Proceedings of the Second Workshop on Scientific Results of *FORV Sagar Sampada*

Editors

V.K. Pillai
S.A.H. Abidi
V. Ravindran
K.K. Balachandran
Vikram V. Agadi

Department of Ocean Development
Government of India
New Delhi
1996

Department of Ocean Development (DOD)
Government of India
Mahasagar Bhavan, Block No-12
C.G.O. Complex, Lodi Road
New Delhi-110 003
India

ISBN : 81-900656-0-2

Citation Styles

For entire volume

Pillai, V.K. Abidi, S.A.H., Ravindran, V., Balachandran, K.K. & Agadi, V.V. (Eds.) 1996. *Proceedings of the Second Workshop on Scientific Results of FORV Sagar Sampada*, (Department of Ocean Development, New Delhi), pp. 564.

For individual article

Goswamy, S.C. & Shrivastava, Y. 1996. Zooplankton standing stock, community structure and diversity in the northern Arabian Sea, In: *Proceedings of the Second Workshop on Scientific Results of FORV Sagar Sampada*, edited by V.K. Pillai, S.A.H. Abidi, V. Ravindran, K. K. Balachandran & V.V. Agadi, (Department of Ocean Development, New Delhi), pp. 127-137.

Designed and Printed by:

Publications & Information Directorate
Council of Scientific & Industrial Research
Pusa Campus, New Delhi-110 012
India

Proc. Second Workshop Scient. Resul. FORV Sagar Sampada, 1996, pp.185–192

Planktonic amphipod distribution in the deep scattering layer of the Exclusive Economic Zone of India

S. Revikala*

Central Marine Fisheries Research Institute,

P.B. No. 1603, Cochin - 682 014

ABSTRACT

The amphipods collected from the deep scattering layer (DSL) of Arabian Sea and Bay of Bengal belonged to 13 families viz. Cystisomatidae, Oxycephalidae, Pronoidae, Anapronoidae, Vibiliidae, Lycaeidae, Lycaeopsidae, Phronimidae, Platyscelidae, Phrosinidae, Scinidae, Lanceolidae and Hyperiidae. The amphipod abundance showed wide fluctuations. Oxycephalidae, Phronimidae and platyscelidae were widely distributed in both the shelf and oceanic regions of the west coast. In the east coast Phronimidae and Phrosinidae were widely distributed in the shelf and these two families together with Vibiliidae and Platyscelidae were widely distributed in the oceanic regions. In this investigation only Phronimidae was found to have wide distribution in the shelf and oceanic regions of both the Arabian Sea and Bay of Bengal. Vibiliidae and Phrosinidae showed aggregation in the oceanic region and these two together with Lycaeidae showed such a trend in the shelf of the west coast. Similarly in the east coast while Lycaeidae and Pronoidae showed aggregation in the shelf, only the former showed that trend in the oceanic region. While Cystisomatidae had a moderate distribution in the shelf of both the coasts and in the oceanic region of the west coast, it had a poor distribution in the oceanic region of the east coast. Vibiliidae and Oxycephalidae were moderately distributed in both the shelf and oceanic regions of the east coast. All other families of amphipods had a poor distribution.

INTRODUCTION

The deep scattering layer (DSL) which exhibits widespread occurrence in the worl oceans supports zooplankton and nekton and hence forms a notable source of forag

* Present address : Chetna, 39/1847, Warriam Road, Cochin - 682 016

for pelagic fishes (Silas, 1972). Earlier Kinzer (1969) noted the occurrence of DSL in the western Arabian Sea and found that the oxygen deficiency was not a limiting factor for plankton concentration. The findings on DSL biomass by Menon & Prabha Devi (1990) stressed the importance of this layer along the Exclusive Economic Zone (EEZ) of India.

The significance of hyperiid amphipods as a planktonic group has been highlighted by Bowman & Gruner (1973) and their role in the food chain of mackerels and herrings (Bowsfield, 1951);tunas (Tsuruta, 1963) and seals (Dunbar, 1946) has been reported. Ecological studies on hyperiid amphipods of waters around Indian sub-continent include those of Nair (1972, 1977), Revikala *et al.* (1990) and Molly Varghese *et al.* (1994). Yet another study showed the distribution and abundance of oxycephalid amphipods (Nair, 1986) collected by International Indian Ocean Expedition (IIOE 1960-1965) which explored only the surface and subsurface waters down to 200 m.

