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Day-Night Composition, Abundance and Distribution of Zooplankton Groups from Mertang Archipelago, Johor, Malaysia

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ABSTRACT

This study was conducted around the waters of Mertang Archipelago, Johor, Malaysia. This study aims to characterize the composition, abundance, and distribution of various zooplankton groups throughout day and night along the east coast of Peninsular Malaysia. Samples were collected using a 140 µm mesh size plankton net and towed vertically from 6 stations during the inter-monsoon season of 2024. The results indicated that zooplankton taxa were most abundant during the daytime (n=49) compared to night-time (n=41). However, at most locations, except for ST6, zooplankton diversity was generally higher at night than during the day. Copepods are the most abundant group in the study area, making up about 75% of the total zooplankton population during the day and 64% during the night. Additionally, the dominant copepod species recorded during the two periods differed, with *Euterpina* spp. dominating at night and *Parvocalanus* spp. dominating during the day. The variation in the zooplankton diversity index between day and night was minimal across all sites, with the majority of zooplankton taxa exhibiting a significantly greater diversity at night.

Keywords: South China Sea, Zooplankton, Biodiversity, Zooplankton, Mertang Archipelago, Johor.

1. INTRODUCTION

The Mertang Archipelago is situated off the coast of Johor and extends between 8 to 35 nautical miles from Mersing. This group of islands and surrounding waters were gazetted as a Marine Park in 2023 under the Malaysia Fisheries Act 1985. Numerous recent studies have focused on inventories of zooplankton mainly along the east coast waters of Peninsular Malaysia particularly Pahang and Johor (see Gan et al., 2010; Lim et al., 2010; Azman and Melvin, 2011; Lim et al., 2012; Azman and Othman 2013; Chew et al., 2014; Chew et al., 2016; Lim et al., 2019; Tan and Azman, 2017; Tan

and Azman, 2018; Tan et al., 2014; Metillo et al., 2019; Peralta and Yusoff, 2015; Shafie et al., 2023; Jeffry and Rahim, 2024).

