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Original Research Paper

STUDY OF MEIOFAUNA DIVERSITY OF MORVA SALT MARSH THANE

Ghanasham J. Hande[1], Shirley B. Agwuocha[2*]
[1,2]Department of Zoology, Thakur College of Science & Commerce

Abstract: The meiofaunal community in the Morva salt marsh consists of ten taxonomic groups. Among these, nematodes were the most abundant, contributing 63.02% of the total population, followed by harpacticoid copepods (16.24%), turbellarians (7.50%), crustacean nauplii (3.18%), and polychaetes (6.30%). The overall population density ranged from 444 to 13,723.52 individuals per (10 cm)², with an average density of 3,480.33 individuals per (10 cm)². A significant proportion over 60% of the organisms were concentrated within the upper 5 cm of the sediment. The major taxonomic groups exhibited a clumped distribution pattern. Variations in meiofaunal abundance and distribution were largely governed by environmental factors such as salinity, dissolved oxygen levels, and food availability.

INTRODUCTION

A salt marsh is a coastal wetland regularly flooded and drained by salt water brought in by the tides, found primarily in tropical and temperate regions. These ecosystems are dominated by salt-tolerant plants, rather than trees. They develop in sheltered areas like estuaries and lagoons where sediments can settle into deep layers of mud and peat. Salt marshes are highly productive, serving as critical nurseries for fisheries *Hamilton (1984)*, *Kathiresan, K., & Bingham, B. L. (2020), Mishra, A. K., & Farooq, S. H. (2025).* Salt marsh ecosystems function as natural coastal buffers by dissipating wave energy and stabilizing sediments, thereby minimizing shoreline erosion. Additionally, they act as biogeochemical filters that trap nutrients and pollutants from terrestrial runoff, contributing to improved water quality and ecosystem health. *Bouma, T. J., et al. (2024) Mandal, U., Bhutia(2023).*

The present study was conducted in the **Morva salt marsh–salt pan complex** located in the Mira–Bhayandar region along the eastern margin of Vasai Creek, Maharashtra, India. The study site lies approximately between **19.30° N latitude and 72.85° E longitude**, forming part of the northern coastal zone of the Mumbai Metropolitan Region.

Study Area: Vasai Creek is a tidal estuarine system associated with the Ulhas River, which ultimately drains into the Arabian Sea. The creek represents a dynamic transition zone between marine and freshwater environments, influenced by semi-diurnal tides and seasonal freshwater influx, particularly during the southwest monsoon (Mandal et al., 2023; Sarangi et al., 2023). The study area is situated on the landward side of the estuary and is characterized by extensive intertidal mudflats, salt marsh vegetation, and man-made salt pans.

Geomorphologically, the area comprises a mosaic of natural and modified coastal habitats, including **tidal mudflats, marshy depressions, mangrove patches, and salt evaporation ponds**. The presence of salt pans indicates anthropogenic modification of the natural wetland system for salt extraction. The

***Corresponding Author:**
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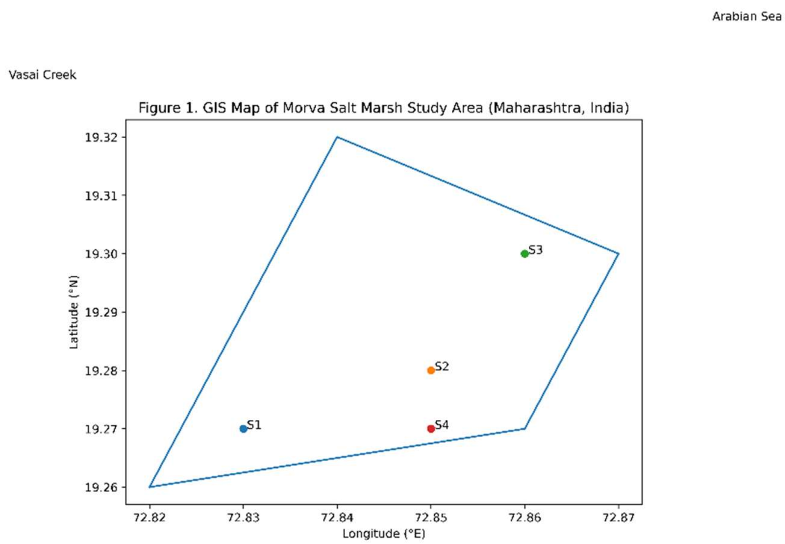
surrounding landscape includes small-scale settlements, agricultural fields, and aquaculture ponds, contributing to varying degrees of anthropogenic influence (Shinde et al., 2025).
The sediment in the study area is predominantly **fine-grained clayey–silty alluvium**, typical of estuary environments. These sediments are characterized by **high salinity, elevated organic matter content, and reduced oxygen conditions** in deeper layers of sediments. Such conditions favour the development of benthic communities, particularly meiofauna (Kathiresan & Bingham, 2020). The upper sediment layers (0–5 cm) are relatively oxygenated and biologically active, while deeper layers tend to be anoxic due to limited water exchange and microbial decomposition processes.
Human Impact: The area features extensive, historically significant salt pans (salt pan lands) that have been used for salt harvesting. These wetlands are now under pressure from rapid urban expansion, resulting in a mix of natural wetlands, mangroves, and industrial/recreational infrastructure development.



