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STUDIES ON THE DISTRIBUTION AND ABUNDANCE OF THE GENUS LUCIFER COLLECTED DURING THE CRUISES OF FORV SAGAR SAMPDA

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ABSTRACT

Distribution and numerical abundance of the genus *Lucifer* in the eastern Arabian Sea and the Bay of Bengal between 4° 30'N and 23°N latitudes are discussed based on 1086 zooplankton collections from 44 cruises of FORV Sagar Sampada. Luciferids were present in 99% of the samples, forming a major component of the planktonic decapods with an abundance of 2,499 per 1000 m³ of water for the entire region. The average abundance of lucifers was 2,591 (number per 1000 m³ of water) for the Arabian Sea and 2,361 for the Bay of Bengal. The density in the shelf area (5,105) was higher than that in the oceanic waters (1,357). The concentration of lucifers observed in the region between 4° 30' N to 10° N was the highest for the entire region of study; 3,996 for the Arabian Sea and 3,505 for the Bay of Bengal. The number in the shelf area of the Bay of Bengal was the highest (6,461) followed by that recorded in the eastern Arabian Sea (4,382). Their abundance in the oceanic regions was 892 and 1,700 respectively. The highest concentration half-degree wise was observed in the shelf region off Andhra coast (58,524). The numerical abundance of lucifers was almost 64% of the total during the monsoon season. However, their abundance was more during the premonsoon season in the Arabian Sea beyond 15°N latitude. The density of lucifers collected during night time was only marginally higher than that in the day time in the eastern Arabian Sea and the Bay of Bengal but considerably high in the shelf region at night during the premonsoon season.

INTRODUCTION

The species of the genus *Lucifer* (Macrura, Penaeidea, Sergestidae) are warm water epipelagic shrimps restricted to Atlantic, Indo-West Pacific and Eastern Tropical Pacific oceans. Of the seven recognized species in the genus *Lucifer*, five are found widespread in the coastal waters of India (Omori, 1977).

Extensive literature available on the seasonal occurrence of *Lucifer* spp. are from the nearshore waters and estuaries of India. Quantitative studies on *Lucifer* spp. encompassing large areas of the Indian waters have been attempted recently from the cruises of RV *Gateshini*. Works of Paulinose et al. (1987) in the Arabian Sea, Nair et al. (1981) and Paulinose et al. (1988) in the Bay of Bengal and Madhupratap et al. (1981) in the Andaman Sea have wider coverage. However, there is a lacuna in the knowledge of the seasonal distribution and abundance of this genus in the seas around India, particularly the oceanic areas of the Indian subcontinent.

The role of *Lucifer* spp. in the zooplankton community is considerable as they play a significant role in the food web of the warm neritic waters, often becoming a major component in the diets of shore fishes and large shrimps (Omori, 1974). The spatial and seasonal distribution of *Lucifer* spp. has great relevance to the fisheries of the region since they have been shown as a good indicator of the presence of a core pelagic fishing ground (Huang, 1987).

MATERIALS AND METHODS

The studies were based on 1086 plankton samples collected since January 1985 to March 1988 in the area within 4°30'N, to 23°N lat. and 75°E to 95°E long. by oblique tows from 150 m to surface using a Bongo - 60 net (mesh aperture 0.33 mm), equipped with a calibrated flow meter. The average No. / 1000 m³ per half a degree square pooled for 1985 - 88 was taken as the index of abundance with reference to area and time.

The faunal content of the eastern Arabian Sea (65° to 77°30'E long.) is compared with that of the Bay of Bengal (77° 30' to 95°E long.). Latitudinal variations of the fauna between region I (from 4°30'N to 10°N lat.), region II (10°N to 15°N lat.), region III (15° to 20°N lat.) and region IV (beyond
variation in densities was observed between the eastern Arabian Sea (2,591) and the Bay of Bengal (2,361).

