STUDIES ON CUMACEA

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DOCTOR OF PHILOSOPHY

By

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D E C L A R A T I O N

I hereby declare that this thesis entitled 'Studies on Cumacea' has not previously formed the basis of the award of any degree, diploma, associateship, fellowship or other similar title or recognition.

Ernakulam,
August, 1983.

Radhadevi. A
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C E R T I F I C A T E

This is to certify that this thesis is an authentic record of the work carried out by Miss A. Radhadevi, under my supervision at the Pelagic Fisheries Laboratory of Central Marine Fisheries Research Institute, Cochin, and that no part thereof has been presented for any other degree in any University.

8/9/1983

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A.R.

STUDIES ON CUMACEA

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1. INTRODUCTION

1.1. Importance of Cumacea

The Cumacea are small peracarida of the sub-class Malacostraca. They range from 0.5 mm to 35.0 mm in length. Their distribution is world wide, occurring from tidal limit to 7657 m depth. The majority of the cumaceans inhabit waters less than 200 m depth and some are found in the intertidal regions as well. Also a number of them are planktonic in habit, especially in the sub-surface waters. The bottom living forms spend most of their time burried in sand or mud. They are predaceous and some have filter feeding mechanism (Kurian and Sebastian 1982). Some are detritus feeders. Though majority of the cumaceans are marine, at least few of them are found in estuaries and brackishwater. There are no fresh water species, but some of them have been known to penetrate into the fresh water also (Jones 1963).

Cumaceans form an important constituent of the food item of the bottom feeding fishes, especially during the larval and post larval stages. Sometimes they occur in large numbers so as to become an important source of food for fishes such as flounders, cod, haddock etc. Kurian (1951) while examining the stomach contents of

the fishes Pseudorhombus triocellatus, Engyprosopon grandisquama, Platycephalus scaber and Saurida tumbil from Trivandrum-Vizhinjom region has identified cumaceans such as Iphinoe brevipes, Cocuma tamrobanica and Hampylaspis spp. in them. He also found a large number of cumaceans in the stomach contents of the post larval flat fishes collected from the 15 fathom line, off Vizhinjom. Jones and Burbanck (1959) have also reported the presence of the cumaceans in the stomach content of the American eel Anguilla rostrata. Zimmer (1933) found Diastylis rathkei, the common cumacean species found in the North sea, in the gut content of man food fishes, he examined.

The cumaceans are also known to serve as indicators of hydrographical conditions. Jones (1955) observed a large number of cumaceans in the vertical plankton net hauls at the Benguela current, off the South West Coast of Africa, in spite of their bottom living habit. He also suggested that the presence of cumaceans in large numbers in the upper layer was not due to their normal vertical migration, but due to the low oxygen concentration near the substratum. Species like Iphinoe fagei and I. africana undertake such migrations in large numbers (Jones 1955). Thus the distribution and abundance of certain species of Cumacea in the surface waters gives an idea of the hydrographical

conditions and environmental variations in the particular area. Considering the importance of the group as food for fishes, and their use as indicator species, much interest has been shown on the study of cumaceans by different workers from different parts of the world.

1.2. Previous works on Cumacea

Valuable information is available on the cumacean taxonomy, morphology, food, feeding, reproduction, development etc. The earliest and most comprehensive contribution to the study of Cumacea is that of Sars (1900) in the Crustacea of Norway. The only monograph on Cumacea is that of Stebbing (1913) in the 'Das Tierreich' series where he has compiled all species known with the relevant literature. Recently a compilation of the cumacean literature has been published by Bacescu (1973). But most of the earlier studies on Cumacea are based on collections made during the voyages and expeditions. The most important are Challenger Expedition (Sars 1887), the plankton Expedition and Danish Ingolf Expedition (Hansen 1895, 1920), the German Deep Sea Expedition and the German and Sweedish South Polar Expedition (Zimmer 1907, 1908, 1913), the Siboga Expedition (Calman 1905), Australian Antarctic Expedition (Calman 1911-1914), British

Antarctic Expedition ('Terra Nova') (Calman 1917), International Indian Ocean Expedition (Murian 1973) and Cruises of 'Vema' (Bacescu 1961, 1962).

Following the studies by Sars (1[illegible]) many papers have appeared based on collections from different regions of the world oceans. The most important works on Cumacea from the Pacific Ocean included taxonomy, distribution and ecology of many species and development of a few species. Hale (1928-1953) during his continuous studies on the cumaceans from Australia has stated that these minute crustaceans form an important part of the bottom fauna of these regions. He described five families of Cumacea mainly from the waters off S. Australia, Victoria, Southern Queensland and particularly New South Wales. Zimmer (1936,1939) made studies on the cumacean fauna of the Pacific coast of North America. Lomakina (1952,1955,1958) contributed much to the studies of Cumacea of Japan. Gamo (1958-1971) reported a number of cumaceans from Sagami Bay, Tanabe Bay, Suruga Bay and Southern sea off Japan.

Harada (1959-1967) made systematic and faunestic studies on the Japanese Cumacea mainly off Shimoda. He also studied the post larval development of Cumopsis diomedeae (Calman) from the coastal waters of Izu Peninsula, Japan. Recent studies on Cumacea by Jones (1969) show that shallow

water forms are very common in the Pacific coasts of apan, Korea, Formosa and U.S.A. The continental shelf of South-west Pacific, especially the coasts of South Australia and NewZealand is very rich in cumaceans (Jones 1976). The are also well distributed on the North-western coasts of Washington and the continental shelf of Southern California. Some are distributed in the Pacific Panaman waters and South East Pacific. Muradian (1979) and Given (1961,1964, 1965) studied the cumacean fauna of the Southern Callfornia. Lie (1969,1971) deals with the Cumacea from Puget sound and off the North western coast of Washington. Gladfetter (1975) studied the cumacean fauna of the Pacific coast off North America. The latest record of the cumacean fauna of Pacific region is that of Muradian (1979) who contributed much to the study of specimens from Pacific Panaman waters and South East Pacific.

Much work has been done on the cumacean fauna of the Atlantic Ocean by many workers. They form an important faunal component of the deep sea benthos. Sars (1871-1927) has made significant contributions on the study of the cumaceans of the Atlantic Ocean. His works include besides descriptions of many species, the anatomy and development as well. Norman (1869,1887,1894) and Scot (1912) made studies on the cumacean fauna of British Sea. Hansen (1887-1920) described

the deep sea cumaceans of West Greenland and Iceland. Fage (1928-1941) recorded a good number of Cumacea from Atlantic Ocean, especially from East Atlantic and Mediterranean Sea and its geographic distribution off North-west Africa. Bacescu (1953,1961,1969) described a number of cumacean species from Mediterranean Sea. Jones 1955) studied the Cumacea in the Benguela current off South west Coas of Africa. He also described many species from the South west Coast of Africa and from the coast of Senegal (W. frica). Romanova (1958) deals with the distribution and ecological character of the North Caspian Cumacea. Brum (1966,1970,1971) described some species from the littoral waters of Brazil. Corey (1970,1970a) worked out the quantitative distribution and diurnal and vertical migration of cumaceans of Scotland. Bacescu and Muradian made extensive studies on the Cumacea of Atlantic Ocean from 1971 to 1979. Bacescu (1971,1972) described a number of Cumacea from the littoral waters of Florida, from the American tropical waters and Saharian bottom of Atlantic. Bacescu and Muradian (1972,1974,1977) also studied the cumaceans of western Tropical Africa (Mauritarian coast), North western Atlantic and West Tropical Atlantic. They described many new genera of Cumacea from the deep waters also. Subsequently many papers have been published on the deep water Cumacea of the Atlantic by Jones and Sanders (1972),

Norman and Sanders (1972) and Jones (1973). Jones (1974) described the Genus Campylaspis from his collections in the deep waters of the Atlantic Ocean. Day (1975) gave a detailed study of the South African cumaceans of the sub-family Vaunthompsoniinae. The latest study on the cumaceans of the Atlantic region is that of Muradian (1976) and Bacescu (1979) in their account on the Crustacea of Western Atlantic, especially of Mexican Gulf.

The work on the Cumacean fauna of the Antarctic region is rather scanty. It includes mainly the studies on the taxonomy and distribution only. The works of Calman (1917), Hale (1937), Lomakina (1963) and Jones (1971) are worth mentioning. Calman (1917) studied some species during the 'Terra Nova' Expedition and Australian Antarctic Expedition. Hale (1937) described a large number of species from the Antarctic region. Lomakina (1963) made studies on the Antarctic Cumacea together with charts showing their distribution during the Soviet Expedition to Antarctic. Jones (1971) gave a detailed account of the Cumacea of the Ross Sea during the Transantarctic Expedition. All the studies include both deep water and littoral cumaceans.

The studies on the cumacean fauna of the Indian Ocean date back to Paulson and Bossman (1888) who recorded four species from the Red Sea. Later Calman (1904,1905)

described a number of species from the Gulf of Manaar, Indonesian region and Sulu Sea. Calman (1907,1911) also recorded many species from the Gulf of Siam, Suez, Penang, Ceylon and Pamban. Kemp (1916) described the cumacean fauna of the Chilka lake. Hale (1929-1952) gave a detailed study of the cumacean fauna of the Indian Ocean. Gurjan (1951,1954, 1961 and 1965) recorded many species from the West Coast of India and from the Bay of Bengal. The latest record of Cumacea from the Indian Ocean is by Bacescu and Muradian (1975). In India six species have been recorded from the brackish water bodies of Chilka lake, Vaili lake, and Vembanad lake. The studies on the Cumacea of the Indian Ocean also revealed that most of them are found in the inshore waters of the East Coast of Africa, Red Sea, West and East Coast of India and Pakistan, Malaya coast, Singapore Bright and West Coast of Australia.

1.3. Scope of the present work

As mentioned earlier, Cumacea play an important role in the marine environment both as food for many commercially important species of fishes and other benthic organisms and as indicator organisms. Hence it is desirable to have a better knowledge of the taxonomy, ecology, biology and distribution of the various species of Cumacea. The present work is directed towards the study of the above aspects. Our

knowledge about the cumacean fauna of India is limited except for the works of Calman (1914) Sewell (1916) and Gurian (1951,1954,1961 and 1965). The Indian coasts have been a neglected region as far as the cumacean studies are concerned, compared to other areas of the world. The present study was undertaken to bring out more information on the systematics, biology, ecology and distribution of the cumacean fauna of the Indian coasts. Samples collected from the Pacific, Atlantic and Indian Oceans by some International Organisations were also worked out and a comparative study has been made.

2. [illegible]

2. MATERIALS AND METHOD

The materials for the taxonomic and distribution studies were mainly obtained from the collections of various expeditions and other international agencies in preserved condition. These materials include the collections from Indian, Atlantic and Pacific regions. Observations were also made on live specimens in order to study the behaviour, habitat and ecology. Collections were made with the help of plankton nets and grabs. In the intertidal region only simple equipment like scoop or corer were used while in deep water, dredges and grabs were employed. The shallow water forms were captured usually by surface night towing of plankton net.

2.1. Methods of collection

A simple method adopted for collecting cumaceans was by means of underwater light trap described by Sheard (1941) and Dale (1953) which consists of an electric globe of low candle power attached to the centre of the mouth of a tow-net. This was lowered to the bottom at regular intervals and kept immersed before each haul for about 15 minutes.

In soft bottoms the most satisfactory collecting machine was found to be the dredge, which will not sink deeply into the deposit and become too rapidly filled, the

bag being made of coarse bolting silk or nylon and the contents passed through a fine sieve of 0.5 or 1 mm mesh. Smaller specimens which pass through the meshes of the sieve were subsequently picked up with a pipette. Cumaceans were also collected by a Peterson grab of .1 m^2 area.

Another method used to collect cumaceans was with the help of Scuba. It was used to obtain benthic samples by carefully pressing an inverted 14 cm diameter plastic petridish (1.25 cm deep) into the substrate (Wadsfeller 1975). Sometimes the instrument was cylinder shaped sampling an area of 0.1 m^2 by 60 cm deep, which was lowered right into the substrate. Different fractions of substrate was then collected enabling analysis of fractions from different level below the surface (May 1975).

In the open ocean cumaceans were collected using the Indian Ocean standard net (Currie 1963). They were collected in large numbers in the vertical hauls and sometimes in the horizontal catches also.

A few species which occur between tide marks, usually on sandy beaches were collected with a hand net which has a fine meshed bag. The surface layer of sand was skimmed off and the remaining sand was shaken thoroughly and emptied into a petri dish. The cumaceans were then easily picked up by a pipette.

Some of the cumaceans collected were examined in liv condition for studying their habitat and all specimens were preserved in 4% neutral formalin or 70% alcohol and kept in labelled bottles for further studies. The identifications were made following the methodology of Stebbing (1913), Hale (1944,1945) and Jones (1963).

2.2. Materials

The materials obtained from various sources and the methods of collection adopted are given below.

( ) International Indian Ocean Expedition Collections deposited in the Smithsonian Institution:

The samples were collected from 25 stations by the Research Vessels 'Anton Bruun' and 'Te Vega' during the period 1963-1965 from the Indian Ocean and consisted of 12 specimens, included both benthic and planktonic forms. The devices used for benthic samples were Campbell grab, Rock dredge, Agassiz trawl and Tenjies trawl. Indian ocean standard net was used for the collection of plankton. Some of the samples were also picked up by hand net and by breaking coral and rocks with geology hammer. Scuba was used at a station near Grand Comoro Island and skin diving was used in possible Madagascar areas.

(2) International Indian Ocean Expedition collections kept in the Indian Ocean Biological Centre, Cochin:

This consisted of 64 specimens from 6 stations in the west coast of India. All the 6 stations located mainly near the shore and collected by the research vessels 'Anton Bruun' 'Dalan' 'Varuna' and 'Kistna' using the Indian Ocean standard nets from [illegible] m depth. The collections were made during the period 1963-1965. All the specimens were planktonic forms.

A map showing the stations in the Indian Ocean is given as Fig.1.

(3) Smithsonian Institution collections from Philippines:

The collections were taken by the 'Galathea Philippine Project' conducted during the year 1967. It included 45 specimens from the benthic collections from 3 stations. The stations were located in the mangrove and coral areas (Refer Fig.2 for stations).

(4) Mexico Bay Collections received from the Mexico Oceanic Sorting Centre:

The collections were made during the period 1972-1974. It included 77 specimens collected from 21 plankton stations in the Mexico Bay and the stations were located near the shore (Refer Fig.3 for stations).

