# Meiofauna community composition and vertical zonation in intertidal mudflats, Chincoteague Bay, Virginia

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## Abstract

The meiobenthos are an abundant and diverse biota that is often overlooked. But meiofauna are vital to larger ecosystems and take a unique role as accessible bioindicators of the greater environment. Meiofauna was systematically collected from sites in Chincoteague Bay, Virginia, and analyzed using R for abundance and diversity between the most oxygenated and least oxygenated horizons. Analysis found several meiofauna taxa in varying quantities across sites. Meiofauna greatly preferred the uppermost oxygenated layers of the sediment over the deeper anoxic layers, with most taxa preferring the oxygenated layer. The reasons for the specific patterns of distribution could be due to higher heavy metal content and lower pH than average, human disturbances of the area, or possibly due to other factors not measured in this study.

## Introduction

Meiofauna are unique for their size and lifestyle, being smaller than 500μm and living within aquatic sediments. The intertidal mudflats of the Chincoteague Bay are expected to hold a diverse and abundant population of meiofauna, and there is a distinct lack of published literature on the area.

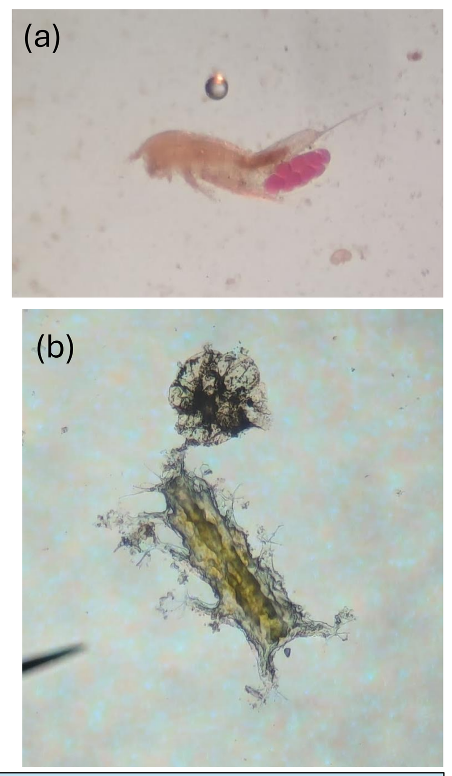
The vertical distribution of these organisms is a point of interest; There is a great difference in distribution between horizons due to differences in oxygen and nutrient availability in the sediment. This zonation may be based on the metabolic needs of each taxa, it also appears to be dependent on other ecological factors. Different taxa react differently to environmental changes, even affecting their vertical distribution, and this is what makes them excellent bioindicators. Comparing our results with factors that are known to change animal distribution between horizons could give insight into the condition of the environment in Chincoteague Bay sediments.

## Methods

1. Established transect line (Figure 1) with 3 quadrats at each sample site
2. Extracted 10 subsamples per quadrat, dividing each by oxygenated and anoxic layers
3. Fixed specimens in 70% denatured ethanol. Stained for 24 hours with carbol Rose Bengal
4. Sifted sample through 45-micron sieve, preserved specimens in 70% denatured ethanol
5. Counted each sample for species identification and animal count, analyzed data with R for abundance, density and diversity

Figure 1. Transect line and quadrat at Sample Site D

Figure 2. Specimens. **a:** Gravid Harpacticoida sp. **b:** Tardigrada sp.




