

## Seasonal changes in abundance of four *Acartia* species (Copepoda, Calanoida) in the coastal waters of Peninsular Malaysia; relationship with monsoon transition

### ABSTRACT

The seasonal variation of *Acartia* copepods from the waters of Peninsular Malaysia was studied via monthly observations at 2 fixed stations on the west coast (Pulau Pinang and Port Dickson) and 2 fixed stations on the east coast (Kijal and Penyabong) from October 2012 to March 2014. In situ temperatures recorded during this period were relatively constant (mean  $29.6 \pm 0.7^\circ\text{C}$ ) at all stations. Salinity measurements were also fairly constant (mean  $30.3 \pm 1.1$  PSU) for all stations during this study except at Penyabong where the salinity during the northeast (NE) monsoon season was significantly lower ( $p < 0.05$ ) (mean  $23.2 \pm 7.9$  PSU) than during the southwest (SW) monsoon season. Concentration of chlorophyll a at Pulau Pinang during the SW monsoon period was significantly higher ( $p < 0.05$ ) (mean  $14.6 \pm 5.4 \mu\text{g/L}$ ) than during the NE monsoon period. Four species of *Acartia* were identified at all stations: *A. amboinensis*, *A. erythraea*, *A. pacifica* and *A. spinicauda*. At Kijal, *Acartia erythraea* population was significantly higher ( $p < 0.05$ ) (mean  $695.7 \pm 618.4$  inds/ $\text{m}^3$ ) compared with the other stations. *Acartia* species composition at Port Dickson was similar to Penyabong, while Kijal was similar to Pulau Pinang. Small-sized species, *Acartia pacifica* and *A. spinicauda* were dominant at Port Dickson and Penyabong, while the larger-sized species, *Acartia amboinensis* and *A. erythraea* were dominant at Kijal. Generalized additive mixed models (GAMMs) were applied to abundance data to describe the environmental preference associated with population recruitment of these species, and the results identified a relative contrast in environmental envelopes occupied by the larger and smaller-sized species. The large-sized species preferred colder and more saline water while the small-sized species preferred warmer and lower salinity water. The succession and co-occurrence of similar sized species is suggested to be a result of the combined effect of species-specific preference to varying temperature–salinity regimes.