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Influence of habitat complexity on fish density and species richness in structurally simple forereef seagrass meadows

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Abstract: Seagrass meadows are highly productive habitats that support commercially and ecologically important fishes and invertebrates. However, evidence of fish-habitat relationships are seldom drawn from forereef seagrass meadows that are structurally simple in terms of species richness and relative size and, consequently, their role as habitats is unclear. In this study, fish-habitat relationships were examined in such meadows in the forereef seagrasses of Tinggi Island and Babi Besar Island, Malaysia, by documenting habitat complexity attributes (canopy height, shoot density and percent cover), distance to adjacent coral reefs, and water depth within 2×2 m quadrats. Fish assemblages were recorded using the Remote Underwater Video Station method. A total of 1166 individuals from 86 taxa were found and enumerated. This study showed that (1) fish density and species richness were significantly associated with seagrass percent cover alone; (2) commercially important carnivores formed the majority of the fish populations in the meadows, and (3) fish density and species richness were positively correlated with distance to the nearest adjacent coral reef, indicating the need to account for the effects of neighboring habitats in studies of this nature. Thus, structurally simple seagrass meadows are still important fish habitats, especially as feeding grounds for commercially significant carnivores.

Keywords: fish-habitat relationships; forereef seagrass; marine park area; remote underwater video station.

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Introduction

Seagrass meadows are well recognized as high-productivity marine habitats that function as nursery and foraging grounds for many commercially and ecologically important invertebrates, fishes, and other large vertebrates including sea turtles and dugongs (Nagelkerken et al. 2000, Duarte 2002, Larkum et al. 2006). Despite this, most marine protected areas (MPA) are declared for the general protection and conservation of coral reefs and mangrove habitats, whilst seagrass habitats receive incidental and thus, indirect protection. This may partly be due to a lack of knowledge about the significance of this habitat in maintaining fish populations (Unsworth and Cullen 2010). Meanwhile, seagrass meadows are declining worldwide at an alarming rate due to numerous factors, including climate change and anthropogenic effects on coastal ecosystems (Duarte 2002, Orth et al. 2006, Waycott et al. 2009). The loss of seagrass habitat also marks a loss of habitat complexity in soft-sediment substrate, causing disruption to ecosystem services that include nursery function and food provision (Duarte 2000, Worm et al. 2006). Consequently, fisheries productivity will be greatly affected by the loss of seagrass, particularly for commercially important fishes that utilize seagrass habitats as nursery and foraging grounds (Hemminga and Duarte 2000, Nagelkerken et al. 2000).

The loss of habitat is not the only concern. The structural quality of a habitat is also an important consideration because habitats can occur as a range of structurally “simple” to “complex” entities in an absolute sense, or can undergo natural or induced changes from one to the other. Ecologists have long acknowledged the importance of habitat structural complexity and its relationship with species richness and abundance, although the mechanisms behind this effect are still unclear (Kovalenko et al. 2012). Habitat complexity has been defined and measured in many different ways (Bartholomew et al. 2000) but, in the popular definition by McCoy and Bell (1991), “complexity” refers to the absolute abundance of habitat structural components.