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7 Studies on planktonic amphipods of the Indian seas

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ABSTRACT

An account of the past 50 years of research carried out on Amphipoda by the Central Marine Fisheries Research Institute and most relevant works carried out on the topic from the Indian seas are presented. The paper highlights the qualitative and quantitative composition, distribution in space and time and the taxonomy of planktonic amphipods of neritic and oceanic waters of Indian region as well as from antarctic waters. Considering the gap in the work done, future research programmes are suggested with a view to satisfy the present need.

Introduction

The order Amphipoda is an important group in the zooplankton under the class Crustacea. It forms a major food item of fishes like *Etroplus* sp., *Johnius* sp., *Pomadasys* sp., *Polynemus* sp., *Ilisha* sp., etc. (Suseelan & Nair, 1969). Realising the importance of these animals in the food web the Central Marine Fisheries Research Institute started work on amphipods since 1951. Now, the contributions by the CMFRI covering the entire west and east coasts of India, in the neritic and oceanic waters of Indian EEZ including Lakshadweep and Andaman seas are available. The study on amphipods was extended even to the Antarctic waters and brought out useful informations through the Institute's participation in the third Indian Antarctic Expedition. The studies by the Institute were mainly concentrated on quantitative and qualitative distribution, diurnal, monthly and seasonal variations and taxonomy. The present paper is a review of the work done on the various aspects

of the amphipods.

The research contributions from the Indian seas by Rabindranath, 1971, 1971a, 1971b, 1971c, 1972, 1972a, 1972b, 1972c, 1972d, 1975; Nair *et al.*, 1972, 1973, 1977, 1979, 1983, 1992a, 1992b, 1993; Shyamasundari *et al.*, 1972, 1973, 1973a, 1977, 1977a, 1979, 1988; Lalitha *et al.*, 1988, 1989, 1989a, 1990, 1990a; Sivaprakasam, 1968, 1968a, 1969, 1969a, 1969b, 1969c, 1970, 1970a, 1971, 1972, 1972a, 1977; Asari *et al.*, 1982, 1983, 1983a; besides the work carried out in the Institute during different periods of time are worth mentioning.

Present status of research

Rabindranath(1971) investigated the amphipods from the southern Indian region and identified two new species of haustoriid amphipods, including a new species of liljeborgiid and two new gammaridean species (*Arugella indica* & *Orchomenella mannarensis*). He also studied the gammaridean amphipods especially of the family Ampithoidae(1972), Amphilochidae(1972), Ampeliscidae(1975) and a new species of *Podocerus*(1972).

Nair(1972) observed a swarm of amphipods along the SW coast of India, and studied (Nair, 1977) the distribution and relative abundance of Paraphronimidae(Hyperiidae) in the Indian Ocean. The life cycle of *Corophium insidiosum* was studied by culturing in the laboratory (Nair & Anger, 1979). Nair *et al.* (1973) made a detailed study on the distribution and abundance of planktonic amphipods in the Indian Ocean and investigated (Nair, 1983) the population dynamics of estuarine amphipods in the Cochin backwaters while Nair and Jayalakshmy (1992) studied the distribution of Oxycephalidae in the Indian Ocean. Significant seasonal variations in species composition was noticed in the SE and SW Indian Ocean during the NE monsoon and during the SW monsoon in the Arabian Sea and SW Indian Ocean. Again, Nair (1992) studied the distribution, ecology, and polymorphic behaviour of the genus *Oxycephalus* of the Indian Ocean, which is the first comprehensive account on the distribution of this genus covering the entire Indian Ocean through seasons. Polymorphic behaviour is mostly restricted to *O. piscator*, mainly due to post-maturity growth, the geographic variations in length are discussed in detail for the first time. Nair (1993) observed *Metalycaea globosa* as a valid species of Oxycephalidae.