(5) Israel Collections from the Red Sea:

These samples were collected by the Israel South Red Sea Expedition (1962) and received from the Hebrew University, Israel. It included 91 specimens collected from 3 stations and all of them were planktonic.

(6) Collections from Vizakhapatnam region (east coast of India) consisted of 42 specimens obtained from benthos using grab from a depth of 4 to 6 fms. during 1973.

(7) Collections from Porto Novo area (East coast of India):

These were collected during the years 1971, 1981-1982 from 5 stations. Four stations were located in the intertidal region near the shore and one station in the Vellar estuary. Quantitative weekly collections of Sumacea were also taken from an intertidal sandy station for a period of one year during 1981. There were 273 specimens in the collections. Fourteen specimens of Sumacea were obtained from Vellar estuary (Porto Novo) during 1982.

(8) Collections from Purakkad area (Kerala coast):

It included only 3 specimens collected in the benthos using grab (.1 m²) from 6 fathoms during 1972-1973.

(9) Collections from Vizhinjam region (Kerala coast):

94 specimens were obtained from 12 fathoms of

Vizhinjam from 2 stations, and the collections were made using the dredge during the years 1945 and 1959. Besides the dredge collections planktonic forms also were collected from Vizhinjam Bay during 1983-1989 about 15 m depth and from the open sea at depths of 2 and 3[illegible] m. In these samples 1251 specimens were obtained.

(i) R.V. Varuna collections from the South west coast of India:

It consisted of a series of bongo - 2 net samples of plankton taken from 7 profiles extending from Ratnagiri to Kuticorin during 1975. A total number of 265 samples were analysed. From samples collected from 8 stations near the shore and depths 10 to 30 m off Karwar, Calicut, Cochin, Quilon, Cape Comorin and Kuticorin, 49 specimens were obtained.

(ii) Collections taken from the Cochin area (South west coast of India):

These collections include both benthic and planktonic forms. A series of plankton collections were made by the Pelagic Fisheries Department of CMFRI during 1983-1985 by 'R.V.Sedalmin'. Collections were taken from 7 stations off Cochin from 10 and 25 m depth and 36 Ostracods were obtained. Another plankton collection containing 378 specimens of Ostracoda obtained from off Cochin during 1972 was also

available for study. A series of vertical plankton hauls also were made at different depths during 1981-1982. Besides, from April to September 1981 a series of benthic samples were also taken from depths ranging from 12-4 m in the inshore regions off Cochin and from 4-1 m depth in the estuary using dredge and grab. Samples were also collected during night using underwater luring trap.

(iv) Collections from Karwar Estuary:

It consisted of 4 specimens obtained in the benthos from 3 m depth during November 1982.

A map of the world showing the stations from where Cynacea specimens were obtained for the present study is given as Fig.4.

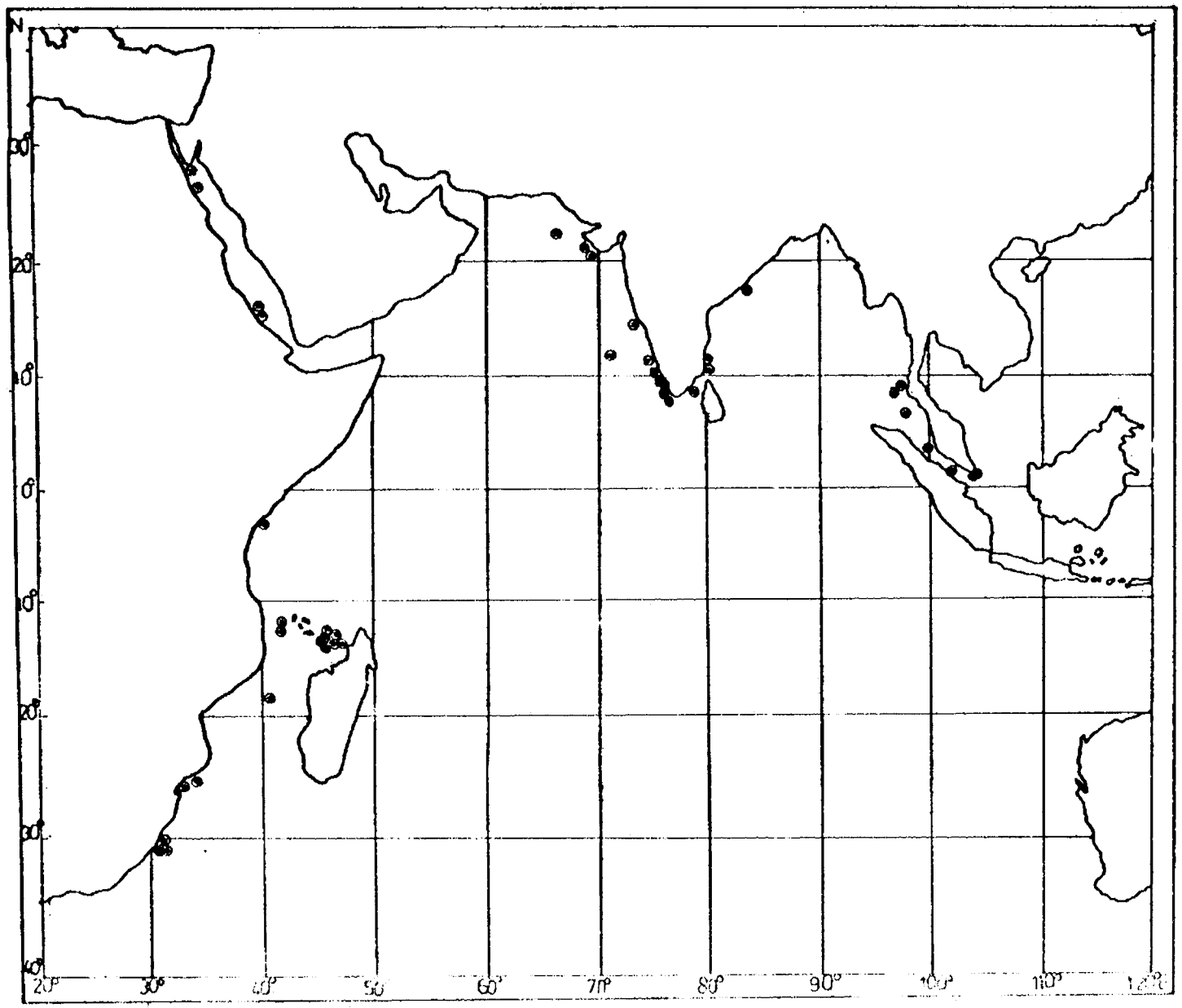


Fig. 1. Map showing the stations in the Indian Ocean from where Cumacea specimens were obtained for the present study.
●● Stations

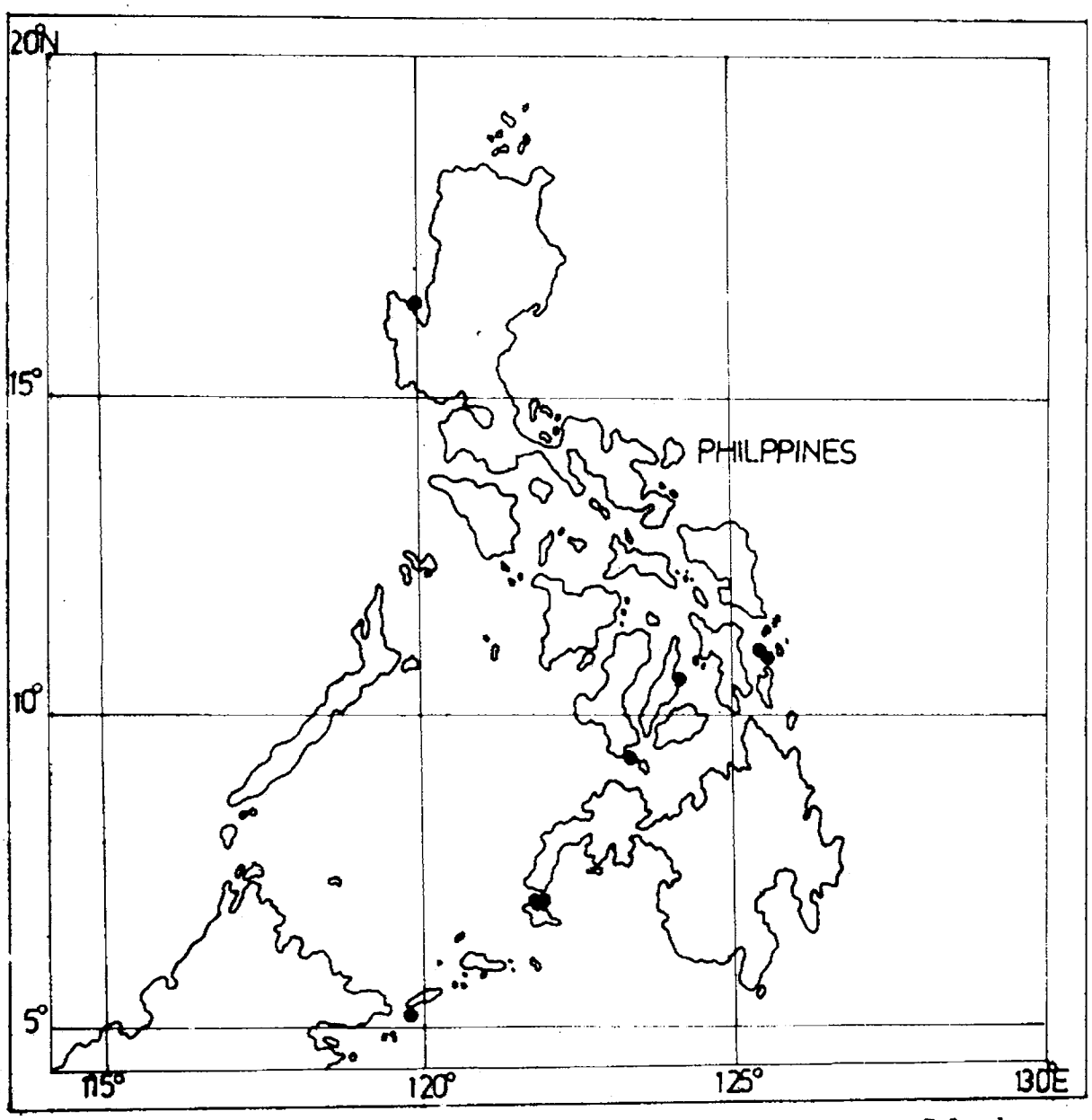


Fig. 2. Map showing the stations in the seas around Philippine Islands from where Cumacea specimens were obtained for the present study. ●● Stations

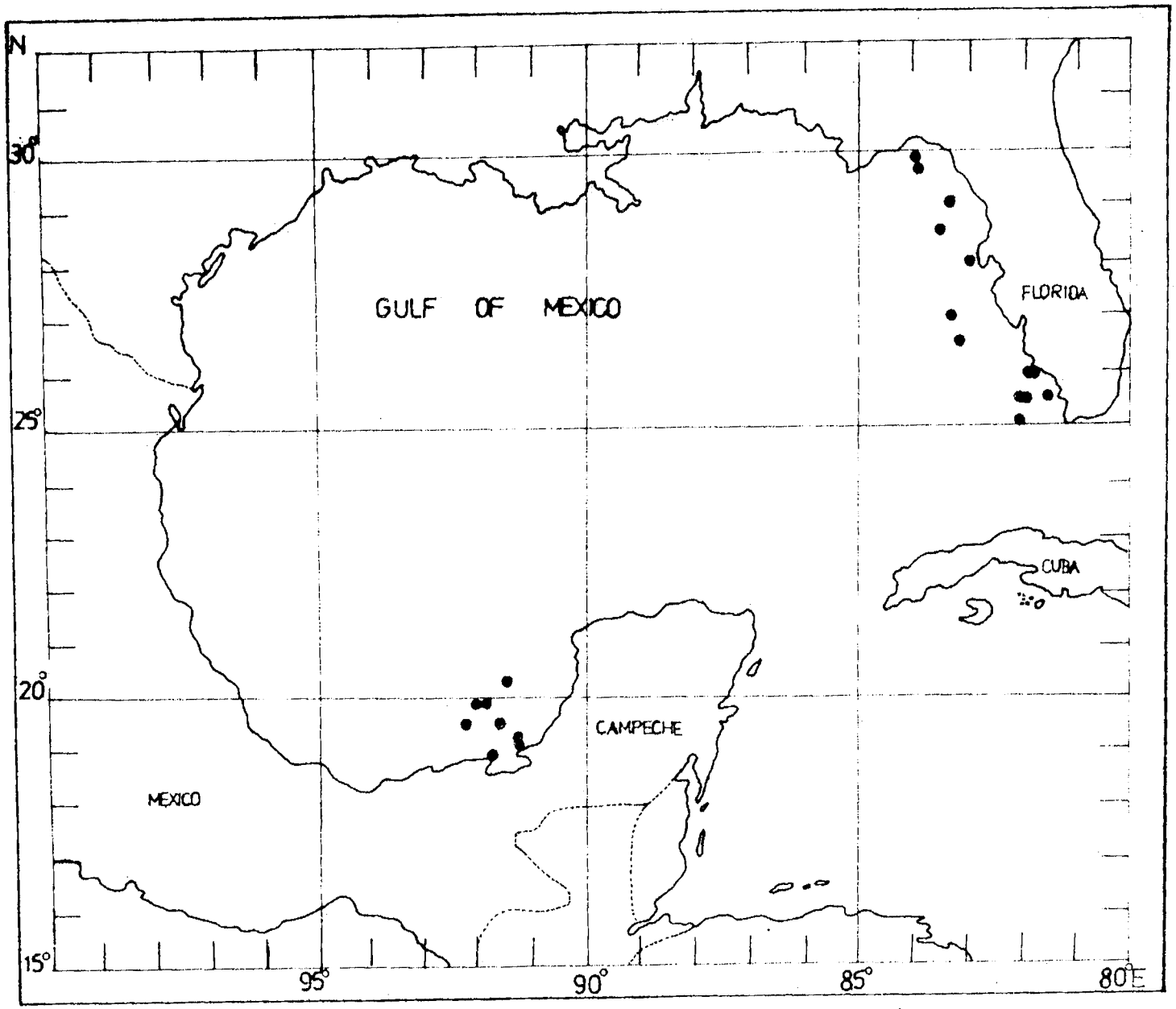


Fig. 3. Map showing the stations in the Gulf of Mexico from where Cumacea specimens were obtained for the present study.
●● Stations