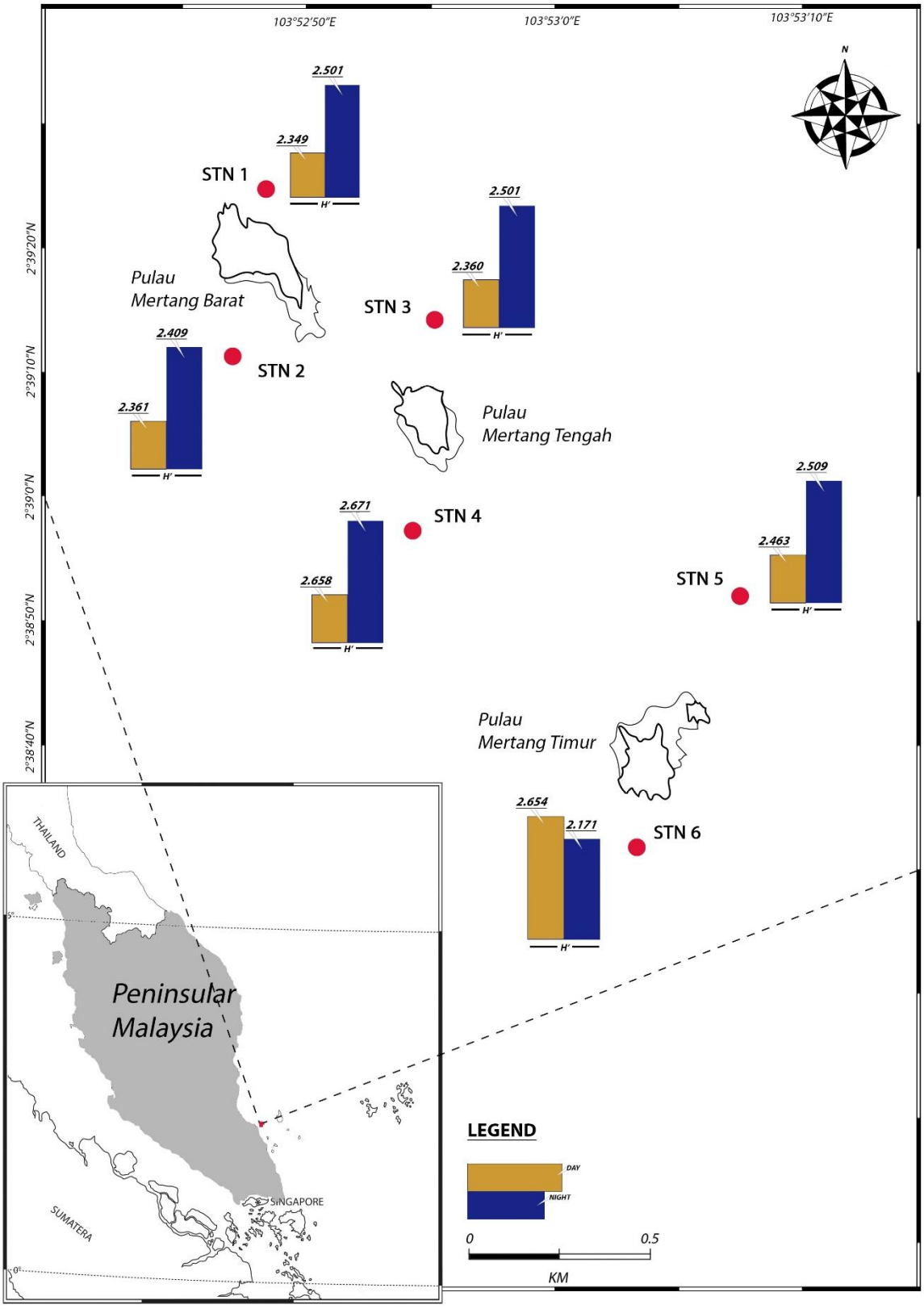

Figure 1. Location of 6 sampling stations in the Mertang Archipelago, Johor, with day and night *H'* values of each station.

Nonetheless, there is currently no data regarding the vertical distribution of zooplankton communities. Zooplankton communities frequently exhibit daily vertical migrations due to factors like avoiding natural ultraviolet light, predation, or variations in food availability. Hence, it is crucial to comprehend the production dynamics of these important coastal zooplankton populations to better understand the impact of a changing ocean climate. Consequently, this study focuses on the initial characterization of zooplankton vertical migration patterns between daytime and night-time in the Mertang Archipelago.

2. METHODOLOGY

Zooplankton samples were collected from six fixed stations around the waters of the Mertang Archipelago, Johor, during the inter-monsoon season of 2024 (Fig. 1). Samples were collected by vertical hauls through the whole water column of a 140 μm mesh plankton net near the sea surface. Immediately after sampling, specimens for morphological examination were fixed in a 10% formalin-seawater solution. Temperature and salinity in the surface water were measured using a multiparameter water quality meter (Aquaread water monitoring system –AP-2000).

Microscopic examination was made in diluted glycerol using stereomicroscopes (OLYMPUS SZ61). For detailed observations, specimens were photographed using an OLYMPUS SZX9 microscope with an attached Canon-M100 for imaging. All materials were lodged at the Universiti Kebangsaan Malaysia Muzium Zoologi (UKMMZ), Malaysia.

3. RESULTS AND DISCUSSION

In most sampling stations, the diversity (H') of zooplankton is greater at night than during the day (Fig. 1). The strongest evidence for this substantial variation may be attributed to the diel vertical migration (DVM) behaviour of numerous zooplankton groups, characterized by ascending to the ocean's surface at night for feeding while evading visual predators during daylight. In addition, ST4 recorded the highest diversity index (H': 2.658 – 2.671), indicating that it likely provides optimal environmental conditions, including stable salinity, temperature, and nutrient availability, broadly consistent with past research (Song et al, 2021; Shafie et al., 2023). Furthermore, the lowest diversity index (H': 2.171) observed at ST6 during the night may suggest an increase in dominating predatory zooplanktons such as chaetognaths and carnivorous copepods.

