ORIGINAL PAPER

Seasonal changes of meiofauna assemblage at Hin Ploeng underwater pinnacle, Rayong Province, the Eastern Gulf of Thailand

Makamas Sutthacheep[a], Laddawan Sangsawang[b], Sittiporn Pengsakun[a], Wanlaya Klinthong[a], Phatthira Karnpakob[a], Charernmee Chamchoy[a] , Laongdow Jungrak[a] , Thamasak Yeemin[a,*]

[a]Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Bangkok, Thailand
[b] Marine and Coastal Resources Research and Development Center the Eastern Gulf of Thailand Klaeng District, Rayong Province, Thailand

*Corresponding author: *thamasakyeemin@hotmail.com*

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Abstract. Meiofauna in sediments are important components of the seafloor, coral reefs, and associated ecosystems, playing vital roles in the marine benthic food web and biogeochemical cycles. Understanding the dynamics of meiofauna in marine ecosystems in Thailand is still limited, particularly in underwater pinnacle ecosystems. This study aims to examine the seasonal changes of meiofauna at Hin Ploeng, an underwater pinnacle located in Rayong Province, the Eastern Gulf of Thailand. The meiofauna samples were taken in both summer and rainy seasons using a PVC core of 3.5 cm diameter. Eighteen groups of meiofauna were found with the dominant groups of Foraminifera, Nematoda, Harpacticoida, Ostracoda, and Bivalvia. The abundance of most meiofauna (forams, nematodes, and gastropods) varied seasonally ($p<0.05$). The diversity of meiofauna in the rainy season ($H' = 0.43$) was significantly higher than that in the summer season ($H' = 0.08$) ($p<0.05$). This study provides crucial information on the meiofaunal assemblage from the underwater pinnacle sediments, suggesting that underwater pinnacles with diverse meiofauna have important ecological functions and processes in marine and coastal ecosystems.

Keywords: diversity, Gulf of Thailand, meiofauna, sediment, underwater pinnacle

1. Introduction

In Thailand's marine environment, underwater pinnacles serve as vital ecosystems hosting a diverse range of marine species. Beyond their role as biodiversity hotspots, these structures also attract divers, providing opportunities to observe marine creatures such as sharks and groupers (Rogers, 2004; Richert et al., 2017). Notably, a study by Sutthacheep et al. (2023) highlighted the tourism potential of the pinnacles, especially within the coral communities of Rayong Province. Meiofauna, though frequently overlooked, are pivotal in coral reef ecosystems, playing key roles in the food chain and serving as crucial tools for sustainable ecosystem management (Moreno et al. 2011). However, research on meiofauna within Thailand's underwater pinnacles remains limited. These adaptable organisms thrive in a wide range of aquatic settings, from marine to freshwater, spanning both tropical and polar environments. Some species even have adhesive organs for attachment, allowing them to inhabit diverse sediments (Heip et al. 1985). They primarily reside in the top 2 cm of sediments, with their distribution influenced by the Redox Potential Discontinuity (RPD), layer depths, and their preference for specific oxygen conditions (Higgins and Thiel 1988). Compared to benthic macrofauna, meiofauna are smaller, have shorter lifespans, and undergo rapid generational changes, often beginning life as larvae in marine sediments. Their high abundance makes them crucial indicators for monitoring environmental changes (Moore and Bett 1989). Remarkably, meiofauna can reach densities 108 individuals per square meter, with their numbers influenced by factors like sediment properties and water depth (Giere 1993; Raes et al., 2007).

Owing to their sensitivity to environmental changes, the importance of meiofauna research has grown in the region, particularly in the Eastern Gulf of Thailand. This area confronts increased storm threats, rising water temperatures, and sea level alterations due to climate change,

especially during the northeastern monsoon season (Tomkratoke & Sirisup, 2020). Hence, a comprehensive understanding of meiofauna across various seasons is essential for both scientific advancement and conservation efforts. This is particularly pertinent in areas like the underwater pinnacles of Rayong Province, where there is still a lack of data on these organisms. Such data could be instrumental in formulating the region's sustainable marine tourism policies and serve as a baseline for preserving and mitigating the impacts of climate change. This study aims to examine the seasonal changes of meiofauna at Hin Ploeng, an underwater pinnacle located in Rayong Province, the Eastern Gulf of Thailand during summer and rainy seasons.

