ON THE ZOOPLANKTON OF THE INSHORE WATERS OF KARWAR DURING 1980-81

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ABSTRACT

Studies conducted during 1980-1981 have shown that there is a good standing stock of holoplankton in the inshore waters of Karwar, in addition to frequent swarms of meroplankton. The variations of both numerical abundance and total biomass are bimodal, one peak occurring during March-April and the other in September or October. Whereas the broad-based March-April peak is a conglomeration of varieties of holo- and meroplankters, the narrow and sharp September|October peak is in the main constituted by sudden and acute swarmings of one or the other of the two cladoceran species *Evadne tergestina* and *Penilia avirostris.* Owing to this constitutional difference, the distribution of biomass, though is concurrent with that of the numerical abundance, does not keep a magnitude similar to the latter; whereas the peaks of both numerical abundance and biomass go hand in hand in March-April, the peak of the latter is far less pronounced than that of the former in September|Octobcr.

In the SW monsoon, when there is a decrease in salinity, temperature and abundance of zooplankton, there is only a minor fishery, which is generally devoid of mackerel. But in the postmonsoon season, following the gradual ascend of temperature and salinity, and a manifold increase in the numerical abundance of zooplankton, chiefly due to the swarming of cladocera, the fishery suddenly improves, particularly with large catches of mackerel. Subsequently, on the approach of summer, while the temperature is still on the increase and the variation in salinity minimal, and with copepods now constituting the greater part of the zooplankton, the fishery gains its height and the catch composition becomes multispecies, a condition continuing though with variations till the advent of next SW monsoon.

INTRODUCTION

Studying the zooplankton of the coastal waters of Karwar, Ramamurthy (1965) had recorded two peaks, onje between March and May and the other during August and November, and swarming of cladocerans when there was lowering of temperature and salinity. He had also found that the lowering of temperature and salinity during monsoon reduced the copepod component, though copepodites were noted all through the year. Nair (1978) too had reported two peaks of zooplankton, one in October-December (peak fishing season) and the other in the premonsoon. Pradhan (1956) had observed that the

lowering of salinity due to the influx of the Kali river in SW monsoon had some influence on the occurrence of mackeral in the Karwar bay. Selvakumar (1970), reviewing the earlier studies, found a relationship between the cladocerans and the mackerel fishery along the west coast of India and contended that the appearance of cladoceran swarms progressively from south to north heralded a like progression of mackerel shoals. The present paper is an attempt to study the composition and fluctuation of zooplankton of Karwar waters based on observations between January 1980 and December 1981 in comparison with the fisheries.

MATERIAL AND METHODS

Weekly samples of zooplankton by surface hauls of 10 min. duration were collected from a station with a depth of 12 m off Karwar between 0630 and 0730 hours, using a net of half a metre in diameter, made of nylon material of mesh size 0.33 mm. The samples were preserved in *5%* buffered formalin prepared in seawater. Biomass of each sample was estimated by determining the displacement volume. A portion of not less than 5 ml was analysed when the displacement volume exceeded 5 ml, otherwise the entire sample was counted for the total number of organisms belonging to each group.

The temperature of the water was read on board a boat 'Aiyala' or, in the monsoon season, on an outrigger canoe, after the sample was taken. The methods described by Strickland and Parsons (1968) were followed for "determining salinity and dissolved oxygen.

The percentage composition of the fishery was calculated from the estimated catch from the Karwar bay.

OBSERVATIONS

Environmental Factors

The fluctuations in the surface temperature, salinity and the dissolved-oxygen content are given in Fig. 1 along with the relative abundance of the important zooplankton groups.

The variations in temperature as well as salinity were more or less similar in the beginning of the year and both recorded their maximum in summer. The salinity declined steeply in the SW monsoon season, but recovered steadily and kept a uniform trend from postmonsoon onward. The temperature fall observed in the monsoon season was steeper than that recorded subsequently toward the end of the year. The Karwar waters remained rich in the dissolved-oxygen content almost throughout the period of study (see Fig. 1).

