ORIGINAL PAPER

Comparing composition and abundance of macroinfauna on sandy beaches and coral reefs at Mu Ko Chumphon, the Western Gulf of Thailand

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Abstract. Macrofauna in sedimentary environments of coastal habitats such as sandy beach, mangrove and coral reef are one of the important components of coastal ecosystems. Knowledge of connectivity between coral reefs and their associated communities is needed to better understand the complexity of food webs in marine and coastal ecosystems. There are no studies on a gradient of macroinfaunaa communities between coral reefs and sandy beaches at the same location in Thailand. Therefore, this study aimed to investigate the composition and abundance of macroinfauna living in sandy beaches and soft bottom of coral reefs at Ko Mattra and Ko Maphrao, Mu Ko Chumphon. Five major macroinfaunas were observed. Nematodes and polychaetes were the major groups at both sandy beach and coral reef habitats. The polychaete *Polydora* sp. was an abundant species on sandy beaches at both study sites. The diversity of macroinfauna on coral reefs was much higher than that of sandy beaches. However, the abundance of macroinfauna on sandy beaches was significantly higher than that on coral reefs. The correlation of macroinfauna density and median grain size showed no statistical significance. This study suggests that macroinfauna can be applied for a bioindicator of sandy beach and coral reef ecosystems as well as utilization for fisheries, mariculture and natural products for the pharmaceutical and cosmetic industries.

Keywords: polychaete, sediment, diversity, Gulf of Thailand

1. Introduction

Macroinfauna in the benthic community function is very important since they occupy different trophic levels in the food web, such as predators and grazers. Moreover, they are parts of the recycling processes in sediments as well (Hutchings, 1998). Macroinfauna communities reflect the environmental conditions, and they can serve as a bioindicator for detecting the environmental status (Pearson & Rosenberg, 1978; Zenetos & Bogdanos, 1987). Macroinfaunaa communities of sandy beaches and coral reefs are dynamic seasonally and spatially (Gray, 2016). They are controlled by ecological interactions (e.g., density-dependent mechanisms) (Defeo and Mclachlan, 2005). Moreover, other environmental conditions such as temperature, food availability, and natural disturbances (storms and rainfall) are essential drivers shaping their community structure (Taylor and Mclachlan, 1980; Lercari and Defeo, 1999; Harris et al., 2011; Bergamino et al., 2013; Lercari and Defeo, 2015; Machado et al., 2016; Corte et al., 2017).

The morphodynamic and hydrodynamic variables are mostly considered as the role of environmental factors on macroinfauna communities (e.g., grain size) (Veloso and Cardoso, 2001; Coutinho and Bernadino, 2017). Moreover, short-term changes in macroinfauna communities are changed by natural disturbances such as storms and heavy rainfall (Costa et al., 2019). Mu Ko Chumphon, selected as a study area for this research, is located in the Western Gulf of Thailand and is characterized by a tropical monsoon climate. Macroinfauna are an essential group of marine and coastal ecosystems, particularly on sandy beaches and coral reefs in the study area. The sedimentary environment is enhanced and characterized by

macroinfauna activities such as the feeding of macroinfauna that helps faster digestion of organic matter, digging holes, and burying within the soil layers result in better air passage. The diversity and density of macroinfauna can indicate ecosystem integrity. Therefore, the understanding of macroinfauna's ecological processes and biodiversity will help explain the dynamics of coral reefs ecosystems, sandy beach ecosystems, and macrofauna communities in the soft bottom and their adaptation to global climate change. This study aimed to examine the composition and abundance of macroinfauna living in sandy beaches and soft bottom of coral reefs in Chumphon Province, the Western Gulf of Thailand.

2. Materials and Methods

2.1 Location of study sites and sample collection

Four study sites are located at both sandy beaches and coral reefs of Ko Mattra and Ko Maphrao in Mu Ko Chumphon Archipelago, the Western Gulf of Thailand (Figure 1). The sediment samples were collected by a new modified grab which was pushed manually into the sediment with a depth of 5 - 10 cm on sandy beaches and coral reefs. The sediment samples were separately collected for a grain size measurement. Macroinfauna specimens were preserved in 10% sea water-formalin. In the laboratory, the specimens were sorted, identified to the family or genus taxonomic levels, and counted. The grain size measurement was conducted using a standard method (English et al.,1997).