The monthly density distribution for the total area surveyed (Fig. 2) and for the eastern Arabian Sea and the Bay of Bengal (Fig. 3) showed a similarity in the distribution pattern. The major period of abundance was around the monsoon with the peak in June in the Arabian Sea and in October in the Bay of Bengal subsequently falling in November and December respectively. Relatively steady numbers were noticed from December to May.

Lucifers were found distributed in higher concentration on the shelf throughout the year (Fig. 4). The major concentration was found along the shelf region in the Bay of Bengal (6,461). The neritic waters in the eastern Arabian Sea had a density of 4,382. However, while the oceanic waters in the Bay of Bengal had very poor density (892), the oceanic waters in the Arabian Sea supported a moderate population (1,700) (Fig. 5).

A very large population of Lucifers was found to be maintained between 4°30′N and 10°N latitudes in the west (3,996) and the east coasts (3,503) while the abundance for the rest of the regions varied between 1,300 and 2,300.

Lucifers were distributed in high abundance in the shelf waters of the Bay of Bengal during the southwest monsoon season with the peak between 15°N and 20°N latitudes. In the Arabian Sea the monsoon abundance extended from 4°30′N to 15°N latitudes beyond which high abundance was noticed during the premonsoon months. In this region during the southwest monsoon lucifers were observed in more concentrations in the oceanic waters than in the shelf waters.

The density of lucifers in samples collected during night time was more than those collected in the day time. However, this variation was not significant (Fig. 8). The density of lucifers during night and day varied relatively little in the oceanic region but varied considerably in the continental shelf (Fig. 9). In the shelf waters the genus was more abundant in the night samples during the premonsoon season (73%) and monsoon (57%) but during the post monsoon season they were more abundant in the samples collected during day time (63%).

**Discussion**

Lucifers were present in more stable numbers
Fig. 1. Spatial distribution of lucifers in the eastern Arabian Sea and the Bay of Bengal.
throughout the year than any other zooplankton group, forming numerically the major component of the planktonic decapods as observed by Menon and Paulinose (1973).

The monsoon cycles have been found to play a significant role in the abundance of lucifers in the Bay of Bengal as a whole and in the Arabian Sea up to 15°N latitude beyond which the impact of seasonal cycle was not significant. In the Bay of Bengal this is in agreement with the observations of Menon (1933), Prasad (1954, 1958) Krishnamurthy (1961), Marichamy and Srinivasa (1979) from the Gulf of Mannar-Palk Bay region and of Sarkar et al. (1986) around 21°N latitude. Canapati and Ramanamurthy (1975) have reported that the major peak of the developmental stages of lucifers off Visakhapatnam was during February-June and that of adults in November. RV Gaveshini cruises in the western Bay of Bengal (Achuthankutty et al., 1980; Nair et al. 1981 and Paulinose et al., 1988) also confirm large aggregation of lucifers in the coastal waters of the Bay of Bengal during the monsoons. Madhupratap et al., (1981) have reported lucifers as the major group of planktonic decapod around Andaman and Nicobar Islands. Goswami (1983) found lucifers forming 9% of the zooplankton around Lakshadweep. Along the southwest coast in the nearshore waters Menon (1945), George (1953), Mukundan (1967) and George and Paulinose (1973) have reported lucifers to be common throughout the year. Naomi and Mathew (1989 M. S.) found lucifers more abundant during the southwest monsoon off Cochin. The present observations along the northwest coast of India are in agreement with those of Nair et al., (1980), Achuthankutty et al. (1981) and Naomi (1986) who have reported lucifers to be more abundant during the premonsoon months (March-April).

Fig. 2. Monthly variations of lucifers in the seas around India.

Fig. 3. Abundance of lucifers in the eastern Arabian Sea and the Bay of Bengal (a) Relative abundance. Monthly and seasonal variations in (b) the Bay of Bengal and (c) the eastern Arabian Sea.

