

COMPARATIVE STUDY OF MACROFAUNAL ASSEMBLAGES IN CORAL REEF AND SEAGRASS HABITATS USING SINGLE-EVENT LIGHT TRAP SAMPLING

¹Myung-Hwa Shin, ²Viera-Aimma Ragie, ¹Sang-Hui Lee,
¹Chi-Hyeon Kim and ^{2,3,*}Azman BAR

¹National Marine Biodiversity Institute of Korea, Seocheon, 325–902, South Korea.

²Department of Earth Sciences and Environment, Faculty of Science & Technology,
Universiti Kebangsaan Malaysia. Bangi, 43600, Malaysia.

³Marine Ecosystem Research Centre (EKOMAR), Faculty of Science & Technology,
Universiti Kebangsaan Malaysia. Bangi, 43600, Malaysia.

*Corresponding Author

DOI: <https://doi.org/10.51193/IJAER.2026.12304>

Received: 02 May 2026 / Accepted: 13 May 2026 / Published: 22 May 2026

ABSTRACT

While coral reefs and seagrass beds are recognized as ecologically significant shallow-water habitats, the extent of interaction or spatial distinction between their macrofaunal communities remains insufficiently understood. Given the nocturnal emergence patterns of many taxa, this study utilized light trap sampling to characterize assemblages across these two habitat types in the coastal waters of Perhentian Island, Malaysia. Specimens were identified to major taxonomic groups and evaluated for total abundance (ind. trap⁻¹ h⁻¹), community composition, and diversity indices, including Shannon–Wiener (H') and Simpson's (1–D) indices. Results indicated that macrofaunal abundance was markedly higher in seagrass habitats (3,952 individuals) than in coral reefs (798 individuals). Seagrass beds supported 25 distinct taxa, while 17 were recorded in the coral reef environment. Although brachyuran larvae were the dominant group across both habitats, accounting for 65% of the total catch, significant community shifts were observed. In seagrass, the assemblage was strongly skewed toward brachyuran larvae (71%), whereas coral reef assemblages demonstrated a more balanced structure dominated by Copepoda (49%). Consequently, coral reef assemblages exhibited greater diversity ($H' = 1.83$) and evenness (1–D = 0.678) than those in seagrass beds ($H' = 1.29$; 1–D = 0.445), where the community was dominated by specific larval forms. Occurrence-based analysis revealed a minimal taxonomic overlap of 0.18%, consisting predominantly of shared brachyuran larvae. These findings emphasize the influence of habitat

architecture and the specialized utility of light trap methodology for capturing nocturnal macrofaunal dynamics. This study provides an essential exploratory baseline for habitat-associated variability and supports the development of future multi-seasonal biodiversity monitoring and conservation strategies for the Perhentian Island marine ecosystem.

Keywords: Macrofauna, light-trap, Seagrass, Coral reefs, Perhentian Island, Malaysia

INTRODUCTION

In tropical marine environments, coral reefs and seagrass beds represent two of the most biologically productive and ecologically important shallow-water habitats. Both systems support diverse macrofauna assemblages and play a critical role in sustaining coastal biodiversity and ecosystem functioning (Moberg & Folke, 1999; Orth et al., 2006; Duarte, 2002).

Despite their close spatial proximity and potential ecological connectivity, the extent of overlap in macrofaunal communities between these habitats remains poorly understood, particularly for species exhibiting nocturnally active patterns (Nagelkerken et al., 2000). Many macrofaunal organisms display pronounced diel behavioural patterns, emerging into the water column during nocturnal periods. This behaviour complicates detection using conventional sampling approaches and may result in their underrepresentation and underestimation in biodiversity assessments (Guest et al., 2015; Robertson et al., 2017).

To address these challenges, light trap sampling has been demonstrated to be an efficient method for capturing nocturnally active and planktonic life stages of benthic-associated assemblages, thereby providing valuable insights into community composition that are otherwise challenging to obtain (McLeod & Costello, 2017; Sigurdsson et al., 2014). Although previous studies have examined macrofaunal and zooplankton assemblages in these waters (e.g., Gan et al., 2010; Jeffrey & Rahim, 2024; Azwa-Liza et al., 2025; Shafie et al., 2021), comparative research employing light trap methodologies across various habitat types remains limited, particularly within tropical regions. Understanding differences in macrofaunal assemblages between structurally complex coral reefs and comparatively uniform seagrass beds is essential for elucidating patterns of habitat utilisation, larval dispersal, and ecosystem connectivity (Gan et al., 2010).