2.2 Data analysis

The total densities of macroinfauna of each study site were statistically analyzed by using a two-sample t-test to detect their differences between sandy beaches and coral reefs using R program. The Shannon's diversity index (H') and Pielou's evenness index (J') were calculated based on the number of individuals for each study site. The Pearson's correlation was used to perform the correlation between total densities and grain size at each study site
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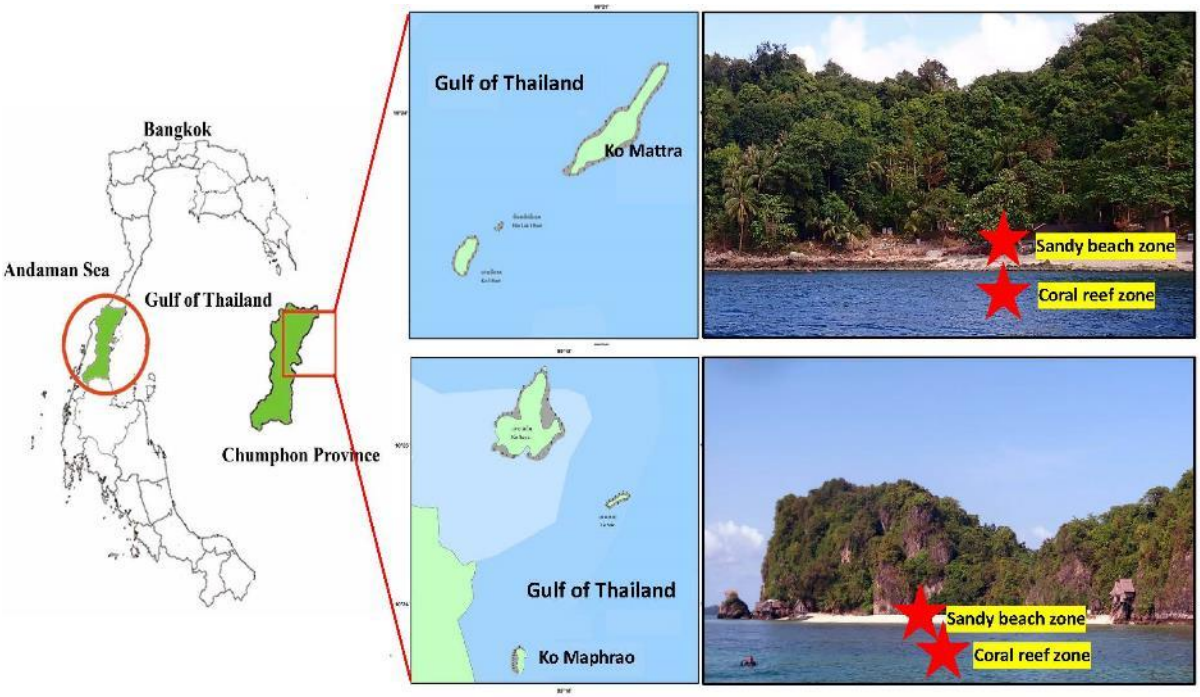


Figure 1. The study sites at Ko Mattra and Ko Maphrao, Mu Ko Chumphon

3. Results

Our results revealed that the total densities of macroinfauna on sandy beaches were significantly higher than those on coral reefs at both study sites (Ko Mattra, t = 4.769; p = 0.009 and Ko Maphrao, t = 3.634; p = 0.022) (Figure 2).

Five major groups of macroinfauna were observed at Ko Mattra (Figure 3), while four groups of macroinfauna were found at Ko Maphrao (Figure 4). The polychaete Polydora sp. was the most abundant species on the sandy beaches at both study sites, while unidentified nematodes and unidentified bivalves were found with the most abundance on coral reefs. The higher nsities of nematodes, polychaetes, bivalves,and amphipods were found on coral reefs. Several polychaete taxa were found only on the coral reefs, such as *Sphaerosyllis* sp., *Magelona* sp., and *Cirratulidae* sp. (Figure 6)

