

## ZOOPLANKTON VARIABILITY IN THE ZUARI ESTUARY, GOA

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### ABSTRACT

Short term variability in the secondary production and composition of zooplankton were studied during February to March 1979 by collecting zooplankton every alternate day from a station located near the mouth of Zuari. Irregularity in the production rate of zooplankton was found to be a characteristic feature. Rate of zooplankton production fluctuated from 52 to 1388 mg C/100 m<sup>3</sup>/day. A total of six peaks in zooplankton biomass was observed and the time lag between two peaks was 7 to 14 days. High values of zooplankton biomass were associated with high tide.

Distribution of various groups of zooplankton indicated variability in their quantitative and qualitative representation. Most common groups like copepods, decapods and chaetognaths followed a pattern similar to that of the biomass. *Lucifer hansenii* formed an appreciable part of the total decapod population. *Acetes indicus* and penaeid larvae were more common in February. Congregations of cirripede nauplii appeared thrice during the period of investigation. *Sagitta bedoti* dominated the samples till middle of March and later *S. inflata* became the most abundant species. Groups like ctenophores, polychaetes, gastropods and cladocerans occasionally appeared in patches. It would appear that spatial heterogeneity in zooplankton population can be better explained by more frequent sampling.

*Key-words* : Zooplankton variation, Zuari estuary.

### INTRODUCTION

Variability is a characteristic feature of plankton distribution. To a certain extent the interaction of the prevailing physico-chemical parameters are responsible for spatial difference in abundance and diversity of zooplankton. Such variations are bound to be well pronounced in an estuarine habitat which is undergoing considerable fluctuations in its physico-chemical characteristics. The available information on zooplankton from estuaries of India are on the seasonal fluctuations of total as well as individual species based on collections usually taken at monthly intervals (Rao, 1977). Report on short term variability in zooplankton from estuaries in India is limited to the investigation made by Santhakumari and Vannucci (1977) on the hydromedusae from Cochin backwaters. Hence, a study was conducted in Zuari estuary for evaluating the short term variability in the rate of secondary production and zooplankton population.

### MATERIALS AND METHODS

The station selected for the study was located towards the mouth of the Zuari estuary (Fig. 1). Zooplankton samples were collected on alternate

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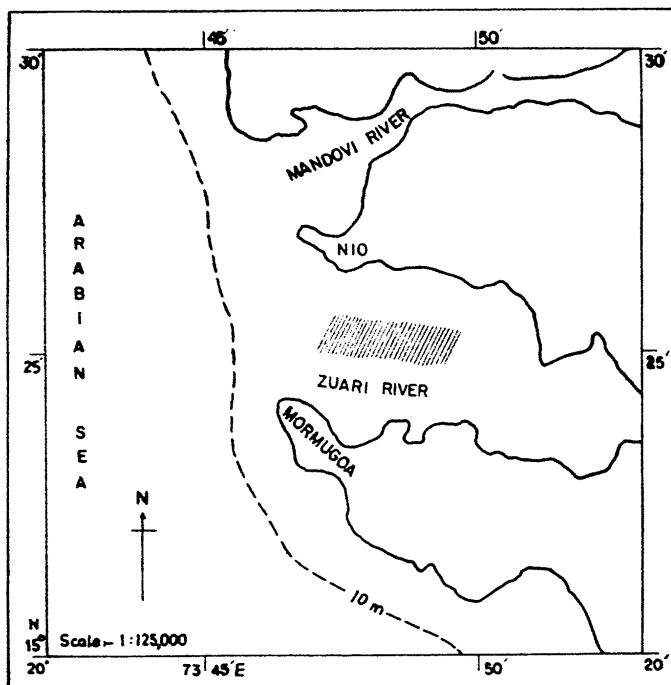


Fig. 1. Map showing the study area (hatched area)

days between 1000 and 1030 hrs from 1-2-1979 to 30-3-1979. Collections were made using an HT net (mouth area 0.25 m<sup>2</sup>; mesh size 0.3 mm) attached with a flow meter. Trial sampling indicated that maximum population was confined to approximately 5-7 m depth and an oblique haul from this depth was representative of the entire water column. Duplicate samples were collected for estimating dry weight and organic carbon (El Wakeel and Riley, 1957). Salinity and temperature were measured using a salinity temperature bridge.