This study aimed to provide an exploratory comparison of macrofaunal communities between coral reef and seagrass habitats using single-event light trap sampling in the waters of Perhentian Island. By evaluating differences in abundance, taxonomic composition, and diversity indices, this study sought to address a critical gap in the biodiversity inventory of nocturnal macrofaunal assemblages and to advance understanding of habitat-related variability in tropical coastal ecosystems. Such knowledge is fundamental for informing biodiversity monitoring, conservation planning, and sustainable marine resources management.

METHODOLOGY

Study Area

Sampling was conducted in the coastal waters of Perhentian Island, Malaysia, encompassing both coral reef and adjacent seagrass habitats. Two sites were selected: (1) coral reef area ($5^{\circ} 55' 2.48''\text{N}$, $102^{\circ} 42' 56.5''\text{E}$) at a depth of 9.7 m, and (2) seagrass beds ($5^{\circ} 55' 2.2''\text{N}$, $102^{\circ} 42' 56.5''\text{E}$) at a depth of 7.3 m. The spatial distribution of sampling sites was presented in Figure 1.

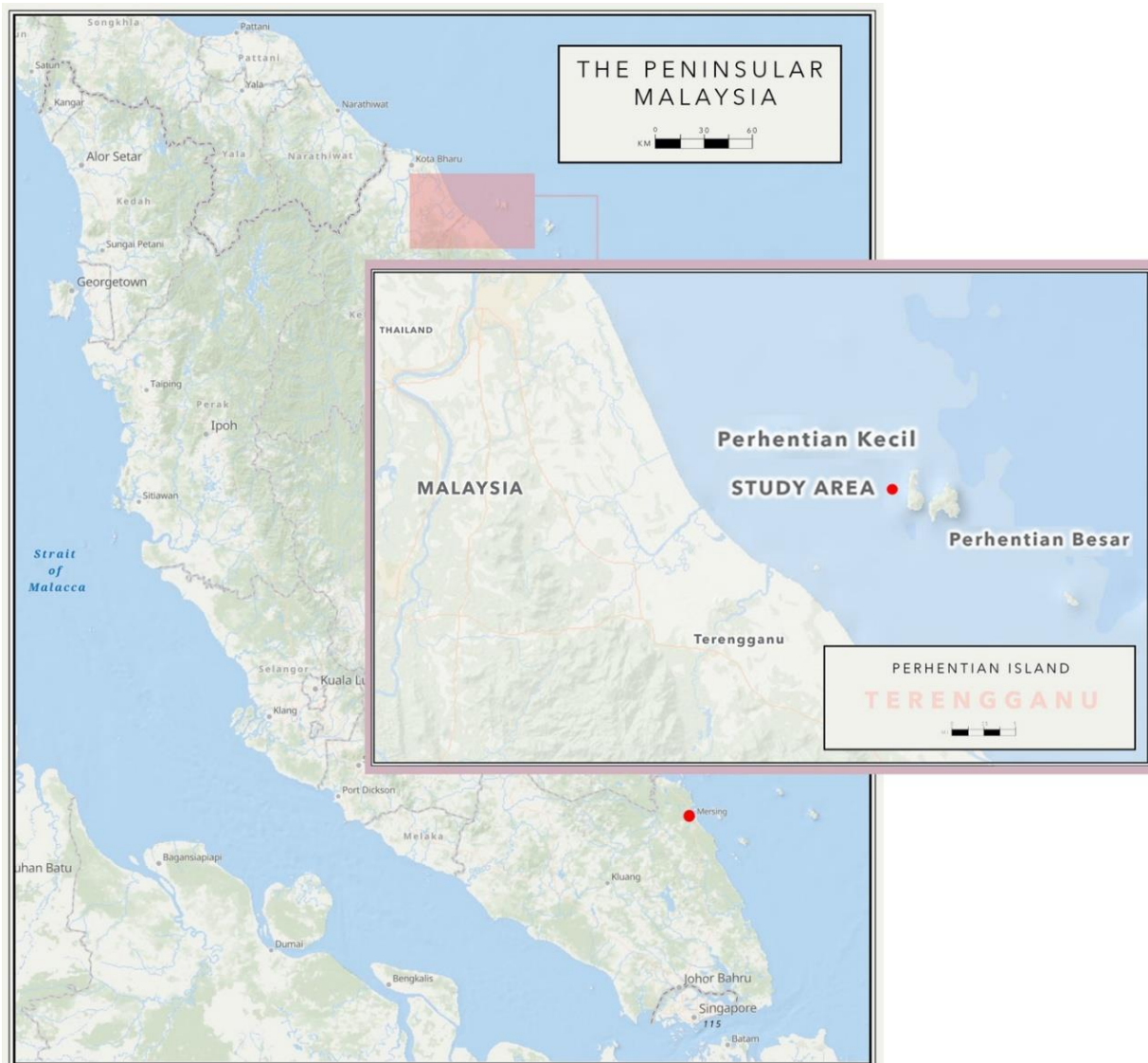


Figure 1: Study site location. The red indicator denotes the specific sampling/observation point within the Perhentian archipelago off the northeast coast of Peninsular Malaysia.

Sampling Design