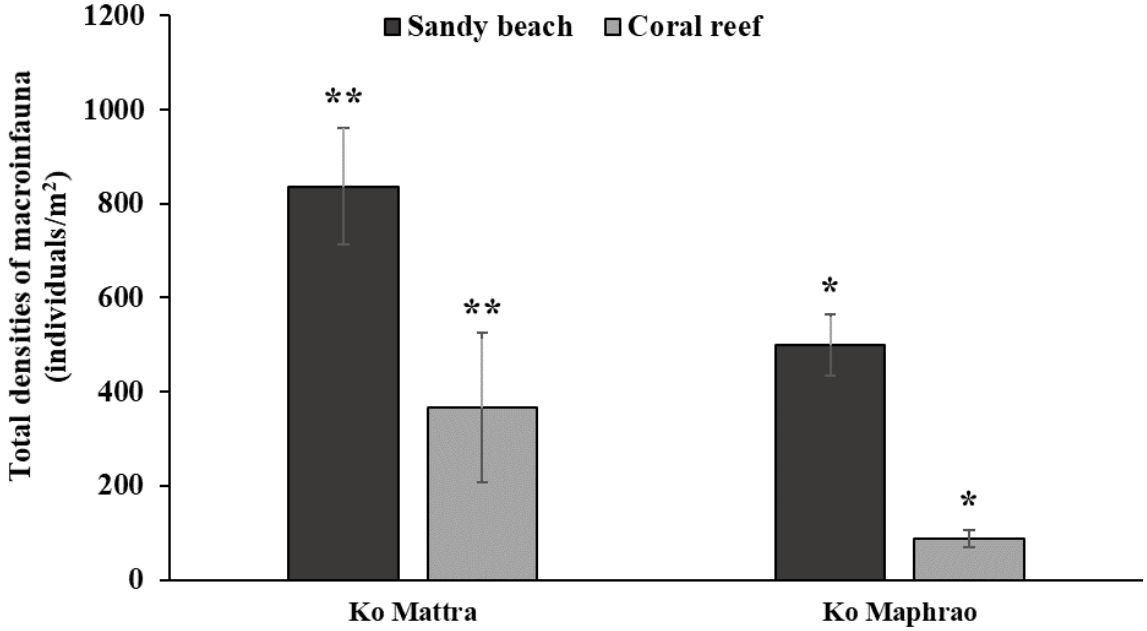


Figure 2. Total densities of macroinfauna on the sandy beaches and coral reefs at the study sites

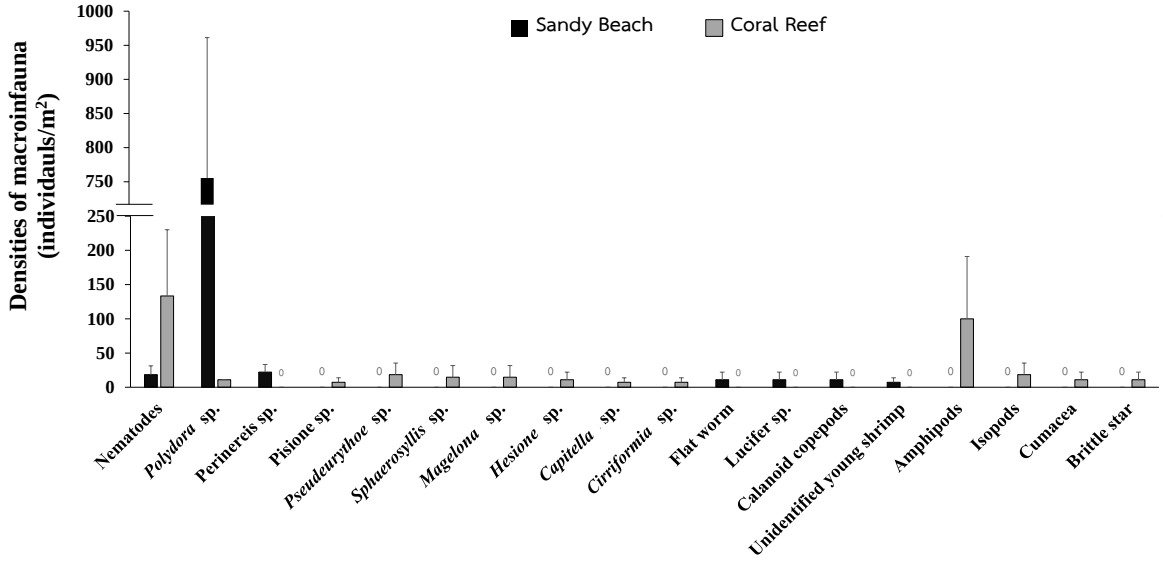


Figure 3. The densityy of major macroinfauna groups at Ko Mattra (Mean±SD)