## Results

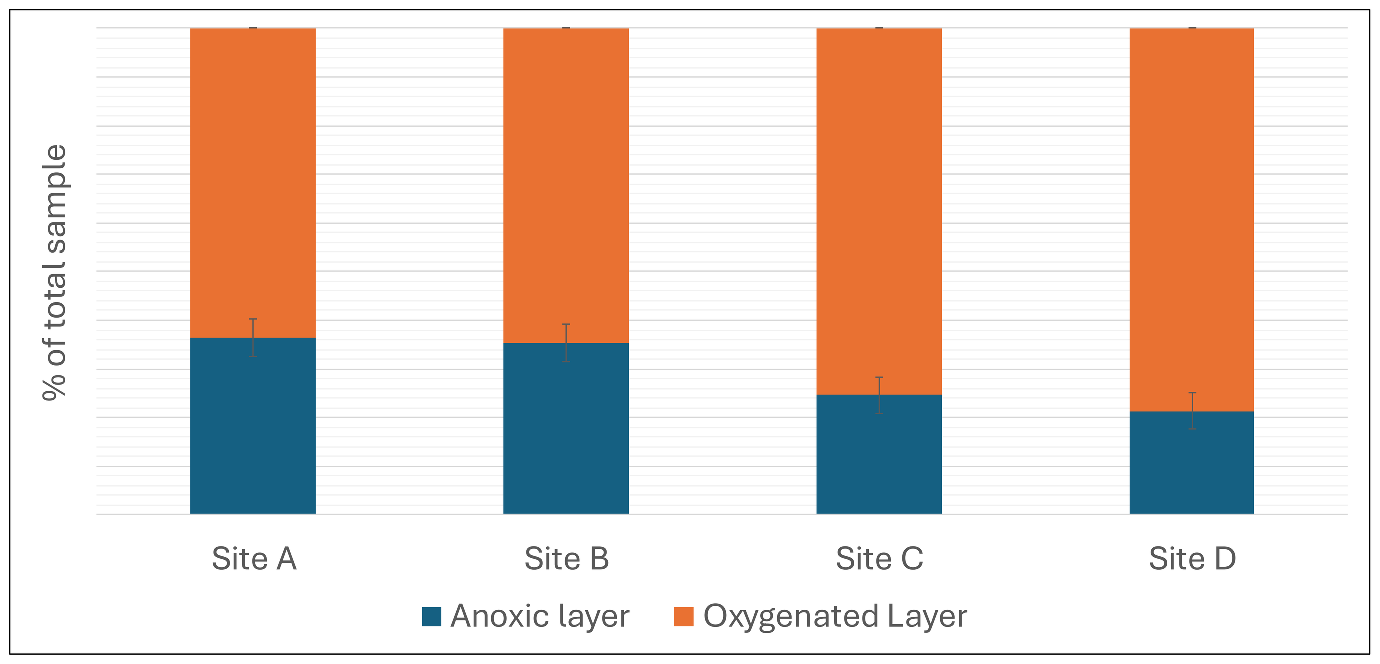



Figure 3. Total animal distribution between sediment layers in all sites

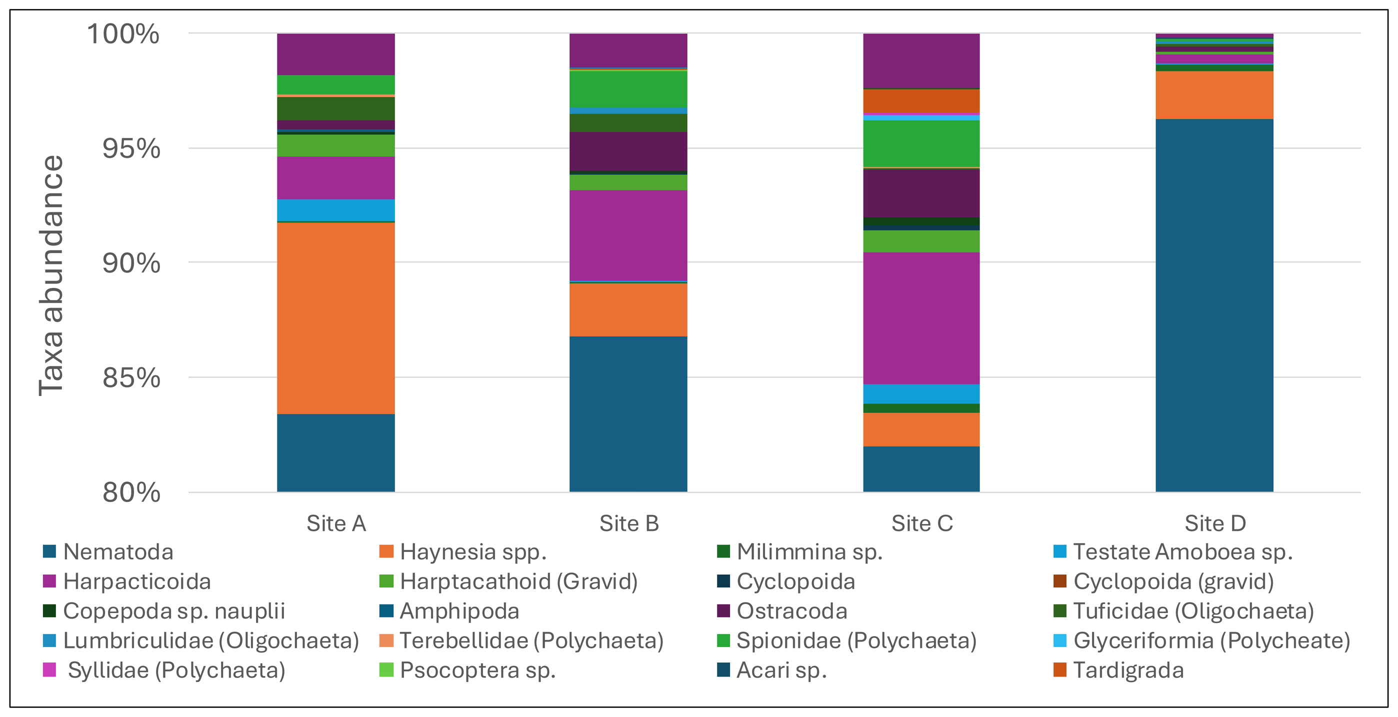



Figure 4. Total taxa distribution  in all sites (scale begins at 80%)

- Statistically significant difference in abundance and density between oxygenated and anoxic layers throughout sites
- 20 unique taxa were identified between all samples
- Nematodes were the dominant taxa in all sites
- Statistically significant difference in animal density between sites, except between Site A and C
- Shannon-Weaver indices (H') found low diversity across all sites (0.090-0.321), low evenness (J') was found across all sites (0.075-0.251)
- Shannon-Weaver indices showed higher diversity and evenness in oxygenated layers
- Oxygenated layer: H'=0.223, J'=0.169
- Anoxic layer: H'=0.168, J'=0.134