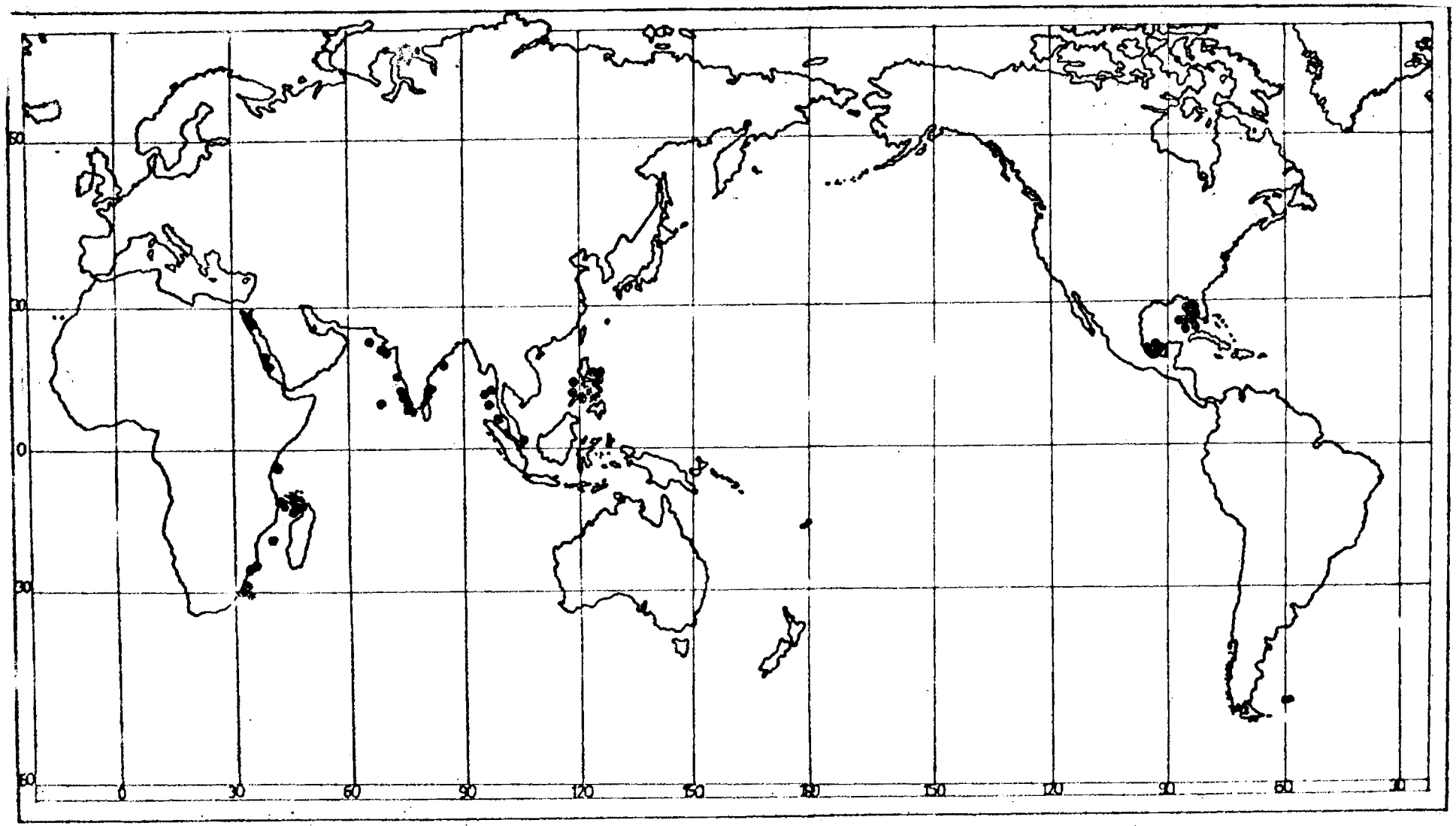


Fig.4. Map of the World showing the stations from where Cumacea specimens were obtained for the present study.
00 Stations.

3. [illegible]

3. TAXONOMIC STUDY

3.1. Systematic position of Cumacea

The systematic position of Cumacea has been much debated among the Zoologists. It got the status of an order only towards the later half of the 19th century. The first form recorded is probably that described by Lepechin in the year 1780, as Oniscus scorpioides, which has turned out to be a species of the Genus Diastylis. Another cumacean form was observed in the year 1774 by Colonel Montagu, and designated by the same specific name; but his author believed that the specimen found was a defective decapod that lost its head. In the year 1828, Milne-Edwards observed apparently the same form and he established a genus Cuma for its reception. It is from this genus that the name of the order is derived. The American Zoologist Say (1818) established the genus Diastylis still earlier than Milne-Edwards. But Milne-Edwards (1828) was of the opinion that both the genera Diastylis and Cuma were only the larval forms of certain higher crustaceans and this assumption was accepted by many of the subsequent authors. According to them the Cumacea should be wholly discarded from the Zoological system, as only representing immature animals. But Kroyer and Goodsir (1841) clearly showed the Cumacea to

be perfect animals and added several new species. There was still doubt among Zoologists for many more years as to the true nature of these minute crustaceans. Meanwhile the investigation of this problematical Crustacea was continued by several distinguished Zoologists like Kroyer, Sp. Bate, and Lilljeborg and all of them agreed in denying the larval nature of the Cumacea. In spite of these observations, Milne-Edwards, even in 1853 opposed the above opinion and he considered Cumacea to be immature animals and placed them along with Phyllosoma, Zoea and other larval forms of Crustacea.

The general acknowledgment of the Cumacea as perfect animals worthy of being ranked in the carcinological system is of the comparatively recent date. It was Sars (1900) who first attempted a detailed description of this neglected group. The number of genera and species at his time were limited. In recent time, by the investigations of several Zoologists, the number of both genera and species have considerably increased.

Jones (1963) threw considerable light concerning the affinities of the cumaceans. According to him the Cumacea is an order of the subclass Peracarida of the class Malacostraca. It resembles the Mysidacea in having a well developed carapace

and exopodites on the thoracic appendages. On the other hand it resembles the Tanaidacea in having the carapace in the form of a fold projecting on each side of the cephalothorax, enclosing a chamber in which lies the respiratory organ formed from the epipodites of the first maxilliped. It resembles Isopoda in not having the eighth thoracic appendage in the larva which emerges from the egg. The females in both the orders lose their oostegites between broods. Cumaceans, tanaids, and isopods have maxillary nephridia, while amphipods and mysids except the lophogastrids, have antennal nephridia. The recent studies by Jones (1963) show that the Cumacea should probably be placed in the branch of the Peracaridan family tree from which also sprung the Tanaidacea and Isopoda, but as an evolutionary divergent line, above the branch giving rise to the Mysidacea and Amphipoda.

3.4. Classification

A satisfactory natural classification of the order Cumacea is not yet available. Stebbin (1913) proposed 26 families, but most of them were based on characters which in some cases are of doubtfully generic value and as such they did not receive general acceptance. Moreover, he gave undue emphasis to the number of pleopods and the exopods of the pereiopods on the basis of which such a large number of

families were created. But many of the families contain only a few species. According to Hansen (192) and Sale (1944a) though the number of pleopods and exopods of peraeopods serve in part as generic indicators, a complete reliance on such a varying character seems to be unjustified.

Today, the more commonly adopted basis for classification has seven families - the Bodotriidae, Leuconidae, Nannastacidae, Cerat cumidae, Lampropidae, Pseudocumidae and Diastylidae (Jones 1963). Bodotriidae, Leuconidae and Nannastacidae, all without a free telson, form a group apart from the rest of the families in which a telson is present.

In the present work Sale's and Jones' classifications are followed as far as possible.

3.3. List of species

Class Malacostraca

Sub class Peracarida

Order Cumacea

Family Bodotriidae

Sub Family Vaunthompsoninae

Genus Heterocuma Biers

1. H. africana Zimmer

2. H. armata Gurjan

Genus *Glyphocuma* Hale

Glyphocuma sp.

3. *G. inaequalis* Hale

Genus *Pseudoeympodomma* Kurian

4. *P. indica* Kurian

Genus *Gigacuma* Kurian

5. *G. halei* Kurian

Sub family Bodotriinae

Genus *Eocuma* Marcusen

6. *E. taprobanica* Calman

7. *E. stellifera* Calman

8. *E. lata* Calman

9. *E. travancoricum* Kurian

10. *E. striata* sp. nov.

Genus *Bodotria* Goodsir

11. *B. pulchella* (Sars)

12. *B. sublevis* Calman

13. *B. scorpioides* (Montagu)

14. *B. pulex* (Zimmer)

15. *B. similis* Calman

16. *B. siamensis* Calman

17. *B. parva* Calman

18. *B. platybasis* Radha and Kurian

19. *B. biocellata* sp. nov.

20. *B. cochinensis* sp. nov.

Genus Pseudocyclaspis Radha and Kurian

21. P. granulata Radha and Kurian

22. P. mexicanaia Radha and Kurian

Genus Cyclaspis Sars

23. C. longicaudata Sars

24. C. herdmani Calman

25. C. levis Thomson

26. C. variana Calman

27. C. longipes Calman

28. C. uniplicata Calman

29. C. unicornis Calman

30. C. cingulata Calman

31. C. striqilis Hale

32. C. cretata Hale

33. C. calmani Hale

34. C. luxta Hale

Genus Iphinoe Sato

35. I. brevipes Hansen

36. I. calmani Fage

37. I. serrata Norman

38. I. inermis Sars

39. I. fagei Jones

40. I. plumanta Kurian

41. I. macrobrachiua Calman

Family Leuconidae

Genus Leucon Kroyer

42. L. longirostris Sars

43. L. acutirostris Sars

Leucon sp.

Genus Hemileucon Calman

44. H. laevis Hale

Family Nannastacidae

Genus Schizotrema Calman

45. S. sordidum Calman

46. S. aculeata Hale

Genus Nannastacus Bate

47. N. zimmeri Calman

48. N. gibbosus Calman

49. N. reptans Calman

50. N. minor Calman

51. N. tardus Calman

52. N. lepturus Calman

53. N. longirostris Sars

54. N. sheardi Hale

55. N. inflatus Hale

56. N. subinflatus Hale

57. N. johnstoni Hale

Genus Cumella Sars

58. C. clavicauda Calman

59. C. hispida Calman

60. C. pygmaea Sars

61. C. limicola Sars

62. C. muncoi Hale

63. C. turgidula Hale

Genus Campylaspis Sars

64. C. orientalis Calman

65. C. rubicunda (Lilljeborg)

66. C. glabra Sars

67. C. nino Hale

68. C. thompsoni Hale

69. C. minuta sp. nov.

70. C. robusta sp. nov.

Family Lampropidae

Genus Hemilamprops Sars

71. H. pellucida Zimmer

72. H. diversa Hale

Family Diastylidae

Genus Diastylis Say

73. D. planifrons Calman

Genus Makrokylindrus Stebbing

74. M. (Coalescuma) fistularis (Calman)

Makrokylindrus sp.

Genus *Paradiastylis* Calman

75. *P. cullicoides* Kemp

Genus *Oxyurostylis* Calman

76. *O. smithi* Calman

77. *O. atlantica* Radha and Kurian

3.4. Taxonomic and identifying characters

Family Bodotriidae

Sub Family Vaunthompsoninae

Genus *Heterocuma* Hiere

Heterocuma africana Zimmer

1921. *Heterocuma africana*, Zimmer, Mitt. Zool. Mus. Natu Berlin, 10, 1, pp. 129–131, figs. 25–27.

1954. *Heterocuma africana*, Kurian, Rec. Indian Mus., 52, Parts 3–4, pp. 294–296, fig. 7.

Locality: Portonovo, 20 m, May - June 1970, 2 ♀♀ 9–9.5 mm, Cape Comorin, 18 m, Bongo, 8.7.1975, 1 ♀ 4 mm, Tuticorin, 10 m, 15.11.1975, 1 ♀ 4.8 mm.

Female: Resembles *Heterocuma africana* Kurian. Slight difference noticed only in the armature of the uropods. Peduncle slightly longer than the last telsonic somite (equal to telsonic somite, Zimmer 1921 and short, Kurian 1954). Peduncle with sixteen spines on the inner margin compared to twelve described by Kurian and seven by Zimmer. Endopod

two-jointed, second joint slightly longer than the first, first join with eleven spines and second with nine marginal spines and three apical spines. Exopod two-jointed slightly longer than the endopod, with numerous long setae on inner margin and free end.

Distribution: West Africa, Andamans off Pier, Ross Island 6-8 m.

Heterocuma armata Kurian

1954. Heterocuma armata, Kurian, Rec. Indian Mus., 52, Parts 3-4, pp. 296-298, fig. 8.

Locality: Portonovo, 2 m, May - June 197 , 1 ♀ 4 mm and 1 ♂ 4.9 mm.

Female: Closely resembles the type specimen. The only difference noticed is that the first pedigerous segment is very distinct here and not as short as in the type. The distal lobe of the basis of the third maxilliped does not show a longitudinal ridge with teeth as described in Heterocuma armata Kurian.

Male (Figs. 5 and 6). Male of this species has not been recorded before and so its description is given here. Carapace less than one-fourth of the total length. Lateral margin of carapace not serrated, flagellum of the second antenna reaches up to last pleon somite.