Nocturnal macrofaunal assemblages were sampled using light traps deployed after sunset to coincide with peak emergence periods. While this study utilizes a single-event sampling design to provide an exploratory baseline, effort was strictly standardized across habitats to ensure comparative validity of the resulting nocturnal snapshots.

The light trap comprised a cylindrical chamber (approximately 41 cm height; 11.5 cm diameter) with a total volume of 4 L. The upper section incorporated a funnel-shaped inlet to channel organisms into the collection chamber while minimising escape. A centrally positioned submersible light source within the trap, with an intensity of 1,200 lumens, attracted phototactic organisms. The lower compartment functioned as the collection chamber (Figure 2A).

Light traps were deployed in situ for a standardised duration. Phototactic organisms attracted to the light source were funnelled into the collection chamber and retained until retrieval. An example of the deployed equipment was shown in Figure 2B (the light trap in action).

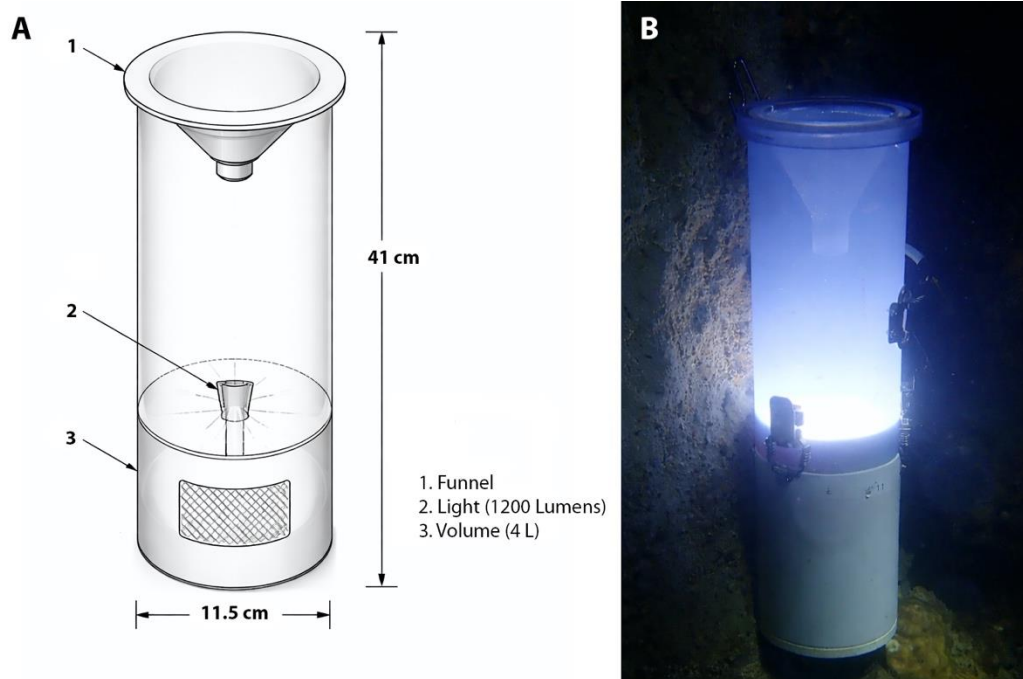


Figure 2: Diagram of the light trap used in the study. (Right) Schematic illustration of the device highlighting key components: (1) funnel entrance, (2) central light source (1200 lumens), and (3) collection chamber with a volume of 4 L. The apparatus measures 41 cm in height and 11.5 cm in diameter. (Left) In situ photograph showing the cylindrical light-trap operating underwater at night at a depth of 7–10 m, emitting a high-intensity light source to attract organisms.

