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ZOOPLANKTON OF VASISHTA GODAVARI ESTUARY, A PRE-POLLUTION STATUS SURVEY*

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ABSTRACT

Result of a pre-pollution status survey of the zooplankton of the Vasishta Godavari Estuary (16° 18'N - 81° 42'E) undertaken between October 1981 and June 1983 are presented. Most of the species recorded tolerate much lower salinities than their counterparts of the estuaries in the west coast. Monthly fluctuations of zooplankton showed a distinct major peak in May and one or two minor peaks between October and February in the lower and upper reaches. However, in the middle reaches major peak was seen in November and minor peaks were observed between February and May. Zooplankton of the lower, middle and upper reaches was compared in terms of richness, diversity and evenness of species. Qualitative richness (99 species of adults and 28 types of larvae) and quantitative abundance of zooplankton indicates that the estuary is a highly productive ecosystem, free of any type of pollution affecting its biota.

INTRODUCTION

THE VASISHTA GODAVARI is the western distributary of the Godavari estuarine system opening into the Bay of Bengal at Antervedi (16° 18' N - 81° 42' E). Along with its shorter branch, Vainateyam, also opening into the Bay at Vadalarevu (16° 22' N - 81° 96' E), it carries about 20 million cusecs of flood water to the sea, a third of the total land drainage carried by the system in a normal year. The commercial exploitation of oil and gas wells of its basin planned from 1985-'86 had in its wake brought in a severe threat of pollution to it. Pollution of an aquatic ecosystem with oil and effluents from oil-based industries is known to result in a drastic change of its water quality along with large-scale destruction of the biota (Gabriel *et al.*, 1975; Fernandez *et al.*, 1977). In order to assess the extent of similar damage likely to be caused to the Vasishta Godavari Estuary, a comprehensive pre-pollution status survey was undertaken between October 1981 and June 1983 to provide base-line data on its hydrography and plankton. While the observations on physico-chemical characteristics were already published (Sai Sastry and Chandramohan, 1990 a, b), the present paper describes the observations on its zooplankton.

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Materials and Methods

Plankton samples were collected from the lower (station 1), middle (station 2) and upper (station 3) reaches of estuary by oblique hauls using a nylo-bolt townet (mesh size 143 μm) fitted with a calibrated flowmeter. The stations were located at 1, 13 and 28 km respectively from the confluence towards the head. Twentyone samples were collected from each of the lower and upper reaches (at fortnightly intervals) and fifty nine from the middle (at weekly/fortnightly intervals) between October 1981 and June 1983, excluding the annual flood period (July-September 1982).

Numerical estimates of smaller zooplankters were made based on aliquot counts (1-10% of the sample), while for larger forms like medusae and mysids the entire sample was examined.

Species Richness (SR), Species Diversity (H′), Species evenness (J′) and Similarity quotient (QS) were calculated using Gleason's formula (Gleason, 1922), Shannon's formula (Pielou, 1975), formula of Pielou (Pielou, 1966) and Juario's equation (Juario, 1975) respectively. Homogeneity between different samples was calculated as suggested by Wieser (1960) and Sanders (1960).

Results and Discussion

Temperature and salinity of the water column from where zooplankton samples were collected are summarised in Table 1.

Zooplankton of the Vasishta Godavari Estuary was qualitatively rich, because of considerable representation of coelenterates (28%), copepods (33%), other crustaceans (18%) and rotifers (12%), in addition to others in smaller numbers and invertebrate larvae of 28 types. Because of their frequency of occurrence and quantitative abundance, 29 species were considered as dominant and characteristics forms of the estuary (Fig. 1). Copepods and invertebrate larvae dominated zooplankton throughout the estuary, the former in the euryhaline/lower reaches of the polyhaline zones in the lower reaches of the estuary and the latter in the polyhaline zone of the middle reaches. Typical marine forms like ctenophores and chaetognaths were distributed according to the salinity gradient, declining in numbers along with decrease in salinity towards the upper reaches. However, *Oikopleura* spp. among the pelagic tunicates and *Sagitta bedoti* among chaetognaths were able to establish themselves and proliferate in the middle reaches for most part of the year. Among the zooplankters of the 'miscellaneous group', limnoplanktonic rotifers formed the bulk and were seen mostly in the upper reaches during early days of recovery phase when the salinity was very low. Coelenterates were largely concentrated in the lower reaches, while copepods, other crustaceans and pelagic tunicates were dominant in the lower and middle reaches. Invertebrate larvae were relatively abundant in the middle and upper reaches.