MATERIAL AND METHODS

For the present investigation 5 stations were chosen out of which, one station is temporary reservoir of water going to salt pans and 4 stations are under salt production. All the stations were sampled only during September, November 2025 and April 2026. Meiofauna samples up-to a depth of 15cm were collected using hand operated plastic corer (4cm in diameter and 15cm length). Replicated samples were taken from each station and preserved in 5% formalin solution in which Rose Bengal was added. Water samples for physico-chemical analysis were collected along with meiofauna samples. Dissolved oxygen was measured using Winkler Titration method and pH of water were measured in the field using *pH* meter. Temperature of water and sediment was also recorded. Mud samples were collected separately for sediment characteristics and organic content.
Meiofauna samples were analysed by using methods of *Parulekar et al. (1976). Annapurna, C., Srinivasa Rao (2017)* method and biomass was determined according to *Crisp Sahoo, G., Ansari (2017)* method and organic content of the sediment was determined by the method of *Poudel, Suraj. (2020), El Wakeel, S. K., & Riley, J. P. (1956).*

RESULT AND DISCUSSION

Environmental features- Environmental data are given in Table 1.

Table 1 — Environmental Parameters					
Station	Temp. °c		Salinity (x 10^{-3})	Dissolved oxygen	pH
	Air	Surface water	(ppt)		
SEPTEMBER					
1	30	26.5	3	1.5	8.5
2	30	28.2	3.4	2	8
3	28.5	28.5	3.7	2.4	8
4	28.5	28	8	3.6	7.5
5	28	28.2	5.4	4.8	8
Av.	29	27.88	4.7	2.86	8
NOVEMBER					
1	27.5	28	4.8	2.9	7.75
2	28	29	3.4	3	7.75
3	29	30	4.6	3.3	7
4	29	30	12.1	2.9	7.5
5	30	32	4.8	2.8	7.5
Av.	28.7	29.8	5.94	2.98	7.5
APRIL					
1	31.2	29.9	29.8	3	7.5
2	29.5	31	28.7	2.6	7.5
3	30.5	30	28.7	3.8	7.5
4	31	30.8	30.8	4	7.5
5	30	31	28.6	3.7	7
Av.	30.44	30.54	29.32	3.42	7.4

Water temperature ranged from 26.5ºC at st 1 in September to 31ºC at st 5 in April with a mean value of 28.5ºC in the area under study. Air temperature did not show any major change (28ºC to31ºC). Salinity Showed wide fluctuation (3×10^{-3} in September to 30.8×10^{-3} in April). During September and November the salinity values are low due to rain fall. Mid November, the rain fall stopped resulting in salinity changes as observed in present study. Comparatively high salinity values were observed at station 4. Dissolved oxygen values were low.

Sediment character:

TABLE-2					
Comparison of Meiofaunal Density and bio mass with Sediment Characteristics.					
Station	Sediment temp. (Cº)	Silt-Clay (%)	Organic matter (%)	Density [no.(10cm)$^{-2}$]	Biomass [mg.(10cm)$^{-2}$]
1	29	94.1	0.97	4048	1.822
2	28.9	97.8	1.18	6868	3.091
3	28.9	86.1	1.14	4056	1.825
4	29.5	74.5	0.88	0402	0.181
5	29.9	84.5	0.92	2009	0.904