## RESULTS AND DISCUSSION

### *Temperature and salinity*

Temperature varied from 26.6 to 30.5 °C (Fig. 2). Temperature values were relatively low in February and it gradually increased during March. Day to day variation in temperature was not drastic. Salinity fluctuation was from 32.5 to 36.0‰. Range in salinity variation was more in February than March.

### *Biomass and rate of secondary production*

Standing stock of zooplankton showed great amount of fluctuations from 2.6 to 74.8 ml/100 m<sup>3</sup> (Fig. 2). Mean zooplankton biomass during the

period was 11.7 ml/100 m<sup>3</sup>. A total of 6 peaks in biomass were observed and the high values were equally spread over the two months. Time lag between two peaks was usually in a range of 7-14 days. During February when temperature was relatively low time lag in peak occurrence of zooplankton was more. Concomitant with the increase in temperature, days required to attain the next peak production was found to be reduced. In general, high values of biomass were associated with relatively high range of temperature of 27.5 to 30.5°C and slightly lower range of salinity (32.5-34‰). The maximum biomass recorded on 1st February associated with low temperature appears to be an abnormal one.

Dry weight of 1 ml of zooplankton was within a range of 55-70 mg. Organic carbon content in zooplankton varied at a rate of 26-33% of dry weight and the mean percentage was 29. These values were taken for the estimation of secondary production. The rate of production varied from 52 to 1388 mg C/100 m<sup>3</sup>/day a mean of 218 mg C/100 m<sup>3</sup> day. The secondary production rate and organic carbon content of zooplankton are comparable to that reported earlier for the same period (Nair, 1980a & b). To a certain extent, the prevailing tide influenced the day to day variation in zooplankton biomass. Relatively, high biomass was encountered during flood and high tide

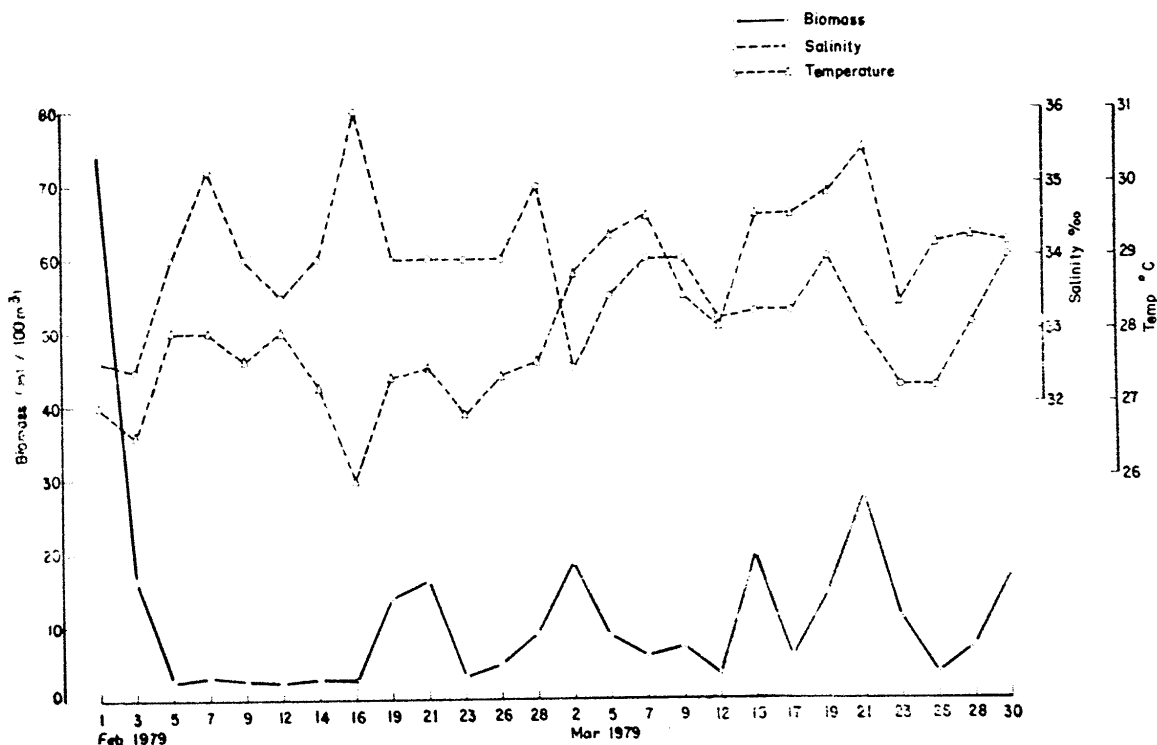


Fig. 2. Distribution of temperature, salinity and zooplankton biomass.

possibly because of the contribution of oceanic population. After assessing the tidal effect on zooplankton sample variability in a nearshore environment, Someoto (1975) also found relationship between tidal fluctuations and the composition of zooplankton samples.