Based on the average density of zooplankters, middle reaches of the Vasishta Godavari Estuary ranked first and was followed by the upper and the lower reaches. Quantitative richness of the middle reaches, contrary to observations elsewhere, was because of frequent addition of nutrient-rich farm drainage on a large scale that triggers production and sudden blooms of phytoplankton, followed by zooplankton. Addition of freshwater at the time of increasing neritic penetration resulted in formation of ecotone in the middle reaches that encouraged the growth of large populations. Domination of zooplankton by low saline and brackishwater species for most part of the study period substantiates this presumption.

TABLE 1. *Distribution of temperature (°C)* and salinity ($x10^{-3}$)* in Vasishta Godavari Estuary*

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
St. 1 (1981-82)									
Temperature	30.3	27.3	24.7	26.1	27.4	28.9	30.7	30.9	29.6
Salinity	23.7	27.3	29.3	27.4	29.6	30.1	33.0	34.2	34.4
St. 2 (1981-82)									
Temperature	29.1	27.8	25.4	26.0	28.2	29.7	30.9	31.8	30.8
Salinity	5.6	17.7	23.6	21.6	23.2	24.9	27.4	29.8	30.7
St. 2 (1982-83)									
Temperature	28.8	28.2	26.3	23.8	27.7	30.0	30.5	32.1	31.2
Salinity	10.4	19.6	23.6	24.4	22.6	23.2	25.7	28.8	18.9
St. 3 (1981-82)									
Temperature	31.3	28.2	25.3	26.3	28.5	30.6	32.2	32.4	31.5
Salinity	0.6	.0.9	10.4	11.8	12.5	13.9	14.9	20.0	19.3

*Average monthly values of the water column.

TABLE 2. *Monthly fluctuations of major groups of zooplankton Density (No. m^{-3}); Salinity ($x10^{-3}$) in parentheses*

Taxonomic group		Lower reaches	Middle reaches	Upper reaches
Total no. of zooplankters	D	2080-519330	910-2708590	31930-1315970
	PP	May	Nov.	May
		(34.2)	(17.5-19.5)	(20.0)
Coelenterates	D	0-140	0-260	0-4
	PP	Oct.-Nov.	Oct.-Nov.	—
		(23.7-27.3)	(5.6-19.6)	
Copepods	D	1700-387800	120-255200	1500-531400
	PP	Feb.-May	Oct.-Nov.	Mar.-May
		(29.6-34.2)	(5.5-19.6)	(13.9-20.0)
Other crustaceans	D	0-80	0-460	0-40
	PP	—	—	—
Invertebrate larvae	D	170-281600	650-751700	5200-674900
	PP	Feb.-May	Nov./Feb./May	Feb.-May
		(> 29.6)	(17.7-29.8)	(> 12.5)
Chaetognaths	D	20-1000	10-16200	0-3300
	PP	May	Feb./Mar.	May
		(> 34.0)	(22.6-24.9)	(> 20.0)
Pelagic tunicates	D	20-51700	0-55400	0-25700
	PP	May	May	May
		(34.2)	(28.8-29.8)	(20.0)
Fish eggs & larvae	D	0-2300	0-4700	0-2500
	PP	—	—	—
Miscellaneous groups (Rotifers, etc.)	D	0-4600	0-24200	0-109300
	PP	Oct.	Oct.	Oct.
		(< 3.0)	(< 3.0)	(< 3.0)