FIG. 5

Heterocuma armata Kurian: Male

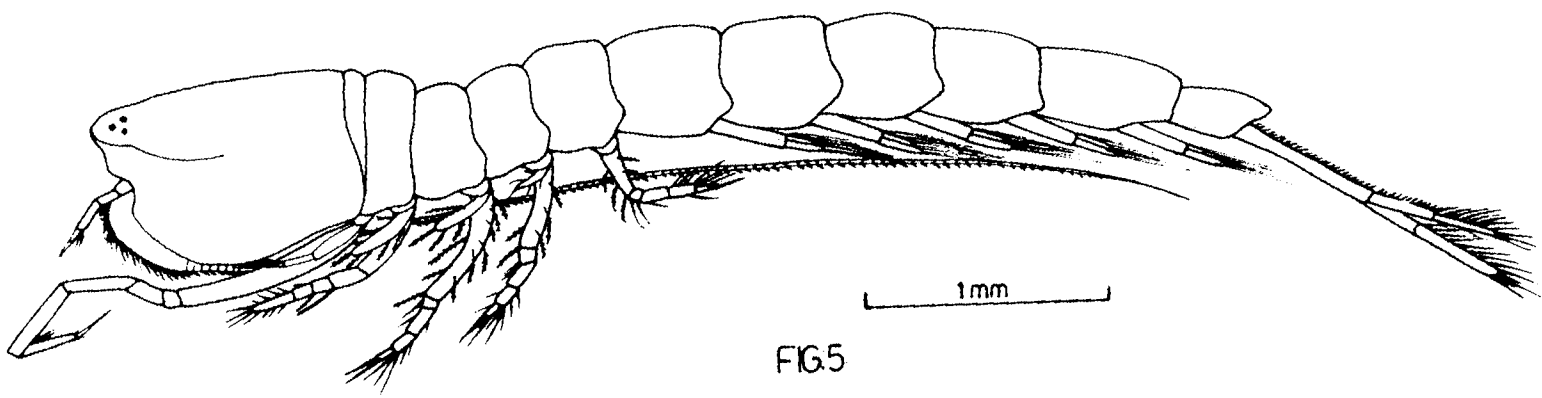


FIG.5

Fig. 6

Interocuma armata Kurian: Male

a. Third maxilliped

b. First peraeopod

c. Uropod

d. *Pseudosympodoma indica* Kurian: Side view of Carapace - Immature male

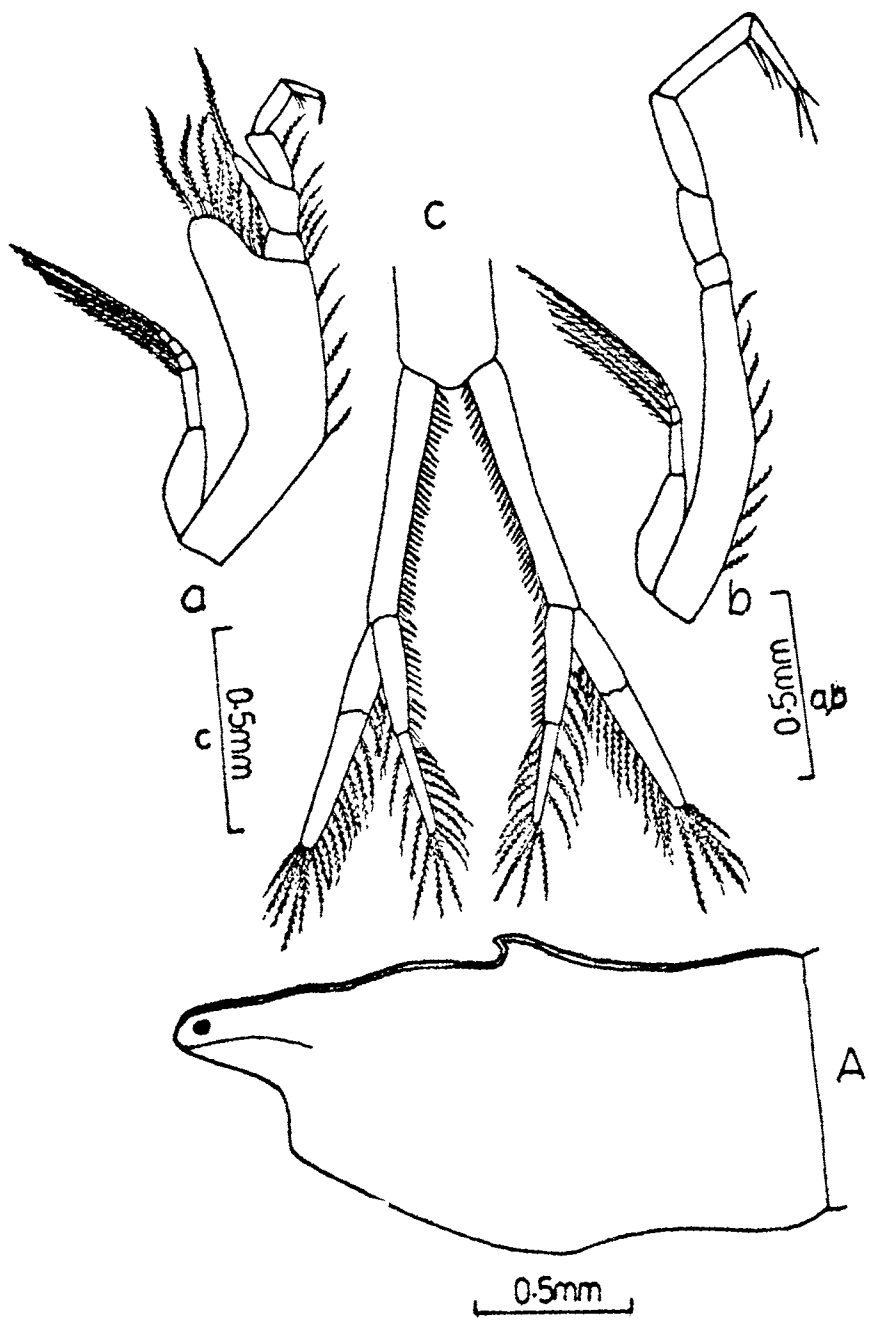


FIG. 6

Basis of third maxilliped without stout teeth on the lateral ridges. Basis of first peraeopod shorter than the rest of the segments combined together, serrated in its inner margin and with short plumose setae. Second paraeopod with basis shorter than the other segments combined together, ischium indistinct, merus with a long stout spine which reaches to about half the length of dactylus. Carpus also with a short stout spine which reaches beyond propodus, dactylus longer than carpus and propodus combined, with numerous spines on both sides and terminal region. Peraeopods 3-5 similar in structure; third and fourth with rudimentary exopods.

Last pleon segment three-fourths the fifth, not produced in between the uropods. Peduncle with thirty-three plumose spines, closely arranged. Endopod two-jointed, first slightly longer than second, with twelve spines and the last one long and stout. The second joint with seven plumose setae on its inner margin, three on its terminal region and six on the external margins. Exopod slightly longer than endopod with thirteen plumose setae on the inner margin and five on the terminal parts. No setae on the external margin.

Distribution: Off Puri, Orissa, 'Madras station 13'.

Genus Glyphocuma Sars

Glyphocuma inaequalis Sars

1944. Glyphocuma inaequalis, Hale, Trans. Roy. Soc. S. Aust. 68, 2, pp. 275-280, fig.36.

Locality: Mud, Lat. 29°34'S, Long. 31°39'E, 1 immature ♂ 7.2 mm.

Immature male. Carapace one-fourth of the total length of the specimen, with well marked dorsal carina having four incisions from the ocular lobe to the middle of the carapace. There are short hairs on these incisions and also through out the body. Ocular lobe with large lenses; granules indistinct. Basis of first peraeopod serrated in the outer margin, ischium without a tooth at its distal angle as in the type description. Third fourth peraeopods with carpus having two or three long terminal setae. Pleopods poorly evoloped. Telsonic emi well produced in between the uropods. Peduncle with long and short setae on the inner margin. Exopod and endopod broken.

Distribution: New South Wales.

Glyphocuma sp.

Locality: Mud, Lat. 30°29'S, Long. 31°37'E, 93 m, Agassiz trawl, 7.9.1964, 1 damaged ♂ 1.5 mm.

Male. Since the cephalothoracic region is crushed and parts of the uropods are missing, identification up to species is not possible. Lateral margin of the carapace dentate. First peraeopod very long, basis slender with numerous short

plumose setae on the outer margin. Telsonic somite projects in between the uropods. Peduncle longer than the telsonic somite, with eleven spines. Endopod two-segmented, first broader and longer than the second, with two stout spines and numerous spinules. Outer margin of the endopod is also provided with short spines. Exopod broken.

Genus Pseudosympodomma Kurian

Pseudosympodomma indica Kurian

1954. Pseudosympodomma indica, Kurian, Rec. Indian Mus., 52, Parts 2-4, pp. 299-302, figs. 9,10.

Locality: Off Visakhapatnam, 40-60 m, Ground-sand and clay, 1 immature ♂ 10.2 mm.

Immature male (Fig.6A). Closely resembles the type specimen. Carapace one-fifth of the total length. Pseudorostrum very short. A distinct dorso-median carina present with a well marked blunt tooth projecting forward in the median line. First pedigerous segment distinct, devoid of carina, second third and fourth with dorso-median carina. Third maxilliped with apical process well produced. First and second peraeopods with exopods. First peraeopod very long, basis shorter than the combined length of the other segments. Tip of the basis with two short plumose setae, propodus very long, carpus only one-third of the propodus, dactylus three-quarters the propodus with setae on the inner margin.

Pleopods poorly developed. Fifth pleon somite twice as long as the telsonic somite, well produced in between the uropods. Peduncle very long with twenty nine to thirty short and long spines on the inner margin. Endopod slightly shorter than exopod, more than half of the peduncle, two-jointed, first joint slightly shorter than second with thirteen-fourteen spines, second joint with nine spines. It has numerous short setae on the outer margin. Three unequal terminal spines are also present. Exopod three-quarters the peduncle with numerous plumose setae in the inner margin and setae on the outer margin.

The adult male specimen obtained previously from Kilakarai has a smooth crest devoid of serrations while the ovigerous female has a dentate crest on the carapace. The young specimen obtained now from the East Coast of India shows a clear blunt tooth projecting forward on the carapace.

Distribution: Kilakarai; Ramnad Dist.

Genus Gigacuma Kurian

Gigacuma halei Kurian

1951. Gigacuma halei, Kurian, Bull. Centr. Res. Inst. Univ. Travancore, (C), 2, 1, pp. 102-105, pl. 2-4, figs. 25-43.

1954. Gigacuma halei, Kurian, Rec. Indian Mus., 52, parts 2-4, p. 290.

Locality: Vizhinjom, St. No.145, 24 m, dredge collection, 25.4.1959, 11 ♀♀ 6.8–9.5 mm, Vizhinjom Bay, 15 m, surface plankton, 5.11.1980, 1 ♀ 8.2 mm, 30.9.1981, 4 ♀♀ 2.5–5.6 mm, 29.7.1982, 1 ♀ 3.2 mm, Vizhinjom, open sea, 20 m, surface plankton, 10.11.1981, 1 immature ♀ 2.8 mm, Vizhinjom, open sea, 20 m, surface plankton, 25.2.1982, 1 immature ♀ 8 mm, Vizhinjom Bay, 15 m, surface plankton, 15.11.1982, 2 ♀♀ 6 mm.

Female. Closely agrees with the type. Difference is noticed only in the numbers of spines and setae on the uropods. Peduncle of uropod with thirteen long and short spines. Outer border of the first joint of the endopod of uropod with four or five spines; the second joint with sixteen to seventeen spines. Inner margin of the exopod with thirteen and outer border with fifteen plumose setae. The spines on the peduncle, the endopod and the outer edge of the exopod are having bifid apices.

Distribution: Trivandrum, Vizhinjom, Cape Comorin, 24–30 m, off Puri, Orissa 8–9 m.

Sub family Bodotriinae

Genus Bocuma Marcusen

Bocuma taprobanica Calman

1904. Bocuma taprobanica, Calman, Ceylon Pearl Oyster Fish. Suppl. Rep. 12, p. 161, pl. 1,2, figs. 1–28.

1913. Bocuma taprobanicum, Stebbing, Das Tierreich, 39, p. 2[illegible].

1951. Eocuma taprobanicum, Kurian, Bull. Centr. Res. Inst. Univ. Travancore, (C), 2, 1 pp. 94-95.

1954. Eocuma taprobanicum, Kurian, Res. Indian Mus., 52, parts 2-4, pp. 284-285.

Locality: Trivandrum, 1945, 1 immature ♂ 4 mm, Vizhinjom, 1945, 13 ♀♀ (4 ovigerous) 3-4.9 mm, ZSI collection, Cochin, Lat. 09°58'N, Long 76°22'E, 4.11.1963, 34 ♀♀ 1.6-5.6 mm, 3 ♂♂ 4.1-5.7 mm, Cochin, 18 m, Bongonet, 12.7.1975, 1 ♀ 2.4 mm, Calicut, 20 m, 15.7.1975, 1 ♀ 4 mm, Off Cochin, 20 m and 25 m, 26.9.1981, 17 ♀♀ (1 ovigerous) 2.4-4.5 mm, 4 ♂♂ 4.5 mm, Purakkad, 12 m, 1 ♀ 7 mm.

Ovigerous female. Carapace one-third of the body, broader than that of the male. Reticulate texture of the carapace prominent. Second pedigerous segment clearly visible and the longest. The third pedigerous segment much wider than its length, the fourth and fifth alike (third and fourth somites are reduced above to narrow transverse bars, Calman 1907). Abdomen slender. Basis of first peraeopod broad. Merus of the second peraeopod has stout spine which reaches beyond the carpus (almost to the end of the limb in previous collection).

Peduncle with three plumose setae and a spinule. Endopod with eleven plumose setae and two spinules; exopod with six plumose setae and no spinule.

Male. Basis of first peraeopod little produced and this projection has a plumose seta terminally. Second peraeopod is the shortest. Abdomen slightly broader than that of the female. Uropod little longer than that of female. Exopod and endopod subequal. Peduncle with thickly packed plumose setae. Endopod with numerous plumose setae and spinules arranged in two layers, exopod with plumose setae on both the margins.

Eocuma taprobanica is very common in Trivandrum and Vizhinjam coasts. It has a maximum intensity in the Trivandrum region between 24–30 m depth during January to April.

Distribution: Gulf of Manaar 12–18 m, Travancore coast 24–30 m, Andamans 4–10 m, Orissa coast.

Eocuma stellifera Calman

1907. Eocuma stellifera, Calman, Trans. Zool. Soc. London, 18, 1, P. 20, figs. 13–17.

1913. Eocuma stelliferum, Stebbing, Das Tierreich, 32, pp. 21, 22.

Locality: Purakkad (Kerala coast) 12 m, 1 ♀ 5.1 mm.

Female. Lateral cornua stout and incurved at its tip, lateral carina well marked. Medio-lateral carina present in the posterior end of the carapace more or less narrowed.

Whole of the carapace covered with thickly packed stellate spots, characteristic of this species. First peraeopod long with a marked distal process in the second joint directed inwards; propodus little longer than carpus. Second peraeopod short. Telsonic somite slightly longer than fifth pleon somite. Peduncle two-third the subequal rami.

Distribution: Gulf of Siam, 15-28 m.