This paper on the amphipods of the DSL up to 540 m is intended as part of an attempt to throw more light into the eco-behavioural peculiarities of this group. Quantitative approach in terms of relative abundance and frequencies of occurrence are presented here. Though the amphipods were identified to species the present analysis has been restricted to the family level distribution which appeared significant by virtue of their eco-behavioural pattern and spatio-temporal distribution.

MATERIALS AND METHODS

The amphipods of the DSL of the Bay of Bengal and Arabian Sea were sampled during the cruises of *FORV Sagar Sampada* during February 1985 - May 1986 with a 2.5 m Issac-Kidd mid water trawl (IKMT). The samples were collected from appropriate depths of DSL recorded by echosounders at a frequency of 38 and 120 kHz. During the operations, the IKMT was fitted with a net sonde to monitor the position of the gear relative to the concentration of the DSL. The net was dragged at a speed of 3 knots for 30 minutes horizontally along the DSL and then hauled. The amphipods were preserved in 5% formaldehyde solution and identified. Relative abundance and frequency of occurrence of each family were calculated. The statistical analysis was done following Wallwork (1976) and Prabhoo (1986).

RESULTS

While the DSL was diffuse in some observations, it was very prominent in other instances. Sometimes it was unilayered while at other times it was multilayered. The amphipod samples considered for the present study belonged to the principal layer of the DSL.

The monthly mean data on the DSL amphipods from the EEZ for day and night is given in Table 1. The abundance showed wide fluctuations. The density was fairly high during the night samplings of March '85 and January and April '86 and high during day samplings of April '85, December '85 and April '86. Low abundance

Table 1 - Monthly mean number of amphipods from the deep scattering layer of the EEZ of India

Period	Amphipods (no./haul)		
	Day	Night	Total
Feb. 1985	14.50	55.21	34.86
March	19.98	131.65	75.82
April	50.08	38.40	44.24
May	No collection		
June	28.22	41.39	34.81
July	26.50	26.99	26.75
Aug.	40.10	29.68	44.89
Sept.	21.65	18.70	20.18
Oct.	10.53	09.33	09.93
Nov.	19.47	42.80	31.24
Dec.	52.10	48.37	50.24
Jan. 1986	23.70	123.65	73.68
Feb.	40.81	70.85	55.83
March	37.36	48.98	43.17
April	90.41	105.95	98.18
May	09.77	18.07	13.92

values were recorded in the night during September '85, October '85 and May '86 and low during day samplings of February '85, October '85 and May '86.

The amphipods belonged to 13 families viz. Cystisomatidae, Oxycephalidae, Vibiliidae, Phronimidae, Platyscelidae, Phrosinidae, Lycaeidae, Pronoidae, Scinidae, Lanceolidae, Hyperiidae, Lycaeopsidae and Anapronoidae. Amphipods that belonged to Oxycephalidae, Phronimidae, Playtscelidae and Phrosinidae had higher relative abundance in the day and night samples of the shelf region of the west coast (Table 2). While the relative abundance of Vibiliidae was higher during day, it was very low during night. In the shelf region of the east coast, on the other hand, Phronimidae, Phrosinidae, and Pronoidae had higher relative abundance in the day and night samples (Table 3). Lycaeidae, however, had a very low relative abundance during day. It was noteworthy that while Oxycephalidae and Platyscelidae had a higher relative abundance in the shelf region of the west coast, they had a low relative abundance in the same region of the east coast. But Pronoidae was relatively more abundant in the east coast and less in the west coast.