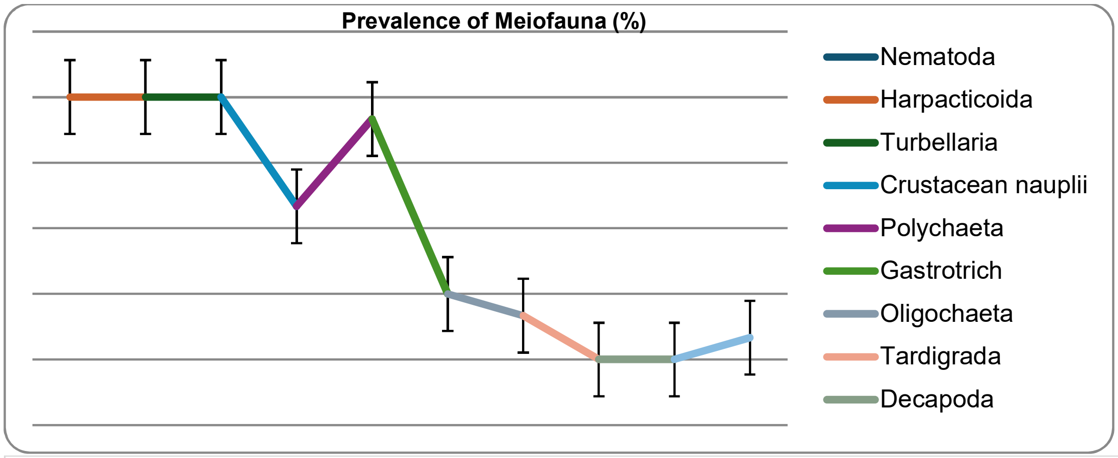
The mud at Morva salt marsh appeared to be loose and well mixed. The sediment was characterised by high percentage of silt-clay fractions (Table 2). In general, silt-clay fraction varied from 74.5% at st 4 to 97.8% at st 2.

Sediment temperature although, did not show much variation between stations. High percentage of silt-clay followed the general trend of high faunal density except at station 4. The dead organic matter in the sediment provides information on the availability of food for the meiobenthos *Gerlach, S. A. (1971) Brankovits, D. (2021).* Biomass values were low [0.18 to 3.09 mg (10 cm)$^{-2}$]. However, low value of biomass does not give the true picture of the total annual turnover of meiofauna.

Faunal density and composition: The salt marsh fauna was characterised by high population density [no (10 cm) during April 2025. (Table 3). Maximum meiofaunal density (17300) was observed at station 2 in April. and minimum (282) at st 4 in September. Average counts for all stations were 3435. An interesting feature of the study was that in the area where salt is being produced (st 4), the faunal density was significantly lower as compared to the other stations. The population, in general was poor in September. but increased in subsequent months.

Table-3	Meiofaunal Density										
[Values no.(10cm)$^{-2}$, are mean of 3 replicates											
Station no	Nematoda	Harpacticoida	Turbellaria	Crustacean naupli	Polychaeta	Gastrotrich	Oligochaeta	Tardigrada	Decapoda	Ostracoda	total
				SEPTEMBER							
1	1143	102	165	13	81	-	-	-	-	-	1504
2	800	1003	203	143	245	89	-	-	13	13	2509
3	1346	405	267	127	241	76	102	-	-	-	2564
4	178	64	20		20					-	282
5	432	13	114	-	13	-	-	-	-	89	661
				NOVEMBER							
1	1061	105	89	114	76	_	102	26	26	-	1599
2	575	76	26	_	89	_	26	_	_	-	792
3	635	51	38	26	26	13	_	_	_	_	789
4	229	26	31	-	64	-	-	-	-	-	350
5	572	38	38	_	38	_	13	26	-	_	725
				APRIL							
1	4699	3645	229	356	152	-	-	-	15	-	9096
2	9296	4039	381	2516	305	534	229	-	-	-	17300
3	5588	1651	559	381	432	76	-	51	-	51	8789
4	502	38	18	13	-	-	-	-	-	-	571
5	3302	381	330	254	51	153	-	-	-	203	4674

Fig1 gives the average values (all months combined) of percentage composition and percent prevalence of all taxa in this study. The meiofauna was represented by 10 taxa in varying proportions nematodes (63.02%), harpacticoides (16.24%), turbellaria (7.50%), crustacean nauplii (3.18%) and polychaetes (6.30%), gastrotrich (1.01%), oligochaeta (0.85), tardigrada (-0.38%), and decapoda (0.09%). The prevalence of dominant taxa was found to be in accordance with the observed percentage composition. accordingly, nematodes, harpacticoides and turbellarians were prevalent over other groups at all the stations.