All the areas of abundance of lucifers in the shelf along the southwest coast and at localised areas along the east coast (off Madras, Visakhapatnam and Orissa) and around the Andamans
or less to several miles in diameter and often sharply delineated by extremely clear and unproductive water. Nair et al. (1980) found lucifers to be a main component of the Zooplankton during March-April as a result of the enrichment caused by the Trichodesmium bloom. In the Bay of Bengal the column productivity in the central areas is reported to be low (Qasim, 1977) and this could be a reason for the very sparse and even distribution of lucifers in the oceanic waters of the Bay.

The present study also reveals that lucifers in the neritic waters of the Bay are 16% more than that of the Arabian Sea. The surface production in the coastal waters in the Bay of Bengal per unit area is reported to be greater than that of Arabian Sea (Qasim, 1977). The concentration of epipelagic shrimps is particularly great in waters where the bottom slopes steeply close to the shore and strong upwelling is frequently observed (Omori, 1974). Hence it is logical to conclude that lucifers aggregate in the areas of narrow and steep continental slope of the east coast where intense upwelling, followed

Fig. 4. Seasonal (a) and monthly (b) variations in the relative abundance of lucifers in the shelf and oceanic waters of the seas around India.

appear to be areas where strong upwelling followed by increased production at the primary and secondary levels is reported (Panikkar and Rao, 1973; Subramanyan, 1973; Menon and George, 1977 and Qasim 1977).

The abundance of lucifers was found to decrease with the increasing distance from the coast as indicated by Omori (1974). Their abundance in the oceanic waters of the Arabian Sea was greater than that in the Bay of Bengal but very patchy, containing some of the richest and some of the least abundant areas. The same feature, characteristic of the Arabian Sea is indicated by Ryther and Menzel (1965) who have reported areas of extremely dense plankton blooms which vary in size from 100 yards

Fig. 5. Monthly variations and the relative abundance of lucifers in the shelf and oceanic waters of the Bay of Bengal (a) and eastern Arabian Sea (b).
by very high surface productivity, is reported. Swarms of lucifer around the peninsular curve during the southwest monsoon is probably related to precipitation and direction of the monsoon winds. Furthermore there is less upwelling south of Quilon and the oxygen rich surface layer is much deeper with better environmental condition (Anon., 1976).

In this study diurnal migration of lucifers was not significant, as the main part of the population is in the upper 150-metre layer both at day and night intimately associated with the productive zones where they eat (Omori, 1974). Apart from food supply, light intensity and temperature are regarded as important factors in the vertical distribution of a neritic genus like Lucifer (Raymont, 1983). This may be the reason for their lesser abundance in the samples during day time in the premonsoon season when the light intensity is more than during the monsoon and postmonsoon seasons.

Fig. 6. Regionwise distribution in the abundance of lucifers in the eastern Arabian Sea and the Bay of Bengal.

Fig. 7. Regionwise seasonal abundance of lucifers in the shelf and oceanic waters of the eastern Arabian Sea and the Bay of Bengal.
**Fig. 8.** Variations in the abundance of lucifers during day and night.

Lucifer spp. are reported to be very common in the diets of pelagic fishes (Prasad, 1954; Rao, 1962; Nath, 1966; Kagwade, 1967; Sreecivasan, 1979). Huang et al. (1987) found the variations in abundance of lucifers and the catch of Decapterus maruadsi similar in the Taiwan waters.

The pattern of distribution and abundance of Lucifer reported in this study agrees with the distribution of young fish of several pelagic species reported by the investigations of the UNDP/FAO Pelagic Fishery Project along the west coast of India (Anon., 1975) and also with the areas of high abundance of the fishery resources of the Indian EEZ (George et al., 1977). Since lucifers play a significant role as food of fish and shrimps in their nursery grounds (Omori, 1974) it seems that the abundance of Lucifer spp. may serve as an indicator of these nursery grounds.

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