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Spatial patterns and key drivers of zooplankton in the north central Indian Ocean

H.B.U.G.M. Wimalasiri[a], W.R.W.M.A.P. Weerakoon[a], R.P.P.K. Jayasinghe[a] and P. Dalpadado [b]

[a]National Aquatic Resources Research and Development Agency (NARA), Crow Island, Colombo, Sri Lanka; [b]Institute of Marine Research (IMR) Bergen, Norway

ABSTRACT

Zooplankton is a vital component in the pelagic marine ecosystems, linking lower to higher trophic levels. A survey was conducted with R/V Dr. Fridtjof Nansen in Sri Lankan waters in summer 2018 to explore zooplankton dynamics in relation to abiotic and biotic variables. A distinct pattern in physical and biological properties characterized Sri Lankan waters into two ecosystems: (1) low production, high temperature, and low salinity in the east, and (2) high production, low temperature, and high salinity in the west. The highest mean abundance (1931 ind. m^{-3}) and biomass (1.79 g dry wt. m^{-2}) of zooplankton were significantly associated with cooler, high saline, and more productive waters in the North West and South West. In general, zooplankton were significantly more abundant in the west (1841 ind. m^{-3}) than the east (707 ind. m^{-3}). The most abundant copepod families were Paracalanidae (20.4%) and Tachidiidae (10.2%). The copepod *Paracalanus parvus* was the most dominant species. Our study reveals that temperature is a key driver explaining 67% of the variance in zooplankton biomass in this region. This study provides novel baseline results on spatial patterns of zooplankton abundance, biomass, and species composition from an understudied region of the north central Indian Ocean.

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Introduction

Zooplankton is a key player in pelagic marine ecosystems particularly as prey for shellfish, fish, marine mammals and seabirds. In addition, zooplankton waste products are also of importance for the vertical flux of organic matter. The sediment matter fuels the benthic community (Maar 2003), thus, zooplankton occupies a key position in shaping the pelagic system and coupling of pelagic and benthic food webs.

Sri Lanka lies within the equatorial belt of the northern Indian Ocean, with the Arabian Sea on its west and the Bay of Bengal on its east sides (de Vos et al. 2014; Hood et al. 2017). The island experiences bi-annually reversing monsoon winds (de Vos et al. 2014; Hood et al. 2017) that act as the major physical driver for coastal and open-ocean upwelling (Sreeush et al. 2018). The physical and biological processes and their variability in upwelling regions are inseparably tied to the strength of the monsoon winds and associated nutrient dynamics (Sreeush et al. 2018). Off the southern coast of Sri Lanka, seasonal reversals in the boundary currents are associated with dramatic variations in the intensity of coastal upwelling, chlorophyll *a* (Chl *a*) concentration and catch per unit effort of fishes (Hood et al. 2017). The surface ocean currents in the region follow the monsoon patterns; during the southwest monsoon (June to October), the eastward flowing South Monsoon Current (SMC) brings high salinity, productive Arabian Sea waters into the Bay of Bengal (Tomczak and Godfrey 1994; Hood et al. 2009). In contrast, during the northeast monsoon (December to April), the westward flowing northeast Monsoon Current (NMC) brings warm and low salinity water to the Arabian Sea from the Bay of Bengal (Wyrtki 1973; Krakstad et al. 2018).

Only sporadic zooplankton studies at varying temporal and spatial scales have been conducted in Sri Lankan and adjacent waters of the Indian Ocean (Nair et al. 1981; Jayasiri 2007; Jitlang et al. 2008; Pitchaikani and Lipton 2015; Lathasumathi et al. 2017). Compared with other oceans, the Indian Ocean is one of the least studied marine regions, hence, an urgent need for further research efforts has recently been stressed (Hood et al. 2009). Particularly,

CONTACT P. Dalpadado padmini.dalpadado@hi.no Institute of Marine Research (IMR), P O Box 1870 Nordnes, N-5817 Bergen, Norway
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