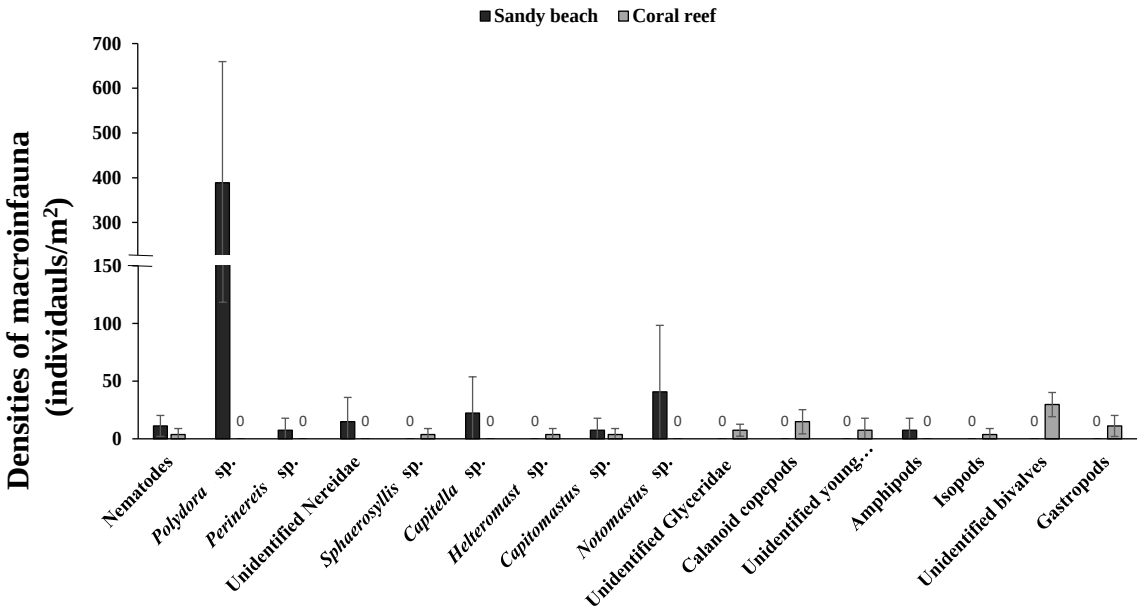
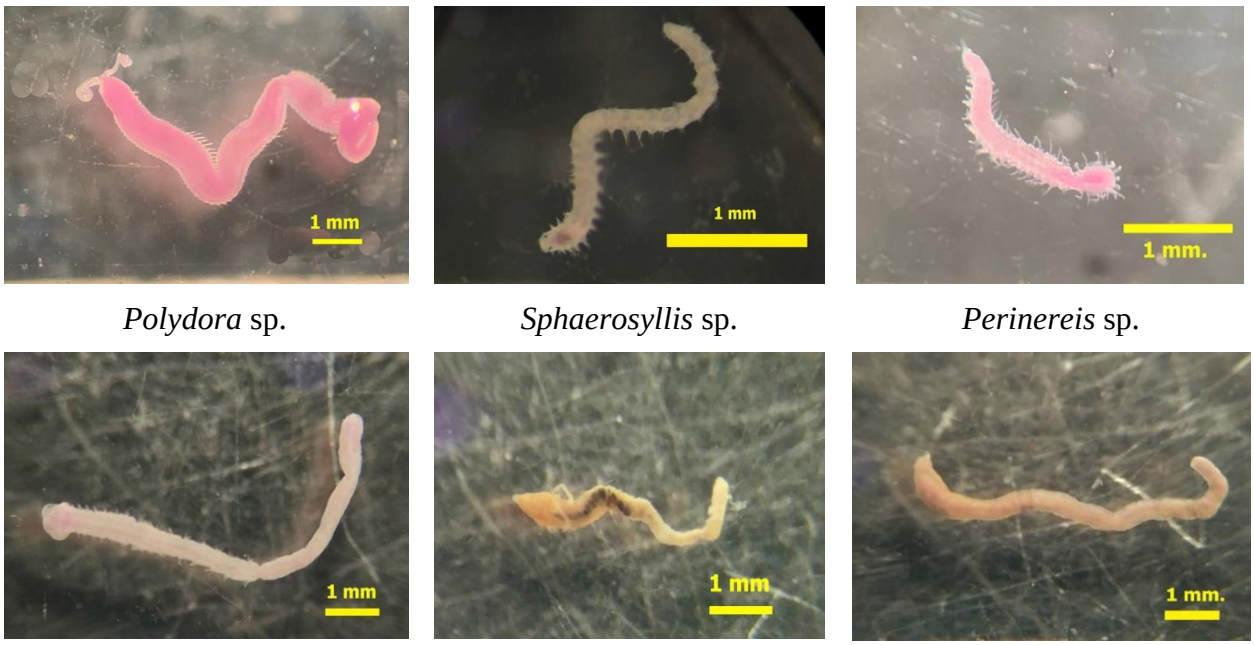


Figure 4. Density of major macroinfauna groups at Ko Maphrao (Mean±SD)



Polydora sp. *Sphaerosyllis* sp. *Perinereis* sp.

Magelona sp. *Cirratulidae* sp. *Capitella* sp.

