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Trophic ecology of a tropical scyphozoan community in coastal waters: Insights from stomach content and stable isotope analyses

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ABSTRACT

Despite the growing concern of scyphozoan jellyfish blooms and their associated threats, there is an acute lack of baseline knowledge regarding the trophic ecology of scyphozoans in tropical waters where blooms of several species sometimes occur at once or successively. Therefore, this study was conducted from June 2010 to December 2011 in the Klang Strait (Malaysia) to elucidate the trophic ecology of eight sympatric species of scyphozoan that occurred in a conjoint mangrove-mudflat habitat. The species diet, trophic position and the relative contribution of primary producers to their nutrition were determined by integrating stomach content examination with stable isotope analysis. Scyphozoans in the Klang Strait are principally carnivores and can be grouped into three major trophic guilds: specialized copepod feeder, copepod and macrozooplankton feeder, and mixed plankton feeder. Bayesian mixing model of δ^{13}C isotope values indicates that the scyphozoans mainly derived their basal carbon source from microphytobenthos and phytoplankton. Analysis of δ^{15}N isotope values reveals that all species are positioned at the third trophic level after mixed zooplankton groups (second) and primary producers (first) in the food web. Scyphozoans thus represent an important trophic link coupling benthic and pelagic primary production to higher-level predators and humans, and are important carbon exporters from nearshore to neritic and offshore waters.

1. Introduction

Despite the growing interest in jellyfish research globally, little is known about the feeding habits and trophic role of scyphozoan jellyfish (Cnidaria: Scyphozoa) in tropical marine ecosystems. Studies conducted in the temperate and subtropical regions have shown scyphozoan medusa to be important predators in the pelagic ecosystem, feeding opportunistically across a wide range of zooplankton including copepods, ichthyoplankton and other gelatinous zooplankton (Arai, 1997; Lilley et al., 2009; Purcell, 1997, 2009; Pauly et al., 2008). Given their propensity to feed on pelagic eggs and larvae of fish (Purcell and Arai, 2001), scyphozoans especially in large blooms can exert significant impacts on fish populations. Conversely, jellyfish can serve as a food source for humans and many marine organisms including commercially important fishes, invertebrates, turtles and sea birds (Purcell and Arai 2001; Pauly et al., 2008; Lebrato et al., 2012; Hays et al., 2018). Therefore, trophic studies on scyphozoans are essential especially in areas of fishery importance where population blooms are on the rise.

Stomach content analysis has proven useful to elucidate various aspects of scyphozoan trophic ecology, including predator-prey relationships (e.g., Brodeur et al., 2002; Tilves et al., 2016), trophic overlap (Purcell and Sturdevant, 2001; Brodeur et al., 2008), diet selectivity (Graham and Kroutil, 2001; Zeman et al., 2016) and temporal dietary shifts (Han et al., 2009; Milisenda et al., 2018). However, stomach examination only provides evidence of recent feeding and what is consumed rather than what is assimilated by the jellyfish. Consequently, scyphozoan prey in stomach content analysis such as mesozooplankton and ichthyoplankton may be over-emphasized while microzooplankton and organic matter that are less visible and quickly digested in the stomach are under-estimated (Pitt et al., 2008a).

Stable isotope analysis provides additional insights about jellyfish trophodynamics especially in characterizing the energy transfer and trophic pathways between jellyfish and their diet sources (Pitt et al., 2008a). Stable carbon isotope value (δ^{13}C) changes little as carbon moves through food webs, and different energy sources may have distinct δ^{13}C values (Vander Zanden and Rasmussen, 1999, 2001;

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