D = Density; PP = Period of primary peak

The maximum density of zooplankters recorded during the present study is comparable to the densities observed by Sivakumar (1982) in Vellar Estuary (88908 m^{-3} with mesh size of 158 μm, by Madhupratap (1978) in Cochin Backwater (17842 m^{-3} with mesh size of 300 μm) and by Bhat and Gupta (1983) in Nethravati-Gurupur Estuary (187032 m^{-3} with mesh size of 200 μm at st. 1). The monthly fluctuations in the total number of zooplankters indicated periods of abundance with a distinct major peak in May and one or two minor peaks between October and February in the lower and upper reaches and a clear major peak in November and one or two minor peaks between February and May in the middle reaches (Table 2). Major peaks were associated with an average salinity of the water column around 34.0 and 20.0 × 10^{-3} in the lower and upper reaches and between 17.5 and 19.5 × 10^{-3} in the middle. Unlike salinity, temperature has no apparent effect either on the qualitative richness or on the quantitative abundance of zooplankton in the estuary. Eventhough blooms of diatoms like *Bacilluria paradoxa, Coscinodiscus* spp. and *Thalassiothrix frauenfeldi* that appeared regularly for most part of the non-flood seasons did not adversely effect the total number of zooplankters, a stray bloom of the dinoflagellate *Gymnodinium splendens,* that appeared in the middle reaches in December 1982 proved toxic bringing down the population density to one-fourth of its normal level (Sai Sastry, 1987).

Salinity tolerance

Spatial and temporal distribution of zooplankters in relation to salinity showed their preference to specific salinity regimes in the Vasishta Godavari Estuary as in other Indian estuaries (Madhupratap, 1987). However, because of their acclimitisation to near estuarine conditions prevailing in the adjoining neritic waters for most part of the year (Ganapati, 1973) they showed greater tolerance to lower salinities. Some species considered as high and medium saline in the estuaries of the west coast behaved like medium and low saline forms in the Vasishta Godavari Estuary (Fig. 1; Table 3). Among the characteristic dominant zooplankters of the estuary, *Aglaura hemistoma, Eucalanus crassus, Acrocalanus gibber, Rhopalopthalmus kempi and Sagitta pulchra* were typical high saline forms and have their centre of abundance close to the lower reaches. *Phialidium hemisphaericum, Bougainvillia fulva, Pleurobrachia* spp., *Beroe* sp., *Asplanchna* spp., *Eucalanus subcrassus, Centropages furcatus, Macrosetella gracilis, Euterpina acutifrons, Neomysis indica* and *Urothoe* spp. were confined to medium salinities and were concentrated around middle reaches. *Phialidium globosum, Blackfordia virginica, Paracalanus parvus, P. aculeatus, Acartia erythraea, A. spinicauda, Oithona rigida, Lucifer hanseni, Sagitta bedoti, S. enflata* and *Oikopleura* spp. were typical euryhaline forms distributed over a wider area in the estuary or for most part of the study period in a given area. Typical limnoplanktonic rotifers of the genus *Brachionus* tolerated a maximum salinity of around 3.0 × 10^{-3} and were confined largely to the upper reaches during the early recovery period. The spatial and temporal distribution and salinity tolerance of the other zooplankters (Table 3) showed that they were mostly restricted to specific areas of the estuary in specified months. They were always in relatively smaller number than the characteristic and dominant forms.

Richness, diversity and evenness of species

In Vasishta Godavari Estuary, the indices of species richness (SR) showed that richness was dependant upon salinity along its axis, the number of species decreasing with decreas in salinity towards the head. The indices for the lower, middle and upper reaches stood at 2.6, 2.1 and 1.6 during 1981-'82 and at 3.1, 1.8 and 1.4 during 1982-'83 respectively. However, inspite of increasing salinity a general decline in species richness was recorded from the recovery to the drought phase. This anomaly in temporal distribution was because of effective elimination of low saline forms as in the case of hydromedusae (Sai Sastry and Chandramohan, 1989) and forms that could not stand competition with related species as in the case of chaetognaths (Sai sastry, 1987). At times, accidental migration of stenohaline forms like *Octocannoides ocellata* and *Solmundella bitentaculate* and stragglers like *Creseis acicula* into the lower and middle reaches helped to stop further decline in the indices of SR.

The indices of species diversity (H') in general showed a decline from the recovery to the drought phase. The diversity was more in the lower and upper reaches during the recovery and stable phases because of concentration of typical marine forms like *Podocoryne* sp. *Mnemiopsis* sp., *Sagitta pulchra, Eucalanus* spp., *Acrocalanus gibber, Labidocera* spp. and *Centropages* spp. in the former and species of rotifers of the genera *Brachionus, Keratella, Lecane, Filinia* and *Hexarthra* in the latter. During the drought phase, the diversity had shown a steady decline along the axis of the estuary towards the head. This was in contrast with the observations of Sivakumar (1982) in Vellar Estuary and Goswami and Selvakumar (1977) in the estuaries of Goa, where diversity increased with increasing salinity from the postmonsoon to the drought phases. Lack of much diversity in zooplankton of Cochin Backwater was attributed to lack of stability, lack of time to diversify and physiological stress imposed by the environment (Madhupratap, 1979). In the Vasishta Godavari Estuary, effective elimination of low-saline species as in the case of hydromedusae (in the lower and middle reaches) and limnoplanktonic rotifers (in the upper) with increasing salinity and phasing out of forms like *Sagitta pulchra* and *S. enflata* because of competition with *S. bedoti* resulted in low diversity during the drought phase.

