Meiofauna Abundance and Community Patterns and Their Link to Environmental Variables in The Jiaozhou Bay, China

MD Abdul Karim, Hong Zhou*, MD Saif Uddin
Department of Environmental Ecology, College of Marine Life Science, Ocean University of China.
*E-mail: hzhou@ouc.edu.cn

ABSTRACT

The abundance and community structure of meiofauna, and their link to environmental factors, were investigated in Jiaozhou Bay, China. In the autumn of 2018, meiofaunal and sediment samples were obtained from 14 distinct locations. In the whole survey, 14 meiofaunal taxa were identified, with free-living nematodes being the most abundant (94.81%), followed by copepods (3.07 %) and polychaetes (1.06 %). Meiofaunal abundance in different stations ranged from (290.83 ± 291.53ind./10cm^2) to (106.41 ± 25.29 ind./10cm^2) and for biomass it was (201.93 ± 122.65 to 57.37 ± 19.74 µg dwt/10cm^2) in different sampling stations. Spearman correlation analysis and BIOENV analysis revealed that salinity and sediment characteristics influenced the meiofauna community in the Jiaozhou Bay.

Keywords: Meiofauna, spatial distribution, nematode, Jiaozhou Bay.

INTRODUCTION

Meiofauna is defined as benthic metazoans retained by 0.042 or 0.031mm mesh and the most diversified group in the marine environment (Giere 1). They are the vital constituents of the benthic food web (Gao et al. 45) and play a key role in ecosystem functions such as nutrient cycling and energy flow (Schratzberger and Ingels, 15). Meiofaunal abundance, distribution, and functional properties might be affected by environmental factors, including water depth, temperature, salinity, sedimentary processes, and food availability (Gao et al. 50; Zeppilli et al. 507; Ngo et al. 28). Meiofaunal assemblages are widely used in ecological assessment due to their high abundance, diverse distribution, and short life history (Kennedy and Jacoby 51; Zeppilli et al. 508).

Objectives

1. To study meiofaunal composition and distribution in the Jiaozhou Bay.
2. To investigate environmental factors influencing meiofaunal abundance and distribution.

MATERIALS AND METHODS

Sampling strategy

Sediment samples were collected in November 2018 at 14 study stations in Jiaozhou Bay. A box corer with a 0.05 m^{2}diameter was used to collect sediment at each sampling point. Four meiofaunal sub-cores were carefully obtained in four box cores using a 2.9 cm inner diameter syringe to a depth of 10 cm from the sediment. The meiofaunal samples were preserved *in situ into* bottles with 20% DMSO for taxa identification. In addition, surface sediment (~2 cm) was also obtained from these replicate core samples for sediment particle size, organic matter, chlorophyll-a, and Phaeophorbide analysis.

Meiofauna extraction

Extraction of meiofauna was done by floatation and centrifugation (1800 rpm, 10 min) using a colloidal silica solution having a specific gravity of 1.15(Ludox™, Aldrich Chemical Company). Individual meiofauna was classified into higher taxon levels and counted under a stereomicroscope according to (Higgins and Thiel, 293).

Measurement of environmental parameters

A Mastersizer 2000 particle size analyzer was used to determine the size of the sediment grains, which can identify fractions between 2 and 2000 m. The Walkley–Black wet titration technique was used to measure the total organic matter of the silt (Walkley and Black, 35). Chlorophyll-a(Chl-a) and Phaeophorbide (Pha) contents were extracted from the frozen samples (about 2 g) using 90% acetone and some solid magnesium carbonate according to the protocol specified by (Liu et al. 207).

RESULTS

Meiofaunal composition and distribution

In the sampled stations, 14 meiofaunal taxa were identified, including Nematoda, Copepoda, Polychaeta, Ostracoda, Oligochaeta, Turbellaria, Hydrozoa, Syncarida, Halacaroidea, Tanaidacea, Cumacea, Amphipoda, Cladocera, and, Kinoryncha. The mean meiofaunal abundance was (214.05±59.75) ind./10 $cm^{2,}$ among which nematodes were found as the most abundant with a mean value of (202.96±56.52) ind./10cm^2, accounting for (94.81%) in total meiofaunal abundance, followed by the copepods (3.07%) and polychaetes (1.06 %). The mean biomass of meiofauna was (150.32±43.08) µg dwt/10cm^2, among which nematodes were the significant contributors with an average of (81.18±22.61) µg dwt/10cm^2, accounting for 54.28% in total meiofaunal biomass, then Polychaetes (21.27%) and Ostracoda (12.08%).

Meiofauna community structure

According to nMDS (non-Metric Multidimensional Scaling) analysis(fig. 1), the study could divide the meiofaunal assemblages into three groups at 86% similarity level. Group 1 consisted of the sites (J-1, J-8), and group 2 consisted of the sites (J-3, J-9, J-12) while group 3 included the rest of the sites (J-4, J-7, J-10, J-11, J-13, J-14).