Eocuma lata Calman

1907. Eocuma lata, Calman, Trans. Zool. Soc. London, 18, 1, pp. 22-23, pl.6, figs. 7-12.

1913. Eocuma latum, Stebbing, Das Tierreich, 39, p.22.

1951. Eocuma latum, Kurian, Bull. Centr. Res. Inst. Univ. Travancore, (C), 2, 1, pp. 96-97.

1954. Eocuma latum, Kurian, Rec. Indian Mus., 52, parts 2-4, pp. 285-287, fig.3.

1958. Eocuma lata, Gamo, Zool. Mag., Tokyo, 67, 12, pp. 383-385, fig.1.

Locality: Off Visakapatnam, 40-60 m, Ground-sand and clay, 1 ♀ 4 mm and 1 immature ♂ 4.1 mm, Portonovo, 20 m, May-June 1978, 3 ♀ ♀ 5.3-5.5 mm, Off Cochin, 10 m, plankton, 16.1.1982, 1 immature ♀ 2 mm. Off Cochin, 15 m, plankton, 22.3.1982, 1 ♀ 2.7 mm, Off Cochin, 30 m, plankton, 16.7.1982, 2 ♀ ♀ 3-4 mm.

Female. Carapace with well marked lateral carinae. Lateral cornua well developed and the tips directed forwards. Pseudorostral lobes distinctly rounded. Antero-lateral tooth not visible or very short and the region between the pseudorostral lobe and lateral cornua nearly straight (triangular tooth, Calman 1907, rounded knob like projection, Kurian 1954). Median carina slightly developed. The surface of the carapace with reticulate texture.

Basis of the first peraeopod shorter than the combined length of the remaining segments, the terminal process project forward and produced to a long plumose seta; propodus slightly longer than carpus. Second peraeopod shorter than third. Abdominal segments cylindrical; telsonic somite only slightly shorter than the previous segment.

Uropods show differences from the type description, peduncle one-third the subequal exopod and endopod with four or five plumose setae, endopod with nine plumose setae and three spinules, exopod with three short plumose setae, ends more or less blunt, with a swelling near its terminal region.

Immature male. Resembles female in most of the characters. Carapace little shorter than that of female. The median

carina is more prominent in male which is continued up to the fifth pleon somite. This is absent in the pedigerous segments in the case of female. Peduncle of uropod has five plumose setae. Endopod with twelve plumose setae and three setinules, exopod with four plumose setae.

Distribution: Gulf of Siam 18–20 m, Trivandrum 24 m, Matusima, Off Yosihama, Japan – 20 m.

Cocuma travancoricum Kurian

1951. Cocuma travancoricum, Kurian, Bull. Centr. Res. Inst. Univ. Travancore, (C), 2, 1, pp.97–99, pl.2, figs. 16–23.

Locality: Off Visakhapatnam, 40–60 m, Ground-sand and clay, 1 ovigerous ♀ 6.7 mm.

Female. Closely agrees with the type description. Lateral cornua horn-like, situated behind the level of the eye lobe. Carapace rigid, covered with hairs and tubercles. All the segments of third maxilliped broad except the slender dactylus. Propodus bears numerous setae on its inner margin and terminal region. First leg not very long, basis broad, the remaining segments slender, the last two segments reach beyond the lateral horns. Second peraeopod shorter than the others. Pleon long and slender, fifth segment, one and a half times longer than the telsonic somite. Peduncle of uropod less than half the length of the telsonic somite

with three or four plumose setae. Uropods broken. Numerous eggs present.

Distribution: Trivandrum, from surface to 30 m.

Lucuma striata sp. nov.

Locality: Off Visakhapatnam, Ground-sand and clay, 40–60 m, 1983, 1 ♀ 5.5 mm.

Female (Figs. 7 and 8). The integument of the body is opaque, strongly calcified. The surface of the carapace is finely pitted. Under high magnification the carapace shows minute shallow pits which are arranged to form a fine reticulated texture. Lateral margins of the carapace and the pleural plates of the thoracic somites are lamellate, rather opaque, beset with many short striated texture.

Pseudorostral lobes slightly in advance of the triangular tooth at the antero-lateral margin. Lateral cornua short and directed forwards. The space between the antero-lateral tooth and lateral horn is concave. The anterior portion of the carapace in between the lateral cornua is as wide as the leggth of the carapace. The lateral carinae are well marked and extend posteriorly where they turn dorsal wards and meet the dorso-median

Fig. 7

A. *Locuma striata* sp. nov. Female

B. Dorsal view of Carapace

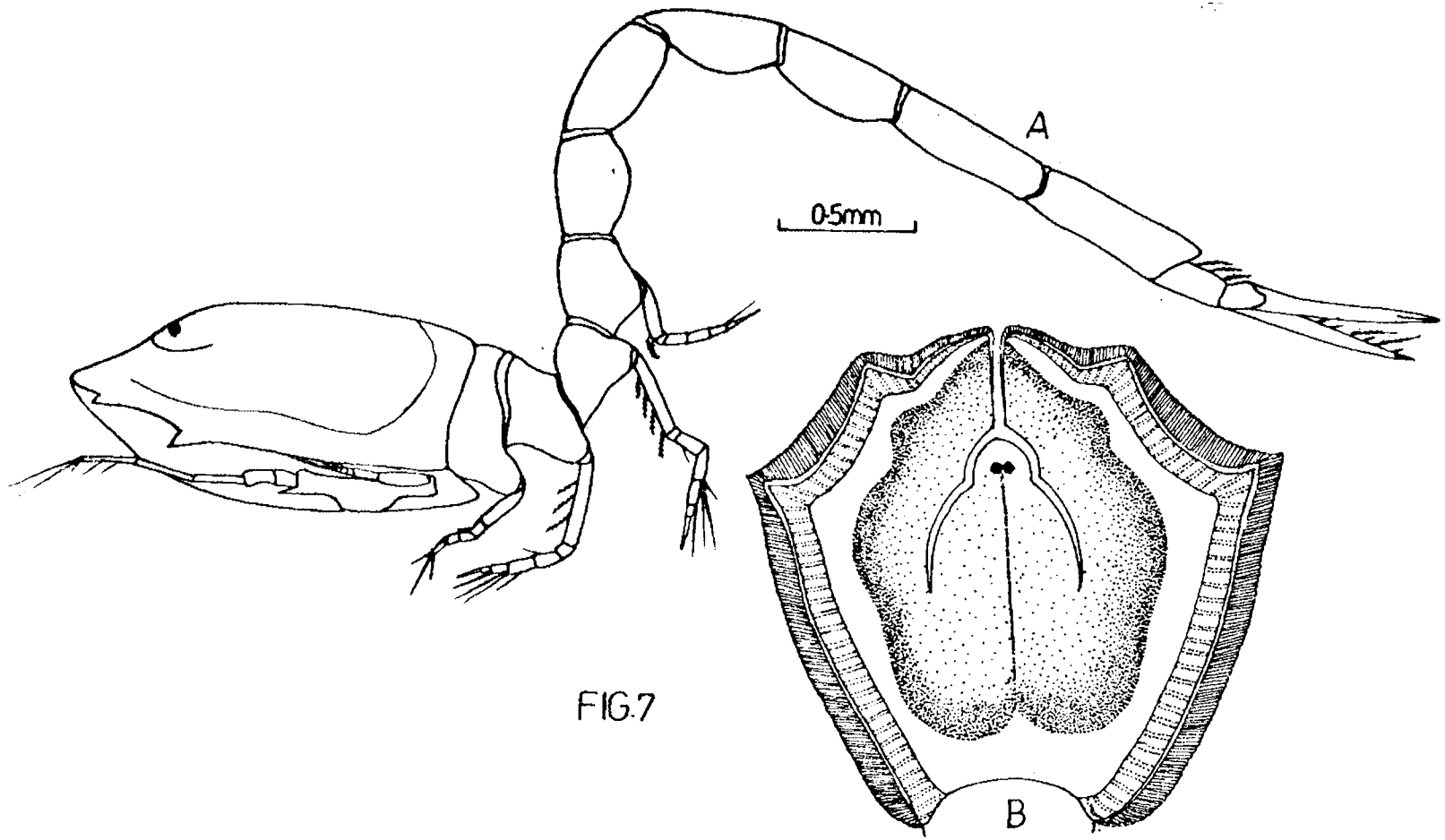


FIG.7

carina. The dorso-median carina is well marked and continued up to the fifth pleon somite. The side of the carapace is striated and the striation is very clear in the anterior region.

First pedigerous segment fused with the carapace. Abdomen long, one and three-fourth times longer than the carapace; segments long and cylindrical. Fifth pleon somite and telsonic somite are equal in length, but telsonic somite is broader.

The first segment of the peduncle of the antennule is longer than the other two combined; second and third subequal. The main flagellum is 3-segmented and acessory flagellum is very minute. Basis of the third maxilliped has a long terminal lobe extending up to the merus which also is expanded terminally; ischium and merus sub-equal, ischium has short plumose setae on its inner margin.

Basis of first peraeopod shorter than the length of the remaining joints combined together. It is produced forwards, ischium and merus subequal and short; carpus, propodus and dactylus slender, the last two being subequal. The dactylus has two or three long terminal spines.

Second peraeopod very short; basis shorter than the other segments combined together; dactylus robust and longer than propodus, has one long and two short terminal spines.

FIG. 3

Eocuma striata sp. nov. Female

a. First antenna

b. Third maxilliped

c. First peraeopod

d. Second peraeopod

e. Third peraeopod

f. Fourth peraeopod

g. Fifth peraeopod

h. Uropod

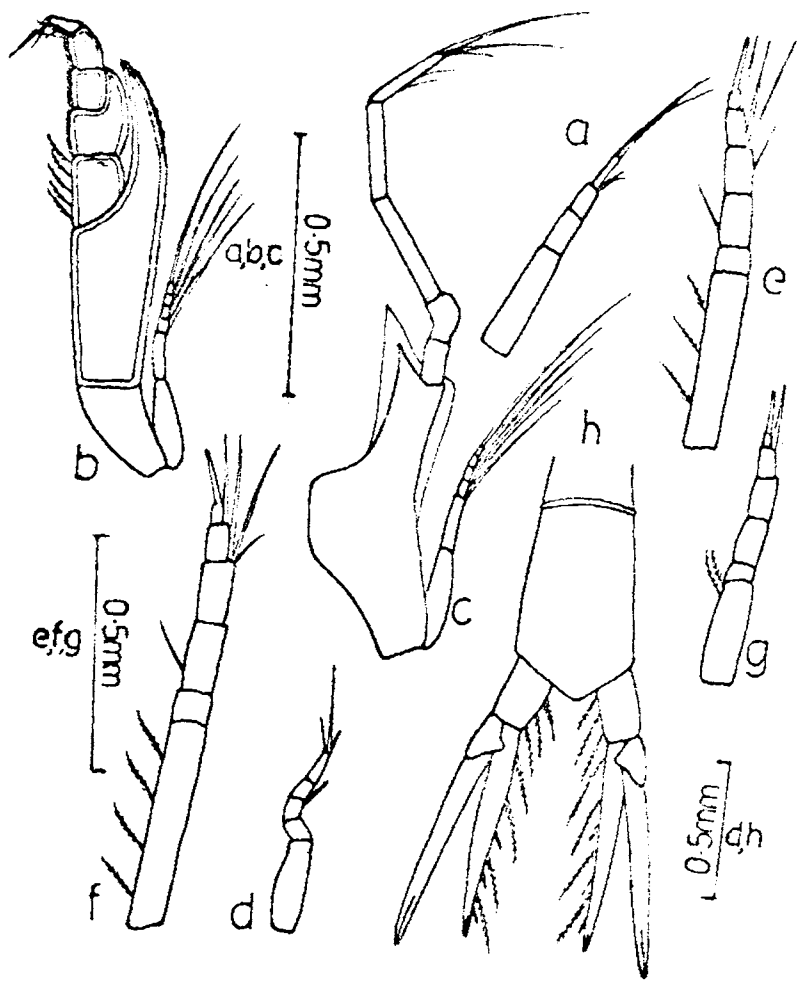


FIG.8

Basis of third peraeopod shorter than the rest of the joints combined together; carpus slightly shorter than merus or subequal, has three terminal setae; propodus also has a terminal seta which reaches beyond the terminal seta of dactylus. The inner margin of basis has plumose setae.

Fourth peraeopod similar to third but slightly long. Fifth peraeopod short, but longer than second; basis shorter than the remaining joints combined together; dactylus short and has a terminal spine.

Peduncle of uropod short, less than half of the exopod with three plumose setae in the inner margin. Endopod, slightly shorter than exopod, has four plumose setae and three spinules. The exopod without any seta; the terminal end is bifid.

The present species is distinguishable from other known species of the genus Eocuma by its unique shape of carapace which is very wide. The opaque integument with strong calcified and pitted recticulated texture of the carapace shows some resemblance to Eocuma amakusensis Gamo, but its carapace is not broad as in the present species. The lateral carina is characteristic, posteriorly it joins with the carina which is very

distinct unlike in all other species of Cuma and is continued up to the fifth pleon somite. Moreover the distinct striated texture of the sides of the carapace is a specific character of this species which distinguishes it from all other related species of the genus.

Genus Bodotria Goodsir

Bodotria pulchella (Sars)

1878-79. Cuma pulchella, Sars, Arch. Math. Naturvid. Kristiania, 1878, 3, p.485, 4, p.24.

1907. Bodotria pulchella, Claman, Bull. Mus. His. Nat. Paris, 13, p.116, fig.1.

1951. Bodotria pulchella, Fage, Faune de France, 54, Paris, pp.34-35, figs.27-28.

Locality: Calicut, 0-20 m, Bongo net, 15.7.1975, 1 ♀ 2.2 mm, Karwar, 10 m, 27.10.1975, 23 ♀ ♀ 2.1-2.2 mm, Off Cochin, 0-15 m, Bongo net, 26.9.1981, 2 ♀ ♂ 2.1 mm.

Male. Carapace short. Two pairs of longitudinal carinae present, free at the anterior end but joined at the posterior end. Eye clearly visible. Basis of the second peraeopod elongated, but not slender, longer than the rest of the segments combined together. The concave side of the basis is finely serrated, but retroverted teeth is not visible.

Peduncle of uropod long with ten short serrated spines and four or five short plumose setae arranged in two rows on the posterior half of the peduncle. Exopod and endopod subequal, less than half of the peduncle. Endopod two-jointed, first being longer and broader than the second, with eight spines; second joint with out any spines but with two unequal terminal spines. Exopod with three plumose setae on the inner margin and three unequal terminal spines.

Distribution: Mediterranean, Bay of Naples, Scotland, England.