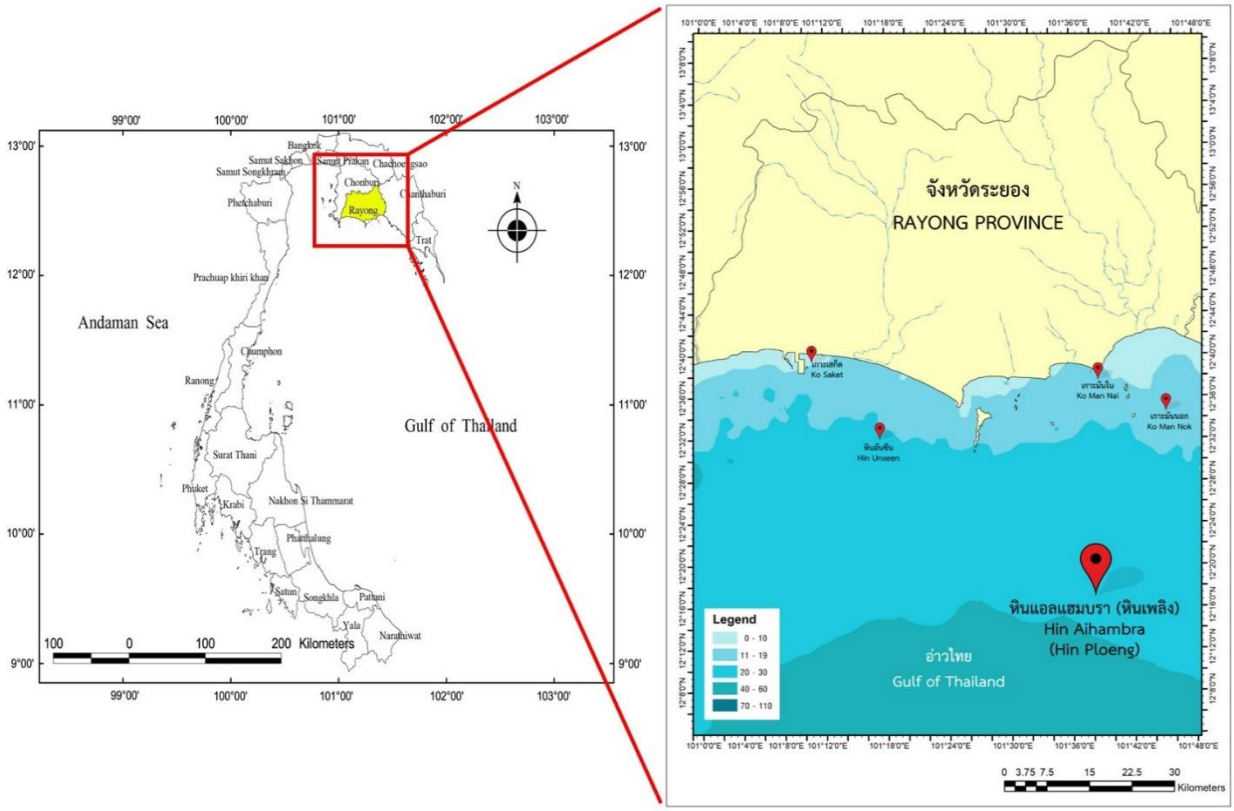

Figure 1. The study site at Hin Ploeng underwater pinnacle, Rayong Province, the Eastern Gulf of Thailand

2. Materials and Methods

2.1 Location of the study site and samples collection

The study site is located at Hin Ploeng underwater pinnacle, Rayong Province, the Eastern Gulf of Thailand (Figure 1). Hin Ploeng is located about 30 km from the mainland and approximately 15 – 16 m in depth.

The coral communities at the study sites were investigated by SCUBA diving along a permanent belt transect with three replicates. The substrate compositions, i.e., live coral, dead coral, rubble, sand, and others were recorded within 50 cm of each side of the transect line (English et al. 1997). The underwater photographs were taken by a digital camera for data rechecking in the laboratory.