Sample Collection and Processing

Upon retrieval, specimens were preserved and transported to the laboratory for analysis. All specimens were sorted and identified to major taxonomic groups using standard identification guides. Owing to the high specimen abundance, identification was conducted at higher taxonomic resolution rather than at species-level classification.

Data Analysis

Macrofaunal assemblages were quantified based on total abundance, standardised as individuals per trap per hour (ind. trap⁻¹ h⁻¹). Community composition between habitats was assessed based on the relative abundance of each taxonomic group.

Diversity was assessed indices, as follows:

Species richness (S) represents the total number of taxa recorded. Shannon–Wiener diversity index (H') reflects community diversity. Simpson's index (1–D) indicates evenness and dominance patterns. Occurrence data were further examined to evaluate the degree of taxonomic overlap between coral reef and seagrass habitats.

Statistical Comparison

Comparative analyses were conducted to evaluate differences in abundance, taxonomic composition, and diversity indices between coral reef and seagrass habitats, thereby elucidating habitat-related variation in nocturnal macrofaunal assemblages.

RESULTS & DISCUSSION

A total of 798 individuals across 17 taxa were recorded in the coral reef habitat, whereas the seagrass habitat yielded 3,952 individuals across 25 taxa (Figure 3). Despite differences in taxonomic richness, Crustacea overwhelmingly dominated both macrofaunal assemblages, accounting for 93.11% in the coral reef and 98.99% in the seagrass habitats. In contrast, Cnidaria were recorded exclusively in coral reef habitat (5.01%) and were absent from seagrass habitat, while Annelida constituted a minor component in both habitats (1.88% in coral reef; 1.01% in seagrass). The pronounced dominance of crustaceans likely reflects their ecological versatility, mobility, and high adaptability, allowing them to exploit diverse microhabitats and trophic resources.