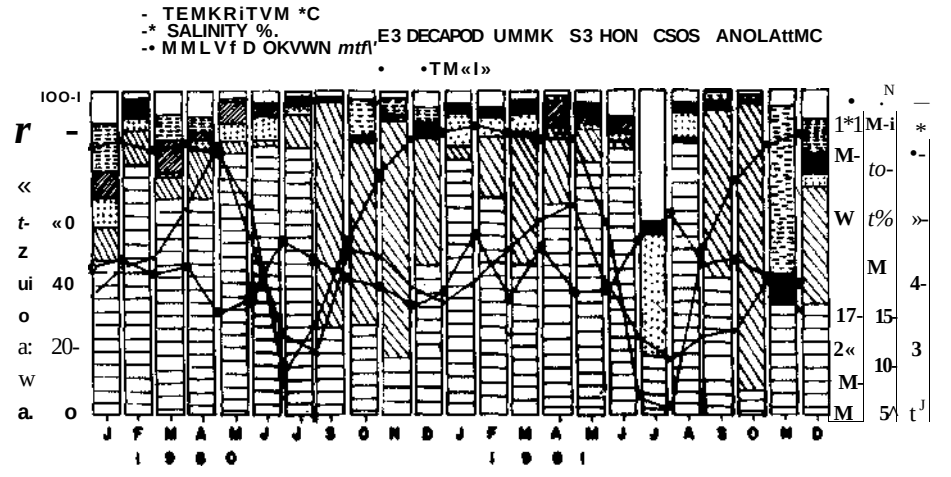

FIG. 1. Relative abundance of important zooplankton groups in relation to environmental parameters.

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The monthly averages of numerical abundance of different groups are given in Figs. 2 and 3 and those of the total zooplankton, copepods and the larval forms along with the total volumes, in Fig. 4.

Copepods: Copepods formed the major portion of the zooplankton except when cladocera occurred in swarms. In July 1981, when most of the organisms were scarce, the copepods constituted 18.2% (Fig. 1) of the standing stock. However, they formed more than 65% in April and 80% in May.

Cladocera: Cladocera (Fig. 1), represented by *Evadne tergestina* and *Penitia avirostris*, far exceeded copepods in numerical abundance during September (70.2%), October (57.5%) and November (73.3%) in 1980, and in October (89.6%) in 1981. Whereas *Evadne* occurred more during September-December in 1980 and March-April in 1981, *Penilia* was dominant in October 1981 (Fig. 2).

Chaetognatha: Chaetognaths occurred in good numbers during March-May and October-December (Fig. 2). *Sagitta enflata* and *S. bedoti* were common, but the former disappeared during July-September. *S. robusta, S. bipunctata, Pterosagitta draco* and *Krohnitta* sp. were observed occasionally.

Sergestidae: Lucifer hanseni was the most commonly occurring species of this group. *L. typus* was encountered in a few samples. Lucifers were more during January, March-May, October and December (Fig. 2).