Table 2- Relative abundance of Amphipod families in deep scattering layer in the shelf and oceanic waters of the west coast of India

Family	Shelf			Oceanic		
	Day	Night	Total	Day	Night	Total
Cystisomatidae	3.80	3.82	3.81	3.43	1.68	2.30
Oxycephalidae	16.30	22.29	19.06	21.28	10.65	14.39
Vibiliidae	19.84	2.55	11.88	6.50	16.32	12.85
Phronimidae	14.95	23.25	18.77	24.23	29.29	27.50
Platyscelidae	18.75	11.78	15.54	11.58	9.68	10.35
Phrosinidae	16.30	13.06	14.81	18.09	17.68	17.82
Lycaeidae	3.80	9.55	6.45	1.89	1.61	1.71
Pronoidae	0.54	0.32	0.44	0.24	0.32	0.29
Scinidae	0.27	0.64	0.44	0.35	1.35	1.00
Lanceolidae	0	0	0	0.47	0.19	0.29
Hyperiidae	0	0.32	0.15	0.12	0.26	0.21
Lycaeopsidae	0	0	0	0	0.06	0.04
Unidentified	5.44	12.42	8.65	11.82	10.90	11.23

The amphipod families were grouped into constancy classes based on their frequency of occurrence viz. accidental (1% - 25%), accessory (26% - 50%) constant (51% - 75%) and absolute (76% - 100%). In the day samples of the shelf region of the west coast Oxycephalidae, Phronimidae and Platyscelidae had moderate frequencies of occurrence and hence were classified as constant, Vibiliidae, Phrosinidae and Lycaeidae as accessory and Pronoidae, Cystisomatidae and Scinidae as accidential. None of the amphipods present in this region had the status of absolute class. In the night samples, on the other hand, Phronimidae and Oxycephalidae came under absolute class due to their very high frequencies of occurrence. Other amphipod families like Platyscelidae and Lycaeidae were categorised as constant, Phrosinidae and Vibiliidae as accessory and Cystisomatidae, Pronoidae, Scinidae and Hyperiidae as accidental.

In the day samples of the shelf region of the east coast Phronimidae had very high frequency of occurrence and was hence classified as absolute and families Cystisomatidae, Vibiliidae, Platyscelidae, Oxycephalidae, Phrosinidae, Lycaeidae, and Pronoidae as accessory owing to their lower frequencies of occurrence. In the night samples Phronimidae and Phrosinidae had moderately high frequencies of occurrence and were classified as constant and families Platyscelidae, Lycaeidae, Pronoidae and Anapronoidae as accessory.

Table 3 - Relative abundance of Amphipod families of the deep scattering layer in the shelf and oceanic waters of the east coast of India

Family	Shelf			Oceanic		
	Day	Night	Total	Day	Night	Total
Cystisomatidae	06.78	00.00	02.56	00.00	05.00	01.59
Oxycephalidae	05.08	00.00	01.92	02.33	10.00	04.76
Vibiliidae	06.78	00.00	02.56	20.93	20.00	20.63
Phronimidae	22.00	12.37	16.03	06.98	30.00	14.29
Platyscelidae	03.39	04.12	03.85	11.63	25.00	15.87
Phrosinidae	28.81	31.96	30.77	39.53	05.00	28.57
Lycaeidae	01.69	21.65	14.10	18.60	00.00	12.70
Pronoidae	25.42	28.87	27.56	00.00	00.00	00.00
Scinidae	00.00	00.00	00.00	00.00	05.00	01.59
Lanceolidae	00.00	00.00	00.00	00.00	00.00	00.00
Hyperiidae	00.00	00.00	00.00	00.00	00.00	00.00
Anapronoidae	00.00	01.03	00.64	00.00	00.00	00.00

In the oceanic region of the west coast Oxycephalidae, Vibiliidae, Phronimidae, Platyscelidae and Phrosinidae had higher relative abundance in the day and night samples (Table 2). In the east coast Vibiliidae Phronimidae, Platyscelidae and Phrosinidae had higher relative abundance in day and night samples (Table 3). Lycaeidae was present only in the day samples.

In the day samples of the oceanic region of the west coast only Phronimidae had very high frequency of occurrence and classified as absolute, Oxycephalidae as constant, Lycaeidae, Phrosinidae, Vibiliidae and Platyscelidae as accessory and Cystisomatidae, Pronoidae, Scinidae, Lanceolidae and Hyperiidae as accidental. In the night collections while Phronimidae was absolute, Oxycephalidae, Vibiliidae and Platyscelidae were constant, Phrosinidae was accessory and Cystisomatidae, Pronoidae, Scinidae, Lanceolidae, Hyperiidae, Lycaeopsidae and Lycaeidae were accidental.

