MARINE BIOLOGY RESEARCH, 2016
VOL. 12, NO. 3, 278–293
http://dx.doi.org/10.1080/17451000.2016.1143107

ORIGINAL ARTICLE

Monsoonal and lunar variability in microzooplankton abundance and community structure in the Terusan mangrove creek (Malaysia)

Yu Lin Yong[a], Li Lee Chew[a,c], Choon Weng Lee[a,b] and Ving Ching Chong[a]

[a]Institute of Biological Sciences, Faculty of Science, University of Malaya, Kuala Lumpur, Malaysia; [b]Institute of Ocean and Earth Science, University of Malaya, Kuala Lumpur, Malaysia; [c]Department of Aquatic Science, Faculty of Applied Sciences, UCSI University, Kuala Lumpur, Malaysia

ABSTRACT
This study documents the monsoonal and lunar effects on species composition and abundance of microzooplankton in a tropical estuary. We investigated microzooplankton abundance in relation to the various environmental and biotic parameters, sampled in the Matang mangrove (Malaysia) from April 2013 to February 2014. A total of 39 microzooplankton taxa comprising four major groups, i.e. loricate ciliates (37.72%), aloricate ciliates (29.46%), dinoflagellates (24.33%) and meroplanktonic nauplii (8.49%) were identified. The loricate ciliates were the most diverse group with 31 taxa recorded. Four major species of loricate ciliates were identified, i.e. *Tintinnopsis beroidea*, *Tintinnopsis rotundata*, *Stenosemella avellana* and *Tintinnidium primitivum*, while Strombidiidae and Strobilidiidae dominated the aloricate ciliates. Although small loricate ciliates were ubiquitous, redundancy analysis shows marked shifts in microzooplankton community structure, from one that was dominated by loricate ciliates during the drier SW monsoon, to aloricate ciliates at the onset of the wet NE monsoon, and then to dinoflagellates towards the end of the drier NE monsoon period. These shifts were associated with rainfall, dissolved inorganic nutrients, salinity, temperature and microbial food abundance. There was no clear lunar effect on abundance of microzooplankton except for *Favella ehrenbergii* and copepod nauplii, which were more abundant during neap than spring tides.

ARTICLE HISTORY
Received 17 September 2015
Accepted 12 January 2016
Published online 27 April 2016

RESPONSIBLE EDITOR
David Montagnes

KEY WORDS
Ciliates; dinoflagellates; phytoplankton; temporal distribution; tropical estuary

Introduction

Microzooplankton are classified as heterotrophic and mixotrophic organisms that range from 20 to 200 µm in size. Planktonic ciliates such as the choreotrichids and oligotrichids (class Spirotrichea) usually dominate in terms of numbers and biomass (Godhantaraman & Uye 2003; Yang et al. 2008; Lynn 2010; Monti & Minocci 2013; Dolan et al. 2013a; Stoecker et al. 2014). Choreotrichids are mainly the tintinnids and aloricate ciliates from the family Strobilidiidae and Strombidinopsidae, whereas oligotrichids are primarily from the Strombidiidae and Tontoniidae in marine waters (Lynn 2010; Agatha 2011; Dolan et al. 2013a). Microzooplankton also include dinoflagellates, foraminiferans and small metazoans such as copepod nauplii and copepodites and meroplanktonic larvae (Calbet 2008).

There has been a dramatic impetus in microzooplankton research ever since their discovery as trophic intermediaries, transferring materials and energy via the microbial loop to higher trophic levels (e.g. Azam et al. 1983; Robertson 1983; Stoecker & Capuzzo 1990; Putland & Iverson 2007). Microzooplankton biomass is always higher than mesozooplankton in estuaries (Buskey & Stoecker 1989) showing their greater importance in pelagic food webs. The small body size of microzooplankton makes them more efficient (than mesozooplankton) in consuming the even smaller nano- and picoplankton; in fact, they are also among the dominant grazers of phytoplankton (Burkill et al. 1993; Schmoker et al. 2013). Nonetheless, there is a general lack of knowledge about the microzooplankton in tropical estuarine and marine waters, thus hampering a deeper understanding of the functioning of the tropical microbial loop. The few studies in tropical waters were conducted mainly in India (Godhantaraman 2002; Jyothibabu et al. 2006, 2008a, 2008b; Asha Devi et al. 2010; Sarkar 2015) and South America (Pettigrosso 2003; Eskinazi-Sant'anna & Bjornberg 2006). Among these studies, the tintinnids

CONTACT Ving Ching Chong chong@um.edu.my Institute of Biological Sciences, Faculty of Science, University of Malaya, Kuala Lumpur, 50603 Malaysia.
The supplementary material for this article is available at http://dx.doi.org/10.1080/17451000.2016.1143107