The indices of species evenness (J') showed moderate fluctuations at all the three stations indicating absence of striking patchiness in the estuary.

Similarity quotient (QS), calculated based on the faunal composition of the three stations in November, February and May, representing the middle of the recovery, stable and drought phases of the estuary respectively, show that the degree of similarity was dependent on the distance separating them. It was more between lower and middle reaches (1.24-1.84) and middle and upper reaches (0.58-0.71) than between lower and upper (0.45-0.55).

Faunal affinity indices (martix method) showed that the percentage of affinity between the three reaches varied from 22 to 36% during the first year and from 22 to 42% during the second year indicating only moderate mixing of the populations inspite of strong tidal currents.

Monthly fluctuations of major groups

The Vasishta Godavari Estuary, like those of other monsoon-fed rivers of the area, experiences a massive annual flood between July and September under the impact of SW monsoon. The non-flood period can be divided into three phases, each with a distinct salinity pattern of its own. They are (a) Recovery phase corresponding to the post-monsoon months of October - December with fluctuating low salinities; (b) stable phase corresponding to the

TABLE 3. *Spatial and temporal distribution of selected zooplankters in relation to salinity*

Species	Stations			Months									Salinity range ($x10^{-3}$)
	1	2	3	O	N	D	J	F	M	A	M	J	
Coelenterates													
Euphysora bigelowi	+	—	—	—	—	—	—	—	—	+	—	—	33.2
Cladonema sp.	—	+	+	—	+	+	—	—	—	+	—	—	16.2-31.5
Turritopsis nutricula	+	+	—	+	+	+	—	—	+	+	—	—	16.2-32.9
Podocoryne spp.	+	+	—	+	+	+	+	—	—	—	—	—	16.2-29.6
Obelia spp.	+	+	—	—	+	—	—	+	+	+	+	+	20.5-34.3
Phialella sp.	—	+	—	—	—	—	+	—	—	+	—	—	23.0-29.2
Octocannoides ocellata	+	—	—	—	—	—	—	—	—	—	+	—	33.8
Phialucium sp.	—	+	—	—	—	+	+	+	+	+	—	+	22.9-31.0
Eirene sp.	—	+	—	—	—	—	+	—	—	—	+	—	23.5-30.1
Eutima sp.	+	+	—	—	—	—	—	—	—	+	—	—	22.9-33.2
Liriope teraphylla	+	+	—	+	+	—	+	+	+	+	+	+	16.2-34.6
Rhopalonema sp.	—	+	—	—	—	+	+	+	+	+	—	+	20.4-30.6
Solmundella bitentaculata	+	—	—	—	—	—	—	—	+	—	—	—	32.0-34.6
Lensia sp.	+	+	—	+	+	+	—	+	+	+	+	+	2.9-34.6
Diphyes sp.	+	+	—	+	+	+	—	—	—	+	—	+	16.2-34.6
Muggiaea sp.	+	+	—	+	+	+	—	—	—	—	—	+	16.2-34.6
Pelagi noctiluca	+	—	—	—	—	—	—	—	—	+	—	—	33.2
Acromitus flagelltus	—	+	+	—	+	+	+	—	—	—	—	—	10.2-12.9
Mnemiopsis sp.	+	—	—	—	+	—	—	—	—	—	—	—	25.7
Rotifers													
Anuraepsis fisa	—	—	+	+	—	—	—	—	—	—	—	—	< 1.0
Keratella tropica	—	—	+	+	+	—	—	—	—	—	—	—	06.5- 2.9
Lecane luna	—	—	+	+	—	—	—	—	—	—	—	—	06.5- 2.9
Filinia longiseta	—	—	+	+	—	—	—	—	—	—	—	—	< 1.0
Hexarthra intermedia	—	—	+	—	+	—	—	—	—	—	—	—	0.7-1.1
Polychaetes													
Tomopteris elegans	+	—	—	+	+	+	—	—	—	—	—	—	22.5-29.6
Travisiopsis dubia	+	—	—	+	+	+	—	—	—	—	—	—	22.5-29.6
Cladoceran													
Podon sp.	—	—	+	+	—	—	—	—	—	—	—	—	< 1.0
Ostracods													
Pyrocypris sp.	+	+	—	—	—	—	—	—	—	+	—	+	31.4-34.5
Cypridina sp.	+	+	—	—	+	+	—	+	+	+	—	+	28.42-34.2
Copepods													
Canthocalanus pauper	—	+	+	+	+	—	—	+	+	+	+	—	16.8-23.1
Undinula sp.	—	—	+	—	—	—	—	—	—	—	+	+	19.1-19.8
Clausocalanus arcuicornis	—	—	+	—	—	—	—	—	—	—	+	—	19.5

