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Effect of coastal development on larval fish abundance in Klang Strait (Malaysia)

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ABSTRACT

Changes in larval fish assemblages were studied before (1985–86) and after (2013–2014) rapid coastal development in the Klang Strait, Malaysia, based on a Before-After-Control-Impact (BACI) experimental design. Fish larvae were sampled by bongo-nets along an 18-km transect from the impact station at the Kapar power station (KPS) to four control stations in increasingly offshore waters. Families Gobiidae, Clupeidae, Sciaenidae and Engraulidae were most abundant at both sampling periods, demonstrating their adaptability and resilience to the natural and anthropogenic disturbances. Coastal development has reduced larval fish abundance at KPS, inevitably shifting higher larval abundance to the control stations. This shift is related to lower sea surface temperature and higher pH. Despite the coastal disturbances, there was an overall increase in total larval fish abundance attributed to the preflexion stage of the Gobiidae, Sciaenidae, Engraulidae, Cynoglossidae and Callionymidae, and the yolk-sac and preflexion larvae of unidentified taxa.

1. Introduction

Fish, in general, can only tolerate a certain range of temperature (Pörtner, 2002) because being an ectotherm, temperature inevitably affects its biochemical and physiological processes (Basu et al., 2002). Altered environmental conditions due to climatic change not only affect fish but other organisms at each of the trophic levels through changes in their physiology and behaviour, which in turn, influenced the overall food web interactions (Pörtner and Peck, 2010). For instance, the decline in the abundance of planktonic prey in addition to their phenological shifts due to an increase of 0.9°C in sea surface temperature has caused asynchrony between primary, secondary, and tertiary production (Edwards and Richardson, 2004). The rise in global temperature in recent decades also diminishes oxygen solubility in water and increases the metabolic demands of these aquatic ectotherms through deoxygenation (Grégoire et al., 2019; Roman et al., 2019). As the metabolic rates of species increase at higher temperatures, so does the energy consumption at each of the trophic level (Kordas et al., 2011). Larval fishes need to consume more food to support the increased energetic demand or die of starvation (Munday et al., 2009). A decline in physiological performance such as slower growth rate and longer developmental times was observed when the temperature exceeds the species' thermal tolerance (Tremont et al., 2015; Madeira et al., 2016); this is particularly true for species living close to their thermal optima (Ong et al., 2015) such as tropical ectotherms (Somero, 2010).

The Klang Strait located in the Straits of Malacca (Fig. 1) is Malaysia's major shipping lane (Murugiah, 2019). Several estuaries and coastal inlets that drain into the Klang Strait serve as major spawning, nursery, and feeding grounds for various species of fish and prawn in the state of Selangor (Chong and Sasekumar, 1981; Chong et al., 1990). In 1987, a 2420 MW power generating plant, the Kapar power station (KPS), was installed in the area to meet the state of Selangor burgeoning energy demand. While the KPS marked the onset of rapid development in the state, it also signified the fast environmental changes that took place in the coastal zone from past to present. These include rapid coastal population growth, housing and infrastructural expansion, agriculture-to-industrial development, port extension, pollution, and the gradual loss of coastal habitats (Chua et al., 1997; Chong, 2006; Haris and Aris, 2012; Sany et al., 2013).

The Kapar power station is responsible for the death of marine organisms by impingement (Azila and Chong, 2010), while induced and natural warming of the coastal waters including other

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