#### Composition

Variability in the distribution of different groups and species are presented in Tables I and II and Fig. 3-5. Copepods formed the dominant group except during 5-7 February. Distribution of copepods followed a pattern similar to that of biomass (Fig. 3). Range in the population of copepod was 93 to 5167  $m^{-3}$ . Maximum density was recorded in that latter half of March.

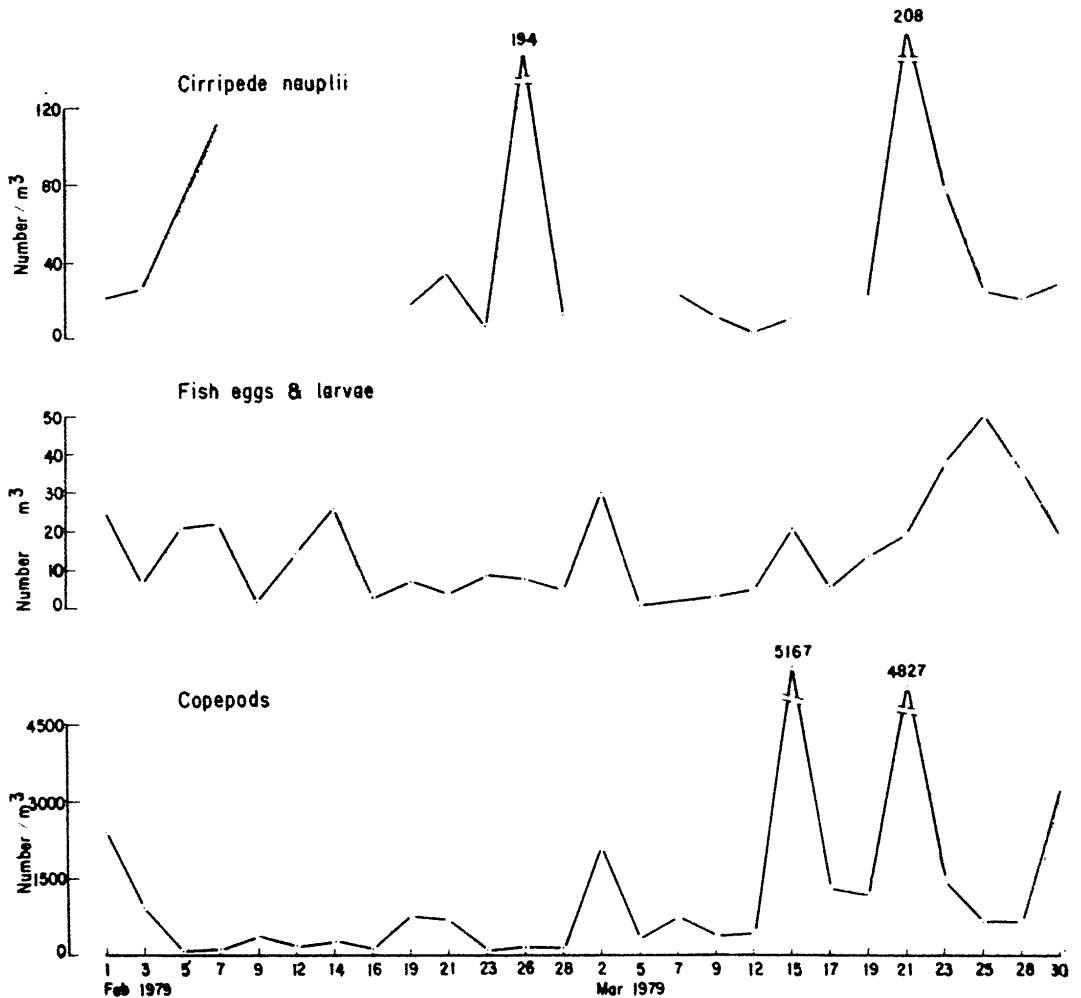


Fig. 3. Variability in the incidence of copepods, fish eggs and larvae and cirripede nauplii.

An appreciable part of the copepods belonged to the families Pseudodiaptomidae, Acartidae, Tortanidae, Pontellidae, Paracalanidae and Centropagidae.