TABLE 3. *Contd.*

Acrocalanus gracilis	—	+	—	—	—	—	—	—	—	—	+	—	28.8
Centropages tenuremis	+	—	—	—	—	—	—	+	—	—	—	—	28.6
C. dorsispinatus	+	—	—	+	+	+	—	—	—	—	—	—	22.5-29.6
Pseudodiaptomus binghami	—	—	+	—	+	+	+	+	—	—	—	—	2.0-14.5
Temora discaudata	+	+	—	—	—	—	+	+	+	—	—	—	23.1-28.6
Labidocera acuta	+	—	—	—	+	+	+	+	+	+	+	+	25.7-34.4
L. kroyeri	+	—	—	—	+	—	—	—	—	—	—	—	25.7
L. pectinata	+	—	—	—	+	—	—	—	—	—	—	—	25.7
Microsetella sp.	—	+	+	—	—	—	+	+	+	—	—	—	11.8-23.6
Oncaea sp.	—	—	+	+	+	+	—	—	—	—	—	—	0.6-10.3
Corycaeus speciosus	+	+	+	+	+	+	+	+	—	—	—	—	0.7-30.7
Mysids													
Siriella affinis	+	—	—	—	—	—	—	—	—	+	—	—	32.9
Potamomysis assimilis	—	+	—	—	—	—	+	—	—	—	—	—	20.3
Erythropsis minuta	—	+	—	—	—	—	—	—	—	+	—	—	27.7
Isopods													
Cirolana parva	+	+	—	—	—	+	—	+	+	+	—	—	2.9-29.0
Sphaeroma sp.	—	+	—	—	—	—	—	—	—	+	—	—	27.7
Amphiphods,													
Elasmopus pectinicrus	+	+	+	+	+	—	—	—	+	+	—	—	12.2-25.7
Caprella subinermis	+	—	—	—	—	—	—	—	+	—	—	—	32.0
Paracapella alata	+	—	—	—	—	—	—	—	+	—	—	—	32.0
Pycongonid													
Nymphon sp.	+	—	—	—	+	—	—	—	—	—	—	—	29.0
Pteropod													
Cresis acicula	+	+	—	—	—	—	—	—	—	—	+	—	29.7-33.8
Pelagic tunicate													
Doliolum sp.	+	—	—	+	—	—	—	—	—	—	—	—	22.5

+ Present ; — Absent. Salinity ranges as observed in the field

months of January - March with relatively stable and moderate salinity; and (c) drought phase corresponding to the premonsoon months of April - June with consistently high salinity and total marine domination.

The monthly fluctuations of major groups of zooplankters during the above period did not show a common pattern at the three stations (Table 2). Coelenterate population declining with increasing salinity points out the domination of low-saline species in the estuary. Copepods, contributing 40-60% of the total zooplankton were dominated by calanoids (26), followed by cyclopoids (4) and harpacticoids (3). The time of secondary peaks in the lower and upper reaches coincided with that of the primary peak in the middle. Species composition of the samples suggested that at least a part of the crop of the lower and upper reaches was contributed by the middle. With an increase in salinity towards the drought phase, the lower and upper reaches developed a distinct assemblage of species of each, depending upon the ambient salinity of the area. However, middle reaches, because of its frequent lowering