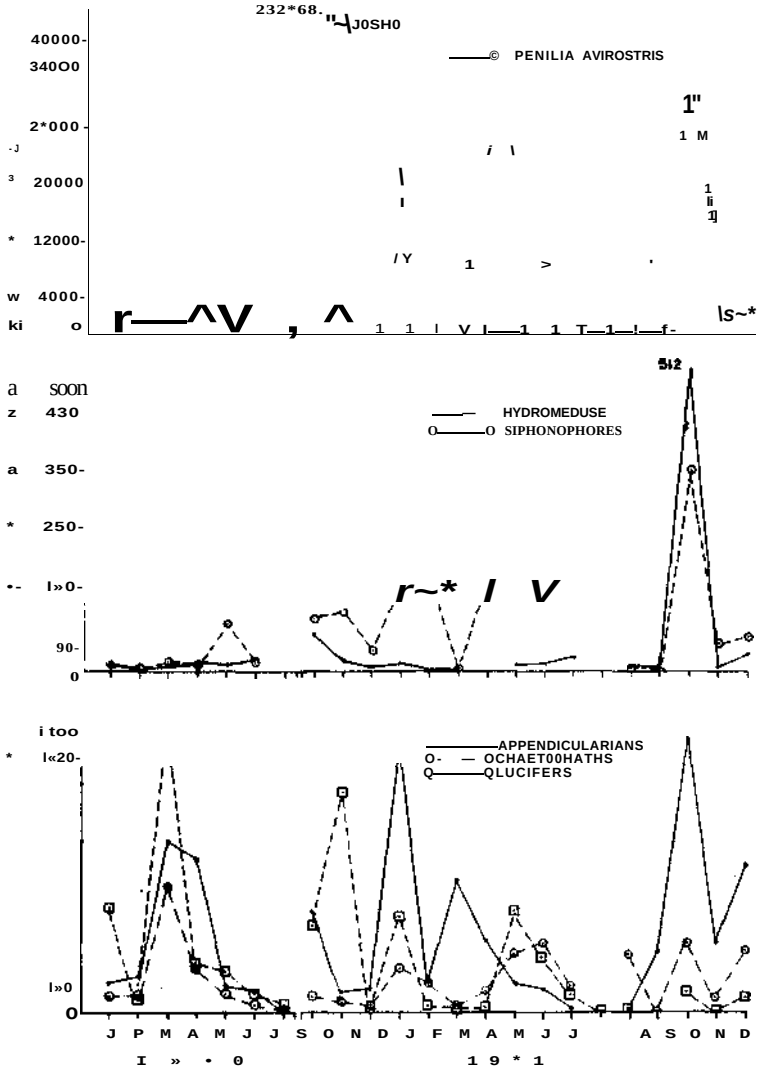

FIG. 2. Monthly abundance of various groups of zooplankters.

Appendicularians: Appendicularians, represented by the genus *Oikopleura*, were moie common between February and April and in October and December (Fig. 2).

Hydromedusae: Hydromedusae recorded an increase during September-October.

Siphonophores: Siphonophores, represented by the species of *Diphyes*, *Lensia* and *Agalma*, were rarely absent except in July and were more in number during January, March-May, September-October and December.

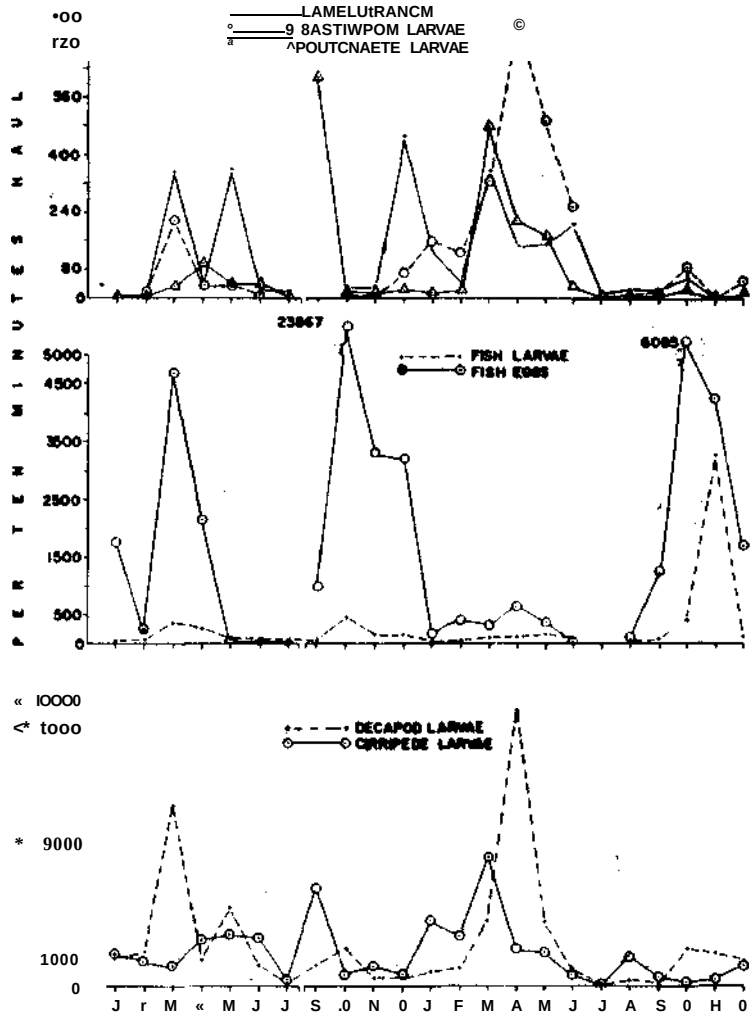

FIG. 3. Monthly abundance of various groups of larval plankton.