Shyamasundari (1972, 1973, 1976, 1988) studied the salinity and temperature, oxygen consumption in relation to salinity and temperature and the developmental stages of the tube building amphipod *Corophium triaenonyx* from Visakhapatnam harbour. Again, she (1979) studied alimentary canal of amphipods: histochemistry of cephalic mucous glands in *Talorchestia martensii* while Shyamasundari and Rao (1977) described the alimentary canal: morphology, histology of cephalic mucous glands and hepatopancreas of *Talorchestia martensii* and *Orchestia platensis*.

Lalitha *et al.* (1988, 1989, 1990) made detailed studies on the littoral sand hopper *Talorchestia martensii*-effect of salinity and temperature, the embryonic development and effect of salinity and temperature on the development of eggs. Again Lalitha *et al.* (1990) studied the annual life cycle of the talitrid amphipod, *Orchestia platensis*.

Sivaprakasam (1969, 1970, 1971, 1972) observed four new amphipods in the collections from the Gulf of Mannar, he studied Gammaridea and Caprellidea from the east coast of India, observed a new species of *Idunella demersalis* (Liljeborgiidae) from India, a new species, *Atylus processicer* from the Gulf of Mannar and studied the Leucothoid amphipod from the Madras coast. The organisation and classification of amphipods, a basic study which is helpful to the beginners in this subject was carried out by Sivaprakasam (1972). A review of the literature and keys to the families of Indian amphipods are given in this account. Again, he (1977) studied the skeleton shrimps of the Tamil Nadu and Kerala coasts and made descriptions and figures of 9 species and keys to the families and Indian species of Caprellidea along with notes on the ecology, distribution and evolution of Indian Caprellidae.

Asari and Myers (1982) made taxonomic studies on the genus *Grandidierella* and described five species from India, while Asari (1983) studied on two new species of gammarids from Andaman and Nicobar Islands. He (1983) studied the biology of brackishwater gammarid amphipods, *Eriopisa chilkenis* and *Idunella chilkenis*. The amphipods of the family Hyperiidae from the International Indian Ocean Expedition, 1959-1965 was studied in detail by Thomas and Maura (1982) and they noticed that the family which comprises about 45% of the Amphipoda, contained 15 species.

Amphipods of the west coast

Among the work carried out along the west coast, the contributions by George (1958), Pillai and Pillai (1974), Silas and Pillai (1977) and Rajagopalan *et al.* (1992) are remarkable. In the Cochin backwater the more important species noticed were *Corophium triaenonyx*, *Photis longicaudata*, *Perioculodes longimanus*, *Erioptsa chilkensts*, *Grandtdierella* sp. and *Hyperia* sp. (George, 1958). He stated that the amphipods contribute to an appreciable portion of zooplankton in Cochin backwater with its maximum in the postmonsoon months and minimum from March to August. The most common species occurring in the plankton may be *Corophium triaenonyx* Stebbing which is observed throughout the year although in small numbers during certain months and seems to be hardy enough to withstand the variations in salinity. He described that the discarded skins, more especially that of *C. triaenonyx* were plenty and on several days it contributed to well over half the entire plankton. According to him *Photis longicaudata* also occurred throughout the year with maximum numbers present in a few months in the monsoon season. During the study he noticed a few specimens of caprellid amphipods in January and February. The abundance of amphipods in the night collections was recorded by Pillai & Pillai (1974) and this abundance was irrespective of the hydrographical conditions and the state of the tide. In Cochin backwater, Pillai (1977) studied the macrobenthos and noticed a rich fauna of amphipods and a maximum of 6850/m² was recorded at a station in December and the dominant form was *Grandtdierella megnae*. Again, Pillai *et al.* (1977) observed maximum amphipods in the Vembanad lake and adjacent waters during December-January and absence during February-June; while abundance was recorded during postmonsoon season, rare during premonsoon and apparently absent during monsoon (Silas and Pillai, 1977). They observed the amphipod species - *Corophium triaenonyx*, *Photis longicaudata*, *Perticuloides longimanus*, *Erioptsa chilkensts*, *Grandtdierella* sp. and *Hyperia* sp. During spring tides, at Thoppumpady of the Cochin backwater, amphipod was one of the major group which were more in the bottom waters during the full moon days in January (Rengarajan and David Raj, 1984). Rajagopalan *et al.* (1986) observed amphipods in the tidal pools and creeks of the mangrove ecosystem of the Cochin backwaters, burrowing amphipods in the mid-tidal zone and amphipods were absent in the upper tidal zone. Bottom macrofauna is found to be different in the backwater stations and culture fields. The domi-

