ORIGINAL PAPER

Composition and abundance of meiofauna on the coral reefs at Mu Ko Surin National Park, the Andaman Sea

Nachaphon Sangmanee,[a,*] Makamas Sutthacheep,[a] Laongdow Jungrak,[a] Siriluck Rongprakhon,[a] Sirirat Jaihan,[a] Prarop Plangngan,[b] Thamasak Yeemin[a]

[a] Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Bangkok 10240, Thailand
[b] Phuket Marine National Park Operation Center 2, Department of National Parks, Wildlife and Plant Conservation, Phuket Province, Thailand

*Corresponding author: *nachaphon.sangmanee@gmail.com*

Received: 27 April 2022 / Revised: 27 April 2022 / Accepted: 30 April 2022

Abstract. Coral reefs are complex ecosystems with a diversity of marine organisms. Biodiversity and ecosystem functions assessment is important data to know the consequences of biodiversity loss. The soft bottom in the coral reef also has a diversity of marine organisms. Meiofauna in soft bottom are one of the communities with high diversity and abundance in the coral reef ecosystem. However, meiofauna studies in tropical countries are limited. Therefore, this study aimed to examine the composition and abundance of meiofauna in coral communities and assess the relationship of meiofauna density and ratio of live coral per dead coral at Mu Ko Surin National Park, the Andaman Sea, in February 2021. Seventeen taxa of meiofauna were observed. The major taxa of meiofauna are Foraminifera, Nematoda, Copepoda and Polychaeta. The highest average total density of meiofauna was observed at Ao Mai Ngam (77.45±5.47 inds. 10 cm^{-2}) and followed by Ao Chong Khad (71.85 ± 27.04 inds. 10 cm^{-2}). Meiofauna composition and abundance were significantly varied among study sites. The correlations between meiofauna density and live coral per dead coral cover ratio were positive Copepoda, Turbellaria and Nematoda density shows a significant positive correlation with live coral per dead coral cover ratio. These positive correlations indicate that live coral cover is a contributor to meiofauna community distribution. Our results highlight that the meiofauna can play a significant bioindicator in coral reef ecosystems because it might reflect environmental quality. Densities and composition changes in meiofauna may affect coral reef food webs under a polluted or stressed environment..

Keywords: meiofauna, coral reef, soft bottom, Andaman Sea

1. Introduction

Coral reefs are complex marine ecosystems with high biodiversity and dynamic populations of marine organisms (Reaka-Kudla 1997). Soft bottom in the coral reef, for example sand and rubble, is an important component of the coral reef ecosystem. The process to become the soft bottom in the coral reef starts through the breakdown of live coral to dead coral, rubble and sand. Many marine organisms live in sedimentary substrates such as bacteria, fungi meiofauna (size 40-500µm) and macrofauna (size > 500µm) (Wolfe et al. 2021). Meiofaunal communities in coral reef ecosystems are important for marine ecosystems. Meiofauna contributes to the marine food web, particularly being a food source for the juveniles of various marine economic species. The essential role of meiofauna will be the food source for the macrofauna and at higher trophic levels, such as juveniles of fish or shrimp, small benthic creatures feed on other, smaller organisms such as copepods, nematodes, diatoms, therefore categorizing those meiofaunas as an important food chain (Coull 1999; Schmid-Araya et al. 2002; Cui et al. 2021). A number of studies have shown that meiofauna in soft bottom such as harpacticoid copepods were found in the stomach and intestines of marine fish. Several marine invertebrates, which are small benthic animals in the muddy bottom show are eaten by other animals living in the sand bottom. The research examining the relationship between meiofauna and predators such as (*Palaemontes pugio*), crab (*Uca pugnax*) and fish (Gobid fish) found that when predators were removed from the experimental area where then marine animals in small sediments are increasing. Those shrimp, crabs and fish feed on meiofauna on the soft bottom. Some reports show that mullet fish prefers to feed on marine animals on the soft bottom, particularly copepod (*Enhydrosoma propinquum*) (Service et al. 1992). The study of marine biodiversity in the sedimentary layer of coral reef ecosystems is a very important element in marine ecosystems. Dead coral fragments and rubble found in the degraded coral reefs can contribute significantly to the diversity of meiofauna and overall marine biodiversity, such as a case study from the Gulf of Thailand (De Troch et al. 2008; Donsomjit et al. 2013, 2015; Ruknawee et al. 2014). In this research, we examine the composition and densities of meiofauna in the coral reefs and to assess the relationships of meiofauna density and ratio of live coral per dead coral at Mu Ko Surin National Park.

