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Seasonal abundance and distribution of ichthyoplankton diversity in the Coleroon estuarine complex, Southeast coast of India

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ABSTRACT

The seasonal abundance and spatial distribution of ichthyoplankton in relation to environmental parameters were made from October 2011 to September 2012 in the estuarine and coastal waters of Coleroon. A total of 25,810 finfish eggs were collected in the Coleroon estuary belonging to 7 orders which include 24 families and 46 taxa. Majority of the eggs represents the order of Perciformes (13 family) followed by Culpeiformes (5 family), Mugiliformes, Anguliformes, Tetradontiformes, Atheriniformes, and Gonorhynchiformes (1 family form each order). In addition, a total of 11,320 finfish larvae also were collected belonging to 7 orders which include 24 families and 45 taxa, the majority of the group belongs to the order of Perciformes (15 family) followed by Culpeiformes (4 family), Mugiliformes, Anguliformes, Tetradontiformes, Atheriniformes, and Gonorhynchiformes (1 family form each order). In the present observation, both eggs and larvae of finfish were higher during postmonsoon whereas lesser number of eggs was recorded in summer and larvae in premonsoon season. The physico-chemical parameters viz., Surface water temperature, salinity, pH, dissolved oxygen, Biological oxygen demand and NH_3 are also provided a relatively stable environment which was favorable for larval production and survival in the Coleroon estuarine region.

1. Introduction

Estuaries and associated coastal waters support many essential fisheries, a fact which contributes to their extremely high economic value (Blaber., 2000). It exhibit characteristic environmental gradients that favor the recruitment of variety of species with diverse physical and tropical structure (Sanchez and Raz-guzman 1997; Sandra and Ramos et al., 2005). Estuaries are potential for fishery development in the aquatic environment and are considered as the potential source for feeding, spawning and nursery ground for most of the fin fishes and shellfishes (Powles et al., 1984; Whitfield, 1999; Blabar, 2000; Elliott and Hemingway, 2002). In addition, marine species are visiting these habitats for reproduction, growth and shelter (Raz-Guzman and Huidobro, 2002; Sandra Ramos et al., 2005). Through the productiveness is very high in a majority of finfish species, yet their eggs and larvae survive only in small numbers because of the shortage of suitable environmental conditions, food and high level of predation (Pepin and Davidsona Dower, 2003).

Change in different environmental parameters changes operating on wide spectrum of spatial and temporal scale have influence the distribution patterns of zooplankton which in turn affect the ichthyoplankton distribution (Lopez-Sanz et al., 2011). Simultaneously, these ecosystems offer protection not only for resident species but also for a wide range of marine taxa (Cowley and Whitfield, 2002; McLusky and Elliott, 2004). For better understanding of quantification the variability of ecosystem processes, ecologists have specified the importance of the relation and biological processes (Munk and Farmer, 1988), and also the significance of their analysis in different spatial and temporal scales (Levin, 1992). Results of survey can be used for monitoring annual changes in the species composition and diversity of community in which the stock of fish are an integrate part and further for casting strength of the population of various fishes. However, few reports are available in public domain in the diversity of Ichthyoplankton around Coleroon estuary. Earlier, Manickasundaram et al. (1987) conducted the study on eggs and larvae in Coleroon estuary even though it was mainly focused only on qualitative study of eggs and larvae. Therefore, after 25 years the present study was focus on finfish eggs and larval distribution, abundance and diversity in the in Coleroon estuary were conducted in seasonally.

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2. Materials and methods

2.1. Description of study area

The Kollidam (referred to as “Coleroon” in Colonial English) river is an southeastern India. The Coleroon is the northern distributary of the Kaveri River which flows towards east and northeast direction for about 95 miles (150 km) and drains in to the Bay of Bengal near the Pazhayar village. It splits from the main branch of the Kaveri River at upper Anaicut in Vathalai which is about 36 km west of Tiruchirapalli. The average depth, width and maximum width of Coleroon estuary are about 5 m, 650 m and 750 m respectively. The nature of the sediment is silt, sandy and clay and tidal influence is felt up to a distance of 15 km from the estuary mouth.

The present investigation, collections of ichthyoplankton were made from October 2011 to September 2012 at five different stations in the estuarine and coastal zones of Coleroon estuary. Station-1 (11°21′57.5″N and 79°49′77.5″E) were located near mouth of Coleroon estuary. Station-2 (11°21′93.2″N and 79°48′17.1″E) were located 3.1 km away from mouth. Station-3 was (11°22′45″N and 79°47′18.6″E) located 2.1 km away from the station-2 and is characterized by four tidal channels on both sides of the river. Station-4 was (11°23′10.5″N and 79°46′06.4″E) located 2.5 km away from station-3 and it is an intermediate saline water. The Station-5 was (11°21′79.3″N and 79°45′26″E) located 3.2 km away from station-4 and in the nearby shore waters of the Bay of Bengal at Coleroon and is situated in the area where the river curl is formed (Fig. 1).