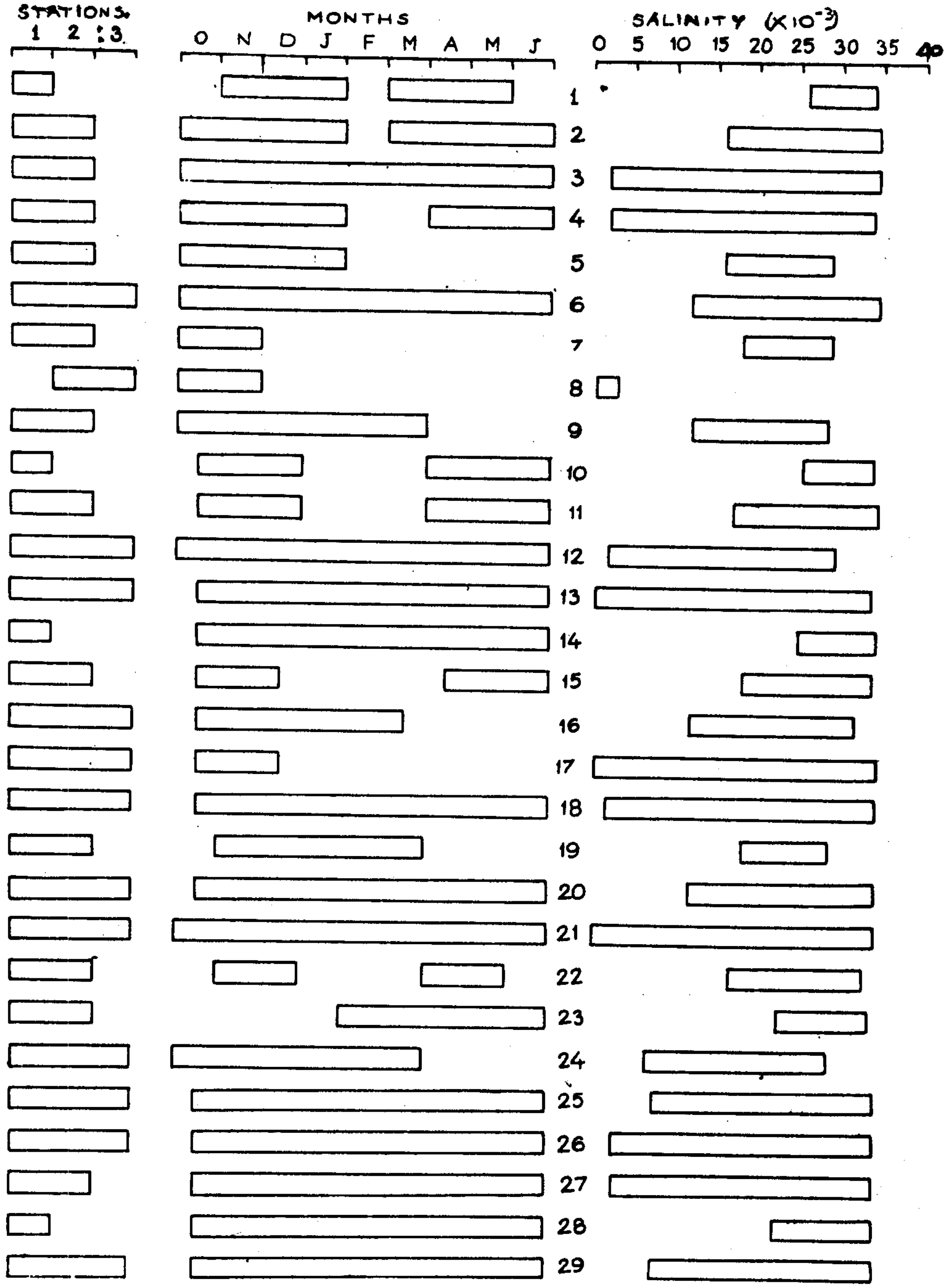

FIG. 1. Spatial and temporal distribution of characteristic and dominant zooplankters and their salinity tolerance. 1. *Aglaura hemistoma*, 2. *Phialidium hemisphaericum*, 3. *P. globosum*, 4. *Blackfordia virginica*, 5. *Bougainvillia fulva*, 6. *Pleurobrachia* spp., 7. *Beroe* sp., 8. *Brachionus* spp., 9. *Asplanchna* spp., 10. *Eucalanus crassus*, 11. *E. subcrassus*, 12. *Paracalanus parvus*, 13. *P. aculeatus*, 14. *Acrocalanus gibber*, 15. *Centropages furcatus*, 16. *Pontella securifer*, 17. *Acartia erythraea*, 18. *A. spinicauda*, 19. *Macrosetella gracilis*, 20. *Euterpina acutifrons*, 21. *Oithona rigida*, 22. *Neomysis indica*, 23. *Rhopalopthalmus kempi*, 24. *Urothoe* spp., 25. *Lucifer hanseni*, 26. *Sagitta bedoti*, 27. *S. enflata*, 28. *S. pulchra* and 29. *Oikopleura* spp.

of salinity due to sudden addition of farm drainage could not sustain rich crops of high-saline species for long, resulting in a general decline in the level of copepod population during the stable and drought phases. Among other crustaceans, the sergestid shrimp *Lucifer hanseni* dominated in the lower and middle reaches, cladocerans and ostracods were restricted to the lower reaches, while amphipods were seen throughout the estuary, though in small numbers. Of the mysids, *Rhopalopthalmus kempi* was dominant and was confined only to the lower and middle reaches. Monthly fluctuations of these crustaceans showed a tri-modal curve with peaks between October and December, February and April and May/June.

Larvae of crustaceans, molluscs and polychaetes dominated the invertebrate larvae of the estuary as in the Hooghly (Saha *et al.*, 1975) and Vellar (Srikrishnadhas *et al.*, 1975) Estuarines. While the larvae of crustaceans dominated in the lower and middle reaches, those of molluscs did so in the middle and upper. Larvae of marine groups like coelenterates, polychaetes and echinoderms declined in numbers with distance from the confluence upwards. A striking inverse relationship was noticed between the larvae of crustaceans and molluscs throughout the estuary. Blooms of cirripede nauplii were recorded during February in the upper reaches. Increase of invertebrate larvae in the middle reaches in November, February and May indicated existence of conducive conditions for large-scale breeding of invertebrates throughout the non-flood period. This might be mostly because of frequent blooms of phytoplankton providing plenty of food to the growing larvae. The fluctuations in the middle reaches were comparable to those of Vellar Estuary as observed by Srikrishnadhas *et al.* (1975).