The meiofauna were sampled by SCUBA divers at Hin Ploeng underwater pinnacle. The sediment samples for the meiofauna study were collected in both summer and rainy seasons using PVC meiocores of 3.5 cm diameter. The meiocores were randomly inserted into the sediment down to a depth of 10 cm and then the samples were preserved in 10% buffered formalin. The meiofauna samples were stained with Rose Bengal and sieved through a 63 μm mesh net in the laboratory. They were sorted, identified, and counted using a stereoscopic microscope.

The grain size measurement was conducted using a standard method of dry sieve analysis (English et al.,1997).

2.2 Data analysis

The total densities of meiofauna at Hin Ploeng underwater pinnacle in Rayong Province were statistically analyzed using a Student's *t*-test. The Shannon's diversity index (H′) and Pielou's evenness index (J') were calculated based on the number of individuals from the study site. The Pearson's correlation was used to perform the correlation between total densities and grain size at the study site.

3. Results

The benthic composition of the coral community at Hin Ploeng underwater pinnacle mainly consisted of scleractinian corals, rock and sand. The mean live coral cover was 79.21%. The mean covers of dead coral and rubble were 1.25% and 0.98%, indicating a very good coral reef condition (Figures 2 and 3).

The results showed that the density of meiofauna at Hin Ploeng underwater pinnacle in summer season (516.16 ± 32.49 individuals/10 cm^2) was higher than that in rainy season (449.28 ± 15.49 individuals/10 cm^2) (Figure 4). Eighteen taxa of meiofauna were found in the rainy season, while five taxa were found in the summer season. Ciliophora, Nemertea, Turbellaria, Polychaeta, Oligochaeta, Calanoida, Cyclopoida, Harpacticoida, Cladocera, Nauplius, Trombidiformes, Ophiurae, and Spatangoida were found only in rainy season. The dominant taxa at Hin Ploeng underwater pinnacle both seasons were Foraminifera, Nematoda, Harpacticoida, Ostracoda, and Bivalvia (Figure 5).

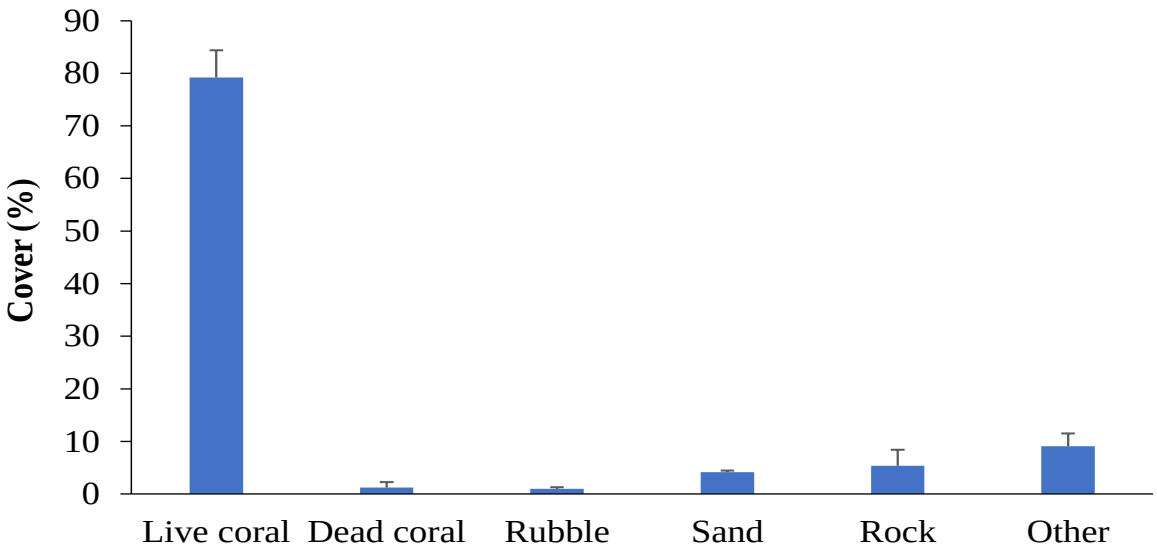

Figure 2. Benthic composition at the study sites (Mean ± SE)