Laival forms: Decapod larvae constituted the major portion of the larval plankton except during September-December, when fish eggs and larvae were dominant (Fig. 3). The sergestid larval stages were dominant among the decapod larvae throughout.

Decapod larvae: Decapod larvae, as a group, which were normally more abundant in summer, formed 9.8% and 8.7% in March 1980 and April 1981, respectively (Fig. 1 & 3).

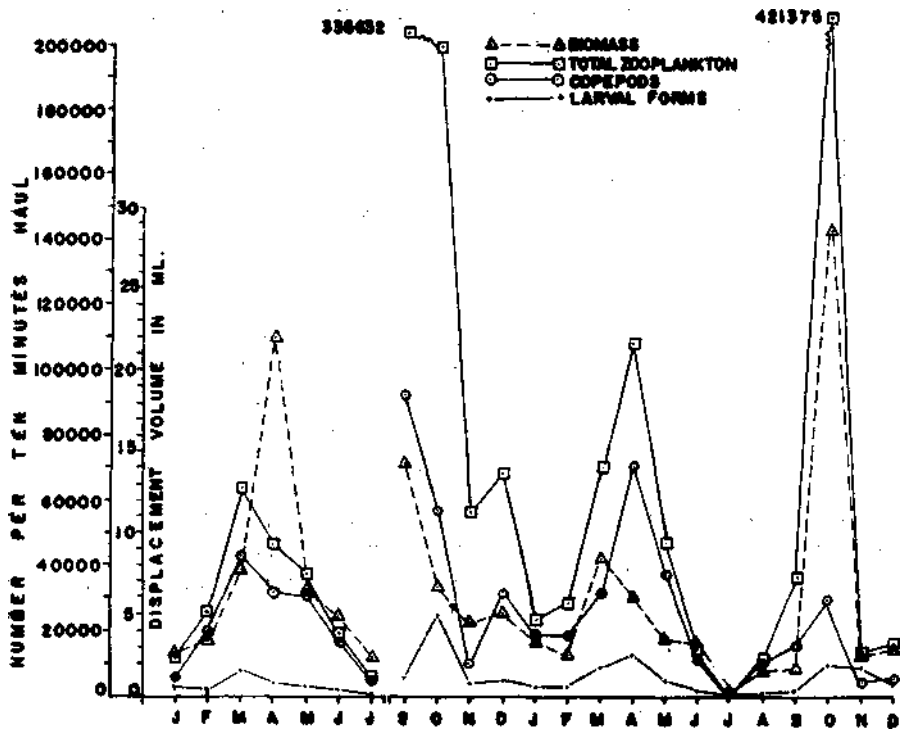

FIG. 4. Variations in biomass, total zooplankton, Copepods and larval forms.

The developmental stages of lucifers were common throughout and were more abundant during February-May, October and December. The larvae of *Aceies* sp. were observed more during March-June, November-December and January. Larvae of *Metapenaeus dobsoni, M. monoceros* and *M. affinis* were common during March-April and November-December and those of *Parapenaeopsis stylifera* in January and between March and May. On the other hand, larvae of *Penaeus indicus* and *P. merguiensis* were scarce throughout. Among the anomuran larvae paguridae dominated during the greater part of the year. Porcellanidae were absent in March, June-July and September. *Callianassa* sp. were encountered during February, May-July and November-December. Larval stages of albuneidae, hippidae and axiidae were rare. *Clibanarius padavensis* and a few other species of *Clibanarius* were observed from February to May and in August, October and December. Caridean larvae of families alpheidae and palaemonidae appeared more frequently than hippolytidae and atyidae, during the premonsoon months and in October. Young ones of *Palaemon semmelinkii* (Jagadisha and SankoUi 1977) were observed only between April and June and those of atyidae in August and September. Larvae of brachyurids occurred almost

throughout the year. A single specimen of Majidae was encountered in March 1981. Though most of the brachyurids belonged to gonoplacidae, leucosiidae, pinnotheridae and xanthidae, larvae of other families also occurred in the samples. Increased abundance of brachyurids was observed during March-June and October-December. *Oratosquilla nepa* and *Acanthosquilla* sp. were the common larval forms of stomatopoda occurring in small numbers during January, May and December. Palinurid phyllosomas were present only in January 1980.