In the day samples of the oceanic region of the east coast most of the families were classified as constant and Oxycephalidae and Lycaeidae which had lower frequencies of occurrence were classified as accessory. In the night samples Phronimidae, Vibiliidae and Platyscelidae were classified as constant and Cystisomatidae, Oxycephalidae, Phrosinidae and Scinidae as accessory. Thus none of the families had very high or very low frequencies of occurrence.

DISCUSSION

The relative abundance of the various families together with their frequencies of occurrence provide a more realistic picture of the spatial distribution (Wallwork, 1976) of the amphipods in the DSL of the EEZ of India. Higher relative abundance and increased frequency of occurrence points to the rich distribution. Thus Oxycephalidae, Phronimidae and Platyscelidae showed wide distribution in the shelf and oceanic waters of the west coast. Bowman (1960) noted that pelagic amphipods were more abundant in high latitudes. Fage (1960) reported higher abundance of Oxycephalids in the Indian Ocean than in other oceans. Nair (1986) found Oxycephalids in 33.63% of the total samples up to a depth of 200 m collected by IIOE. The present investigation revealed that besides Oxycephalidae, Phronimidae and Platyscelidae also had the similar status as far as their distribution is concerned in the west coast. Phronimidae and Phrosinidae in the shelf waters and Vibiliidae and Platyscelidae together with the above two families showed wide distribution in the oceanic waters of the east coast. Thus Phronimidae has been found to be the only family with wide distribution in the shelf and oceanic waters of both the Arabian Sea and Bay of Bengal.

An increased relative abundance and lower frequency of occurrence is indicative of aggregation (Wallwork, 1976). While Vibiliidae, Phrosinidae and Lycaeidae had distribution with aggregation in the shelf waters of the west coast, the two former families showed this status in the oceanic waters. In the east coast shelf waters, on the other hand, while Lycaeidae and Pronoidae showed aggregation, only the former showed such a trend in the oceanic waters. Cystisomatidae showed a moderate distribution in the shelf waters of both the coasts and in the oceanic waters of west coast and a poor distribution in the oceanic waters of the east coast. Vibiliidae and Oxycephalidae also showed a moderate distribution pattern in the shelf and oceanic waters of the east coast. In the shelf waters of the west coast families like Pronoidae, Scinidae and Hyperiidae and in the oceanic waters of this coast besides these families Lycaeidae, Lanceolidae and Lycaeopsidae had a very poor distribution. The present finding as far as Hyperiidae is concerned is at variance with that of Nair (1986) who recorded this family to have the maximum abundance and wide distribution up to 200 m depth in the Indian Ocean. An explanation for this, perhaps, be the avoidance of the net by these along with others. Anapronoidae and Cystisomatidae together with Scinidae were poorly represented in the shelf and oceanic waters of the east coast.

The relative abundance variability of different families of amphipods during day and night samplings in the shelf and oceanic waters and scintillations in their frequency of occurrence could be due to their ecological and behavioural attributes. In this context it is noteworthy that several hyperiid amphipods exhibit commensalism and parasitism on other zooplankton (Bowman & Gruner, 1973). It is known that most hyperiids are associated with some species of gelatinous zooplankton, at least during some stage of their life history. For several phronimids the salps are both a source of food and protection. Other amphipod families like Lycaeopsidae, Pronoidae and Platyscelidae exhibit association with Siphonophores and Hyperiidae with medusae.

Oxycephalids are known to be associated with Ctenophores also though many are free living forms.

The amphipod density was fairly high during the night samplings of March 1985 and January and April 1986 which are the premonsoon months of both the years. Similar trend was observed during April 1985, December 1985 and April 1986 when the mean amphipod abundance maxima were recorded for the day samplings. Following the trends of amphipod abundance during day and night samplings, the aggregate mean values of abundance also showed the peaks for the months of March 1985, January 1986 and April 1986. Kathirvel (1990) recorded the peak occurrence of Phyllosoma larvae in the DSL of Indian EEZ during October-April period. Similarly Balasubramanian & Suseelan (1990) recorded the maximum average catch of the swarming crabs in the DSL of the west coast of India during the premonsoon period.

