

Elucidating food webs of lower trophic levels in a coral reef ecosystem by carbon and nitrogen stable isotope analyses

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The food webs of lower trophic levels in coral reef ecosystems have long been a black box in which secondary and fish productions are sustained being high, even though primary production is considerably low due to their oligotrophic environments. As possible alternative carbon sources in the ecosystems, several investigations suggested the importance of coral mucus and benthic microphyte. Yet, in order to quantitatively and qualitatively understand the flows of carbon and materials, it is necessary to make sure how those possible carbon sources are transferred from lower to higher trophic levels. To clarify what happens in such a black box, therefore, it is essential to look at the carbon sources and trophic structures of zooplankton communities that serve as energy and material transporters at lower trophic levels. We investigated carbon and nitrogen stable isotope of sorted zooplankton groups and possible alternative carbon sources. Zooplankton, coral mucus, suspended sediment and seawater samples were collected from the coral reef at Bidong Island, Malaysia in August 2009. Zooplanktons were taxonomically sorted whenever possible and copepods were specifically classified into genus-levels. We measured their abundance and biomass, as well as chlorophyll a concentrations of suspended sediment and seawater. The delta the ¹³C value of phytoplankton was estimated from the average values of herbivorous zooplankton groups. Their values ranged from -23 to -21 per mill and were fit into the range of the reported values in previous literature. The delta ¹³C and delta ¹⁵N values of 36 zooplankton groups ranged from -22.5 to -13.5 per mill and 2.4 to 7.3 per mill, respectively. They were statistically categorized into two clusters: one indicating the delta ¹³C values similar to the estimated values of phytoplankton (ca.-22.0 per mill), and another with the values close to coral mucus (-14.8 per mill). Also, most zooplankton groups including 15 genera of copepod had lower delta ¹³C (ca.-21.5 per mill), but several abundant groups with higher delta ¹⁵N such as mysids, fish larvae and siphonophora showed significantly higher delta ¹³C values (ca.-18.7 per mill) than those of the estimated food chain based on phytoplankton. These results suggest that although most groups can be categorize into the food chain originated from the carbon sources with lower delta ¹³C (most likely phytoplankton), the contribution of coral mucus that indicate higher delta ¹³C becomes more substantial as trophic levels increase in the coral reef ecosystem.

Keywords: Stable isotope, coral reef, zooplankton, food web, lower trophic level