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Original Research Article

Seasonal variation of zooplankton and pelagic fish catch in the fishing grounds off Tiruchendur coast, Gulf of Mannar, India

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ABSTRACT

The present study on zooplankton species diversity, abundance and water quality parameters with special emphasis on pelagic fish catches in three fishing grounds off Tiruchendur coast was conducted from January 2009 to December 2010. As zooplankton are playing important roles in transfer of energy to the pelagic food webs, an attempt was made to understand the role of zooplankton on pelagic fish catch in the potential fishing grounds. Stations 1–3 are located about 3.7 km, 14.1 km and 17.3 km from the Tiruchendur coast respectively. Sea surface temperature (SST) in three stations varied from 25.0 to 31.7 °C and minimum and maximum SST recorded unifromly in monsoon and summer seasons. Dissolved oxygen and salinity varied from 4.15 to 6.2 mg/l and from 33 to 36.3 PSU respectively. Total of 49 species of zooplankton have been documented during the study. Zooplankton diversity was significantly differed from seasons to seasons. Calanoid and larvae of crustacean's crabs were dominant group in three stations and significantly contributing to the pelagic fishery. High and low population density recorded during summer months and monsoon season respectively. The statistical analyses showed that, physical parameters significantly (positive) correlated with zooplankton abundance; however, chemical parameters exhibited significant negative correlation with zooplankton density in stations 1 and 2. Among the pelagic fishes, *Sardinella longiceps* and *Scomberomorus commerson* are the dominant species in the study. The high rate of zooplankton population density and maximum pelagic fish catch were inconsistent due to lacking period between spawning and fish catch.

1. Introduction

Zooplankton inhabits oceans at all the depths and occupies every ecological niche that is considered as the chief index of utilizing aquatic biotope at the secondary trophic level (Goswami and Padmavathi, 1996). Sea surface temperature, salinity and inorganic nutrients are some of the important factors that are reported to cause spatial changes among zooplankton population (Lawrence et al., 2004). The abundance of zooplankton can be taken as a good index of the availability of fishery resources (Nair and Peter, 1980). Similar to other regions, zooplankton community in Gulf of Mannar is dominated by copepods (Jagadeesan et al., 2013), and 71% of copepods domination in Cochin waters of Arabian Sea was reported by Goswami and Shrivastava (1996). Recent studies on climate change

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which use zooplankton, mainly the copepods as the indicators (Anon, 2009), showed a significant correlation between the Earth's changing climate and zooplankton community. According to Hobday et al. (2006), oceanic warming and climate change together will cause large southward shifts in the distribution of many tropical and sub-tropical zooplankton species displacing many local species, as well as resulting in an earlier annual appearance of many groups. These impacts will alter trophic and competitive relationships among species and disrupt food webs in coastal and oceanic environment. There is a chance of altering the distribution, the timing, and composition of zooplankton communities in the future, with consequence for all marine life including fish, marine reptiles and mammals higher up the food web (Hobday et al., 2006). Climate change will enhance the stratification and it will lead to lower abundance of zooplankton but increased incidence of jellyfish blooms, with impressive effects on higher trophic levels. In Indian Ocean, studies related to zooplankton distribution and abundance has been carried out mostly in the Arabian Sea (Madhupratap and Haridas, 1990; Smith et al., 1998; Hitchcock et al., 2002; Smith and Madhupratap, 2005). Few detailed studies were carried out in the Gulf of Mannar. Among them, Prasad (1954) undertook a comparative study of the plankton of the Gulf of Mannar and the Palk Bay. A study on distribution of plankton in Tuticorin coastal waters of Gulf of Mannar with special emphasis on hydrography was undertook by Saravanane et al. (2004). Studies related to seasonal variation in offshore waters particularly in fishing grounds of Gulf of Mannar is meagre, hence the present study carried out and relationship between zooplankton abundance and fish productivity has been established.