Fish eggs and larvae were found throughout the period of study and their population ranged from 1 to 50/m<sup>3</sup> (Fig. 3). The rocky area close to the estuary harbours *Balanus amphitrite* and hence cirripede larvae appeared at regular intervals. Cirripede nauplii occurred in high density on three occasions during the period of observation. The time lag between the peaks was 19-23 days. During the remaining period they were either not present or obtained in very few numbers.

In the order of dominance decapod was next to copepods. The density of decapods varied between 8 and 1307 m<sup>-3</sup> (Fig. 4). The peak occurrence of this group coincided with the peak in total zooplankton biomass. *Lucifer*

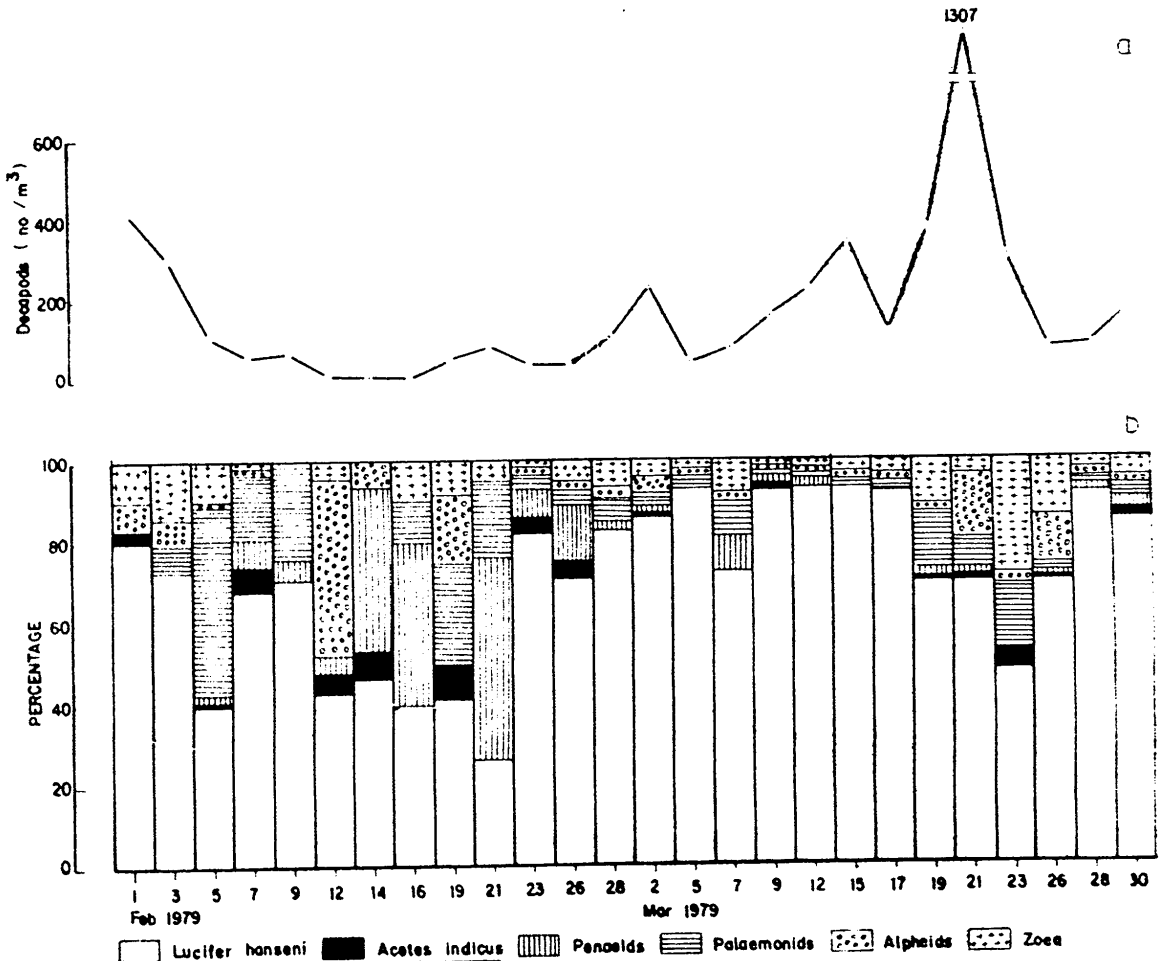


Fig. 4. Variability in the total number (a) and percentage incidence (b) of different species and groups of decapods.

