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Trophic dynamics of few selected nearshore coastal finfishes with emphasis on prawns as prey item

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ABSTRACT

A trophic dynamic study of marine finfishes was undertaken based on stomach content analysis of twenty four species (N = 1742) collected from the nearshore coastal waters off Goa, west coast of India (15°29′07.6″ N to 15°34′44.3″ N, and 73°38′10.5″ E to 73°46′03.1″ E) during November 2010 to May 2013. This study aimed to thoroughly understand the feeding attributes of finfishes, and comprehend the possible effects of bycatch-related loss of biomass on trophic ecology. The study assessed diet preferences of the finfishes, their feeding guilds, significance of prawns as prey items, and the influence of mouth parts in prey selection. Altogether 84 prey taxa were identified from the stomach contents. Percentage Index of Relative Importance (IRI) values revealed that zooplankton (34.74), prawns (21.71), phytoplankton (19.80), and teleosts (18.62) were the major prey categories, and, among prawns, *Metapenaeus dobsoni* (%IRI = 19.34) was the single-most important prey item. Cluster analysis revealed three major trophic guilds namely 'teleost feeders' (mean Trophic Level (TrL) = 4.06 ± 0.42; mean B = 0.46 ± 0.24), 'zooplankton feeders' (mean TrL = 3.43 ± 0.29; mean B = 0.23 ± 0.13), and 'prawn feeders' (mean TrL = 3.86 ± 0.25; mean B = 0.48 ± 0.32), with low diet overlap among them. Principal Component Analysis of prey categories and mouth parts of finfishes suggested that zooplanktivory is associated with gill raker density as well as number of gill arches bearing rakers, whereas gape height determined the size of large-sized prey (fish and invertebrates). The study identified *M. dobsoni*, mysis and teleosts as highly influential prey for predatory finfishes. The present results could be useful to resolve broader issues in fisheries management.

1. Introduction

Tropical coastal waters are biologically productive environments, which support large, complex food webs (Pimm and Kitching, 1987) and serve as nurseries for a variety of coastal and marine species (Beck et al., 2003; Kostecki et al., 2010). These organisms are involved in complex ecological relationships, e.g., trophic interactions (Pascual and Dunne, 2006). Tropical demersal food webs are far more complex than pelagic webs owing to large numbers of species and diverse communities (Abdurahiman et al., 2010). However, in shallow coastal waters, there is no clear distinction between benthic and pelagic food webs and, bentho-pelagic coupling of food chains is prominent.

Trophic dynamics determine the sustenance of fish populations, which in turn regulate the fishery in an ecosystem. Moreover, the downfall of a single fishery may result either in the increase or decrease of other trophically-related species, widely known as trophic cascades (Heath et al., 2014). Therefore, knowing the diet preferences and food partitioning among predatory fishes is essential knowledge for understanding ecosystem functioning. Diet preferences of fishes vary according to prey availability and ontogeny-related morphological variations especially of mouth parts such as gape width or height, gill raker density, teeth structure (Gerking, 1994; Lukoschek and McCormick, 2001). Additionally, knowing the effects of fishing mortality on trophic ecology, especially through the mortality of bycatch, and ontogenetic changes is critical for effective management of fishery resources (Bijukumar and Deepthi, 2006).

Although trophic interactions and food webs in coastal habitats are known to support coastal fisheries (Abrantes et al., 2015), earlier studies from the Indian region mostly dealt with the qualitative aspects of trophic ecology (Rao, 1964). Subsequent studies attempted to provide detailed information on the feeding ecology of single species or particular groups (Rao, 1981; Manojkumar, 2008; Hegde et al., 2014). Qasim (1972) employed the "trophic guilds" concept to categorize Indian marine fishes into broad trophic groups, and the "food chain model" concept to explain the trophic dynamics of these fishes. Recently, Abdurahiman et al. (2010) made a comprehensive attempt to