The present study also demonstrates that daily abundance estimates of zooplankton are typically higher (except for ST4). A survey by Alldredge and King (2009) revealed that the abundance and total biomass of daytime zooplankton, primarily consisting of small copepods and veliger larvae, were observed to be 3 to 8 times greater at surface levels than at midwater or near-bottom depths. Station ST2, ST3, and ST5 exhibited the highest abundance of zooplankton, particularly during daylight hours, indicating that these sites may possess more advantageous environmental conditions such as elevated nutrient concentrations, ideal temperature ranges, or reduced human interference (Fig. 2A). In contrast, ST6 exhibits the lowest overall abundance, recording values of 83.95 ind/m^3 during the daytime and merely 38.77 ind/m^3 at night. In general, the abundance estimates of zooplankton during daylight hours were greater than those observed at night at Pulau Mertang. Similar results were found in a study by Abbasi et al. (2018) along the North Arabian Sea coast near Karachi, suggesting a higher abundance of zooplankton during daylight hours as opposed to night-time. Research has demonstrated that zooplankton assemblages are predominantly comprised of copepods, whose numerical dominance exceeds 60% of the constituent composition. In this research, copepods (recorded 64% of the overall zooplankton composition) were identified as the most prevalent and dominant taxon within zooplankton communities. Night-time observations consistently revealed a higher diversity of copepod taxa relative to daytime observations across all sampling stations (Fig 2B). At ST1, the number of copepod taxa rose significantly from 13 during the day to 20 at night. At ST2 (daytime: 14; night-time: 17), ST3 (daytime: 14; night-time: 16), ST4 (daytime: 13; night-time: 20), ST5 (daytime: 13; night-time: 20), and ST6 (daytime: 13; night-time: 20).

Notable disparities have been observed in copepod taxonomic representation, with night-time surveys typically yielding a more diverse array of species compared to those conducted during the daytime period (Rezai et al. 2011, Hays 2003, Fernandez de Puelles et al. 2023). This phenomenon is frequently linked to diel vertical migration, a behaviour in which numerous copepods ascend to shallower waters at night to feed and evade predation by visual predators during daylight hours (Fig. 3).