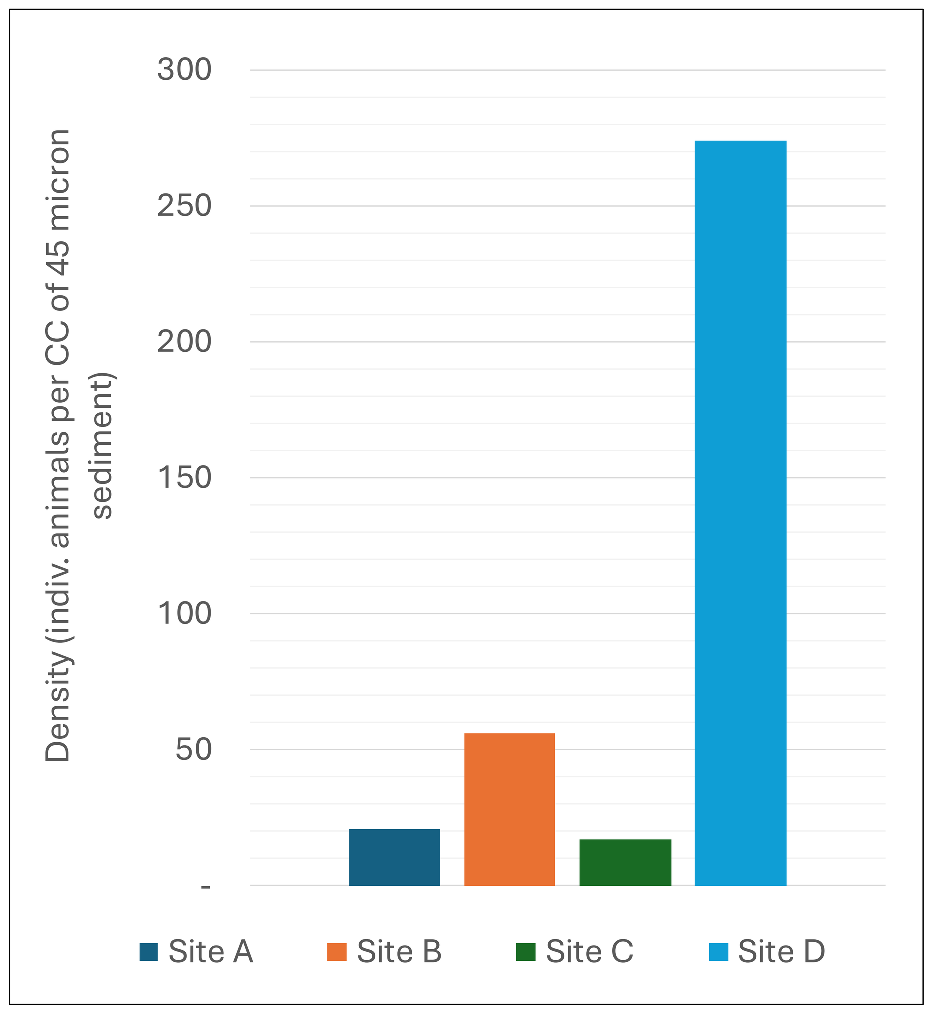



Figure 5. Average animal density in all sites

## Discussion

- Soft bodied organisms like Turbellaria may not be represented due to high artifacting from the fixation and preservation method, and further identification of Nematoda was not done for the same reason
  - Absence of taxa in these samples does not necessarily mean they are not in the environment
- These results for SW indices are likely due to the massive number of nematodes in each sample site
- Gee et al (1992) suggests high zinc and mercury content may explain higher count in Harpacticoid copepods
- "Small scale disturbances" may be to blame for discrepancies in annelid distribution (Reise 1984)
- Low pH and high temperatures could allow nematodes to flourish (Hale et al 2011)
- The differences in abundance and density between sites could be due to differing resource availability or environmental factors, along with human disturbance to the area

## Conclusions

Overall, the meiofauna population was abundant, but was not as diverse as would be expected. Diversity was heavily skewed towards Nematoda and was lacking in greater amounts of other species that may be expected. These results could be due to abiotic environmental factors that are correlated with anthropogenic effects, such as lowered pH or high heavy metal content, and could be a point of further investigation. The absence of species in these samples may be due to environmental conditions or issues in the sampling procedure not favoring those species.

Procedures used here could be improved in terms of creating results that more accurately reflect the environment, namely with the use of more effective fixative agents to lower artifacting, collection methods with higher yields, and increasing the number of samples and sample sites.

## References & Acknowledgements

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Ellison, R.L. (1984). Foraminifera and meiofauna on an intertidal mudflat, Cornwall, England: Populations; respiration and secondary production; and energy budget. *Hydrobiologia*, 109, 131-148.

Gee, J.M., Austen, M.C., De Smet, G., Ferraro, T., McEvoy, A., Moore, S., Van Gausbeki, D., Vincx, M. & Warwick, R.M. (1992). Soft sediment meiofauna community responses to environmental pollution gradients in the German Bight and at a drilling site off the Dutch coast. *Marine Ecology Progress Series*, 91, 289–302.

Giere, O. (2009). Meiobenthology 2nd ed. *Springer, Berlin, Heidelberg*

Hale, R., Calosi, P., McNeill, L., Mieszkowska, N., Widdicombe, S. (2011) Predicted levels of future ocean acidification and temperature rise could alter community structure and biodiversity in marine benthic communities. *Oikos,* 120:661–674

Majdi, N., Threis, I., & Traunspurger, W. (2017). It's the little things that count: Meiofaunal density and production in the sediment of two headwater streams. *Limnology and Oceanography*, 62(1), 151–163.

R Core Team (2024). R: A Language and Environment for Statistical Computing. *R Foundation for Statistical Computing, Vienna, Austria*.

Reise, K. (1984). Indirect effects of sewage on a sandy tidal flat in the Wadden Sea. *Neth. Inst. Sea Res. Publ*. Ser. 10, 159–164.

Schratzberger, M., Gee, J.M., Rees, H.L., Boyd, S.E., Wall, C.M. (2000). The structure and taxonomic composition of sublittoral meiofauna assemblages as an indicator of the status of the marine environment. *J. Mar. Biol. Assoc. U. K.* 80, 969–980.