2. Materials and Methods

2.1 Location of study sites and sample collection

Six study sites are located on the coral reefs at Ao Jaak, Ao Mai Ngam, Ao Suthep, Ao Chong Khat, Ao Pak Kaad and Ao Mae Yai, Mu Ko Surin National Park, the Andaman Sea (Figures 1 and 2). Triplicated sediment samples were collected using PVC 3.5 cm in diameter. Meiofauna in the soft bottom was fixed with 10% of formalin in seawater and transported to the laboratory. To extract meiofauna from sediment in the laboratory, the sediments were washed through a 5-mm sieve and a 63-micron sieve and then stained by 1 gram per liter solution of Rose Bengal to clearly sort out meiofauna from the sediment. The samples were then transported to the laboratory for the identification process. Meiofauna was identified to taxon level, counted them under a stereomicroscope (Nabavi 2013; Dezfouli et al. 2016).

The percent cover or coral communities at each station were observed in a total area of 90 m2 with triplicated permanent belt transects (30x1 m). The transects were set up parallel to the shoreline (English et al,1997). Live coral cover was recorded using a digital camera (Olympus TG-5).

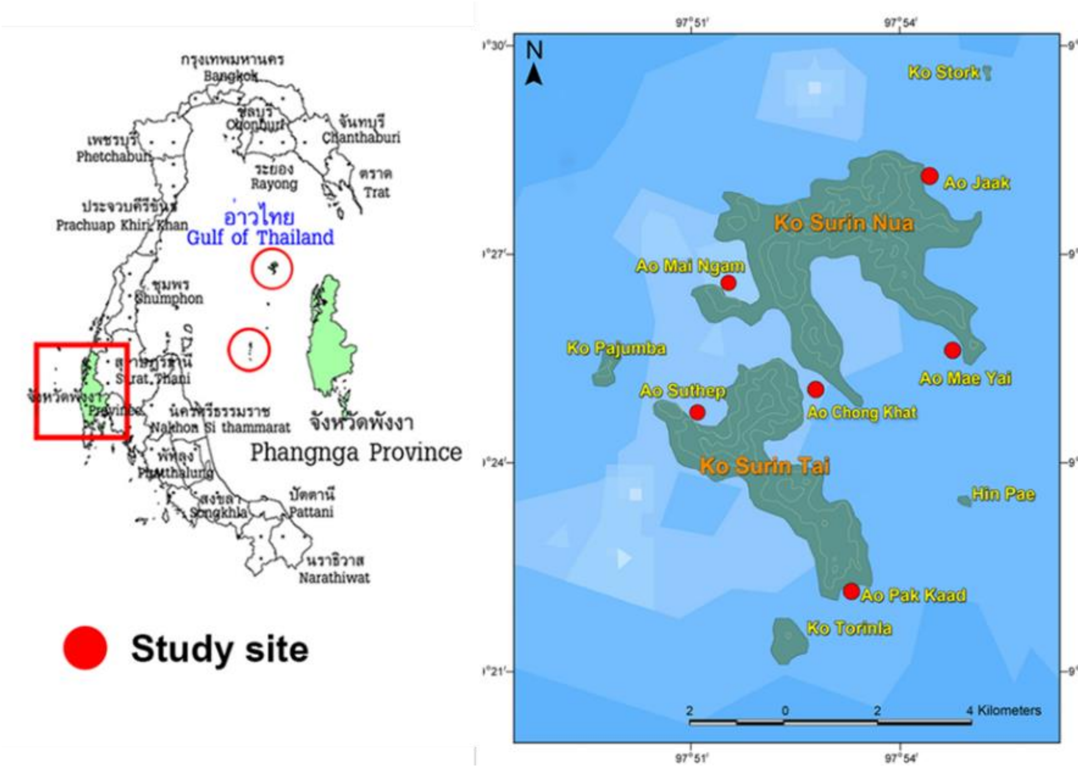


Figure 1. The study sites at Mu Ko Surin National Park

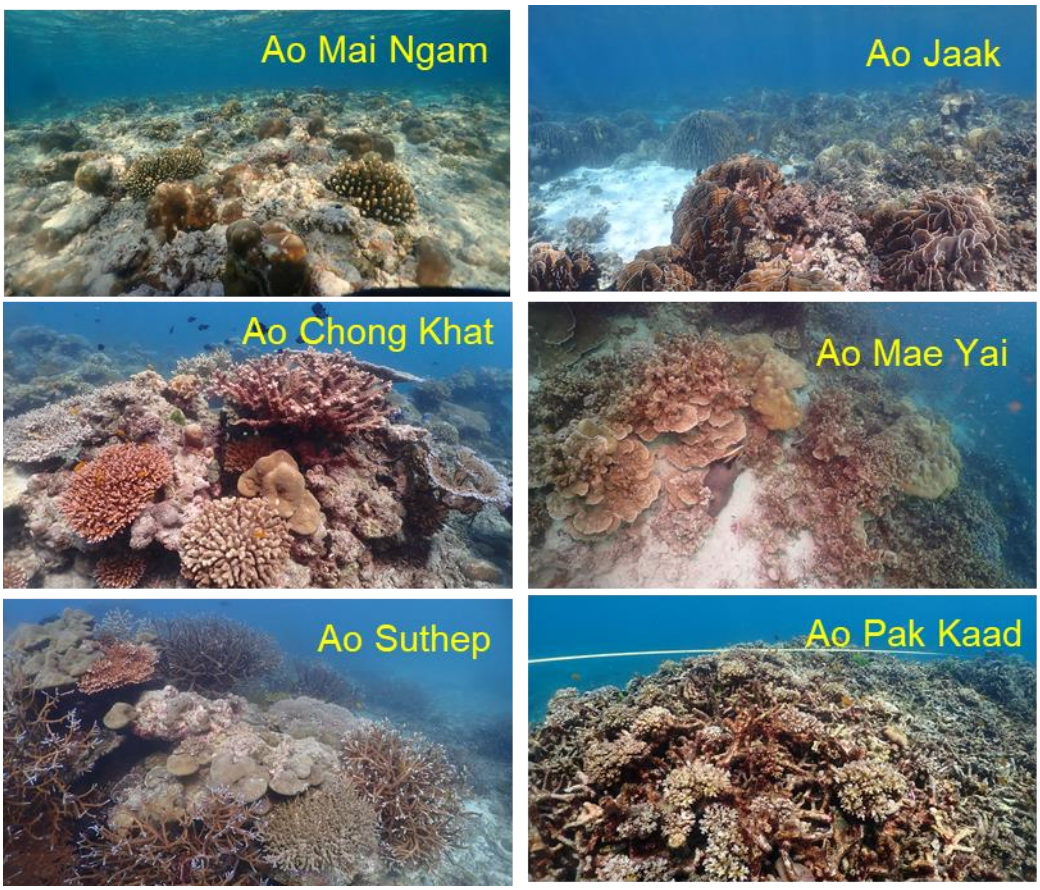


Figure 2. Coral reefs at each study site in Mo Ko Surin National Park

3. Results

The results showed the total meiofauna density at the study sites (Figure 3). Ao Mai Ngam showed the highest density of meiofauna, which was about 77.45±5.47 individuals/10 cm^2. and it was significantly different compared with Ao Pak Kaad, Ao Jaak and Ao Suthep. The high densities of meiofauna were found at Ao Mai Ngam, Ao Chong Khat, and Ao Mae Yai which are located in the shelter areas. However, Ao Suthep had the lowest density of meiofauna (40.09 individuals/ 10 cm^2).

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).

Seventeen meiofauna groups were found at the study sites (Figures 4 and 5). The major groups of meiofauna were Foraminifera, Nematoda, Polychaeta, and Copepoda and those were found at all study sites. The other groups of meiofauna were Turbellaria, Nemertea, Ostracoda, Amphipoda, Ciliophora, Oligochaeta, Tardigrada, Isopoda, Gastropoda, Scaphopoda, Bivalvia, Echinoidea and Sipuncula.