Fish eggs and larvae: Fish eggs and larvae were common except during June-August (Fig. 3). Great number of fish eggs occurred during March-April in 1980 and October-December of both the years and once in January in 1980. The number of fish larvae observed was high usually during the summer months and from October to December. They (Fig. 1) constituted 15.3% in January and 12.3% in October in 1980 and as high as 51.9% in November 1981.

Cirripede larvae: Cirripede larvae were present throughout (Fig. 3), often forming a large portion of the total zooplankton, with a maximum of 38.2% (Fig. 1) in July 1981, when most of the other forms were absent. *Balanus nauplii* and cyprids were more common during April-June and September 1980 and from January to May and in August in 1981.

Molluscan larvae: The larvae of lamellibranchs or gastropods, and sometimes both, were common, and the period of their abundance varied between the two years (Fig. 3). Lamellibranch larvae were more abundant during March, May and December in 1980 and in January and from March to June in 1981. The gastropod larvae showed marginal increases during March and December in 1980, but the variations in their abundance had followed a trend simlar to that of lamellibranchs in 1981.

Polychaete larvae: The polychaete larvae were common in March-June and September.

Other groups: Pteropods, represented by *Cresehs acicula,* occurred during a greater part of the year and were more conspicuous in April, October and December in 1980 but only in October in 1981. Ostracods occurred only during November-December in 1980. Mysids were rare and a few specimens of *Rhopalophthalmus* sp. appeared in April and October. Gammarid amphipods were common especially during August-October. Doliolids were rare but occurred in a large number once in October 1981. Only one species of ctenaphore, *Pleurobrachia globosa,* was present, during February, April, June, August and October. The cyphonautes larvae of brachiopods, both *Pelagodiscus* and *Lingula,* appeared in all the months other than July-September. Echinoderm larvae were present during January-March, November and December.

Fishery

The percentages of the important groups that constituted the fishery of Karwar are given in Fig. 5. The seasonal variations in the composition of the fish catch during both 1980 and 1981 followed more or less a similar trend. The monsoon fishery included gobids, flat fishes, eels, prawns, crabs, *Platycephalus* sp. in addition to engraulids, sciaenids, *Opisthopterus tardoore, Otolithus* sp. and sometimes oil sardine also.

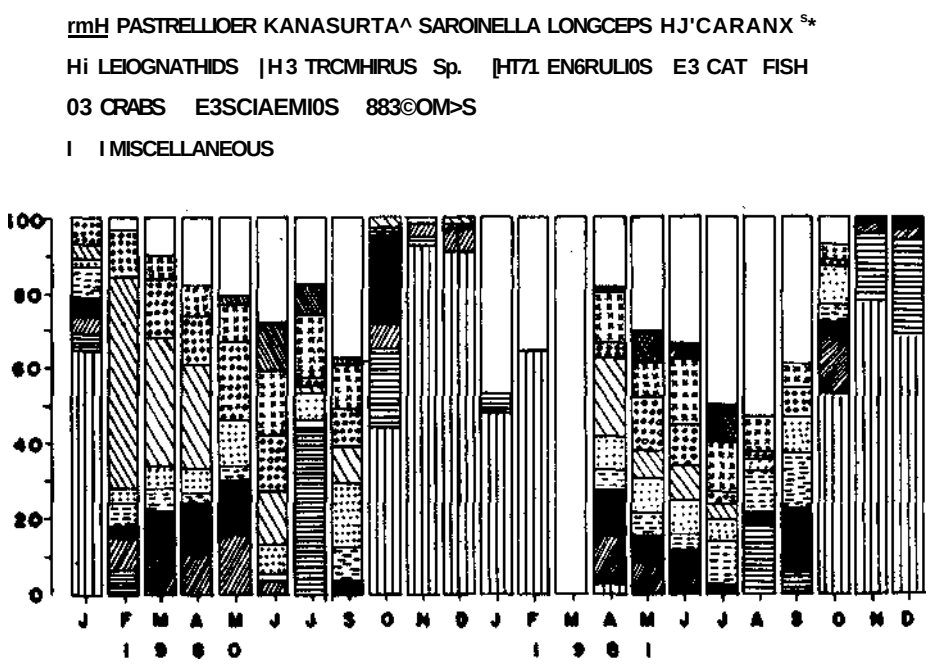

FIG. 5. Percentage composition of the fishery of Karwar region.