Among chaetognaths, Sagitta bedoti was the dominant chaetognath of the estuary (96%) all along its axis, followed by S. enflata (3%) in the lower and middle reaches and S. pulchra (0.7%) restricted only to the lower reaches. Among pelagic tunicates, Oikopleura spp. dominated throughout the estuary. Fish eggs and larvae were largely concentrated in the lower reaches and decreased towards the middle and upper. Among the zooplankters of the 'miscellaneous group' rotifers were the single largest component confined to the upper and middle reaches for a very short time during the early recovery phase. Appearance of *Cresis acicula* (pteropod) in the lower and middle reaches was due to accidental drifting of its swarms from the neritic waters.

Mechanism of repopulating the estuary after the annual flood

Zooplankton crop of the Vasishta Godavari Estuary showed a gradual and consistent rise from the lower to the upper reaches during the recovery phase, along with neritic penetration. This suggests operation of a mechanism involving large-scale recruitment of neritic forms to repopulate the estuary, after the cessation of annual flood. The role of quiscent stages in repopulating the estuary from within, if any, is yet to be investigated. Ganapati (1973) has shown that near-estuarine conditions prevail in the neritic waters of the Bay of Bengal for most part of the year because of land drainage of the major rivers of India and Burma flowing into it. Since most of the zooplankters of the Vasishta Godavari Estuary come from the neritic water adjoining it after being exposed to near-estuarine conditions for long, they show a wide range of salinity tolerance unlike their counterparts elsewhere.

In conclusion, from the qualitative richness and quantitative abundance of zooplankton, the Vasishta Godavari Estuary might be considered as a highly productive eco-system, free from pollution of any sort that affects its biota.

Since the time of completion of the present study, the Vasishta Godavari Estuary has witnessed hectic activity associated with tapping of oil and gas from the wells located along its banks and off its mouth. The impact of this is yet to be documented.

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