Bodotria sublevis Calman

1907. Bodotria sublevis, Calman, Trans. Zool. Soc. London, 18, 1, p.3, pl.1, figs.1-3.

1913. Bodotria sublevis, Stebbing, Das Tierreich, 39, p.25.

1951. Bodotria sublevis, Kurian, Bull. Centr. Res. Inst. Univ. Travancore, (C), 2, 1, pp.80-81.

Locality: ISRSE, Entedebir 1, about 3 m from high tide level, 11.3.1962, 5 ♀ ♀ 1.3-1.9 mm, Vizhinjom, open sea 20 m, surface plankton, 11.3.1982, 1 ♂ 1.8 mm, Off Cochin, 15 m, plankton, 16.7.1982, 1 ♀ 1.5 mm

Female. Carapace granular, without hairs and spines. Eye distinct with corneal lenses. Basis of the third maxilliped longer than the other segments combined together and expanded distally with three or four plumose setae. Basis of first peraeopod as long as the other segments combined together,

carpus longer than merus and propodus, dactylus slender. Pleon longer than cephalothorax, telsonic somite half of the fifth somite and less than half of the peduncle of uropod. Peduncle without spines or serration. Exopod and endopod subequal and three-fourths the peduncle. First joint of the endopod twice as long as the second, with two long spines terminally and two or three spinules in the margin. Second joint with two unequal terminal spines and a spinule in the margin (six and four spinules in the first and second joint respectively - Kurian, 1951 and five and two - Calman, 1907). Exopod with three or four setae on the inner margin and two unequal terminal spines.

Distribution: Gulf of Siam, Trivandrum.

Bodotria scorpioides (Montagu)

1804. Cancer scorpioides, Montagu, Trans. Linn. Soc. London, 7, p.70, fig.5.

1907. Bodotria scorpioides, Calman, Trans. Zool. Soc. London, 18, 1, p.3.

1913. Bodotria scorpioides, Stebbing, Das Tierreich, 39, pp.25-26.

1958. Bodotria scorpioides, Lomakina, Opred. po faune SSSR, no.66, pp.281-283, fig.190.

Localities: IOSE, Nossi-Be, Madagascar, 1 immature ♀ 3.5 mm, IOKSE, Entedebir 1. Grab, 5 m, 20.3.1962, 3 ♂ ♀ 2 mm, IOKSE, Entedebir 1, Light plankton 5 m, 19.3.1962, 48 ♂ ♀ 2-3 mm.

Male. Pseudorostrum short. Paired lateral carinae not developed. The basis of the first peraeopod longer than the other segments combined together, carpus equal to propodus. Fifth pleon somite much longer than the telsonic somite and narrowed distally. Peduncle of uropod thrice as long as the telsonic somite with seven or eight short plumose setae and seven spines arranged in two rows. Exopod and endopod subequal, more than half the length of the peduncle. First joint of endopod, more than twice as long as the second, with seven spines on the inner margin, second joint without any spines but with two unequal terminal spines. Exopod with six setae on the inner margin and two unequal terminal spines.

Distribution: British Isles, France, Norway, Mediterranean.

Bodotria pulex (Zimmer)

1903. Cuma pulex, Zimmer, Zool. Jb. (Syst.), 18, p.166, tf.A-C.

1913. Bodotria pulex, Stebbing, Das Tierreich, 32, pp.26-27.

1967. Bodotria pulex, Harada, Jap. J. Zool., 15, 3, pp.224-226.

Locality: [illegible], Lat.26°[illegible]'S, Long.33°[illegible]', 135 m, rock dredge, 22.8.1964, 1 ♀ 5.5 mm, Vizhinjom, plankton, 25.4.1959 2 ♂ ♂ 2.5 mm, [illegible] collection, Cochin, Lat. [illegible]', Long. 76°22'[illegible], 4.11.1963, 6 ♂ ♂ 2.1-3.5 mm, 6 ♀ ♀ (3 ovigerous) 1.7-2.3 mm.

Male. Very closely resembles the specimen from off Shimoda, Shima (Japan). Pseudorostrum very short, dorso-median carina very distinct on the carapace, thoracic somites and first five pleon somites. Free pedigerous segments with well developed lateral ridges. Carapace shorter than one-fourth of the total length. The basipodite of the first peraeopod is longer than the other segments combined together, it is furnished with a clump of spines on its inner middle part. Carpus broad and longer than merus or propodus but not as much as described by Harada. Peduncle of uropod with its inner border fringed with a series of long setae on its whole length and another series of short spines on its distal two-thirds. Exopod and endopod subequal, three-fourth the peduncle, endopod with thirteen inner marginal spines and two unequal terminal spines. Exopod with seven or eight long setae and two terminal spines.

Female. Similar to male. Peduncle with no setae or spines. Endopod with seven marginal spines and a terminal spine and exopod with six setae.

Distribution: Enoshima, Shimoda (Japan).

Bodotria similis Calman

1907. Bodotria similis, Calman, Trans. Zool. Soc. London, 18, 1, p.4, pl.1, figs.4-9.

1913. Bodotria similis, Stebbing, Das Tierreich, 39, p.27.

1951. Bodotria similis, Kurian, Bull. Centr. Res. Inst. Univ. Travancore, (C), 2, 1, pp.81-82.

1954. Bodotria similis, Kurian, Rec. Indian Mus., 52, Parts 3-4, p.276.

1962. Bodotria similis, Gamo, Publ. Seto. Mar. Biol. Lab., 10, 2, pp.156-161, figs.3-5.

Locality: Laccadive, 1 ♀ 2.9 mm, Vizhinjom, 25.4.1959, 4 ♀ ♀ 2.5-2.7 mm, Vizhinjom bay, 15 m, surface plankton, 30.9.1981, 29.7.1982, 4 immature ♀ ♀ 1.6-2 mm.

Male. Closely resembles the previous records. Carapace one-third of the total length and broad. Ocular lobe large with distinct corneal lenses. Median carina of carapace not prominent, but clear in pedigerous and thoracic segments except in the last pleon segment. A well marked lateral carina on either side of the carapace which continues up to the last pedigerous segment. First pedigerous segment indicated by a suture (Kurian 1951). Pedigerous segments and abdominal segments broad and tapering towards the distal segment. Peduncle of uropod of mature male with

eight spines and four plumose setae and that of immature male is devoid of spines and setae, but highly serrated. Exopod and endopod of uropod subequal, endopod with nine or ten spines and exopod with three plumose setae.

Distribution: Gulf of Siam 12–20 m, Trivandrum and Cape Comorin 26–30 m, Japan.

Bodotria siamensis Calman

1907. Bodotria siamensis, Calman, Trans. Zool. Soc. London, 18, 1, p.5, pl.1, figs.13–15.

1913. Bodotria siamensis, Stebbing, Das Tierreich, 32, pp.27–28.

Locality: ISOE Collection, Lat. 09° 11', Long. 76° 29', 4.11.1963, 1 ♀ 2.6 mm, Cochin, 18 m, Bongonet, 12.7.1975, 1 ovigerous ♀ 2.1 mm, Karwar estuary Benthos, November 1982, 2 ♀↑ ♀↑ (ovigerous) 2.4 and 2.5 mm, 2 immature ♂ ♂ 1.7 and 1.8 mm.

Female. Resembles the type description. The spiniform antero-lateral tooth described by Calman (1907) and Stebbing (1913) is indistinct. Basis of the first peraeopod broad and little shorter than the rest of the joints combine together. Peduncle of uropod twice as long as the telsonic somite. Exopod and endopod subequal, three-fourth the peduncle. Endopod with nine spines on the inner margin and a long and stout terminal spine (slender terminal spine–Calman). Exopod with four or five plumose setae on the inner margin.

Distribution: Gulf of Siam.

Jodotria parva Calman

1907. Jodotria parva, Calman, Trans. Zool. Soc. London 18, 1, p.5, pl.1, figs.16-18.

1913. Jodotria parva, Stebbing, Das Tierreich, 39, p.28

Locality: IOAS, Horizontal plankton, Sasawa Channel, 7.4.1962, 1♂ 2♀♀ (5 adults, 2 ovigerous and 5 immature) 0.3-2.1 mm.

Ovigerous female. Calman's description of this species is incomplete and hence some additional facts observed in the ovigerous female are included here. Carapace one-fourth of the total length of the specimen. A faintly marked longitudinal ridge is present on either side of the carapace. Antennal tooth not exactly rounded as in type description.

Basis of third maxilliped longer than the other segments combined together, with two plumose setae on its outer terminal expansion, merus longer than carpus, carpus and propodus subequal in length; all these three segments with short plumose setae on the inner margin, dactylus very short.

Basis of first peraeopod almost as long as the other segments combined together, merus and carpus subequal in

length, propodus slightly shorter than merus or carpus, dactylus short.

Pleon subequal to cephalothorax, fifth pleon somite twice as long as the telsonic somite. Peduncle of uropod slightly shorter than the last two pleon somites combined together, without spines or setae. Exopod and endopod subequal, three-fourth the peduncle, endopod with one spine on its inner edge, about two- third of its length and another close to the apical spine; the inner margin between these two spines is serrated, exppod with four or five setae on the inner margin.

The measurement of the adult female specimen recorded from the Gulf of Siam is only 1.5 mm compared to 2-2.1 mm of the present collections.

Distribution: Gulf of Siam.

Bodotria platybasis Radha and Kurian

1981. Bodotria platybasis, Bull. Dept. Mar. Sci. Univ. Cochin, 12, 1, pp.23-28, figs.1,2.

Locality: Portonovo, intertidal fine sand, 7.2.1978-27.2.1981, numerous adult females and ovigerous females 1.5-2.5 mm, 13 immature males 1.5-1.7 mm, off Quilon (10.7.1975), Calicut (14.4.1975), Cochin (12.7.1975), Karwar (27.10.1975), plankton 17 ♀♀ Vizhinjom bay, 15 m, surface plankton, 30.8.1982, 3 ovigerous ♀♀

Ovigerous female. Resembles Bodotria parva Calman. Pseudorostrum short and blunt, antero-lateral tooth rounded as in Bodotria parva. Two faintly marked longitudinal ridges seen on each side of the carapace which do not reach the posterior margin. A slight crescentic transverse ridge present near the hinder end of the carapace.

Basis of third maxilliped very broad, longer than the combined length of the remaining segments, on the inner side at the bent portion there are three or four small teeth. Basis of first peraeopod broad as in third maxilliped, as long as the other segments combined together.

Exopod and endopod of uropod subequal, three-fourth the peduncle. Exopod with three setae on its inner margin and two unequal terminal spines. Endopod with two unequal terminal spines and an inner spine slightly away from the terminal region. There is faint serration between these spines. The brood pouch revealed eggs or larval stages numbering from 17-31 in different specimens.

Immature male. Agrees closely with the female specimen. Lateral carina and crescentic transverse ridge near the posterior end of the carapace faintly marked.

Third segment of first antenna has a bunch of hairs on its terminal portion, flagellum of second antenna not

developed. Third maxilliped similar to that of male with broad basis. Basis of first peraeopod also broad with three short spines on its inner margin. Pleopods on the first three pleon segments developed, that of fourth small. Fifth pleopod not developed. In some specimens a small projection is noticed. Uropod similar to that of female.

A. platybasis has been collected from the east and west coasts of India. Majority of the specimens were obtained from an intertidal sandy ground at Portonovo. The occurrence of the species was at its maximum in September. This species is found in association with the mysis Gastrosaccus simulans.

Dodotria biocellata sp. nov.

Locality: Off Cochin, plankton, 1979, 22 ♂♀ .9–1.3 mm, 1 immature ♂ 1.5 mm.

Female (1.3 mm) (Figs.9 and 10). Body short, carapace less than one-third the total length of the body, with oblique rows of granules. Eye distinct with ten corneal lenses. First pedigerous segment short, second segment very large and prominent with two large dark red coloured spots dorsally, one on either side of the mid-dorsal line.

Basis of third maxilliped broad, longer than the rest of the segments combined together; it is produced to a

Fig. 9

A. Boeotria biocellata sp.nov. Female

B. Boeotria biocellata sp.nov. Immature male

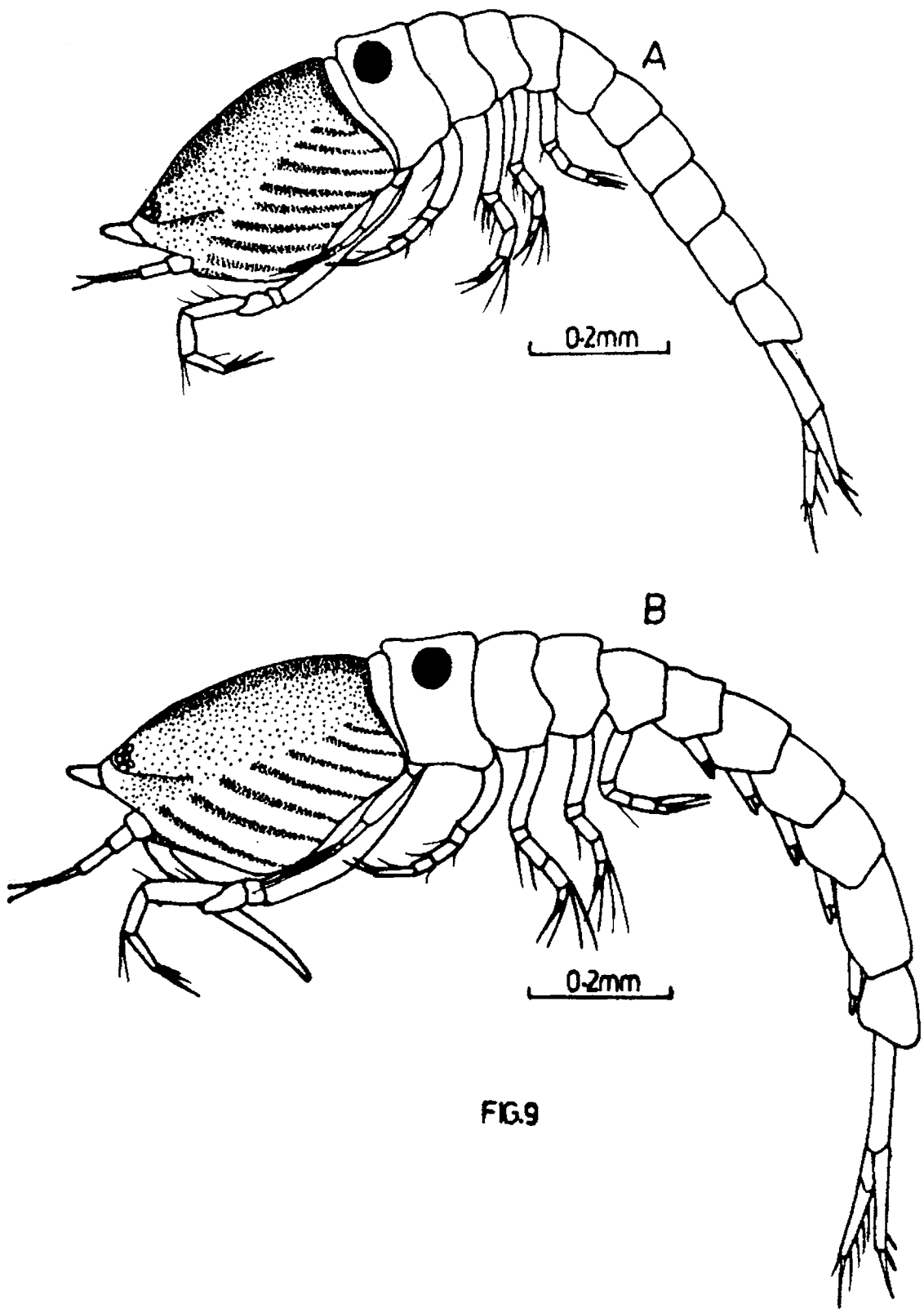


FIG.9

short lobe with two long plumose setae terminally; carpus longer than merus or propodus with four short setae on the inner margin.