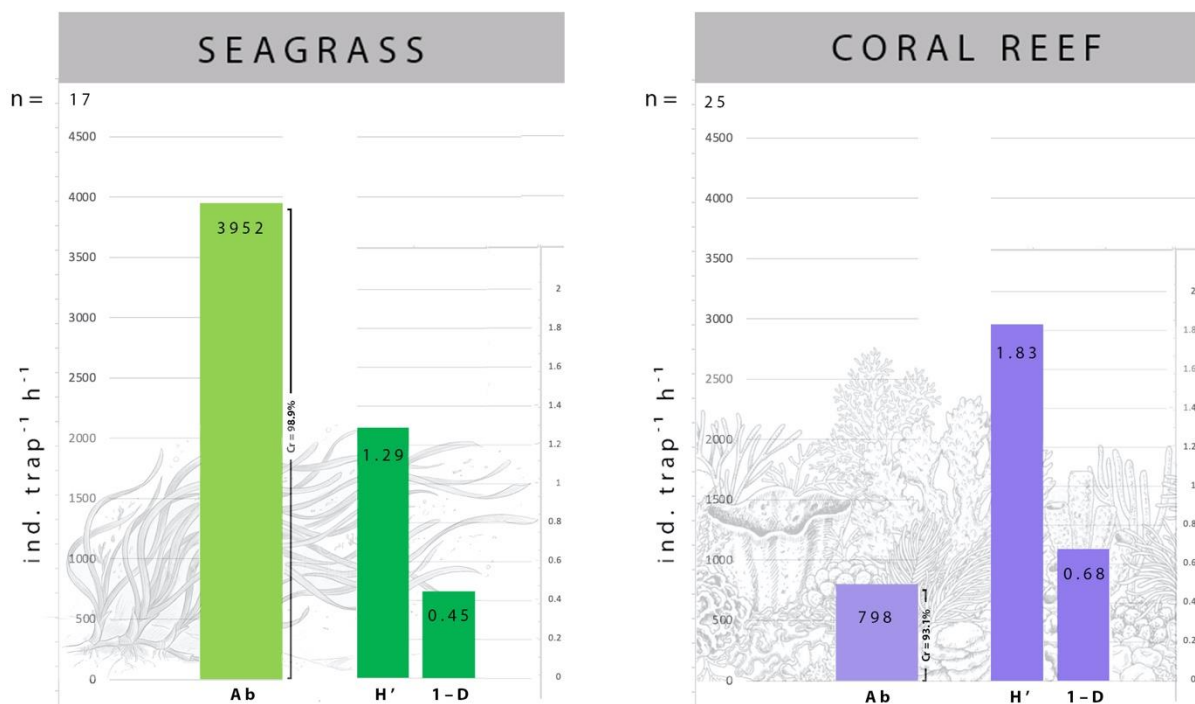


Figure 3: Differences in macrofaunal community structure between seagrass and coral reef habitats, based on abundance (Ab), major group of taxonomic composition (n), diversity indices (H' and 1-D) and percentage of Crustacea (Cr)

The Shannon–Wiener diversity index was higher in the coral reef ($H' = 1.83$) than in the seagrass habitat ($H' = 1.29$), indicating greater species diversity and richness. Simpson’s index further revealed higher dominance in the coral reef community ($1-D = 0.76$) relative to the seagrass habitat ($1-D = 0.49$), suggesting that the community skewed towards fewer highly abundant taxa in the coral reef. The coral reef assemblage exhibited higher taxonomic diversity and greater dominance effect, whereas the seagrass assemblage, despite its lower taxonomic diversity, exhibited a more even distribution among taxa.

The near-exclusive dominance observed in seagrass habitats—specifically brachyuran larvae—is likely attributable to the structural complexity of the meadow, which provides essential refuge and nursery grounds. However, it is significant to acknowledge that the overwhelming prevalence of certain groups, such as brachyuran larvae in seagrass (71%) and Copepoda in coral reefs (49%), may also reflect phototactic bias inherent to the light trap methodology. Conversely, the restriction of cnidarians to coral reef environments aligns with their dependence on hard substrates and stable environmental conditions for attachment and growth. The relatively low representation of annelids in both habitats may reflect either limited sampling efficiency for infaunal taxa or competitive exclusion by more dominant groups. These patterns indicate distinct habitat-specific variation in

macrofaunal assemblage composition, influenced by substrate characteristics, habitat complexity, and ecological specialisation.

Crustacean assemblage composition differed markedly between seagrass and coral reef habitats when evaluated based on relative abundance (Figure 4). In the seagrass habitat, the assemblage was overwhelmingly dominated by brachyuran larvae, accounting for approximately 71% of the total abundance. Secondary contributors comprised Decapoda and Mysida (~7% each), followed by Isopoda (~5%), Cumacea and Ostracoda (~4% each), and Amphipoda (~2%), while Stomatopoda contributed negligibly (<1%). In contrast, coral reef assemblages exhibited a comparatively more balanced taxonomic structure, with Copepoda comprising the largest proportion (~49%) of total abundance, followed by brachyuran larvae (~30%), and Amphipoda (~12%). The remaining taxa, including Decapoda (~3%), Ostracoda (~2%), Isopoda (~2%), Mysida (~1%), and Cumacea (~1%), contributed only minor proportions, whereas Stomatopoda were absent. These compositional patterns demonstrate clear habitat-specific structuring of crustacean assemblages, characterised by a marked shift from brachyuran larval dominance in seagrass habitats to copepod dominance in coral reef habitats, alongside greater taxonomic evenness among minor taxa in reef-associated assemblages.