*hanseni* formed the major part of the decapods (40-93%). *Acetes indicus* was more common in the collection during the month of February. Penaeid larvae started appearing on 5 February and attained the maximum on 21 February followed by a secondary peak on 21 March. Penaeid larvae represented in the collections were *Metapenaeus dobsoni*, *M. monoceros*, *M. affinis* and *Penaeus merguensis* in the order of abundance (Table I). Palaemonids and alpheids were commonly found in the area. High concentration of palaemonids were observed during 5-21 February and 19-25 March. Peak in the population of alpheids was recorded on 12 February. Brachyuran, macruran and porcellanid zoea were also represented in the collections. Incidence of brachyuran zoea was more than the other two contributing 1.2 to 26.4% of the total decapods. Porcellanid zoea were better represented in March than February.

Variability in the total number and percentage occurrence of chaetognaths is shown in Fig. 5. The pattern of distribution of chaetognaths followed that of the biomass. The population of chaetognaths fluctuated between 22 to 4010 / 100 m<sup>3</sup>. *Sagitta bedoti* and *Sagitta enflata* were commonly found while *S. pacifica* was recorded only once during the period of study.

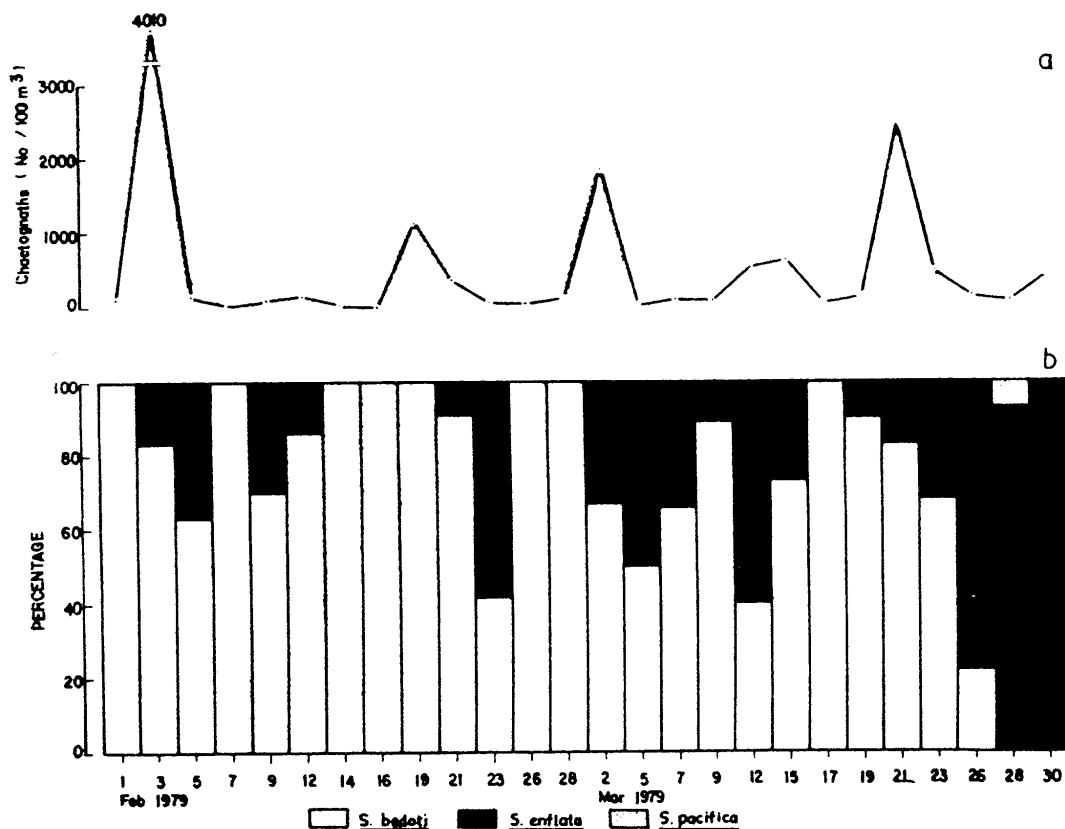


Fig. 5. Variability in the total number (a) and percentage incidence (b) of different species of chaetognaths.