Basis of first peraeopod shorter than the other segments combined together; carpus about twice as long as merus with three thin setae on the inner margin; dactylus slightly longer than propodus.

Second peraeopod with short basis; carpus longer than merus or propodus but shorter than propodus and dactylus combined together.

Third and fourth peraeopods similar in structure; basis of third peraeopod as long as the other segments combined together; merus and carpus subequal in length. Fifth peraeopod short.

Peduncle of uropod without spines or setae; exopod subequal in length to peduncle and slightly longer than endopod; exopod with two setae on the inner margin and endopod with two unequal terminal spines and an inner spine slightly away from the terminal region.

This species resembles *J. platybasis* Madha and Kurian collected from Portonovo in the shape of the body, presence

Fig. 1.

Godotria biocelleta sp.nov. Female

a. First antenna

b. Third maxilliped

c. First peraeopod

d. Second peraeopod

e. Third peraeopod

f. Fifth peraeopod

g. Uropod

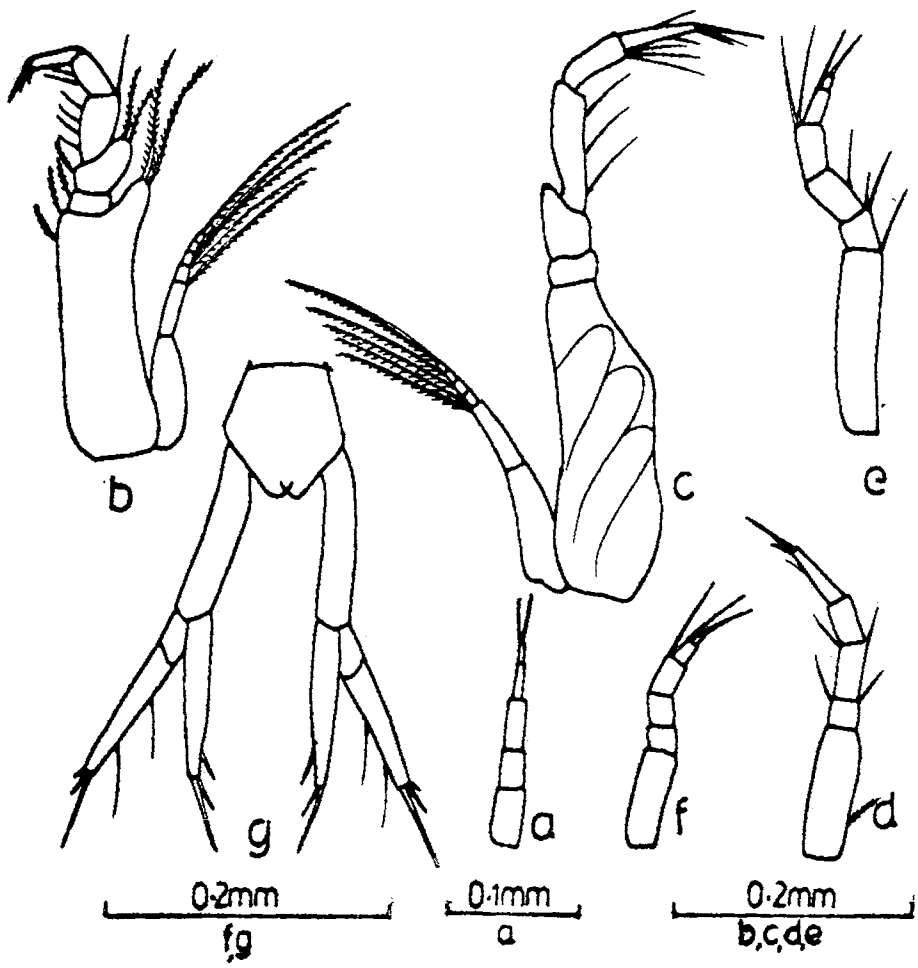


FIG.10

of broad basis for the third maxilliped and first peraeopod and in the nature of the uropods, but it differs in having two characteristic dark red spots on the dorsal side of the second pedigerous segment, oblique rows of granules on the carapace and in the presence of clearly visible first pedigerous segment.

An immature male specimen, 1.5 mm in length is also present which closely resembles the female specimen.

Ioxotria cochinensis sp. nov.

Localities: Kas - R/75/12, St. No.49, Cochin, 12.7.1975, 13-5 m, 2 ovigerous ♀♀ 1.5 and 1.7 mm, Vizhinjom, open sea, 2- m, surface plankton, 30.9.1981, 1 ♀ 3-.8.1982, bay, 15 m, 3 ♀♀

Female ovigerous) (Figs.11 and 12). The animal possesses a well-developed brood pouch having embryos. The carapace is almost ovoid in shape as seen from above and widest distally. It is provided with small reticulate sculpture with a fine pitted background. The dorsal surface is almost flattened and devoid of hairs or spines. A faint dorso-median carina on the carapace which extends upto the end of the last segment of pleon. On each side of the carapace there is a long hy groove which reaches the posterior end and curves towards the mid-dorsal region.

A lateral carina which begins from the anterior region of the carapace extends up to the end of the last pedigerous segment.

The carapace is one-third of the total length of the animal and its width is equal to its length. The antennal notch slightly concave. The ocular lobe is rather small, semicircular in shape, reaches the apex of the pseudorostrum. The pseudorostrum is situated in the middle portion as seen from above.

The combined length of the thoracic segments is lesser than that of the carapace. The dorsum of the first free thoracic segment is almost concealed, where as the sides are exposed. The second segment is very large and its widest breadth is as much as that of the carapace. The third to fifth segments are successively narrowed.

The abdomen is shorter than the cephalothorax. The fifth segment is the longest; sixth about three-fourths as long as the fifth.

The first segment of the peduncle of the antennule is broad, and longer than the combined length of the second and third segments. The second segment is shorter than the third. The main flagellum is two-segmented; the distal seg

Fig. 11

Jodotria cochinensis sp.nov.

Avigerous female

A. Dorsal view

B. Lateral view

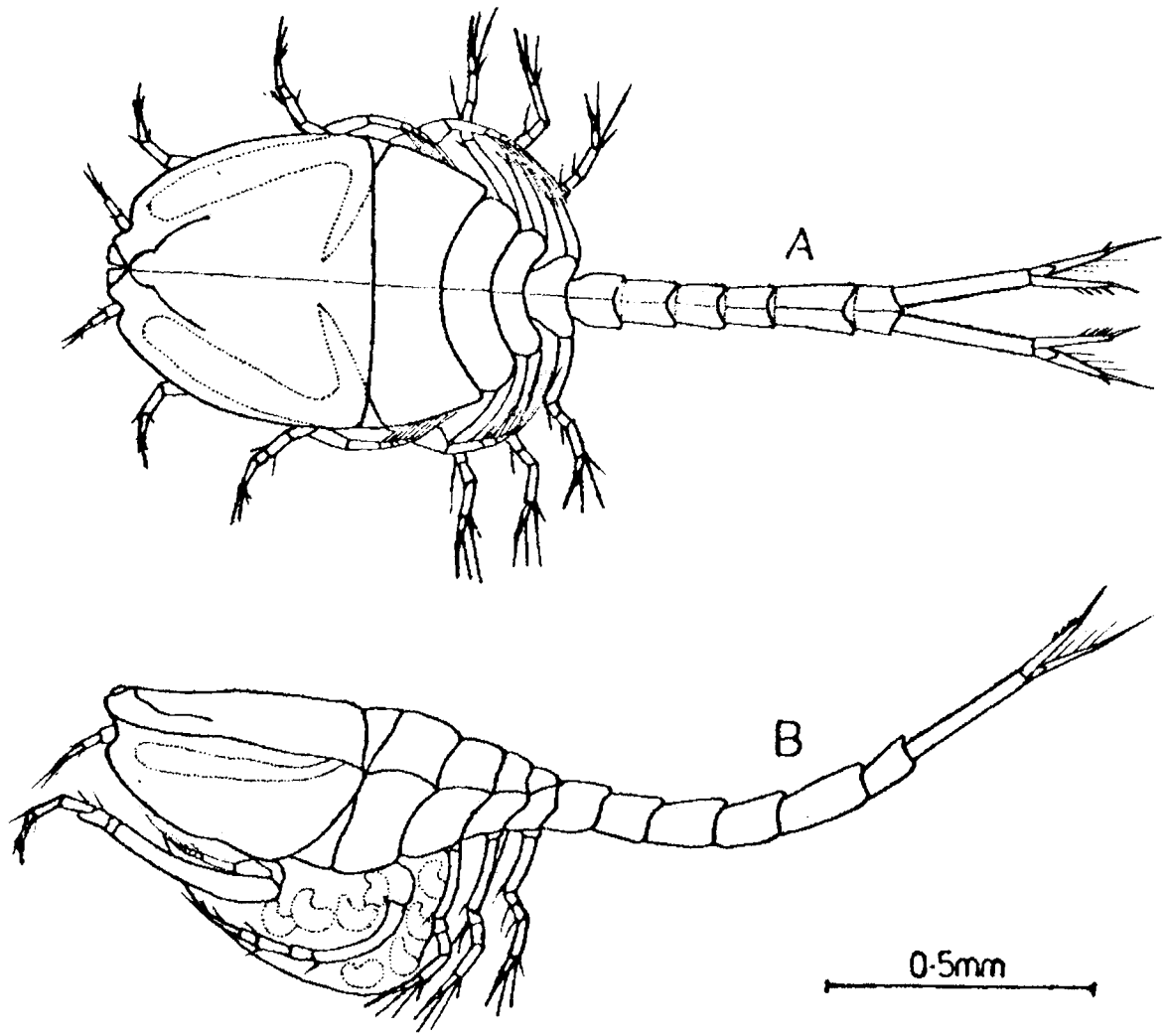


FIG.11

is furnished with two subequal aesthetascs. The accessory flagellum is very minute.

Basis of the third maxilliped broad, longer than the other segments combined together. It is prolongated terminally and provided with three plumose setae on the apical portion of the prolongation and four on the inner border. Merus also has a terminal seta on the external side. Carpus little longer than merus, with three short setae on the inner margin.

Basis of first peraeopod is little longer than the remaining segments combined together. Posterior portion of the basis is broad and anterior portion is narrowed. Ischium very short, less than half of the merus; carpus longer than merus or propodus, with a slender seta on the inner border. Propodus, is nearly equal in length to the dactylus, with two apical setae.

Basis of the second peraeopod is little shorter than the rest of the segments combined together. Carpus is slightly longer than merus and bears a strong spine on the external distal part and a seta on the inner margin. The propodus is only half of the carpus, dactylus nearly twice as long as the propodus, with two long and two short spines.

Fig. 12

Podotsia cochinensis sp.nov.

Ovigerous female

a. First antenna

b. Third maxilliped

c. First peraeopod

d. Second peraeopod

e. Third peraeopod

f. Fifth peraeopod

g. Uropod

h. Endopod (enlarged)

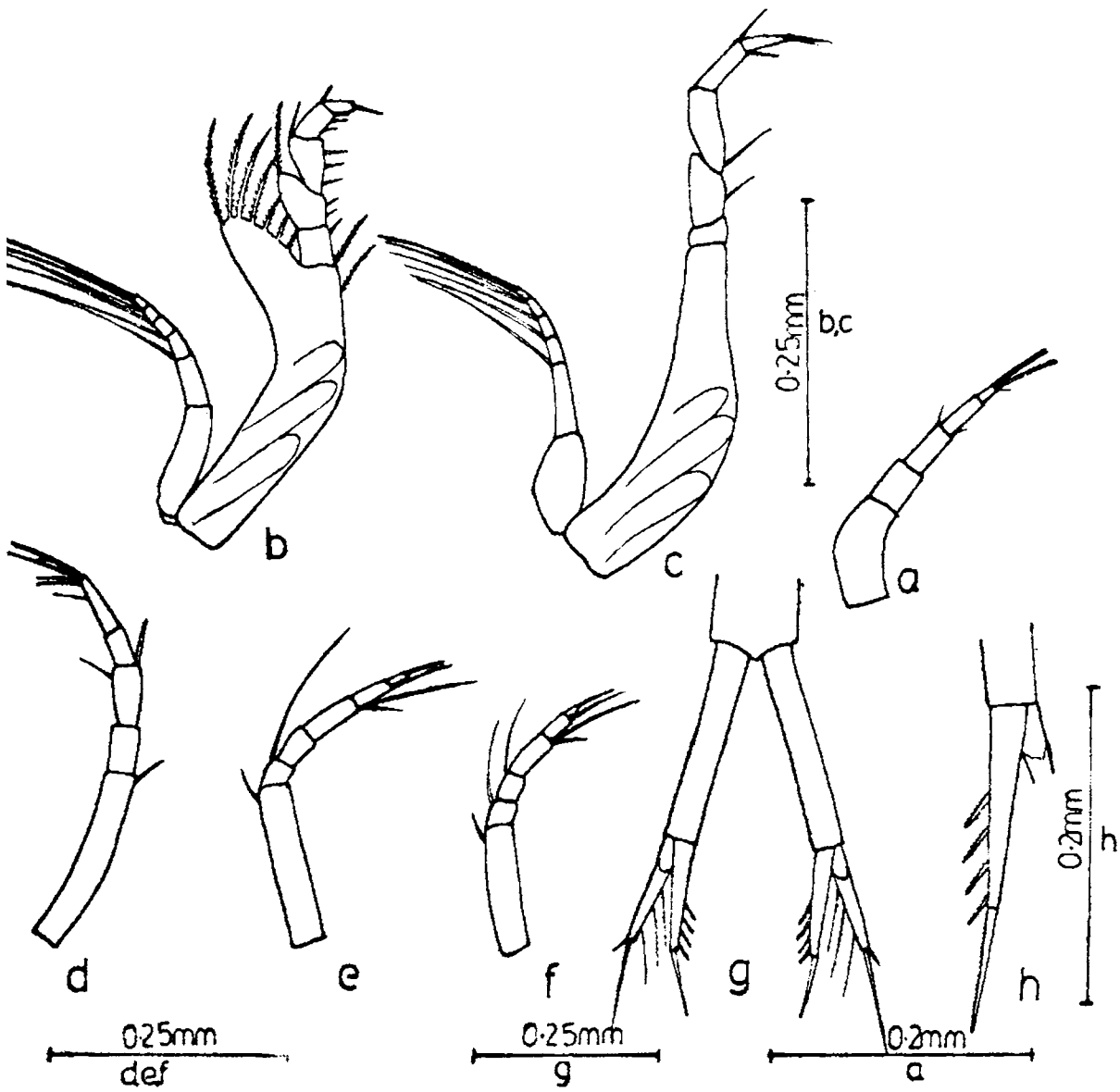


FIG.12

Basis of third peraeopod slightly shorter than the other segments combined together. Ischium produced to a very long seta on the external distal part which extends up to the level of propodus. Carpus longer than merus or propodus with two unequal terminal setae. Propodus also has a terminal seta; dactylus very short.