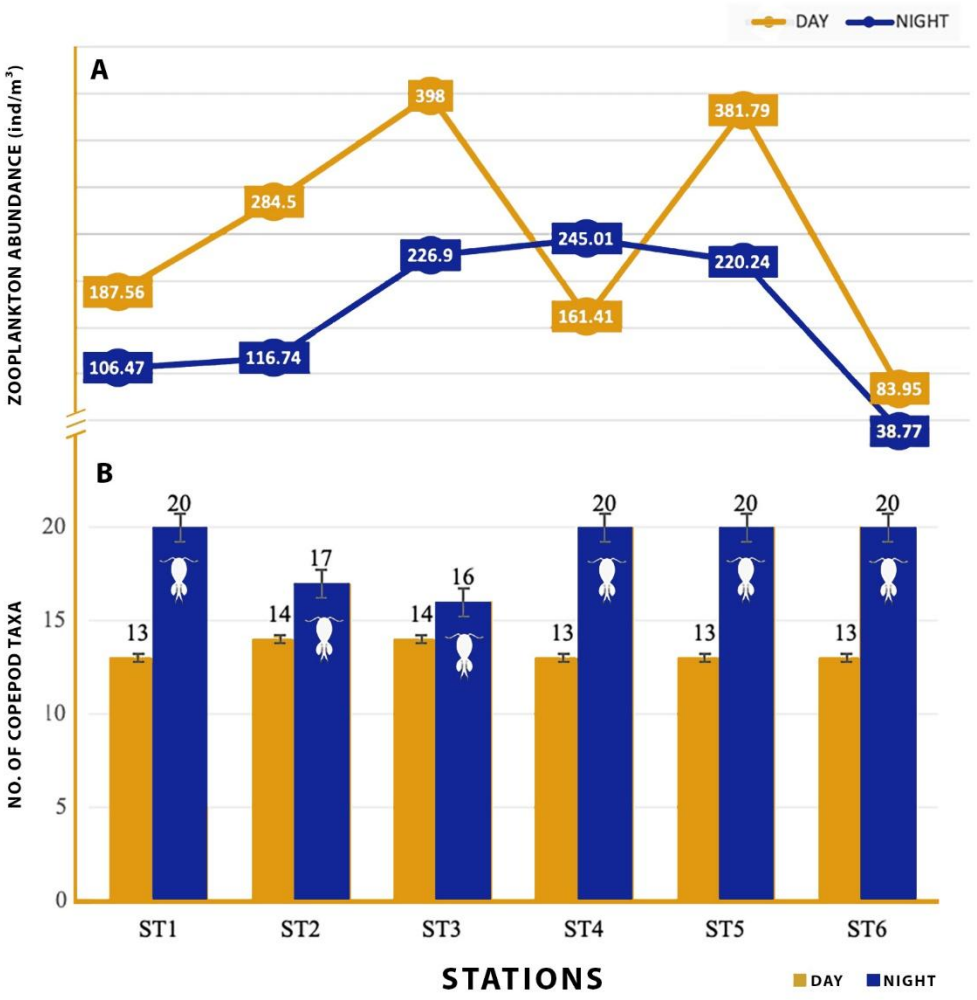

Figure 2. A: Comparison of zooplankton abundance estimates during day and night sampling. B: Number of copepods taxa recorded during day and night sampling across six stations (ST1–ST6).

