsequently, predation and competition for food may be significant for the zonation of meiofauna on sandy beaches also, in spite of the fact that factors controlling these networks are not really equivalent to on rocky shores. Zonation on sandy beaches isn't so obvious as on rocky shores and is in certainty three-dimensional. This is an outcome of the dynamic environment of the beach and the moving of populaces that possess it.

The examination uncovered unmistakable seasonal variation in interstitial meiobenthos along the coast of Thiruvananthapuram, Kerala on the southwest coast of India. The meiobenthic abundance when all is said in done was found as per sediment granulometry and physico-chemical characteristics of water winning along the coast. Temperature, pH, salinity, dissolved oxygen, sediment composition and % of organic carbon in the sediment are demonstrated to be significant clear parameters identified with the abundance and distribution of meiobenthos. Distinctive meiofaunal segments demonstrated contrast in vertical development. A descending relocation of meiofauna has been seen in the examination territory because of better drainage, high temperature and presentation.

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