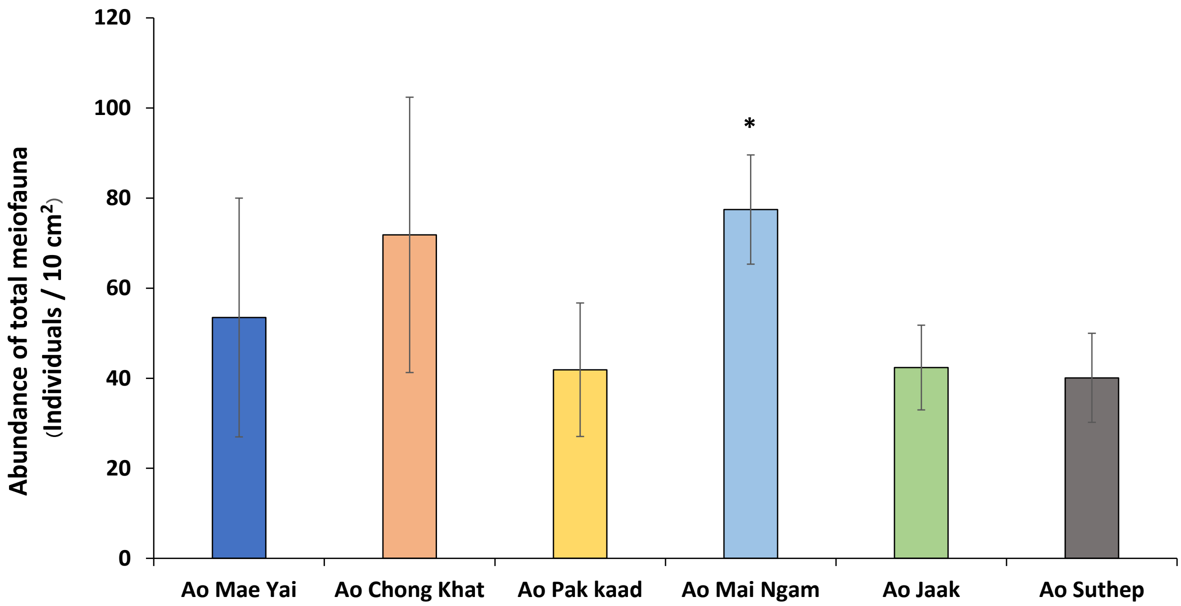


Figure 3. Total densities of meiofauna from coral reefs at