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Versatile hermit crabs harness multiple-source energy from coastal mudflats: implications for fish production

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Abstract The versatile hermit crabs, *Diogenes moosai* and *Diogenes lopochir*, are hypothesised to utilise multiple primary sources of energy in the coastal mudflat. Stable carbon and nitrogen isotopes were analysed to determine the primary sources of nutrition (mangrove, benthic microalgae and phytoplankton) and trophic contribution of mudflat hermit crabs to fish predators in Matang mangrove estuary, Peninsular Malaysia. Stable isotope analysis in R showed that benthic microalgae are the major contributor of the total carbon assimilated by diogenid hermit crabs, followed by phytoplankton and mangrove. Interestingly, hermit crabs are one of the few marine organisms that can digest and assimilate lignocellulosic carbon of the mangrove. However, the relative contribution of the primary sources is site dependent and varies along the estuarine gradient with increasing dependency on mangrove-derived carbon by hermit crabs from offshore waters to estuary. The Sciaenidae is the major group of predatory fish of hermit crabs; the implication is that the dense population of hermit crabs with their versatile feeding habits channels energy from three basal sources to support coastal fish production.

Keywords *Diogenes* · Mangroves · Stable isotope · Primary sources · Coastal mudflat · Sciaenid fish

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Introduction

Hermit crabs are one of the most conspicuous groups of crustaceans inhabiting the intertidal and subtidal habitats. These animals are not only unique for using snail shells to protect their soft abdomen, but also known to employ various feeding modes depending on food availability (Schembri 1982). They can feed on planktonic microorganisms and detrital matter via filter feeding (Boltt 1961; Gerlach et al. 1976), predate on smaller animals, as well as scavenging on carrion (Hazlett 1981). Such versatility in their feeding habits is likely an adaptation to the diverse settings of their habitats. The role of hermit crabs as scavengers and their ability in deposit and filter feeding (Schembri 1982) may constitute an important trophic link in the ecosystem food chain where they are fed upon by larger predators, thus transferring energy from primary producers to animals of higher trophic levels. Despite the ubiquitous presence of hermit crabs, the trophodynamics of these animals is poorly understood. Previous studies had only described feeding