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Microbial abundance and nutrient concentration in riverine and coastal waters of North-East Langkawi

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ABSTRACT. We measured both biotic and abiotic variables at 19 stations along the three river systems and also off the Langgun island in the North-East (NE) Langkawi region. Temperature ranged between 29.8–31.3ºC whereas salinity ranged between 22–32. pH was between 7.4 and 8.2 whereas redox potential ranged between –82 to –32. Dissolved oxygen (DO) concentration ranged between 120–280 µM. Both pH and DO concentration were lower upstream of the rivers. For inorganic nutrient concentrations; ammonium (NH_4) ranged between 0.56–4.30 µM, nitrate (NO_3) between 0.31–1.46 µM, nitrite (NO_2) between 0.04–0.38 µM and silicate (SiO_4) between 1.36–15.23 µM. Of the nitrogen species, NH_4 was dominant, making up to 79% of total dissolved inorganic nitrogen (mean=57%). Total suspended solids (TSS) in the water samples were high, ranging between 270 to 330 mg L^{-1} whereas particulate organic matter (POM) constituted a very small component of TSS (<5%, 3.6–14.4 mg L^{-1}). For biotic variables, chlorophyll *a* (Chl *a*) concentration that represented the photoautotrophs present in the water, with the range of 1.49–8.24 µg L^{-1}. Bacteria ranged between 1.5–5.3×10^6 cells mL^{-1} whereas phototrophic picoplankton and protists ranged between 1.7–4.3×10^5 cells mL^{-1} and 0.8–1.6×10^4 cells mL^{-1}, respectively. Marine bacteria cultured ranged from 4×10^2 to 1.2×10^5 cfu mL^{-1}. Although our limited sampling was inadequate to detect controlling factors for bacterial abundance, our study showed that bacteria could have caused the lower DO concentration in the rivers in NE Langkawi.

ABSTRAK. Kami mengukur kepekatan parameter biotik dan abiotik 19 stesyen sepanjang tiga sistem sungai dan Pulau Langgun di sekitar timur-laut (NE) Langkawi. Suhu air adalah antara 29.8 – 31.3ºC manakala saliniti antara 22 – 32. pH adalah antara 7.4 dan 8.2 manakala keupayaan redoks adalah antara –82 hingga –32. Kepekatan oksigen terlarut (DO) pula antara 120–280 µM. Kedua-dua pH dan kepekatan DO adalah lebih rendah di bahagian hulu sungai. Bagi kepekatan nutrien inorganik; ammonia (NH_4) adalah antara 0.56–4.30 µM, nitrat (NO_3) antara 0.31–1.46 µM, nitrit (NO_2) antara 0.04–0.38 µM manakala silikat (SiO_4) antara 1.36–15.23 µM. Daripada spesis nitrogen, NH_4 adalah paling dominan, membentuk sehingga 79% jumlah nitrogen inorganik terlarut (purata=57%). Keputusan kami menunjukkan jumlah pepejal tak mendap (TSS) adalah tinggi, antara 270–330 mg L^{-1} manakala bahan organik partikulat (POM) merupakan komponen kecil TSS (<5%, 3.6–14.4 mg L^{-1}). Bagi pembolehubah biotik, kepekatan klorofil *a* (Chl *a*) adalah antara 1.49–8.24 µg L^{-1}. Bakteria adalah antara 1.5–5.3×10^6 sel mL^{-1} manakala pikoplankton fototrofik dan protis masing-masing adalah diantara 1.7–4.3×10^5 sel mL^{-1} dan 0.8–1.6×10^4 sel mL^{-1}. Bakteria marin yang dikultur antara 4×10^2 hingga 1.2×10^5 cfu mL^{-1}. Walaupun bilangan penyampelan kami terhad, dan tidak mencukupi untuk mengesan faktor pengawal kelimpahan bakteria, kajian kami menunjukkan bahawa bakteria mungkin telah menyebabkan kepekatan DO yang rendah dalam air sungai di NE Langkawi.

(bacteria, picoplankton, inorganic nutrients, chlorophyll *a*)

INTRODUCTION

It has been two decades since the term 'microbial loop' was introduced to describe the importance of the microbial food web on the recycling and mineralization of organic matter in aquatic habitats [1]. Evidences suggest that the microbial food web is a key component in both coastal and estuarine ecosystems [2]. However, research on the microbial food web in Malaysian waters has been limited to culturable-specific bacteria and its participation in nitrogen cycle [3,4]. This study is