the study sites

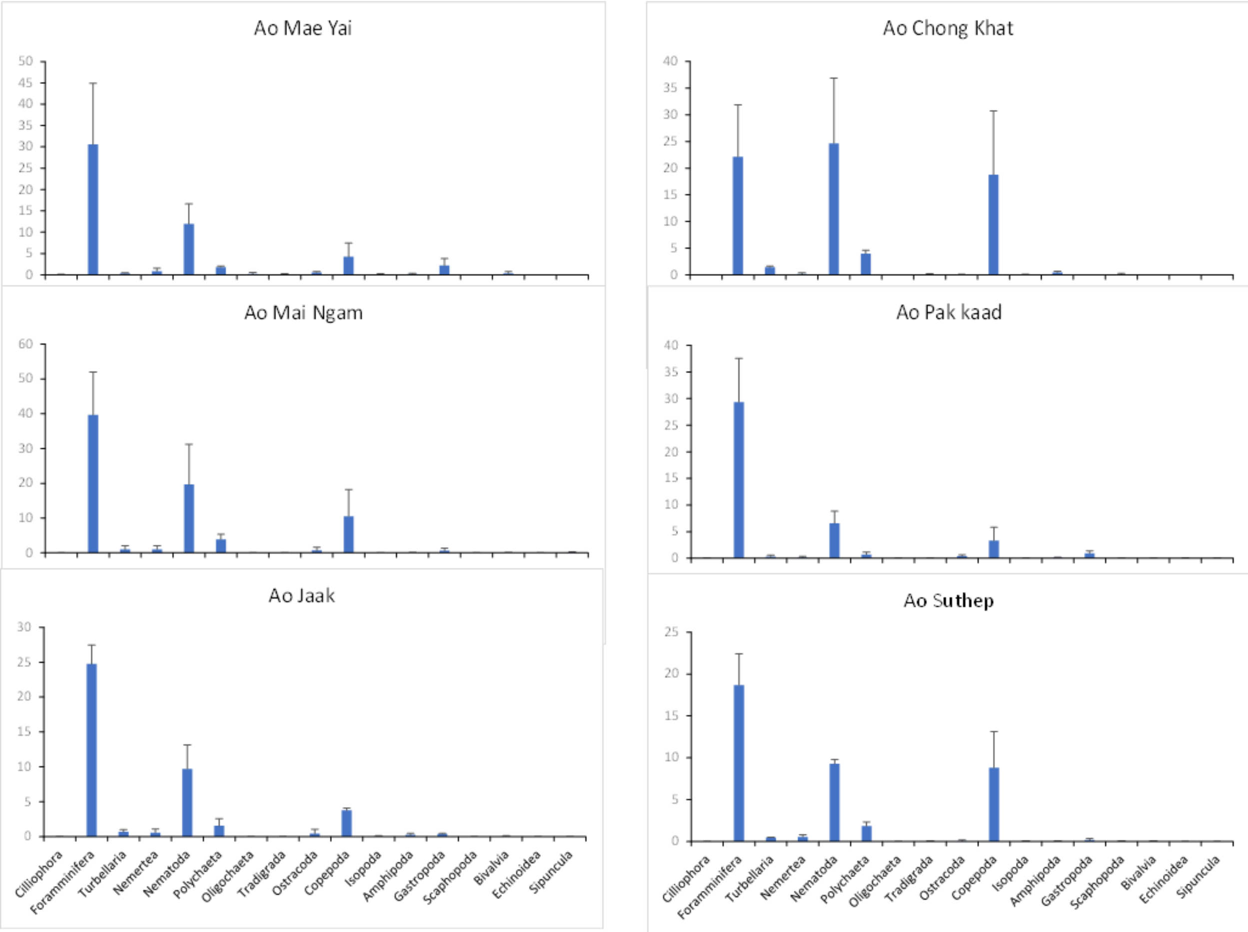
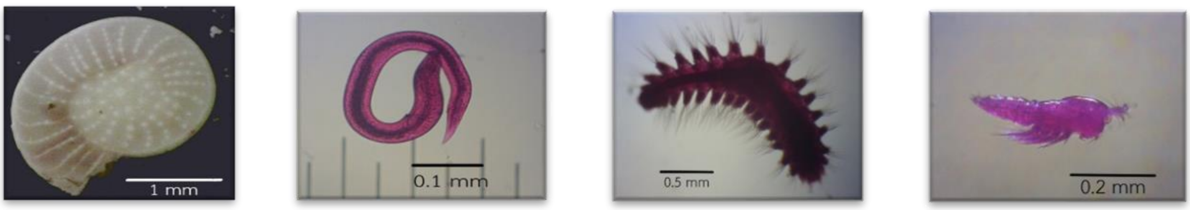