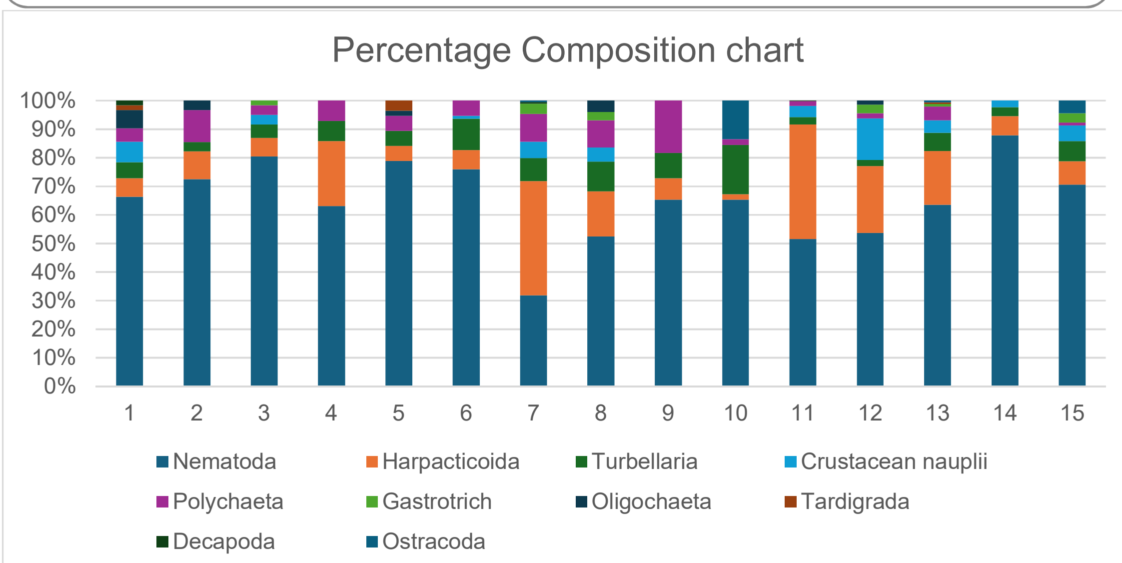
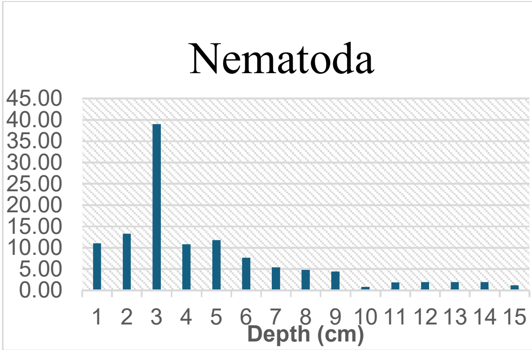
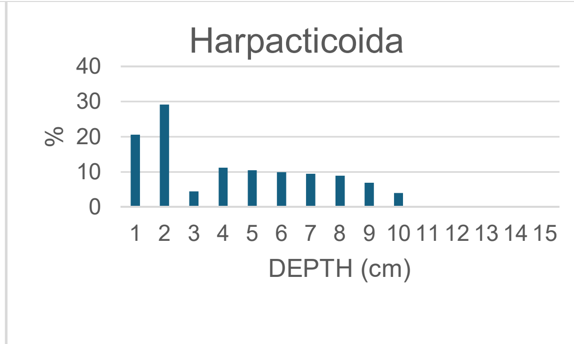
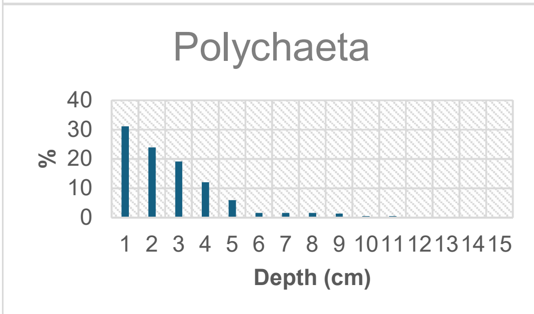


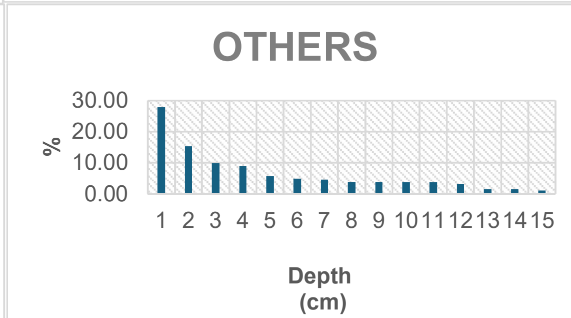
Fig: 1 Prevalence and percentage composition of meiofauna