nant species recorded were *Grandidierella gilesi* and *Melita* sp. in the backwater and *Melita* sp. in the culture fields (Singh & Menon, 1993). Amphipods are found to be one of the major group in the mangrove ecosystems in Cochin area (Shajma & Balan, 1993). On sandy beaches when pursued, amphipods dig rapidly into the sand, head first and disappear quickly (Prasad, 1958).

In the coastal waters of Calicut, George (1953) observed amphipods soon after the onset of the monsoon and thereafter only nominally present. The more common forms he observed belonged to the family Hyperidae. In Vizhinjam also amphipods were sparingly present (Rani, 1986). But Rajagopalan *et al.* (1992) described the peaks in amphipods during 1984-'85, 1985-'86, 1986-'87, 1987-'88 & 1988-'89 of August, February, January, August and April respectively in Vizhinjam waters. They also noticed the salinity and temperature at which these peaks occurred during 1984-'85, 1985-'86 and 1987-'88 as 32.7ppt., 34.3ppt. & 34.6ppt. and 25.2°C, 29.2°C & 28°C respectively. At Colachel, Suseelan *et al.* (1985) noticed only *Hyperia* sp. that too in negligible numbers. Ramamurthy (1966) observed that amphipods occur rarely (10 per ml) during June, July, August, September and October along the north Kanara coast. In the shallow waters of the Karwar Bay a swarm of amphipods *Atylus minikoi* (Walker) is reported (Naomi, 1979) to occur and in the inshore waters of Karwar the common amphipods were gammarids especially during August-October (Naomi, 1986). At Kandla in the Gulf of Kutch region it was present during February-April (Ramamurthy and Dhawan, 1967). Along the Bombay coast, Pillai (1970) observed that the common amphipods present were *Hyperia* sp. and *Primno* sp. the former species being fairly abundant during the months of November, February and March while *Oxycephalus* sp. and *Simorhyncotus* sp. were observed only during May and February respectively. Monthwise occurrence of amphipods in the shelf waters off Bombay showed its availability in October, March, September and November (Radhakrishna & Pillai, 1985); while Pillai & Bhat (1987) noticed amphipods to form 0.4% of the zooplankton during the postmonsoon months along the northwest coast of India.

Amphipods in the mud bank areas

The formation of mud banks is a common phenomenon along the Kerala coast and realising the importance of mud banks in the fishery of the area, studies on the different aspects including zooplankton in the mud banks were

carried out and the studies on amphipods was one among them. Studies on the diurnal variations in the distribution of amphipods in the mud bank at Purakkad-Thottappally region south of Alleppey in Kerala, during May and August were carried out by Mathew *et al.*(1977) and noticed its presence in moderate numbers in August(0.8%) but during May it was poorly represented. Their percentage composition in the collections of August varied from 0.20 to 2.40, however, they did not show any diurnal variations. Only stray specimens were recorded during monsoon period (Mathew *et al.*,1984).

Amphipods of the east coast

Along the east coast, investigations on amphipods were carried out mainly by Nayar (1966). He made a detailed study on the gammaridean amphipods of the Gulf of Mannar with special reference to those of the pearl and chank beds and a complete list with synonyms of all the reported species from the Gulf of Mannar together with the descriptions has been given in this account, which can be used as a guide for those who pursue work on this group. In the inshore waters off Mandapam, amphipods occurred during February-May and July-November which were mostly hyperids (Prasad,1956). The amphipods are found to get associated with seaweeds in nature and a detailed study in this line was carried out by James *et al.*(1986) and noticed that qualitatively amphipods form one of the major components while quantitatively it took the 2nd place. They were found associated with cultured seaweed *Gracilaria edulis* in the coastal waters of the Palk Bay and the Gulf of Mannar. In the stomach contents of fishes and crabs captured from these seaweed culture sites amphipods also were observed. In the inshore waters of Tuticorin, amphipods were noticed during March-June and October-November periods in negligible proportions (Marichamy *et al.*,1987). The studies on amphipods was extended to Kakinada Bay where they formed less than 0.2%, *Hyperia* spp. and *Corophium* spp. being the common forms (Narasimham *et al.*,1984).