Figure 4. Total densities and abundance of meiofauna from coral reefs at the study sites



Foraminifera Nematoda Polychaeta Copepoda

Figure 5. The major group of meiofauna were found at the study sites

The percentages of live coral and dead coral cover at the study sites were shown in Figure 6. The percentage of live coral cover was higher than dead coral cover at all study sites. Live coral and the dead coral cover ratio at Ao Mae Yai and Ao Chong Khat were significantly higher than that of the other study sites.

Correlations between the abundance of total meiofauna and live coral and dead coral cover ratio were shown in Figures 7 and 8. A positive correlation between total meiofauna density and the ratio of live coral per dead coral cover was found. Among seventeen meiofauna groups, a positive significant correlation was observed between the ratio of live coral and dead coral cover and Copepoda, Nematoda, and Turbellaria.

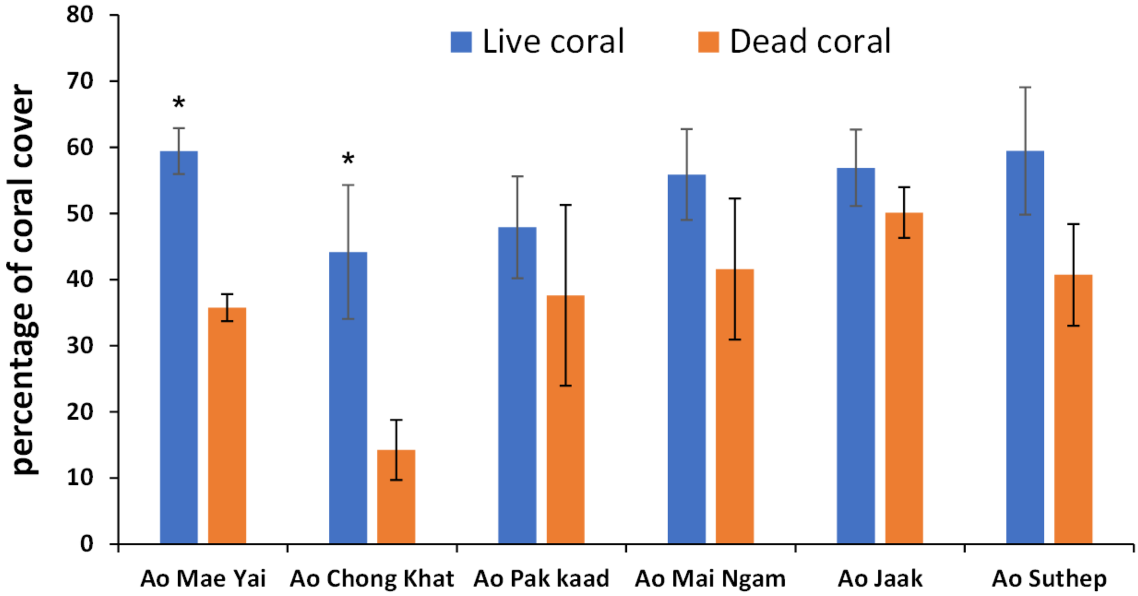


Figure 6. Percentage of live coral and dead coral cover at the study sites.

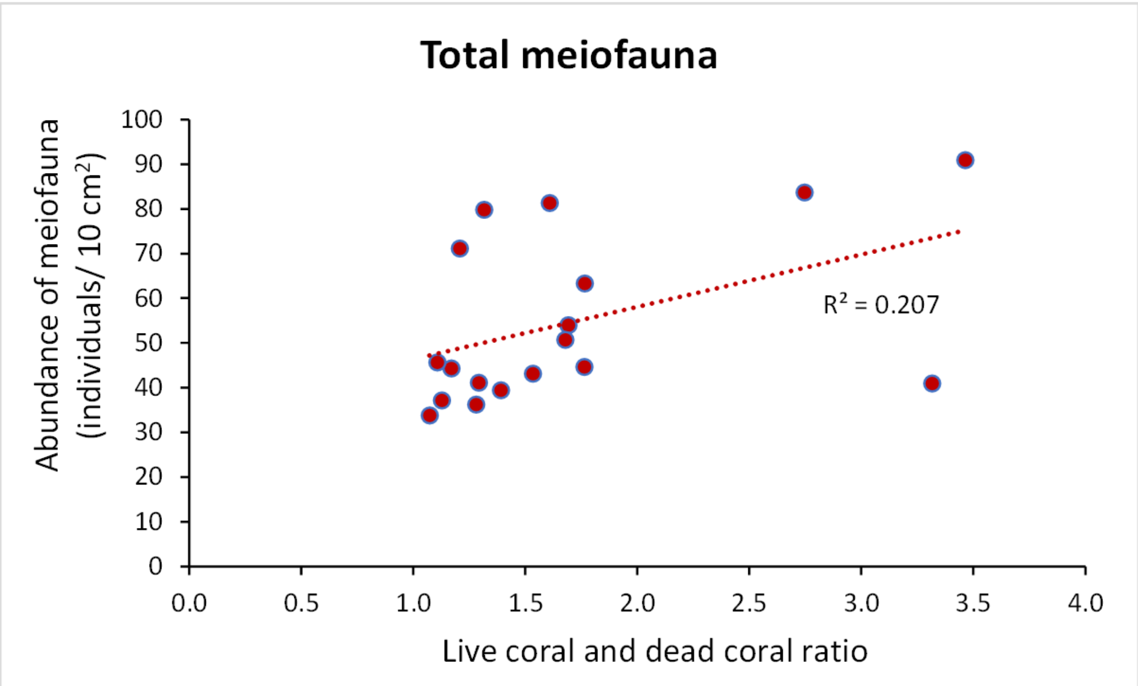


Figure 7. Correlations between the abundance of total meiofauna and live coral and dead coral cover ratio.