Figure 6. Dominant polychaete found at the study sites

Table 1. Median grain size, Shannon diversity index and evenness index at the study sites

	Ko Mattra		Ko Maphrao	
	Sandy beach	Coral reef	Sandy beach	Coral reef
Median grain size (mm)	0.72±0.15	0.55±0.25	0.67±0.08	0.49±0.13
H’	0.48±0.04	1.94±0.09	0.91±0.19	2.00±0.03
J’	0.25±0.01	0.75±0.01	0.43±0.02	0.86±0.01

The analysis of median grain sizes indicated that the particle size on sandy beaches was higher than that on coral reefs at both study sites but no statistically significantly different (Ko Mattra, t=0.823, *p*=0.456; Ko Maphrao, t=1.652, *p*=0.174). Regarding the diversity, the coral reefs exhibited a higher species diversity index and evenness index than those observed on sandy beaches at both study sites (Table 1). The statistical analysis showed no statistical significance in terms of the relationships between macroinfauna densities and median grain sizes (t=1797, *p*=0.102, r = 0.445; Figure 5).

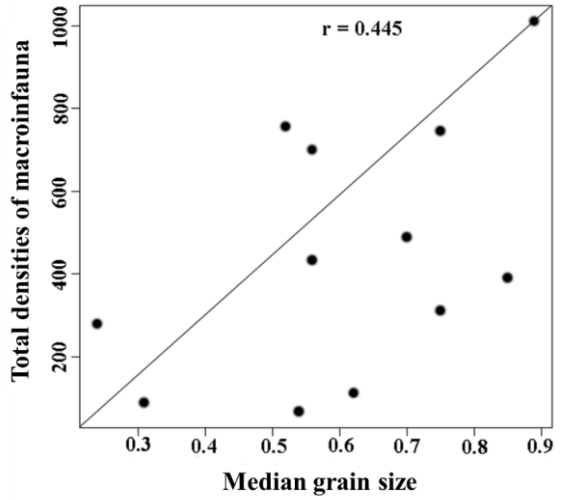


Figure 5. Correlation of macroinfauna density and median grain size at the study sites

4. Discussion

In this study, we found that the densities of macroinfauna on the sandy beaches were significantly higher than those on the coral reefs as a result of the high abundance of the polychaete Polydora sp. This polychaete is in a genus, the family Spionidae and is one of the most common invertebrates of coastal, estuarine, and marine benthic environments. This polychaete taxa has a particularly wide geographical distribution, usually indicating organic pollution (Anger et al., 1986). Some macroinfauna species on a sandy beach have high population densities, probably due to their adaptation to a combination of food availability and habitat heterogeneity that reduced competition and predation (Klumpp et al., 1988).

Our results showed that the macroinfauna diversity of coral reefs was higher than that of sandy beaches. This resulting might be from physical environmental factors, habitat complexity, and relationships with predatory (Hauser et al. 2006; Serrano and Preciado, 2007). High diversity of macroinfauna communities can be observed within the protected areas, suggesting that the coral reef protected areas are essential reservoirs of marine biodiversity (Hyland et al., 2006). In the present study, the majority of polychaete species are found with a small number of individuals belonging under a few genera. Polychaetes are the most common and important taxon in terms of abundance and diversity on a sandy beach (Gray and Elliott, 2009). The most abundant species in some families (e.g., Spionidae, Capitellidae, and Onuphidae) have previously been reported with large numbers throughout the Indo-pacific region (Froján et al., 2005; Williams, 2007; Pamungkas, 2017). Such importance of rare species is found that suggests a relatively unstressed environment. The proportion of polychaetes within the macroinfauna is ranged from 45 to 90% that was also consistent with other studies conducted in the region (Angsupanich and Kuwabara, 1995; Muthuvelu et al., 2013) and the same habitats further away (Alongi, 1990; Hutchings, 1998; Turner and Kendall, 1999).

There are several benefits from polychaetes that have been reported, such as indicators of organically enriched marine sediments, feeds of aquatic animals, and enhancing reproduction in shrimp and fish broodstocks (Giangrande et al. 2005; Meunpol et al., 2005; Palmer et al. 2014; Nederlof et al., 2019). Moreover, there are several potentials of pharmaceutical uses from polychaetes, such as antimicrobial, antibacterial, anticancer, and antifungal activities (Elayaraja et al., 2008; Fonseca et al., 2008; Bruno et al., 2019). This study implies the application of macroinfauna for a bioindicator of sandy beach and coral reef ecosystems, as well as utilization for aquaculture and natural products for the pharmaceutical industry

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