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Investigating factors driving phytoplankton growth and grazing loss rates in waters around Peninsular Malaysia

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Abstract In tropical waters where temperatures are relatively stable, we investigated whether the relationship between phytoplankton growth and grazing loss rate across different habitats around Peninsular Malaysia can be attributed to its eutrophication states. We measured phytoplankton growth (μ) and grazing loss (g) rates in waters off Bachok Marine Research Station (BMRS), located northeast of Peninsular Malaysia. Chlorophyll-*a* (chl-*a*) concentration ranged from 2.90 to 15.78 μg/L and was dominated by nano- and micro-phytoplankton (>2 μm in size). Using the Landry and Hassett dilution method, μ at BMRS ranged from 1.02 to 1.58/d whereas g varied from 0.07 to 0.88/d. Grazing accounted for 35% of the primary production at BMRS. A systematic review of available data in waters around Peninsular Malaysia, revealed how μ fluctuated over a wide range (0.01–1.80/d) and correlated with chl *a* distribution (R^2=0.181, P<0.001). However, the relationship was only significant at <9 μg/L chl *a* for mesotrophic waters and <16 μg/L chl *a* for eutrophic waters. In contrast, g ranged from 0.00 to 1.01/d, and correlated with μ at all locations. The g/μ slope ranged from 19% to 84%, and was generally similar for waters around Peninsular Malaysia. However, all the g/μ slopes had a positive y-intercept except for BMRS, and this seemed to suggest the availability of alternative prey supporting grazing at the other stations.

Keyword: phytoplankton growth; grazing loss; grazing pressure; Bachok Marine Research Station (BMRS)

1 INTRODUCTION

In the oceans, primary production is mainly carried out by phytoplankton (Duarte and Cebrián, 1996; Field et al., 1998), and phytoplankton biomass that is produced is transferred to higher trophic level via grazing (Vargas et al., 2007; Selph et al., 2016). Across different regions, microzooplankton grazing accounts for an estimated 44% to 79% of daily primary production (Schmoker et al., 2013). Phytoplankton production not grazed is either lost through horizontal export or sinking (Turner, 2002; Stukel et al., 2011). As primary production and grazing loss rates are affected by different environmental drivers (Boyce et al., 2010; López-Urrutia and Morán, 2015; Zhang et al., 2018), their values are distributed over a wide range and are site-specific. It is important to measure these biological processes as the balance between both primary production and grazing rates affects the distribution of primary producers (Zheng et al., 2015; Cermeño et al., 2016).

In a cross-compilation study of 110 datasets by Schmoker et al. (2013), only 24% were from tropical waters. Data from Sunda Shelf were clearly lacking even though two additional studies were published from the Sunda Shelf waters i.e. Strait of Malacca (Lim et al., 2015, 2018) and Strait of Singapore (Schmoker et al., 2016). Sunda Shelf waters are highly productive tropical waters (Ooi et al., 2013), and clear differences in terms of eutrophication exist in waters around Peninsular Malaysia (Lim et al., 2018).

Although temperature is an important environmental driver of biological processes (Boyce

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