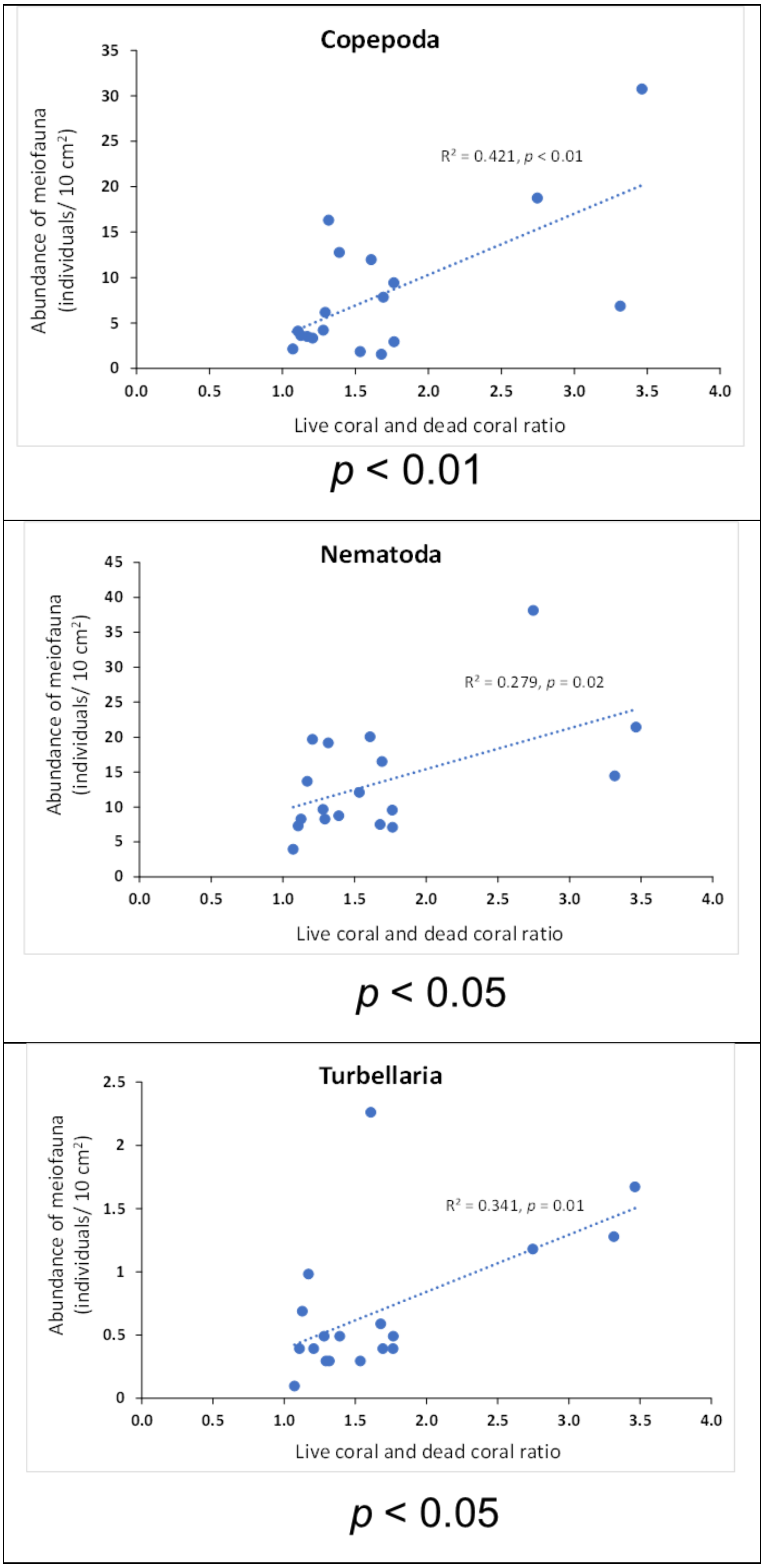


Figure 8. A positive significant correlation was observed between the ratio of live coral and dead coral cover and Copepoda, Nematoda, and Turbellaria.

4. Discussion

Based on the findings, seventeen meiofauna taxa were found at Mo Ko Surin National Park and the average meiofauna density varied among study sites. The habitat types in the reef slopes of the Maldivian archipelago (Indian Ocean), affected by different hydrodynamic conditions, influence community structure and diversity of meiofauna (Semprucci et al., 2019). Meiofauna can also be used as a bioindicator for detecting environmental changes. Some studies revealed that major meiofauna groups, such as polychaetes, harpacticoid copepods and nematodes on a coral reef in Brazil showed divergent responses to the various predicted climate change scenarios in reductions of seawater, pH and increased temperature (Sarmento et al., 2017). The several benefits of polychaetes have been reported as an indicator of organic matter in marine sediments, feeding aquatic animals, and lead to reproduced broodstocks in shrimp and fish (Giangrande et al. 2005; Meunpol et al. 2005; Palmer et al. 2014; Nederlof et al. 2019).

A study in shallow-reef lagoon ecosystem on the Great Barrier Reef, Australia showed a novel vision in coral reef trophodynamics between surface-sediment meiofauna and deposit-feeding sea cucumbers and community shifts in a future ocean with significance for the functioning of coral reefs from the bottom up (Wolfe et al., 2021). Our results suggest that the meiofauna communities can play a major role in coral reef ecosystems, and they may be gradually changing in total population densities and their composition which may affect the coral reef food webs.