ACKNOWLEDGEMENT

The author is thankful to Dr.K.J. Mathew for his guidance and to the Director for providing facilities to carry out this work. Sincere thanks are due to the DOD for financial assistance.

REFERENCES

Balasubramanian, C.P. & Suseelan, C. 1990. Preliminary observations on the distribution and abundance of the swarming crab *Charybdis (Goniohellenus)* Smithi Macleay in the deep scattering layers along the west coast of India, In: *Proc. First Workshop Scient. Resul. FORV Sagar Sampada*, edited by K.J. Mathew, (CMFRI, Cochin) 385 - 391.

Bowman, T.E. 1960. The pelagic Amphipod genus *Parathemisto* (Hyperiidae: Hyperiidae) in the North Pacific and adjacent Arctic Ocean, *Proceedings of the United States National Museum*, 112 (3439): 343-392.

Bowman, T.E. & Gruner, H.E. 1973. The families and genera of Hyperiidae (Crustacea, Amphipoda), *Smith. Contri. Zool.* 146: 1-64.

Bowsfield, E.L. 1951. Pelagic amphipods of the Belle Island Strait region, *J. Fish. Bd.Canada*, 8 : 134-163.

Dunbar, M.J. 1946. On *Themisto libellula* in Baffin Land coastal waters, *J.Fish. Res. Bd. Canada*, 6 (6) : 419-434.

Fage, L.1960 . Oxycephalidae. Amphipods pelagiques, *Dana. Rept.* 9(52) : 1-145.

Kathirvel, M.1990. On the collections of Phyllosoma larvae by Issacs-Kidd mid water trawl from the west coast of India, In: *Proc. First Workshop Scient. Resul. FORV Sagar Sampada*, edited by K.J. Mathew, (CMFRI, Cochin) 141-146.

Kinzer,J. 1969. On the quantitative distribution of zooplankton in deep scattering layers, *Deep-Sea Res.* 16 : 117-125.

Menon,N.G. & Prabha Devi,L. 1990. Studies on the biomass in the deep scattering layers of the Indian EEZ, In: *Proc. First Workshop Scient. Resul. FORV Sagar Sampada*, edited by K.J. Mathew, (CMFRI, Cochin) 257-271.

Molly Varghese, Mathew,K.J., Naomi,T.S., Geetha Antony & Solomon,K. 1994. On the quantitative abundance of amphipods around Andaman-Nicobar Islands, *Second Workshop on Scientific Results of FORV Sagar Sampada*. (Abstracts).

Nair,K.K.C.1972. A note on an amphipod swarm along the south-west coast of India, *Curr. Sci.* 41 (5) : 185-186.

Nair,K.K.C. 1977. Distribution and relative abundance of Phronimidae (Hyperiidae : Amphipoda) in the Indian Ocean, *Proc. Symp.warm water Zoopl.* (UNESCO/NIO, Goa) 155-167.

Nair,K.K.C.1986.*Studies on the Amphipods (Hyperiidae : Oxycephalidae) of the Indian Ocean.* Ph.D thesis. Univ. of Kerala, pp.364.

Prabhoo,N.R. 1986. Collembolan community in a bamboo grove and grass plot, In: *Proc. 2nd Int. Nat. Seminar on Apterygota*, edited by R.Dallai, (University of Siena, Italy) 149-155.

Revikala.S., Mathew, K.J. & Scariah, K.S. 1990. Preliminary studies on planktonic amphipods collected by *FORV Sagar Sampada*, In: *Proc. First Workshop Scient. Resul. FORV Sagar Sampada*, edited by K.J. Mathew, (CMFRI, Cochin) 115-117.

Silas,E.G. 1972. Investigations on the deep scattering layers in the Laccadive Sea, *Proc. Symp. Corals and Coral reefs*, (Mar. Biol, Ass. India, Cochin) 257-274.

Tsuruta,A. 1963. Distribution of plankton and its characteristics in the oceanic fishing grounds with special reference to their relation to fishery, *J.Shimonoseki, Coll Fish.* 12 : 13-214.

Wallwork, J.A.1976. *The distribution and diversity of soil fauna*, (Academic Press, London) pp. 356.

* * *