Amphipods of oceanic regions

The investigations were carried out in Indian EEZ including the seas around Laccadives and Andaman-Nicobar islands and brought out many useful information on the amphipods.

Pelagic amphipods under the families Vibliidae, Paraphronimidae,

Studies on planktonic amphipods of the Indian seas

Hyperiidæ, Phronimidæ, Phrosinidæ, Lycaeopsidæ, Pronoidæ, Lycaetidae, Brachyscelidæ and Platyscelidæ in the collections of CMFRI made on board R.V. Varuna from Arabian sea were studied in detail with species wise illustrations and descriptions by Pillai (1966) which helped to correct certain errors in the earlier descriptions. In another account full illustrations with key for the identification of all the 15 species under the family Oxycephalidæ were given (Pillai, 1966). Seasonwise study in the northwest coast of the Indian EEZ was carried out (Bapat *et al.*, 1982) by collecting amphipods with an Indian Ocean standard net (vertical hauls from a standard depth of 200 m to surface). It was found that the relative abundance (in % among different zooplankton groups) in the three seasons were: 0.087, 0.738 and 0.245 during premonsoon, monsoon and postmonsoon seasons respectively.

Amphipods are found to be present in sheltered rocky areas in Indian waters (Panikkar, 1951) while in the inshore waters of the seas around India, their representation was poor (Girijavallabhan *et al.*, 1983). The occurrence of amphipods in the EEZ of India and adjoining seas was investigated by Revikala *et al.* (1990); based on samples collected during the cruises of FORV Sagar sampada and the observations are as given below. While amphipods at an average rate of 2278/1000m³ occurred in the shelf waters off the west coast, only 1501/1000 m³ occurred in the same area off the east coast. On the other hand, in the oceanic region the numerical abundance was relatively low being 1014/1000 m³ off the west coast and 925/1000 m³ off east coast indicating that the amphipods were abundant in the shelf waters of the west coast than other regions. The seasonwise study showed always maximum during premonsoon except the first region (4° 30'N - 10° N) off east coast but there was no regular pattern in the eastern Arabian sea. The northern region (20° N - 23° N) above 20° N off west coast i.e. 4th region, contributed more amphipods than the other latitudinal regions off the west and east coasts. The faunal distribution (specieswise) in the DSL of the EEZ of India was investigated by Revikala (1996). According to her studies the amphipods of this area belonged to 13 families viz. Cystisomatidae, Oxycephalidae, Pronoidæ, Anapronoidæ, Vibiliidae, Lycaedæ, Lycaeopsidæ, Phronimidæ, Platyscelidæ, Phrosinidæ, Scinidae, Lanceolidæ and Hyperiidæ. Qualitative distribution of amphipods showed that the number of species were more (30 spp.) in the oceanic waters of west coast than in the shelf waters (23 spp.) of that coast. The oceanic waters of east coast also had higher number of amphipod spe-

cies(19 spp.) than the shelf waters of that coast(17 spp.). Thus the west coast was qualitatively richer than the east coast. All species of *Cystisoma*, *Phronima colletti*, *Phronimella elongata*, *Platyscelus* sp., *Phrosina semilunata* and *Anchylomera blossevilli* were found to be ubiquitous in distribution. But *Eupronoe* sp. was restricted to the shelf area of both the coasts. The data on the relative abundance of the various amphipod families in terms of day and night distribution and frequencies of occurrence in both shelf and oceanic waters of the Arabian sea and the Bay of Bengal are also described.