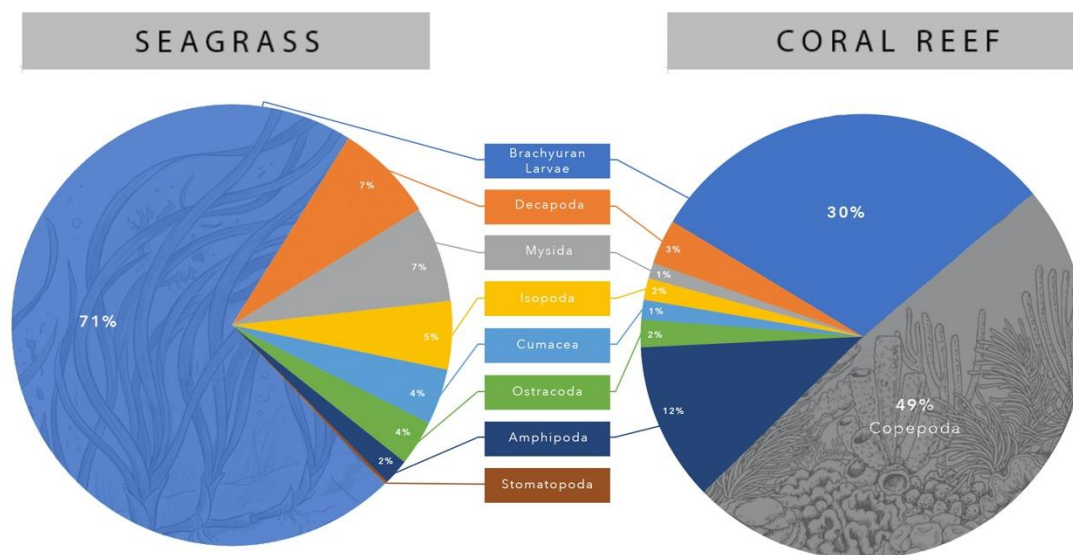


Figure 4: Relative composition (%) of major crustacean groups in seagrass and coral reef habitats based on trap catches (ind. trap⁻¹ h⁻¹). Pie charts illustrate the proportional contribution of each taxonomic group to total abundance within each habitat.

In the seagrass habitat, brachyuran larvae were overwhelmingly dominant, with 2782 individuals recorded. Additional crustacean groups included cumaceans (160 individuals), ostracods (130 individuals), isopods (150 individuals), and mysids (230 individuals). Amphipods, represented by several families, occurred at relatively low abundances relative to the dominant taxa (see Fig 5).