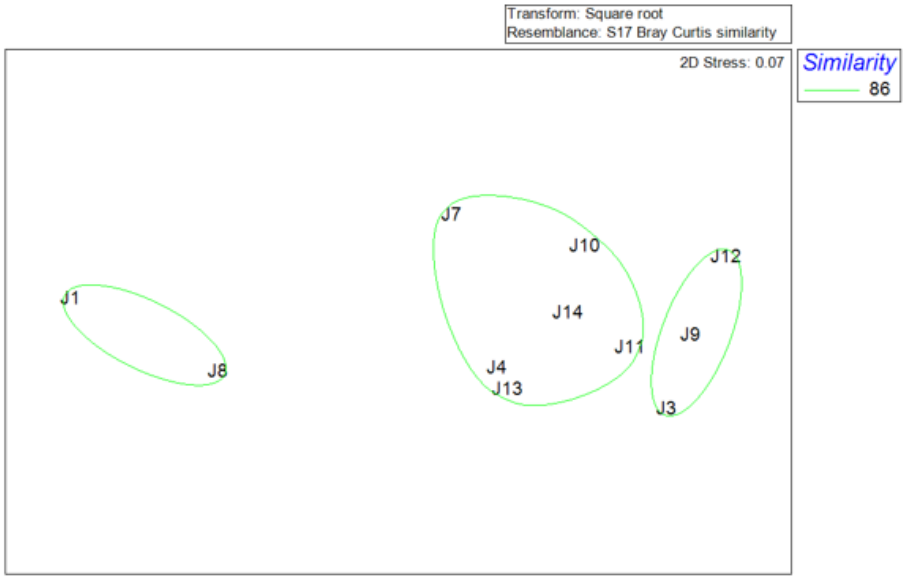

Figure 1. MDS ordination of meiofaunal assemblages in Jiaozhou Bay, 2018.

Principal component analysis (PCA) results are shown in (fig.2). The first axis (PC1) was responsible for 46.3% of the total environmental variance, whereas PC1 and PC2 together accounted for 66.5%.The key contributors to PC1 were sand(0.417), water depth(0.307), silt-clay proportion (-0.400), sediment median diameter (-0.413), sediment phaeophorbide concentration (-0.397), and those to PC2 were sorting co-efficient of sediment (0.555),skewness (0.530), sediment chlorophyll-a concentration (-0.415).

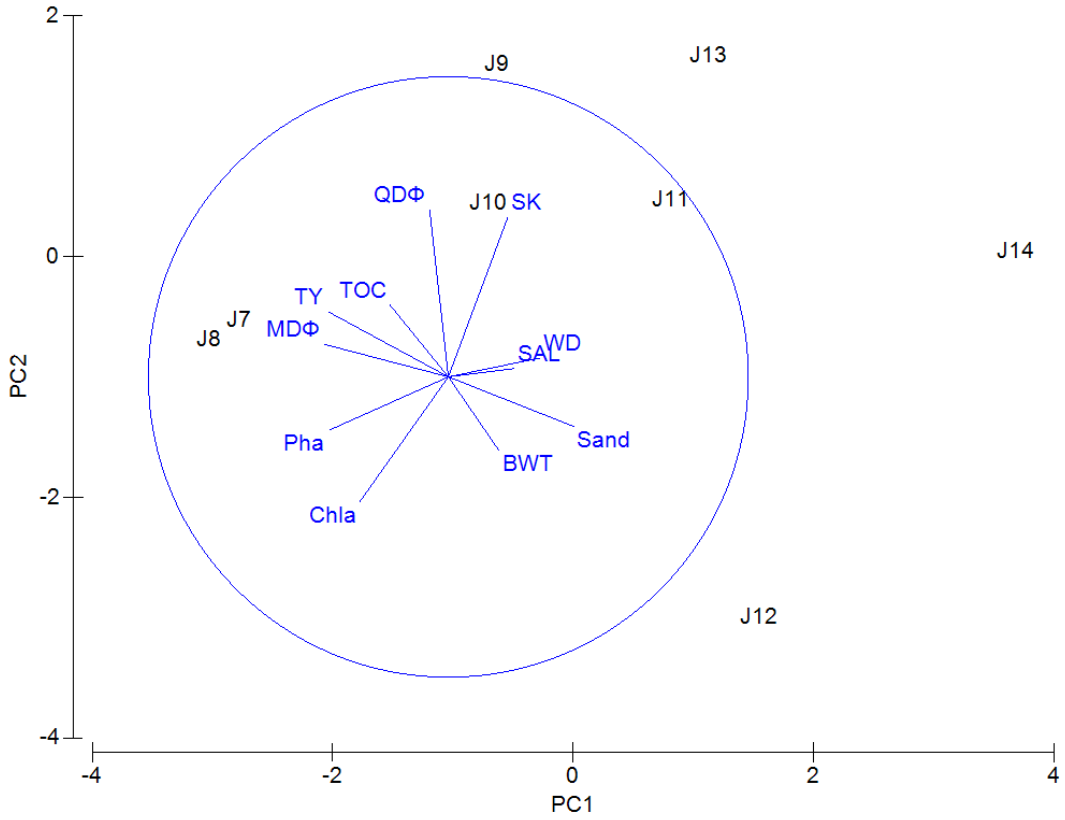

Figure 2. Principal Component Analysis (PCA)based on the environmental factors in Jiaozhou Bay, 2018.

Influence of environmental Variables on Meiofauna Distribution in the Jiaozhou Bay

According to Spearman correlation analysis, salinity was found as the most important environmental factor to influence meiofauna and nematode distribution. BIOENV (biota-environment best matching) analysis of meiofauna communities and ecological variables revealed that salinity had the highest coefficient (0.381) with meiofaunal assemblages. In addition, water depth, sediment sorting co-efficient, phaeophorbide was also significantly influenced meiofauna communities of the Jiaozhou Bay.

CONCLUSION

The abundance and distribution of meiofauna in Jiaozhou Bay, as well as their relationship with environmental conditions, were studied. The most abundant taxa were nematodes, followed by copepods. The abundance and distribution of the meiofauna community were regulated by salinity and sediment properties.

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