In the lagoons and open sea of Lakshadweep, amphipods constituted less than 1% of the zooplankton in Kadmat, Kiltan, Chetlat, Agatti, Kalpeni, Bangaram, Bitra and Kavaratti islands (Girijavallabhan *et al.*, 1989). But Silas (1972) noticed contribution of amphipods as 2% of the total zooplankton in the deep scattering layers in the Lakshadweep sea. He also studied the day and night variations and observed 77% at night and rest in daytime collections.

In the coastal waters of Andaman & Nicobar islands amphipods were recorded in all collections but only in negligible ratios (Marichamy, 1983). An elaborate study on the quantitative distribution and abundance of amphipods in the Andaman sea in space and time was carried out by Molly *et al.* (1996). This study was based on the amphipods present in the zooplankton samples collected during 1988-'90. The salient features of the study is given here. Monthly distribution revealed that the mean number of amphipods per 1000 m³ of water reached the maximum of 1763 in January and the minimum of 315 in July. The seasonal density was maximum during the NE monsoon and minimum for the SW monsoon and their mean numbers were estimated as 812 and 463 per 1000 m³ of water respectively. The spatial distribution indicated that the amphipods were relatively at higher concentration with an average of 732 per 1000 m³ between 12° 30' and 14° 30' N and at low concentration with 513 per 1000 m³ between 10° 30' and 12° 30' N latitudes, while the overall mean number estimated for the Andaman sea was 629 per 1000 m³ of water. In general, they were abundant in the region where the station depths ranged between 50 and 100 m with the mean estimated as 800 per 1000 m³ of water. Analysis of day and night samples did not show any remarkable variation.

Amphipods of antarctic waters

CMFRI has participated in the third Indian Antarctic Expedition and amphipods along with other zooplankters in that region were studied. Daily variations in the abundance of amphipods in the coastal waters off Queen Maud Land, Antarctica was investigated from 12th January to 25th February 1984 i.e. from mid summer to the beginning of winter (Mathew & Vincent, 1986) and observed that in the 5th & 6th weeks the amphipods showed remarkable increase in number, registering an increase of more than 100% over the preceding week's population. During the 6th week, the highest of 50% of zooplankton was contributed by amphipoda. Percentage of increase or decrease of amphipods in the weekly mean numerical abundance during the summer months were +233.33, +660, and -7.04 during 5th week, 6th week and 7th week respectively.

Regarding spatial distribution of amphipods in the Antarctic waters, a highly patchy, with a meagre representation of less than 1% of the total zooplankton was observed (Mathew, 1986). They were present mainly in the southern grid and their latitudinal occurrence was interesting in that they were almost concentrated towards south. The middle and northern grids had them only at one station each that too in very small numbers. The occurrence in each of the grids from south to north was 17, 2 and 1 respectively per 1000 m³ of water. Again, studies were conducted in the latitudinal distribution of amphipods in the southern ocean, covering an area between 61° 31' S and 21° 34' S and 22° 56' E to 56° 53' E which included the Antarctic, sub-Antarctic, and sub-tropical zones (Mathew & Vincent, 1986). Amphipods formed 1.15% of zooplankters during the investigation and were relatively more in the sub-Antarctic zone. They were comparatively more abundant in the mid zone between 40° and 50° S. Relative abundance of amphipods in the various latitudinal zones expressed as no./1000 m³ of water is given below:

	<u>Antarctic</u>	<u>Sub-Antarctic</u>	<u>Sub-tropical</u>
Amphipods	236(7.55%)	2461(78.78%)	427(13.67%)

Future research priorities and conclusion

In future, the study of amphipods have to be taken up, considering the gaps in the work already carried out in this topic. Taxonomic studies has to be strengthened further and full illustrations with descriptions and keys of all

the Indian species of amphipoda has to be brought out which can be a useful reference for the beginners in this subject. Study on specieswise availability in time and space has to be carried out to understand the behaviour of each species. As amphipods are a major constituent of food of many fishes their culture will have to be taken up in future to assess the possibility of using this as a live food organism. Since amphipods can withstand a wide range of salinity the culture of this can very well be tried along with studies on its nutritional value as live feed, its acceptability in the culture systems, etc..

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