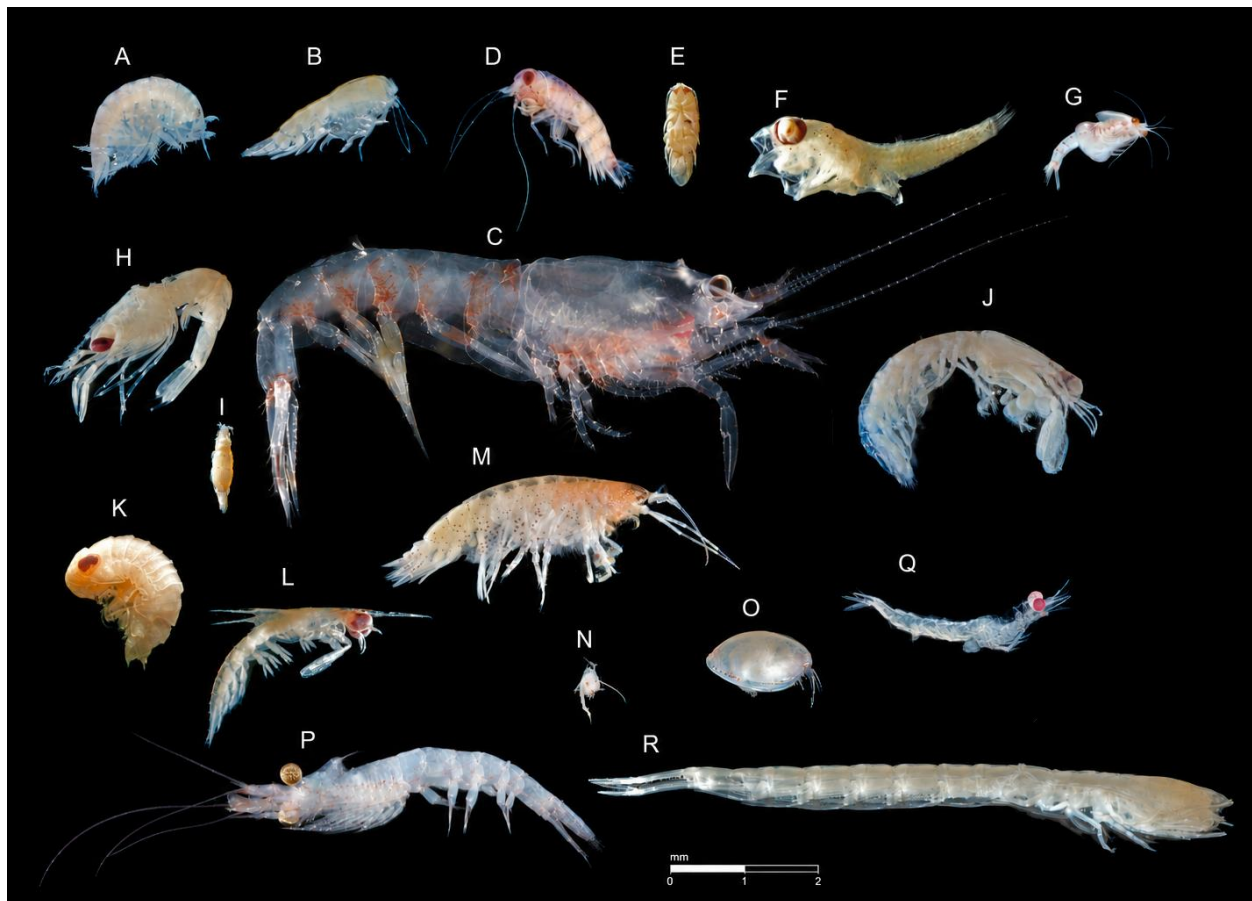


Figure 5: Representative macrofauna collected from seagrass light trap. Specimens illustrate the diversity of crustaceans and other taxa commonly encountered, including: A. Amphipoda (Urothoidae), B. Amphipoda (Ampeliscidae), C. Decapoda, D. Amphipoda (Dexaminidae), E. Isopoda, F. Fish larva, G. Mysida, H. Decapoda, I. Isopoda, J. Stomatopoda, K. Isopoda, L. Decapoda, M. Amphipoda (Ampeliscidae), N. Brachyuran larva, O. Ostracoda, P. Mysida, Q. Mysida, R. Cumacea

In the coral reef habitat, the assemblage was dominated by copepods (342 individuals), followed by brachyuran larvae (212 individuals) and amphipods. Other taxa, including alpheids (27 individuals), decapods (23 individuals), and carideans (15 individuals), occurred in lower abundances (See Fig 6).



Figure 6: Selected macrofaunal taxa obtained from coral reef light trap collections. The specimens illustrate the range of crustaceans and associated organisms present, including: A. Amphipoda (Urothoidae), B. Zoea, C. Alpheid, D. Amphipoda (Amphilochidae), E. Copepoda, F. Cumacea, G. Polychaete, H. Caridea, I. Crab, J. Mysida

These results indicated clear habitat-specific structuring of crustacean assemblage, with seagrass habitat supporting higher overall abundances of most major groups, whereas coral reefs harboured distinct assemblages characterised by relatively higher copepod densities. Overall, the coral reef assemblage exhibited a more even distribution among taxa, whereas the seagrass assemblage was strongly skewed towards a limited number of highly abundant taxa, particularly larval forms. The high abundance of these specific life stages is influenced not only by habitat productivity but also by the strong positive phototaxis exhibited by active, planktonic swimmers during nocturnal emergence. This selectivity suggests that while light traps are efficient for capturing mobile, light-

attracted assemblages, they may simultaneously underrepresent cryptic, sessile, or non-phototactic taxa within the same environment. Consequently, the observed abundance patterns highlight the intersection between actual habitat density and the differential catchability of various taxonomic groups.

CONCLUSION

This study provided baseline insights into nocturnal macrofaunal assemblages within the coral reef and seagrass habitats of Perhentian Island, revealing both variations and shared patterns in community structure. Crustacea overwhelmingly dominated both habitats, while Cnidaria were confined to coral reefs, and Annelida remained minor components. In terms of differences, seagrass habitats supported substantially higher macrofaunal abundance, whereas coral reef habitats exhibited taxonomic richness. These variations in taxonomic composition and diversity indices, as reflected by the Shannon–Wiener and Simpson’s indices, highlighted habitat-specific patterns influenced by structural complexity and ecological specialisation. It is significant to acknowledge that the employment of single-event light trap sampling may introduce methodological biases in terms of relative abundances and the presence of certain taxa, particularly cryptic or less mobile species. Nevertheless, the observed patterns emphasised the importance of integrating species richness, abundance variation, composition, and diversity indices in evaluating nocturnal macrofaunal dynamics. Future monitoring programs should prioritize replicated, multi-seasonal sampling and species-level identification to resolve the finer ecological dynamics and habitat-specific complexities of Perhentian Island’s nocturnal biodiversity.