Figure 3. Coral communities at the study site

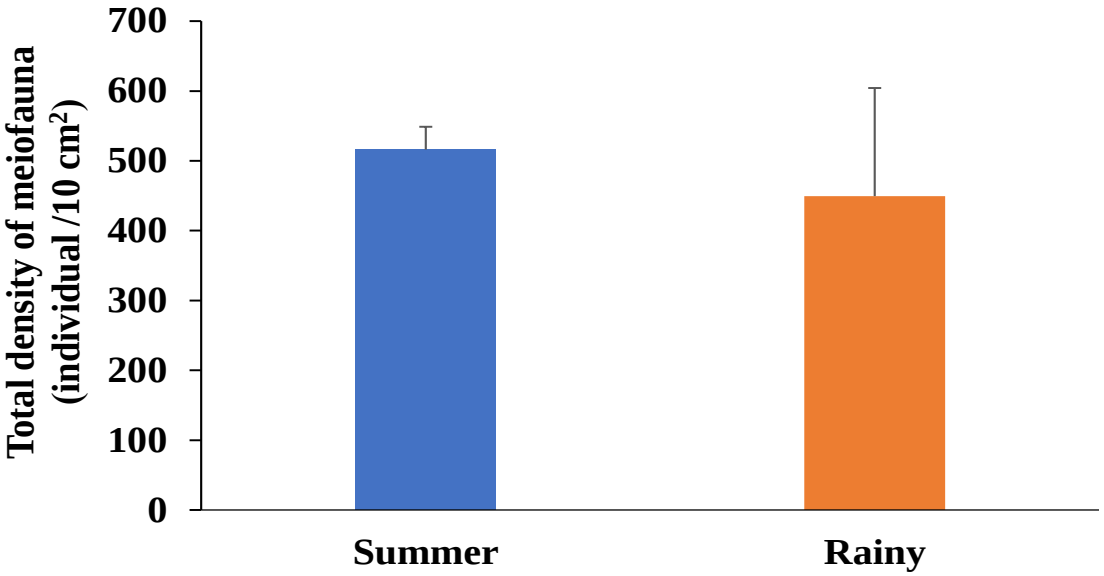

Figure 4. Density of meiofauna at Hin Ploeng underwater pinnacle

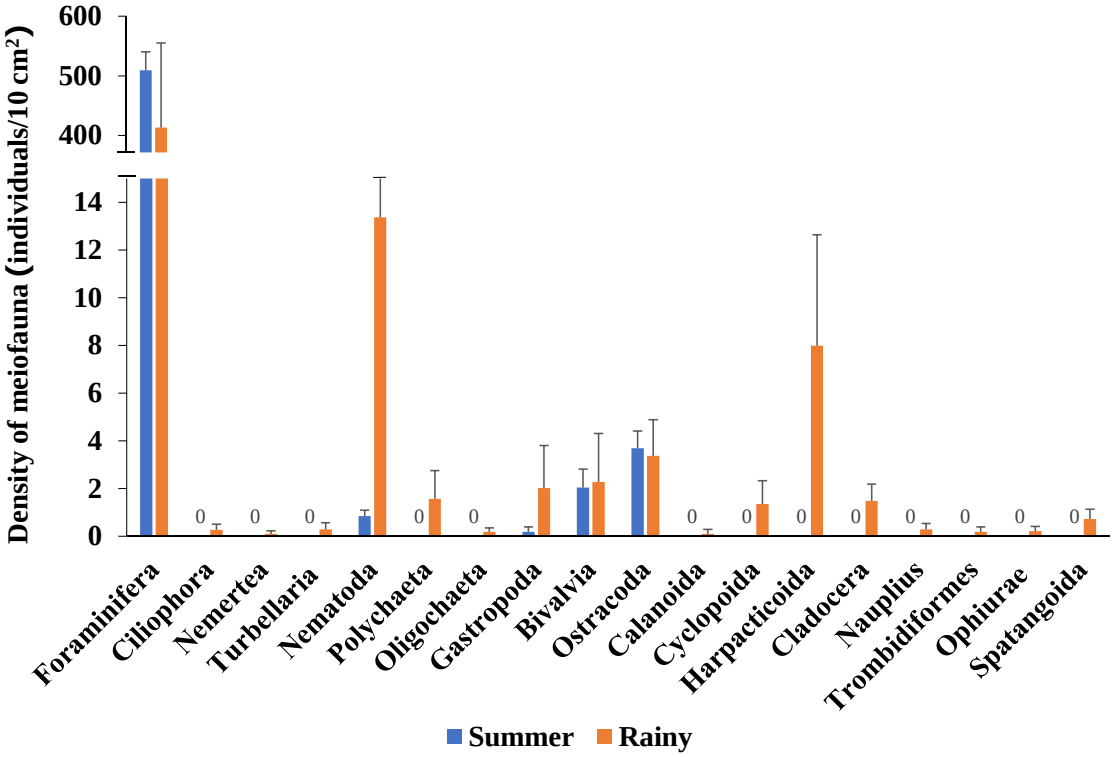

Figure 5. Composition of meiofauna at Hin Ploeng underwater pinnacle

The abundance of meiofauna (forams (t= 3.02, p<0.05), nematodes (t= -4.48, p<0.05), and gastropods (t= -4.65, p<0.05)) varied seasonally (Table 1 and Figure 6). The diversity of meiofauna in rainy season (H′ = 0.43, J' = 0.02) was significantly higher than that in summer season (H′ = 0.08, J' = 0.01), (p<0.05). The analysis of median grain sizes indicated that the particle size in the summer season was higher than in the rainy season (Table 2). The correlation analysis showed a significant relationship (r = -0.39, p<0.05) between meiofauna density and median grain size. A negative correlation between total meiofauna density and median grain size was found. (Figure 7 and Table 3).

Table 1 The *t*-test analyzes the abundance of meiofauna at Hin Ploeng underwater pinnacle

Taxon	Season	*Mean*	N	*t*	*SE*	*p-values*
Foraminifera	Summer	509.39	15	3.02	31.67	0.00
	Rainy	413.48	15			
Nematoda	Summer	0.84	15	-4.48	2.79	0.00
	Rainy	13.37	15			
Gastropoda	Summer	0.18	15	-4.65	0.39	0.00
	Rainy	2.01	15			

Table 2 Median grain size, Shannon diversity index and evenness index at Hin Ploeng underwater pinnacle

Source	Season	
	Summer	Rainy
Median grain size (mm)	1.05 ± 0.12	0.86 ± 0.25
Shannon-Wiener index (H')	0.08 ± 0.05	0.43 ± 0.10
Pielou's evenness (J')	0.01 ± 0.05	0.02 ± 0.09

4. Discussion