Table I. Incidence of penaeid larvae and zoea (no./100 m<sup>3</sup>)

Date	<i>M.</i> <i>dobsoni</i>	<i>M.</i> <i>monoceros</i>	<i>M.</i> <i>affinis</i>	<i>P.</i> <i>merguiensis</i>	Brachyuran zoea	Macruran zoea	Porcellanid zoea
1.2.79	---	---	---	---	2005	---	2005
3.2.79	---	---	---	---	4011	---	---
5.2.79*	80	80	---	---	1310	80	---
7.2.79	270	180	---	---	45	---	---
9.2.79	---	405	---	---	---	---	---
12.2.79	---	69	---	---	69	---	---
14.2.79	243	245	---	---	---	---	---
16.2.79	241	80	---	---	80	---	---
19.2.79	---	---	---	---	434	---	---
21.2.79	3824	430	---	---	424	---	---
23.2.79	277	---	40	---	40	---	---
26.2.79	464	---	---	58	116	---	58
28.2.79	138	---	46	---	644	---	46
02.3.79	234	---	---	---	935	---	468
05.3.79	---	---	---	---	102	---	---
07.3.79	469	156	---	---	469	---	156
09.3.79	179	107	---	---	184	36	71
12.3.79	27	---	27	---	375	---	27
15.3.79	---	---	---	---	643	214	215
17.3.79	---	---	---	---	361	45	45
19.3.79	511	219	73	---	4384	---	219
21.3.79	832	416	---	---	6241	---	---
23.3.79	---	---	---	---	7754	---	310
26.3.79	---	---	41	---	1145	---	41
28.3.79	---	---	---	---	263	---	---
30.3.79	179	357	---	---	536	---	---

\* Record of *Solenocera* Sp.

*S. bedoti* is a typical neritic species (Nair, 1977). During February *S. bedoti* dominated the samples. From the beginning of March *S. enflata*, an oceanic species became more common and from 26 to 30 March they dominated the samples.

Fluctuations in the incidence of some groups of zooplankton which were not very common are given in the Table II. Most of these groups occurred in patches for a few days and then disappeared and reappeared after a few days. Cladocerans were represented by *Penilia avirostris* and *Evadne tergestina*. Aggregations of cladocerans and gastropods were encountered in the middle of March.

The present short term study indicates great amount of fluctuation in the zooplankton standing stock as well as incidence of various groups/species. Such patterns of incidence suggest that the most important source of variability in plankton abundance is the patchy distribution of organisms. This variability creates difficulty in determining how representative is the average density of animals present over a wider area or longer period. It would appear that spatial heterogeneity in density and composition of zooplankton can be better explained by more frequent sampling.

Table II. Incidence of rare groups of zooplankton (no/100 m<sup>3</sup>).

Date	Hydro-medusae	Ctenophore	Polychaetes	Gastropods	Mysids	<i>Penilia avirosotis</i>	<i>Evadnae tergestina</i>	Appendicularians
1.2.79	396	132	—	527	—	—	—	—
3.2.79	—	668	—	—	167	—	—	—
5.2.79*	—	20	—	—	—	120	60	—
7.2.79	—	—	60	69	—	54	—	360
9.2.79**	—	—	54	54	—	—	—	20
12.2.79	—	—	91	91	—	—	—	—
14.2.79	—	—	—	108	—	—	—	40
16.2.79	—	20	54	27	—	—	—	27
19.2.79	—	35	56.5	56.5	35	—	—	1130
21.2.79	—	—	—	—	—	—	—	—
23.2.79	40	40	—	—	—	—	—	79
26.2.79	—	—	174	—	58	—	232	—
28.2.79	46	230	46	—	—	—	—	—
02.3.79‡	—	701	468	—	—	—	—	—
05.3.79	—	70	70	—	—	—	—	70
07.3.79	—	—	—	—	—	—	—	313
09.3.79	—	107	—	—	—	—	—	—
12.3.79**	27	27	27	—	—	—	536	—
15.3.79**	214	429	1501	429	—	858	643	—
17.3.79§	—	45	45	135	—	5555	11787	1037
19.3.79	—	219	1169	4384	—	8037	3653	—
21.3.79	416	—	1248	29126	—	—	—	—
23.3.79	—	—	—	5829	—	—	—	—
26.3.79	—	—	82	818	—	—	—	82
28.3.79	—	—	1423	—	—	—	—	1159
30.3.79	—	—	536	—	—	—	—	357

\* Record of stomatopod larvae. \*\* Record of siphonophores. ‡ Record of cephalopod larvae. § Record of isopods.

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