2.2. Sample collection and analysis

Ichthyoplankton sample collections were collected during the early hours at 3am to 6am over a period of one year from October 2011 to September 2012. Sampling was made with help of a standard plankton net (mesh size-158 μm; No-10) in the surface waters at a constant speed (5 km/hr) for 15 min at each station. Samples were taken in the direction of the water current at an average speed of 2.5 knots. The volume of water filtered was quantified with the help of calibrated flow meter (Model General Oceanics). Water quality parameters such as surface temperature, salinity, dissolved oxygen, pH, biological oxygen demand and ammonia were observed following standard methodologies. The entire study period was divided into four seasons i.e., monsoon, post monsoon, summer and pre monsoon.

Samples were kept in cool condition until laboratory processing following the method of Kirkwood (1996). The collected samples were immediately preserved with 4% neutralized formalin. In each station the whole sample was observed with the help of microscope (Model) the individual eggs and larvae were sorted out and kept in the 4% formalin in separate vial for future analysis. The eggs and larvae of individual species were identified by using the following existing literature Panikkar and Nair (1945), Bal and Pradhan (1951), Nair (1952), Bapat (1955), Balakrishnan (1959), Ganapati and Raju (1961b), Raju and Ganapathi (1967), Bensam, Tamachandrakarthak. (1967), Vijayaraganan (1973), Ramanathan and Natarajan (1979), Thangaraja (1982), Venkataramanujam (1985), Manickasundaram et al. (1987), Manickasundaram and Ramaiyan (1990), Lalithambika Devi (1993), Prince Jeyaseelan (1998) and Ramaiyan et al. (2005). The number of individuals per taxa were counted from the entire sample and then converted to a standard water amount of 100 m^3. Statistical analysis was made to correlate the eggs and larvae with the environmental factors.

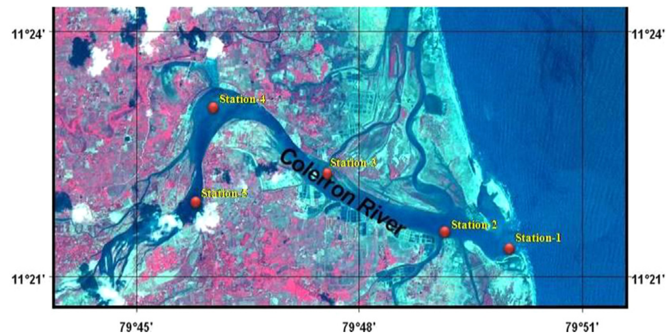

Fig.1. Study area Coleroon estuary, Southeast coast of India.

3. Results and discussion

3.1. Environmental parameters

Most of the environmental variables analyzed in the present study exhibited significant seasonal differences as observed in other equatorial estuaries (Costa et al., 2008; 2009; Magalhães et al., 2009, 2009b; Leite et al., 2010; Pereira et al., 2010). The physico-chemical variables in the present study are subjected to wide spatial temporal variations. In the present study the temperature lowest value (19.5 °C) was observed in premonsoon at station-5 and a highest value (29.3 °C) was receded during postmonsoon at station-2 (Fig. 2(a)) in 2012. The significant highest positive correlations could be observed between temperature with eggs and larvae ($p < 0.01$) from all the station respectively. The results are suggest that the abundance of larval fish and species number are less so at lower temperature and increased with the warm temperature (Okazaki and Nakata 2007). It was also found that sea surface temperature was significantly positively correlated with zooplankton wet weight (Chen et al., 2012).

Many authors have carried out research on the influence of water salinity on fish development (Boeuf and Payan, 2001). In the present study, the salinity which varied between 8.5‰ and 28.2‰ and low salinity value was observed in monsoon at station-5 and high in post monsoon at station-1 (Fig. 2(b)) were registered in 2012. Salinity coefficient values showed highly positive correlation with eggs and larvae ($p < 0.01$) from all the station respectively. In addition, station-1, 3, 4 and 5 significantly correlated at 5% level (P value < 0.05) and in station-2 was remarkably correlated at 1% level (P value < 0.01). Moderate salinity values were observed during the pre and post monsoon periods, which represent a transition period between monsoon and summer. Similar type of seasonal salinity fluctuations were obtained during the dry period, both in the ebb and flood tides (Fabiana teixeira et al., 2009).

Dissolved Oxygen level varied from 3.9 ml/l to 6.9 ml/l, the minimum Dissolved Oxygen value during monsoon 2012 at station-5 and the maximum Dissolved Oxygen value in summer 2011 at station-1 (Fig. 2(c)). The low concentration of dissolved oxygen observed during the summer season could be attributed to the lesser input of freshwater into the study area. The maximum of dissolved oxygen content was high in monsoonal season due to the consequent renewal of freshwater flow. The overall observation shows, the DO concentration was high throughout the study period. Hence, it could not be the major factor that decreased the water quality (Boyd et al., 2002; Prakash et al., 2007). The positive correlations were observed in all the seasons show the significant relationship between the ichthyoplankton densities with Dissolved oxygen (P value > 0.1). Biological Oxygen Demand (BOD) was recorded minimum (0.4 ml/l) in premonsoon season at station-5 and the maximum (1.6 ml/l) in monsoon season at station-1. The number of ichthyoplankton is found to decrease with