In the present study, a total of eighteen meiofauna taxa were identified during the summer and rainy seasons. The densities of meiofauna on underwater pinnacle in the summer season are higher than in the rainy season due to the high abundance of Foraminifera. Previous studies showed that Foraminifera responds directly to environmental incentives, and their long-life span makes them an excellent proxy to understand ecological variations compared with the other meiofauna and can be a bioindicator of water quality and reef health. (Goldstein 1999; Murray 2006; Schueth and Frank 2008; Uthicke et al. 2010; Natsir and Subkhan 2012; Sangmanee et al. 2022; Sadanandan et al. 2023; Sutthacheep et al. 2023).

Sangmanee et al. (2022) found seventeen taxa of meiofauna on the coral reefs at Mu Ko Surin National Park, the Andaman Sea. The dominant taxa of meiofauna were Foraminifera, Nematoda, Copepoda and Polychaeta. Our results also showed that Foraminifera and Nematoda were the dominant meiofauna groups. Copepoda and Polychaeta were not abundant at Hin Ploeng underwater pinnacle. However, Harpacticoida, Ostracoda, and Bivalvia were dominant at our study site. The positive correlations between meiofauna density and live coral per dead coral cover ratio were documented for Copepoda, Turbellaria and Nematoda at Mu Ko Surin National Park. These positive correlations imply that live coral cover is a contributor to meiofauna community distribution. The live coral cover at Hin Ploeng underwater pinnacle was also very high (79.21%) and may affect meiofauna community distribution at our study site.

