

CLADOCERAN SWARM IN RELATION TO MACKEREL FISHERY ALONG THE WEST COAST OF INDIA

R. ALFRED SELVAKUMAR

National Institute of Oceanography, CSIR Panaji (Goa)

THE Indian mackerel, *Rastrelliger kanagurta* (Cuvier), is one of the most important commercial fishes. On an average about 10% of the total marine fish catches from the Indian Coast include mackerel, of which about 98% is landed on the west coast. Fluctuations in the landings of mackerel are well known from year to year, the causes of which are still not properly understood. On the west coast of India the mackerel is caught from Ratnagiri to Quilon, but the major concentrations occur between Ratnagiri and Cochin. The actual fishing season lasts from August to March. Mackerel appears earlier in the south and late during the season northwards. Their movements from north to the south also follow a similar pattern (Panikkar, 1952).¹ The appearance of mackerel seems to be associated with the south-west monsoon.

such as copepods, cladocerans, tintinnids and larvæ of several groups predominate. Subrahmanyam (1959) also observed that on certain occasions when the phytoplankton is composed mainly of setoid forms like *Chaetoceros* sp., *Bacteriastrum* sp., *Rhizosolenia* sp., etc., a fall in the zooplankton biomass occurs. Thus an interrelationship between the occurrence of setoid forms and the appearance of smaller zooplankton organisms such as cladocerans is evident.

The association of cladoceran swarm with the onset of mackerel fishery was studied by the author based on the observations made at Karwar during the 1966 fishing season and at Goa in 1969 season. A review of earlier studies clearly indicates the relationship as given in Table I. Karwar and Goa fall along mackerel fishery belt where very high catches are

TABLE I

Showing the relationship between the cladoceran peak and the mackerel fishery period along the west coast of India as observed by various authors at different localities

| Mackerel fishing season | Locality | Period of cladoceran abundance and its peak | Author |
|---------------------------------|-----------------|--|--|
| July/August to February | .. Trivandrum | July to October peak at July | Menon, M. A. S. (1945) |
| August to March | .. Cochin | July to September peak at August | George, M. J. (1958), Menon, N. R., Venugopal, P. and Goswami S. C. (1969) |
| August/September to March/April | Calicut | July to November peak at August | George, P. C. (1953) |
| September/October to March | .. Karwar | August to February peak at September/October | Noble, A. (1962), Ramamurthy, S. (1965) |
| October to March | .. Panaji (Goa) | September to February peak at October | Selvakumar, R. A. (Unpublished) |

Mackerel is a plankton feeder and its movement in dense shoals in the inshore waters during the post-monsoon season is associated with the availability of plankton in abundance during that period (Panikkar, 1952; Bhimachar and George, 1952² and Noble, 1962).³ Subrahmanyam (1959)⁴ has stated that the outburst of phytoplankton depends upon the outbreak of monsoon from south towards north. The peak in the zooplankton abundance occurs during the south-west monsoon season, immediately after the phytoplankton bloom. During this period, usually the smaller zooplankton

recorded. In 1966, the cladoceran swarm was noticed in the plankton at Karwar during the first week of October. Soon after the swarm, the mackerel shoals were sighted inside the bay and the first "rampan" net was operated for mackerel on 9-10-1966. Similarly, during 1969, the cladoceran swarm was observed in the plankton in the coastal waters of Goa in the third week of October and within a week heavy catches of mackerel were landed. The cladocerans referred to here were *Eudae tergestina* Claus. and *Penilia avirostris* Dana. Amongst the cladocerans *Eudae* appeared

earlier and was greater in abundance than *Penilia* in the plankton both at Karwar and at Goa. This seems to confirm the observations made by George (1953)⁵ at Calicut and Ramamurthy (1965)⁶ at Karwar.

A review of the report on food and feeding habits of mackerel suggests a possible trophic relationship between mackerel and cladoceran in the coastal waters. It is known (Pradhan, 1956)⁷ that only the juvenile mackerel of size 18–22 cm. contribute mostly to the commercial catches in the post-monsoon months. Bhimachar and George (1952) have observed that the cladocerans formed a substantial part of the diet of juvenile mackerel during the period August to December and it is during this period that the cladocerans are abundant in the plankton. Noble (1962) has observed maximum cladocerans in the stomachs of mackerel during September, when *Evadne* was dominant in the plankton. Menon (1945)⁸ reported from the Trivandrum coast that the cladocerans have a maximum abundance from July to October.