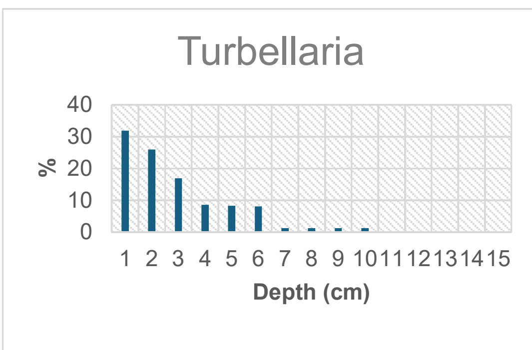
Vertical distribution – depth distribution of meiofauna is given in fig.2. More than 60% of the fauna was in the top 5 cm layer of the sediment. The fauna progressively decreased with increasing sediment depth. All major groups were in the deeper layers except harpacticoids, which were confined only up to the top 10cm layer. The downward movement of a significant number of taxa reflects favorable condition prevailing there in the sediments. *Ingole, B. S(1987)* Added to this favorable nature of the substratum (loos silt clay which allow movement of pore water and easy penetration of fauna). *Schratzberger, M.(2017).*

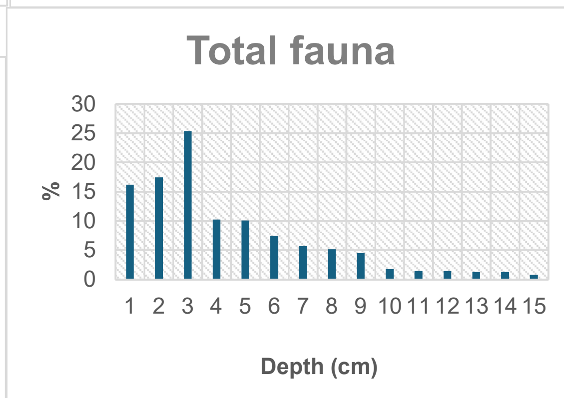












The average density of meiofauna was analyzed using a two-way ANOVA. (table-4).
The results revealed significant variations in mean population density across both different months and sampling stations. However, the variation among months was more substantial than that observed among stations, as indicated by the higher F-ratio values. This suggests that temporal environmental factors exert a stronger influence on meiofaunal distribution than spatial differences.

Table-4 Two way ANOVA

Station vs Months						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Station	80123960.47	2	40061980	6.023991	0.007585	3.402826
Between Months	90688853.33	1	90688853	13.63659	0.001141	4.259677
Interaction error	80123960.47	2	40061980	6.023991	0.007585	3.402826
Within	159609710.4	24	6650405			
Total	410546484.7	29				

Food supply and oxygen availability are 2 important factors limiting the distribution and abundance of meiofauna in the salt marsh. *John M. Teal, & Wolfgang Wieser (1966). El-Serehy(2015).* Normally oxygen reduces with sediment depth accompanied by reduction in the meiofauna density down in the sediment. The oxygen value recorded in the sediment are also low. Meiofauna are adapted to living under reduced oxygen tension. *Alan A. Dye*

(1983). Availability of food may therefore be the chief factor in the distribution and abundance of meiofauna in the salt marsh. The population density recorded is very high and is comparable to that (10×10^6 m^{-2}) in the mud flats and is much higher than that either from seagrass bed or from intertidal sand. This indicates that mud flats of marsh may favor high meiofaunal population because of the availability of detritus which provide main food for the development of meiofauna population Ellison*, R. L. (1984)*. *Kim, K., et al. (2023)*. *Høgslund, S., et al. (2025)*. *Sajan, S. (2017)*. *Datta, T. K., & Chakraborty, S. K. (2015)* Although the present study covers only 3 months data, the effect of salinity on meiofauna is very evident.

The density of meiofauna decreases with depth in natural sediment is known *John M. Teal(1966), Dye, A. H. (1978), Pomeroy, L. R.(1981)* and it is true in the present study also. The reason given for such a distribution is the decreasing food and increased oxygen tension.

The distribution pattern of most taxa observed in this study demonstrates a patchy nature within the ecosystem, as also reported by Sikaro (1977). The markedly lower population density at Station 4 may be attributed to sediment characteristics and the infiltration of brine. In contrast, the elevated densities of nematodes and harpacticoids—key food sources for many prawn and fish larvae—suggest that the study area has favorable conditions for mariculture.

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