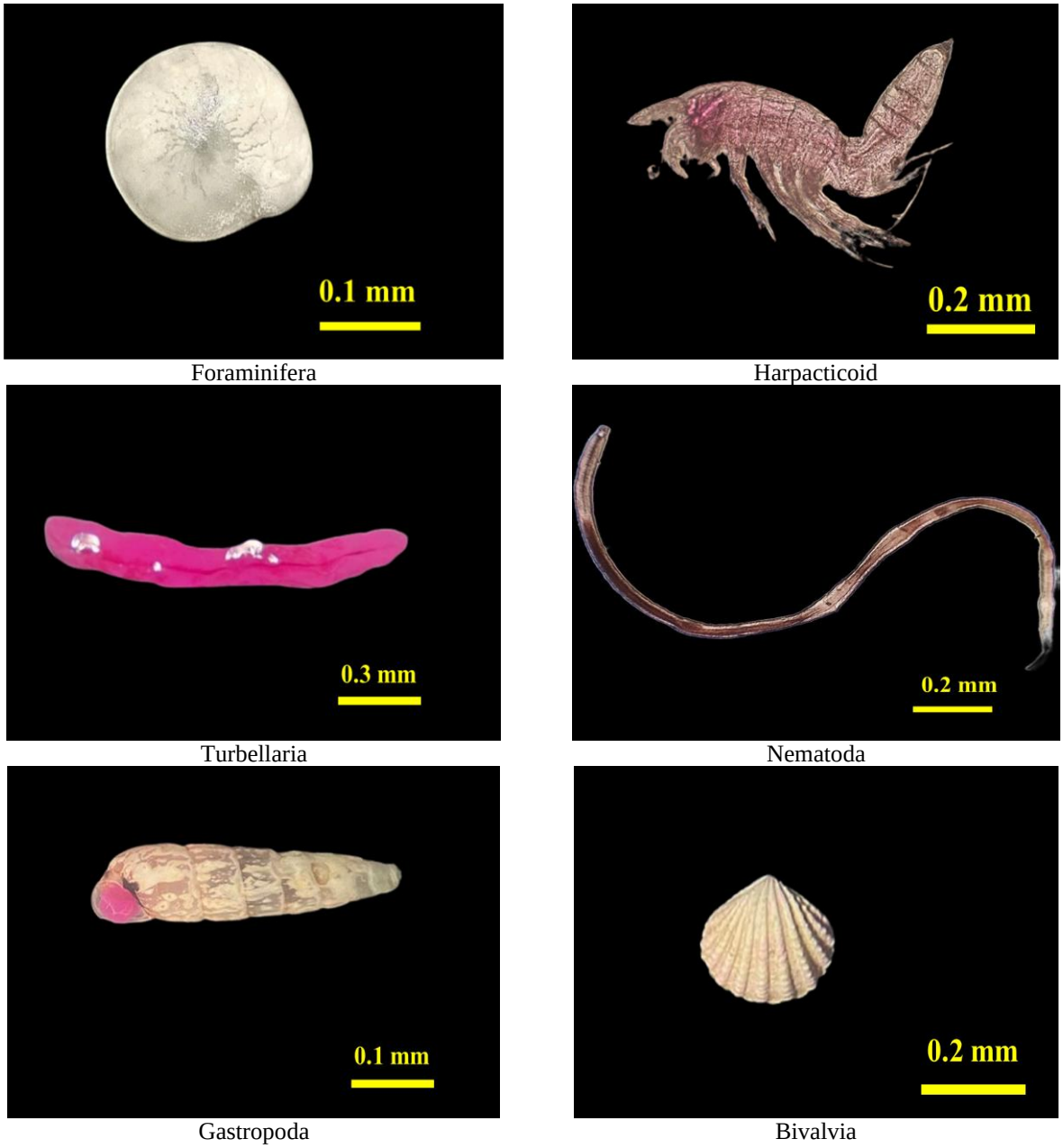

Figure 6. Dominant taxa of meiofauna at Hin Ploeng underwater pinnacle

Table 3 The correlation analysis between meiofauna density and median grain size

	Correlation	**Density (individual/ 10 cm^2)**
Median grain size (mm)	Pearson Correlation	-0.396
	Sig. (2-tailed)	0.03
	N	30