Acknowledgments
This study was funded by a budget for research promotion from the Thai Government awarded to Ramkhamhaeng University. We are most grateful to the staffs of Department of National Parks, Wildlife, and Plant Conservation and the staffs of the Marine Biodiversity Research Group (MBRG), Faculty of Science, Ramkhamhaeng University for their field work assistance.

References

Coull, BC (1999) Role of meiofauna in estuarine soft-bottom habitats. Austral Ecol 24: 327-343.

Cui C, Zhang Z, Hua E (2021) Meiofaunal Community Spatial Distribution and Diversity as Indicators of Ecological Quality in the Bohai Sea, China. J Ocean Univ China 20(2): 409-420. https://doi.org/10.1007/s11802-021-4550-5

Dezfouli TT, Nabavi SMB, Ghatromi ER, Sajjadi N (2016) Study on the meiofauna community structure in Sajafi shores as the bio-indicator of environmental pollution. Open J Ecol 6(10): 632-644. https://doi.org/10.4236/oje.2016.610059

De Troch M, Raes M, Muthumbi A, Gheerardyn H, Vanreusel A (2008) Spatial diversity of nematode and copepod genera of the coral degradation zone along the Kenyan coast, including a test for the use of higher-taxon surrogacy. African J Mar Sci 30: 25-33

Donsomjit W, Sutthacheep M, Yeemin T (2013) Meiofauna associated with degraded coral reefs at Ko Tao, the Gulf of Thailand. In: Proceedings of 39th Congress on Science and Technology of Thailand. 4pp.

Donsomjit W, Yeemin T, Sutthacheep M, Jaiharn S, Niemsiri R (2015) Composition and abundance of meiofauna from coral communities in the Eastern Gulf of Thailand. Proceedings of the 41st Congress on Science and Technology of Thailand (STT41). 480-484 p.

English S., Wilkinson C. and Baker V. (1997) Survey manual for Tropical marine resources. 2nd edition. Australian Institute of Marine Science, 390 pp.

Giangrande A,Licciano M, Musco L (2005). Polychaetes as environmental indicators revisited. Mar Poll Bull 50:1153-1162

Meunpol O, Meejing P, Piyatiratitivorakul S (2005) Maturation diet based on fatty acid ontent for male Penaeus monodon

(Fabricius) broodstock. Aquac Res 6(12):1216-1225
Nabavi SMB (2013) Meiobenthos in the ROMPE Sea Area. Technical Report Series, Ropme Oceanographic Cruise.
Nederlof MAJ, Jansen HM, Dahlgren TG, Fang J, Meier S, Strand O, Sveier H, Verdegem MCJ, Smaal C (2019) Aquac Environ Interact 11: 221-237
Palmer PJ, Wang S, Houlihan A, Brock I (2014). Nutritional status of a nereidid polychaete cultured in sand filters of mariculture wastewater. Aquac Nutr 20(6): 675-691.
Ruknawee S, Yeemin, T, Sutthacheep M, True J, Piromvaragorn S, Klinthong W, Sangmanee K, Samsuvan W (2014) Meiofauna in coral communities from Krabi Province, Thailand and Mergui Archipelago, Myanmar. In: Proceedings of the 40th Congress on Science and Technology of Thailand (STT40). 855 – 859 p.
Reaka-Kudla M (1997) The global biodiversity of coral reefs: a comparison with rainforests. In: Reaka-Kudla M, Wilson DE, Wilson EO (eds) Biodiversity II: understanding and protecting our biological resources. Joseph Henry Press, pp 83–108
Sarmento VC, Pinheiro BR, Montes MdJF, Santos PJP (2017) Impact of predicted climate change scenarios on a coral reef meiofauna community. ICES J Mar Sci 74: 1170-1179. https://doi.org/10.1093/icesjms/fsw234
Semprucci F, Gravina MF, Magni P (2019) Meiofaunal dynamics and heterogeneity along salinity and trophic gradients in a Mediterranean transitional system. Water 11(7). https://doi.org/10.3390/w11071488
Service SK, Feller, RJ, Coull BC, Woods R (1992) Predation effect of three fish species and a shrimp on macrobenthos and meiobenthos in microcosms. Estuar Coast Shelf Sci 34(3): 277-293
Wolfe K, Kenyon TM, Mumby PJ (2021) The biology and ecology of coral rubble and implications for the future of coral reefs. Coral Reefs 40(6): 1769-1806. https://doi.org/10.1007/s00338-021-02185-9