The fishing season, in the real sense, normally begins in the early post-monsoon, with sporadic occurrence of mackerel. Soon the fishery becomes very active with good catches of mackerel; during the November-December period of 1980 mackerel formed above 90% and during the same period of 1981 they formed about 70%. The catfishes, sciaenids, leiognathids, *Caranx* sp, sharks, ribbonfishes and *Lactarius lactarius* all contributing to the fishery, the fishery became multispecies and gained strength in the postmonsoon season.

DISCUSSION

Fig. 4 shows that the varations in the numerical abundance of organisms and the biomass are bimodal, with one peak in September-October and the other

in March or April. The dissimilarity in composition of these post- and premonsoon peaks and the numerical superiority of the former may be attributed to the upwelled water (Sharma 1968) together with the influx of river and land drainage replenishing the nutrients in the coastal waters and causing spurts of primary and secondary productions. Such phenomena are known to occur all along the southwest coast (Mukundan 1967).

Cladocerans occurred in swarms in the postmonsoon season; *Evadne tergestina* constituted the postmonsoon peak of 1980 and *Penilia avirostris* that of 1981. It is significant that the swarm (2,32,968 |haul) observed in September 1980 occurred when the monthly mean surface salinity was less than 15%. The cladoceran population recorded in September was the highest in 1980 (Fig. 2), but then the mackerel fishery was extremely poor. Whereas in October when the cladocera abundance was reduced to less than one half of that of the previous month the mackerel formed the major part of the fish catch. On the other hand, in October 1981 the occurrence of the swarms of cladocera and shoals of mackerel were almost simultaneous. Probably large shoals of mackerel followed almost immediately the swarms of cladocera in the inner nearshore region of Karwar as suggested by Selvakumar (1970). Though the cladocerans constituted a sizable percentage of the zooplankton population while the salinity continued to incrase (Fig. 1), the extraordinary spurt of abundance of organisms noticed in the early part of the postmonsoon subsided before the end of November. Consequently there was a sudden drop in the numerical abundance of zooplankton population (Fig. 4). However, mackerel continued to dominate the fishery up to January or February. Soon after die swarms of cladocera ceased the change in the population structure became conspicuous and the various constituent groups notably fish eggs (November 1981) and larvae recorded increased abundance.

Following the decrease in the abundance of cladocerans and increase in salinity and temperature the zooplankton was enriched by the appearance of developmental stages of various organisms and fish eggs and larvae. The concentration of fish eggs forming 51.9% in November 1981 was the highest recorded during the period of study. On the approach of summer, when more or less stable salinity conditions prevailed and the temperature was on a steady increase, the composition of the zooplankton population underwent remarkable change with copepods constituting the bulk of the biomass, which, together with the larval decapods and other groups, formed the broad-based premonsoon peak in March or April. During the period of these changes in the plankton population, beginning from January |February, the fishery of both the pelagic and the demersal species gained strength and consequently the composition of the fish catch became diverse. This condition continued till the advent of the SW monsoon.

Fish eggs and larvae were in greater abundance during March-April and from October to December unlike in the nearshore waters of Mangalore, where Suresh and Reddy (1975) observed them in abundance during August-November, and in the coastal waters of Bombay, where Gajbhiye et al (1982) observed similar abundance during the pre- and postmonsoon months. The larvae of the commercially important prawns were present during the greater part of the year, those of *Penaeus indicus* and *P. merguiensis* being the least abundant among them. Increased abundance of the larvae of *Metapenaeus dobsoni, M. monoceros, M. affnis* and *Parapenaeopsis stylifera* indicates that these species showed greater preference to moderate to high salinity and a slightly higher temperature for intense spawning activity.

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