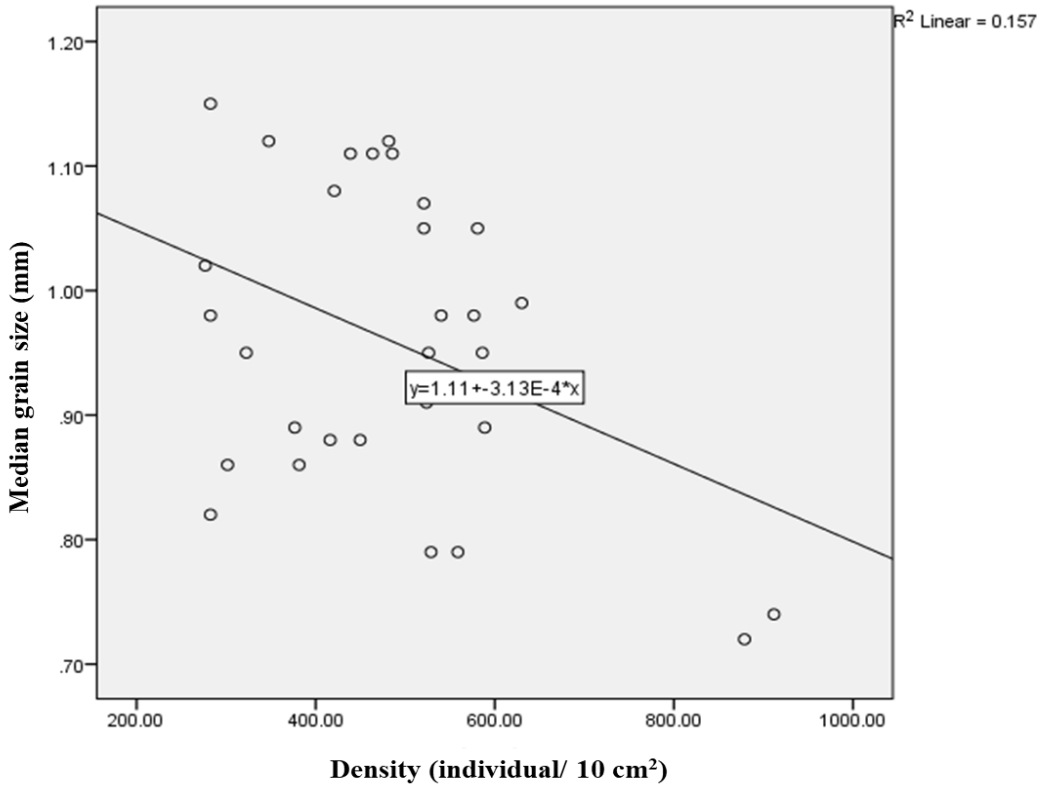

Figure 7. Correlation of meiofauna density and median grain size at Hin Ploeng underwater pinnacle

Diversity of Foraminifera, Nematoda, and Gastropoda varied seasonally. Venekey et al. (2019) showed the effects of seasonal variation of amazon river discharge on the benthic community change through time of meiofauna and nematodes in the Biological Reserve of Piratuba Lake, the Amazonian coast of Bazil. The significant changes in meiofauna and nematodes between seasons and depths were correlated to higher salinity and food availability in the dry season. The reason for the significant seasonal changes in the taxa composition and abundance of meiofauna may be due to the effects of seasonal changes in environmental variables, particularly median grain size (Song et al 2022). The total density of meiofauna and medium grain size are significantly negatively correlated based on correlation analysis.

The present study provides basic information for seasonal change of meiofauna at Hin Ploeng underwater pinnacle. However, in order to reflect the annual fluctuation of meiofauna, continuous studies of meiofauna should be carried out and the effect of seasonal changes, such as temperature and salinity, on the distribution of meiofauna needs further study.

Acknowledgements

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