This relationship becomes more certain when temperature and salinity data during the cladoceran maxima and mackerel fishery period are examined. Cladoceran abundance in the plankton off Calicut is recorded when the temperature and salinity ranged between 24.4–26.5° C. and 30.5–33.3‰ (George, 1953). Similarly, in the Cochin region *Evadne* was observed in large numbers in the plankton from July to September when salinity was low (George, 1958).⁹ Ramamurthy (1965) has observed that the cladocerans constituted a major group in the coastal plankton during the later half of the south-west and early north-east monsoon (August–November) and that *Evadne* appear to prefer a lower salinity (16.17–30.94‰) than *Penilia* (29.0–33.56‰) whereas the corresponding temperature is 26.0–27.6° C. for *Evadne* and 26.5–28.0° C. for *Penilia*. Recently, Menon, Venugopal and Goswami (1969)¹⁰ found that the cladoceran abundance is maximum near the Cochin harbour in August and September when the salinity is low.

At Goa, during October 1969, when the cladoceran swarm occurred, it was noted that the conspicuous phytoplankton were setoid forms such as *Chaetoceros* sp., *Thalassiothrix* sp., *Nitzschia* sp. and *Ceratium* sp. So a possible association seems to exist between these four forms and cladocerans.

Both *Evadne* and *Penilia* were equally abundant during the third week of October 1969, at Goa, the average temperature, salinity and oxygen were 28.0° C., 32.00‰ and 3.50 ml./l. respectively. From the table given by Ramamurthy (1965) it is evident that the cladocerans are absent during the period of south-west monsoon. They appear in August and reach their peak abundance in October. This peak obviously coincides with the onset of the mackerel fishing, which as reported earlier by Pradhan (1956) starts in October at Karwar, whereas Noble (1962) observed the cladoceran peak in September at Karwar.

The occurrence of peak abundance of *Evadne* and *Penilia* which follow the phytoplankton bloom appears to be associated with the favourable water temperature and salinity of 26–28° C. and 27–32‰ respectively in the waters of west coast as observed by various authors. There is enough reason to propose that the appearance of cladoceran swarm and their progressive movement from south to north heralds the mackerel shoals.

Further investigations on the occurrence and growth of cladoceran forms in association with phytoplanktonic elements constituting the plankton crop in the coastal waters is in progress which would render more evidence towards the proposed correlation.

ACKNOWLEDGEMENT

The author wishes to thank Dr. N. K. Panikkar, Director, National Institute of Oceanography, Panaji (Goa), for his encouragement and guidance in the present investigation and to Dr. S. Z. Qasim, Shri R. Jayaraman and Dr. P. V. Dehadrai, Scientists of the Institute, for critically going through the manuscript and offering helpful suggestions.

1. Panikkar, N. K., *J. Bombay nat. Hist. Soc.*, 1952, **50**, 741.
2. Bhimachar, B. S. and George, P. C., *Proc. Ind. Acad. Sci.*, 1952, **36** (3), 105.
3. Noble, A., *Indian J. Fish.*, 1962, **9** (2), 701.
4. Subrahmanyam, R., *Proc. Ind. Acad. Sci.*, 1959, **50**, 113, 189.
5. George, P. C., *J. Zool. Soc. India*, 1953, **5** (1), 76.
6. Ramamurthy, S., *J. Mar. biol. Ass. India*, 1965, **7** (1), 127.
7. Pradhan, L. B., *Indian J. Fish.*, 1956, **3** (1), 141.
8. Menon, M. A. S., *Proc. Ind. Acad. Sci.*, 1945, **22** (2), 31.
9. George, M. J., *Indian J. Fish.*, 1958, **5** (2), 375.
10. Menon, N. K., Venugopal, P. and Goswami, S. C., *Abstracts, First All-India Symposium in Estuarine Biology*, Madras, 1969.