Among the zooplankton groups, copepods are the important grazers of phytoplankton and micro zooplankton, and hence they form a major trophic link to many predatory invertebrates and fish (Atkinson, 1996). Most of the pelagic, demershal fishes and prawn species depend on copepods at early stages of their life cycle (Perumal et al., 2008). The studies carried out in Indian coastal waters were about the quantitative distribution and abundance of zooplankton due to meagreness of samples resulted with non-conclusive outcome (Mathew et al., 1990). Information related to diversity indices of zooplankton and other faunistic components in an ecosystem is very much essential to understand the ecosystem health (Krishnamoorthy and Subramanian, 1999). The abundance and population density of phytoplankton and zooplankton are related to fishery productivity of an ecosystem.

As zooplankton playing important roles in pelagic food webs and transfer of energy, it is essential to study the ecological status of zooplankton in respect to prevailing hydrographical factors of fishing grounds to understand their role on fishery productivity. Understandings of seasonal variations of zooplankton dynamics as well as their time dependent changes in plankton biomass are necessary to reveal the complex interplay of physical, chemical and biological processes. Hence, the present study was conducted for the period of two years to assess the distribution, abundance and population density of zooplankton covering four seasons including, post monsoon, summer, pre monsoon (SW monsoon) and monsoon (NE monsoon) at potential fishing grounds off Tiruchendur coast. Studies on temporal variations of zooplankton community were also included to establish their composition, structure and hydrographical role in the pelagic fish catches off Tiruchendur coastal waters of Gulf of Mannar. This study would be useful for the sustainable utilization of the fisheries of the targeted area.

2. Materials and methods

2.1. Description of the study area

Tiruchendur is a coastal town (Lat: 8°.29′.19.1″ N and Long: 78°.7′. 26.62″ E) in the Thoothukudi District of Tamil Nadu. It is located between Thoothukudi and Kanyakumari and situated on the bank of Gulf of Mannar, Southeast Coast of India. Gulf of Mannar, located between the southeast coast of India and west coast of Sri Lanka is a unique marine environment, and rich in biodiversity. More than 3600 species of plants and animals inhabits Gulf of Mannar and is rightly referred as biologists' paradise. Three traditional fishing grounds were chosen for investigation:

Station 1 is located about 3.7 km from the shore at 10 m depth (Lat: 8°.27′.28.48″ N Long: 78°.8′.18.48″ E) (Fig. 1). This station is well known as a lobster and other crustaceans fishing ground with rocky bottom.
Station 2 is located (Lat: 8°.27′.23.32″ N and Long: 78°.14′.57.06″ E) about 14.1 km from the shore at 30 m depth. The distance between Stations 1 and 2 was about 10 km. Cuttlefish, pomfret, sardine fishes, Indian mackerel, seer fishes and other fishes are caught in this ground designated as Station 2 (Fig. 1).
Station 3 is located (Lat: 8°.30′.46.2″ N and Long: 78°.16′.48.15″ E) about 17.3 km from the shore at 32 m depth and it is the important potential fishing ground for pelagic fishes such as sardine, anchovy, Indian mackerel, seer fishes and *Lates calcarifer* (Fig. 1).

2.2. Data collection and methodology

To measure the physico-chemical characteristics of Tiruchendur coastal waters, surface water samples were collected at monthly interval from three different fishing grounds (Stations 1–3) off Tiruchendur coast for a period of two years from January 2009 to December, 2010. Rainfall data was obtained from the meteorological observatory of Tiruchendur Taluk Office, Tiruchendur. Air temperature (AT) and sea surface temperature (SST) were measured using a standard mercury thermometer. Light penetration in the water column was measured with the help of a Secchi disc (20 cm dia), and the light extinction coefficient (LEC) was calculated using Pool and Atkins (1929) formula. Euphotic zone depth was calculated as described by Ramadhas and Santhanam (1996). Salinity was measured with the help of a Salinometer (Make E-2) and result was counter checked by the silver nitrate titration method. pH was measured using "Elico" pH metre (Model Li-120). Dissolved oxygen of the study area was estimated by the modified Winkler's method (Strickland and Parsons, 1972).