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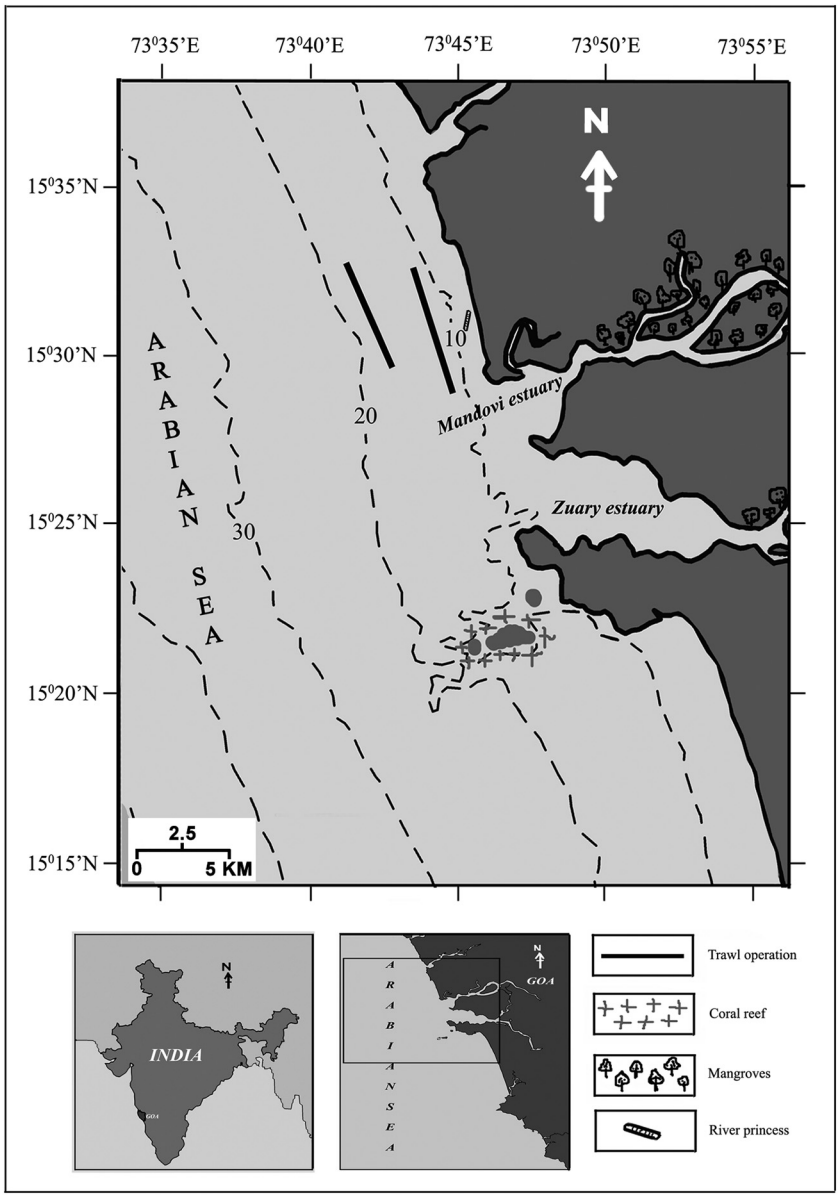

Fig. 1. Map showing study area.

elucidate the trophic ecology of commercially exploited demersal finfishes from the south-eastern Arabian Sea, with emphasis on trophic organisation and prey-predator interactions. However the along west coast of India, only a few studies have attempted to elucidate trophic dynamics of finfishes using both qualitative and quantitative analyses (Suseelan and Nair, 1969; Thangavelu et al., 2012; Rohit et al., 2015). In light of the above, an attempt is made to provide an in-depth analysis of the diet and feeding attributes of selected finfishes to determine (a) the importance of prawns as a prey resource, and (b) the influence of mouth parts in prey selection.

2. Materials and methods

2.1. Study area

The study area comprises the trawling grounds off Goa, central west coast of India latitudes 15°29′07.6″ N to 15°34′44.3″ N, and longitudes 73°38′10.5″ E to 73°46′03.1″ E (Fig. 1). The substratum is of mixed sand-silt type interspersed with submerged rocky patches (Hegde et al., 2013). These waters receive an ample quantity of nutrients and freshwater from the adjacent Mandovi estuary (Wafar et al., 1997). They are subjected to a strong seasonal upwelling during the south-west monsoon period, resulting in marked seasonal differences in hydrographic regimes and productivity that contribute to the rich fishery. The area also serves as nursery grounds for juveniles of several marine teleost species (Ansari et al., 1995).

2.2. Sample collection

Fish samples were collected fortnightly on-board a 15 m long single-day commercial shrimp trawler during daytime (0600 to 1200 h) from November 2010 to May 2013, except during the fishing ban from June to September. Sampling locations were recorded with 12-channel GPS and depths were obtained from Naval Hydrographic Chart no. 2022. A trawl net with 20 m head-rope and foot-rope lengths and with mesh sizes of 25 mm (mouth), 15 mm (middle) and 9 mm (cod end) was towed at 2–3 knots. Fish samples were collected, temporarily preserved in ice and brought to the laboratory.