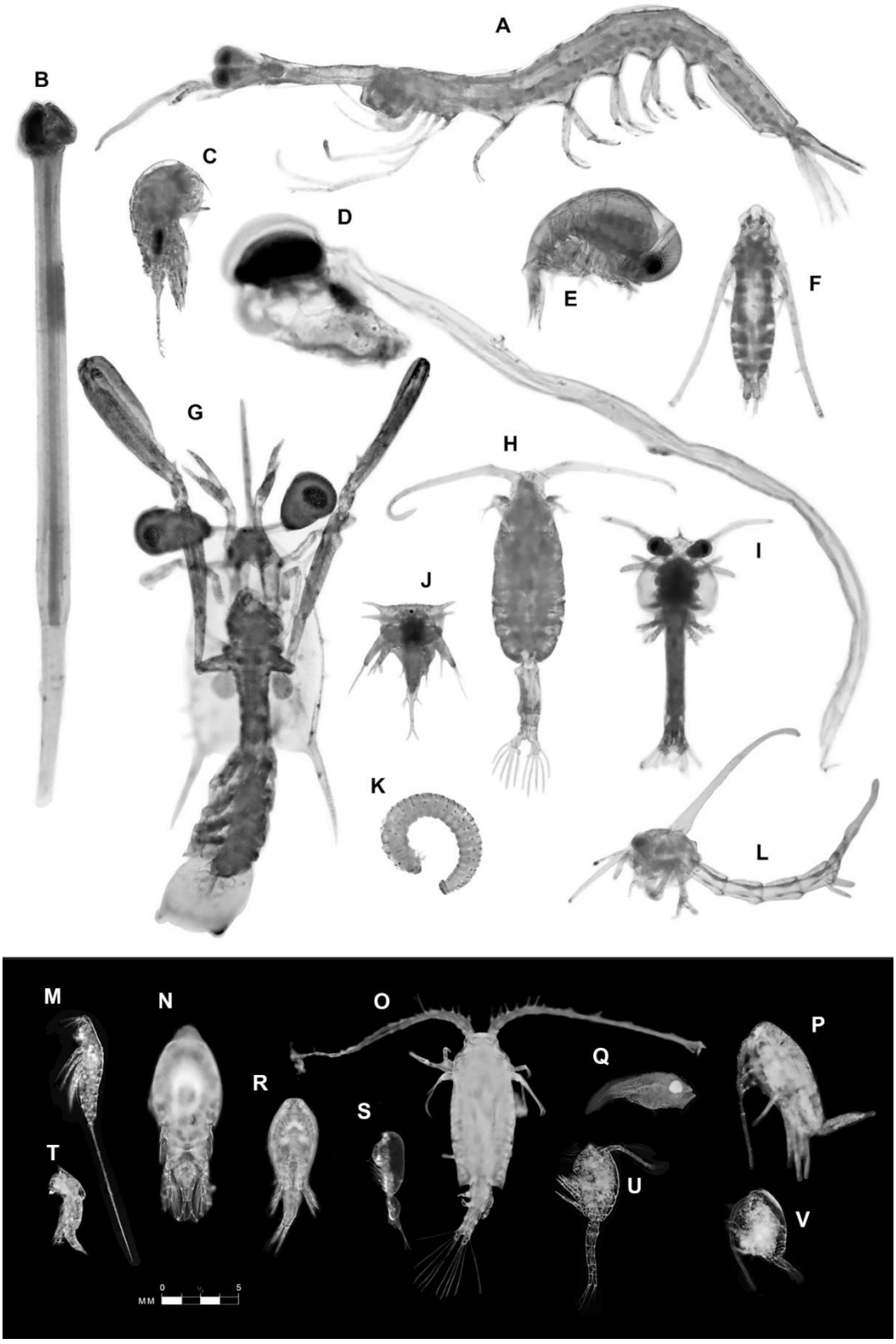

Figure 3. Some common and/or indicative zooplanktons from day samples (white background) and night samples (black background). A, Lucifer; B, Chaetognatha; C, *Calanus* spp.; D, Oikopleura; E, *Hyperia* spp.; F, *Eucalanus* spp.; G, Stomapod larva; H, *Acrocalanus* spp.; I, Caridean larva; J, Balanus nauplius; K, Polychaete larva; L, Brachyuran Larva; M, *Microsetella* spp.; N, *Corycaeus* spp.; O, *Centropages* spp.; P, *Parvocalanus* spp.; Q, fish larva; R, *Oncaea* spp.; S, *Farranula* spp.; T, *Euterpina* spp.; U, *Oithona* spp.; V, *Temora* spp. Scale bar equals to 5 mm.

4. CONCLUSION

These findings contribute valuable insights into the zooplankton ecology of the Mertang Archipelago, Johor, Malaysia. In this study, the zooplankton community exhibited a characteristic day-night composition pattern, and the identified zooplankton groups corresponding to each daily vertical migration phase were essentially in agreement with earlier research. Preliminary investigations suggest that the long-term implementation of environmental monitoring along coastal areas could facilitate a more nuanced understanding of the ecosystem and provide critical insights into future changes in zooplankton diversity.

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Authors contributions

Azwa Liza Binti Zokerefli: field sampling, analysed the data, prepared figures, authored and reviewed drafts of the paper.
Che Aliea Syakila Binti Che Suhaimi: field sampling, analysed the data, prepared figures, authored and reviewed drafts of the paper.
Azman Abdul Rahim: conceived and designed the study, field sampling, prepared figures, authored and reviewed drafts of the paper and approved the final draft.

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Conflict of Interest

The authors declare that there are no conflicts of interests.

Informed consent

Not applicable.

Ethical approval & declaration

In this article, the animal & zooplanktons regulations are followed as per the ethical committee guidelines of Marine Ecosystem Research Centre (EKOMAR), Faculty of Science and Technology, Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia; the authors observed the Day-Night Composition, Abundance and Distribution of Zooplankton Groups from Mertang Archipelago, Johor, Malaysia. The Animal ethical guidelines are followed in the study for species observation, identification & experimentation.

Data and materials availability

All data associated with this study are present in the paper.

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