ACKNOWLEDGEMENTS

This work was supported by a grant from the National Marine Biodiversity Institute of Korea (Grant No. 2024I00600). A special thanks to Ivan See (YBD Reef Adventures), as well as the staff and dive team at Marriott Perhentian for their essential field-work assistance. Finally, we wish to acknowledge the reviewers whose constructive feed-back significantly improved the quality of this manuscript.

AUTHOR CONTRIBUTIONS

Myung-Hwa Shin: conceived and designed the study, field sampling, analysed the data, conceived and designed the study, analysed the data, authored and reviewed drafts of the paper.

Viera-Aimma Ragie: analysed the data, prepared figures, authored and reviewed drafts of the paper.

Sang-Hui Lee: field sampling, analysed the data, prepared figures, authored and reviewed drafts of the paper.

Chi-Hyeon Kim: field sampling, analysed the data, prepared figures, authored and reviewed drafts of the paper.

Azman BAR: conceived and designed the study, field sampling, prepared figures, authored and reviewed drafts of the paper and approved the final draft.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

- [1]. Azwa-Liza, B.Z., Che-Alia, Syakila B.C.S., Azman, B.A.R. (2025). Day-night composition, abundance and distribution of zooplankton groups from Mertang Archipelago, Johor, Malaysia. *Species* 26: e34s3161. DOI: <https://doi.org/10.54905/diss.v26i78.e34s3161>
- [2]. Duarte, C. M. (2002). The future of seagrass meadows. *Environmental Conservation*, 29(2), 192–206.
- [3]. G.M. Sigurdsson, B. Morse, R. Rochette. 2014. Light traps as a tool to sample pelagic larvae of American lobster (*Homarus americanus*). *J. Crustac. Biol.*, 34, pp. 182-188, <https://doi.org/10.1163/1937240X-00002219>
- [4]. Gan, S.Y., Azman, B.A.R., Yoshida, T., Majid, A.M., Toda, T., Takahashi, K., Othman, B.H.R. (2010). Comparison of day and night mysid assemblages in a seagrass bed by using emergence traps, with key to species occurring at Pulau Tinggi Malaysia. *Coas Mar Sci*; 34(1):74–81
- [5]. Guest, J. R., Baird, A. H., Goh, B. P. L., & Chou, L. M. (2015). Multispecies spawning synchrony in corals of Singapore. *Coral Reefs*, 34(3), 759–763.
- [6]. Jeffry, N.E.B., Rahim, A.A. (2024). Zooplankton from the waters of Sri Buat and Sembilang, Pahang, Malaysia. *Species*; 25:e26s1673. <https://doi.org/10.54905/diss.v25i75.e26s1673>
- [7]. L.E. McLeod, M.J. Costello. 2017. Light traps for sampling marine biodiversity. *Helgol. Mar. Res.*, 71, p. 2, <https://doi.org/10.1186/s10152-017-0483-1>
- [8]. Moberg, F., & Folke, C. (1999). Ecological goods and services of coral reef ecosystems. *Ecological Economics*, 29(2), 215–233.
- [9]. Nagelkerken, I., van der Velde, G., Gorissen, M. W., Meijer, G. J., van 't Hof, T., & den Hartog, C. (2000). Importance of mangroves, seagrass beds and coral reefs as nurseries for important coral reef fishes. *Marine Ecology Progress Series*, 202, 175–192.
- [10]. Orth, R. J., Carruthers, T. J. B., Dennison, W. C., Duarte, C. M., Fourqurean, J. W., Heck, K. L., Jr., Hughes, A. R., Kendrick, G. A., Kenworthy, W. J., Olyarnik, S., Short, F. T., Waycott, M., & Williams, S. L. (2006). A global crisis for seagrass ecosystems.

- BioScience, 56(12), 987–996.
- [11]. Robertson, D. R., Hernández, W. J., & Victor, B. C. (2017). Diel activity patterns of coral reef fishes and the influence of nocturnal emergence on community structure. *Marine Biology*, 164(9), 1–14.
- [12]. Shafie B. B., Man A., Ali N. F. & Rahim A. A. 2021. Macrobenthos diversity along the exclusive economic zone of east coast peninsular Malaysia. *Journal of Environmental Biology* 42 (3):817-823. [https://doi.org/10.22438/JEB/42/3\(SI\)/JEB-13](https://doi.org/10.22438/JEB/42/3(SI)/JEB-13)