Fourth peraeopod is similar to that of the third, but the basis is slightly longer than that of third.

Basis of fifth peraeopod little shorter than the remaining segments combined together. Ischium and merus more or less subequal and each bears a long slender seta on the external terminal part.

The peduncle of uropod is rather long and slender and two and a half times as long as the last abdominal segment. It bears very slight serrations on the inner border. The exopod and endopod subequal, only half of the peduncle. Endopod one-jointed with four serrated spines located on the posterior part and a long terminal serrated spine. Exopod has three plumose hairs on the inner border and two unequal spines at the distal end.

The present specimen agrees with Bodotria ovalis Gamo (1965) from Japan in the presence of a flat ened carapace, expanded dorso-lateral margin of the carapace,

very large second pedigerous segment, strong lateral carina and in the nature of the peduncle of uropod. These resemblances are only superficial and a careful study of the appendages and the proportionate lengths of the carapace, free thorax and abdomen shows that it is quite distinct from the allied Japanese form. Carapace is one-third of the total length of the animal in J. ovalis Gamo, whereas it is one-fourth in the present species. The carinae of the pedigerous segments and first three abdominal segments are raised in the case of J. ovalis, but in the present specimen the above segments have more or less smooth dorsal margin. There is marked difference in the nature of the third maxilliped, basis is more flattened and longer than the remaining segments combined together in the present specimen whereas it is slender and twice as long as the other segments combined in J. ovalis. Differences are also noticed in the nature and proportionate length of the bases of second to fifth peraeopods. The bases of all these peraeopods (2-5) bear plumose hairs on their inner margins in J. ovalis which are completely lacking in the present form. Endopod has seven spines on the inner border and there are two teeth on its distal end in the case of J. ovalis. In the present specimen there are only four spines.

Moreover, the present species which is represented only by ovigerous female specimens is very small having a maximum length of 1.7 mm compared to the 4.2 mm length for *P. ovalis* Gamo (Ovigerous female).

Genus *Pseudocyclaspis* Radha and Kurian

Integument granular, twelve well developed ocelli in the eye lobe. Five pedigerous segments visible in the lateral view, first very short. Second peraeopod with third joint distinct. Endopod of uropod simple with terminal and subterminal spines.

This genus is related to *Bodotria* Goodsir and *Cyclaspis* Sars. In the presence of a terminal and subterminal spine in the uropod, it agrees with *Bodotria*, but in the presence of frontal pair of ocelli and the distinct third segment of the second peraeopod it is related more to *Cyclaspis* than *Bodotria*. The present genus is distinct from the two related genera in the presence of twelve well developed ocelli compared to eleven in *Cyclaspis* and ten in *Bodotria* (Harada 1967).

Pseudocyclaspis granulata Radha and Kurian

1981. *Pseudocyclaspis granulata*, Bull. Dep. Mar. Sci. Univ. Cochin, 12, 1, pp.53-56, figs. 1,2.

Locality: Gulf of Mexico, Lat. 25°30'N, Long. 82°[illegible]'W, 8.3.1974, 1 ♀ 3.9 mm.

Male. Body highly granular. Cephalothorax less than half the length of the specimen. Eye lobe with twelve well developed ocelli. There is a short sublateral ridge which becomes obscure posteriorly. First pedigerous segment very short. Basis of third maxilliped longer than the remaining segments combined together and produced terminally up to three-fourth the length of the merus and bears two long plumose setae apically and short plumose setae on each margin. Basis of first peraeopod as long as the other segments combined together. Bases of second to fifth peraeopod with serrated margins. Peduncle of uropod has numerous plumose setae through out its margin and five or six serrated spines in the posterior part. Endopod with nine serrated spines and two unequal short serrated terminal spines. Exopod devoid of any spines or setae on the inner margin but provided with three unequal terminal serrated spines.

Pseudocyclaspis mexicansis Radha and Kurian

1981. Pseudocyclaspis mexicansis, Bull. Dept. Mar. Sci Cochin, 12, 1, pp.56-59, figs.3,4.

Locality: Gulf of Mexico, Lat. 18°57'N, Long. 91°42.5'W, 11.8.1972, 1 immature ♀ 3.6 mm.

Immature male. Carapace less than one-third of the animal with minute hairs and granules. In the mid-dorsal region of the carapace, there is a longitudinal ridge which attains a short length. A well marked sub-lateral ridge is present on either side of the carapace. Pseudorostrum short, attaining the level of ocular lobe. Twelve eye lenses present. The antennal notch large and wide and antennal tooth subacute. All the five free pedigerous segments bear lateral plates.

Basis of the third maxilliped bent at the middle, longer than the combined length of the remaining segments. Basis of the first peraeopod shorter than the remaining segments combined together. Pleopods not well developed. Peduncle of uropods bears short hairs throughout its inner margin. Exopod and endopod subequal, three-quarters the peduncle, endopod with three spines on the inner margin and a terminal and sub-terminal spines. Exopod without setae

Genus Cyclaspis Sars

Cyclaspis longicaudata Sars

1865. Cyclaspis longicaudata, Sars, Forh. Vid. Selsk. Christiania, 1864, p.207.

1913. Cyclaspis longicaudata, Stebbing, Das Tierreich, 37, pp.30-31.

Locality: ICOC collection, Lat. 23°12'S, Long. 67°12'E, 11.11.1964, 1 ♀ 7 mm.

Male. Body long, transparent. Eyes wanting. The third segment of the peduncle of first antenna twice as long as the second joint. Flagellum of the second antenna does not reach beyond the pleon. Basis of the third maxilliped very broad and bears an apical process. All the segments of the first peraeopod long, basis with an apical process, carpus and propodus long and nearly twice as long as the dactylus. Second peraeopod the shortest. Telsonic somite subequal to the fifth pleon somite. Peduncle of uropod short, highly serrated with thickly packed plumose setae. Exopod and endopod long; three times longer than peduncle; endopod provided with two sets of spines, exopod with short setae on the external and internal margins.

Distribution: N.W. and N.E. Atlantic, W. Norway, W. Ireland, Bay of Biscay and Mediterranean.

Cyclaspis herdmani Calman

1904. Cyclaspis herdmani, Calman, Ceylon Pearl Oyster Fish. Suppl. Rep. London, 12, pp.171-172, pls. 3,4, figs.56-66.

1913. Cyclaspis herdmani, Stebbing, Das Tierreich, 39, p.32.

1954. Cyclaspis herdmani, Kurian, Rec. Indian Mus., 52, parts 3-4, pp.279-280.

Locality: Vizhinjom Bay, surface plankton, 15 m, 1/2 m net, 30.9.1981, 1 immature ♂ 3.3 mm, 4 ♀♀ 2.2–2.6 mm

Immature male. Carapace with pitted appearance, one-third of the total length. Eye lobe prominent with corneal lenses indistinctly defined. Inner margin of the basis of second peraeopod provided with fine teeth all through out the margin. Peduncle of uropod, subequal to exopod and endopod, with ill developed setae, endopod with nine spines, exopod with three or four plumose setae.

Female. Carapace less than one-third of total length. Last telsonic somite produced in between the uropod, exopod slightly longer than endopod, with three plumose setae; endopod with four short spines arranged in the middle margin.

Distribution: Gulf of Manaar, Andaman Islands.

Cyclaspis levis Thomson

1892. Cyclaspis levis, Thomson, J. Linn. Soc. Zool. London, 24, p.264, pl.16, figs.1–6, pl.17, figs.7–26.

1913. Cyclaspis levis, Stebbing, Das Tierreich, 39, pp.32–33.

1963. Cyclaspis levis, Jones, N.Z. Dept. Sci. Industr. Res. Bull., 152, pp.23–30, fig.42.

Locality: Off Visakhapatnam, 40-60 m, Ground-sand and clay, 1 ♀ 2.3 mm.

Female. Carapace granular. Basis of the first peraeopod as long as the other segments combined together. A long apical plumose seta on the basis; carpus and propodus subequal. Fifth pleon somite twice as long as the telsonic somite. Peduncle of uropod slightly serrated on the inner margin. Endopod with five spines posteriorly and an apical spine; exopod slightly longer than endopod, with four or five setae on the inner margin.

Distribution: New Zealand.

Cyclaspis varians Calman

1912. Cyclaspis varians, Calman, Proc. U.S. Nat. Mus., 41, p.610, figs.1-5.

1913. Cyclaspis varians, Stebbing, Das Tierreich, 32, p.33.

Locality: I.N.S., Lat. 12°43'N, Long. 68°22'E, 28 m, Shrimp trawl, 18.11.1963, 1 ♀ 1.9 mm.

Female. Body highly granular. Pseudorostrum short. Eye not visible. A spout spine on the third pedigerous segment. First peraeopod the longest. Pleon segments very broad. Peduncle of uropod longer than telsonic somite, but little shorter than exopod and endopod. Endopod, broader than

exopod, with four marginal spines and two unequal terminal spines. Exopod little longer than endopod with two plumose setae and two unequal terminal spines, one being very long.

Distribution: USA, Vineyard Sound, Woods Hole - surface.

Cyclaspis longipes Calman

1907. Cyclaspis longipes, Calman, Trans. Zool. Soc. London, 18, 1, pp.6-7, pl.5, figs.1-5.

1913. Cyclaspis longipes, Stebbing, Das Tierreich, 32, p.34.

Locality: Gulf of Mexico, Lat. 25°30'N, Long. 82°[illegible]'W, 8.3.1974, 1 ovigerous ♀ 3.1 mm, Lat. 29°[illegible]'N, Long. 83°2[illegible]'W, 1 ♀ 3.1 mm, lat. 25°3[illegible]'N, Long. 81°35'W, 2 ♀♀ 3.1 mm, Lat. 26°[illegible]'N, Long. 81°57'W, 1 ♀ 2.3 mm, Lat. 25°30'N, Long. 81°43'W, 22 ♀♀ 2-2.4 mm, Lat. 29°5[illegible]'N, Long. 83°51'W, 1 ♀ 3 mm.

Ovigerous female. Agrees with type description. First pereopod not as slender as described by Calman. Peduncle of uropod, as long as telsonic somite, with inner margin serrated. Uropod with ten-eleven short spines and two unequal terminal spines; exopod little longer than endopod, with three unequal terminal spines.

Distribution: Danish West Indies, Cruz Bay.

Cyclaspis uniplicata Calman

1907. Cyclaspis uniplicata, Calman, Trans. Zool. Soc. London, 18, 1, p.13, pl.4, figs.1-20.

1913. Cyclaspis uniplicata, Stebbing, Das Tierreich, 33, p.36.

1954. Cyclaspis uniplicata, Kurian, Rec.Indian Mus., 52, parts 2-4, pp.278-279.

Locality: Vizhinjom, 24 m, st. no.145, 25.4.1959, 1 ♀ 3.7 mm (immature).

Female (immature). Resembles the original description of immature female by Calman. Single tooth on the carapace at the base of eyelobe very distinct. First pedigerous somite distinct dorsally as a narrow band. Peduncle of uropod slightly shorter than exopod without any setae, spine or serrations. Endopod little shorter than exopod (as long as exopod, Kurian 1954) with nine spines on the median margin and tapers to a sharp point. Exopod with three spines on the inner margin and an apical spine.

Distribution: Gulf of Siam, 10-20 m, Andaman Islands.

Cyclaspis unicornis Calman

1907. Cyclaspis unicornis, Calman, Trans. Zool. Soc. London, 18, 1, pp.7, 14, pl.5, figs. 9-11.

1913. Cyclaspis unicornis Stebbing, Das Tierreich, 33, p.36.

Localities: Gulf of Mexico, Lat.29°[illegible]'N, Long 83°2 '[illegible], 1 ♀ 2.4 mm, Lat. 28°[illegible]'[illegible], Long. 82°[illegible]4'[illegible], 2.5.1974, 1 ♀ 2 mm, Lat. 29°40'[illegible], Long. 83°51'W, 5.5.1974, 1 ♀ 2.3 mm, Lat. 27°30'[illegible], Long. 83°12'[illegible], 1 ♀ 2 mm, Lat. 27°[illegible]'[illegible], Long. 83°14'W, 1 ♀ 3.2 mm, Lat. 25°3[illegible]'[illegible], Long. 81°35' 2 ♀ ♀ 2 mm, Lat. 26°[illegible]'[illegible], Long. 81°4[illegible]'W, 3 ♀ ♀ 2-2.9 mm, Lat. 26°[illegible]'N, Long. 81°57'W, 6 ♀♀ 1.9-2.3 mm.

Female. Eye distinct, eye lenses clearly visible. First pedigerous segment hidden in dorsal view by the paired blunt projection on the posterior side of the carapace. Basis of first peraeopod as long as the other segments combined together, no terminal process for the basis. Peduncle of uropod slightly longer than telsonic somite, with out any serration. Exopod and endopod of uropod subequal to peduncle, endopod, slightly shorter than exopod, with numerous short spinules, with one spine on the median margin. Two unequal terminal spines for endopod and three for exopod.

C. unicornis is a common species in the Gulf of Mexic

Distribution: Spanish West Indies, Cruz Ba .

Cyclaspis cingulata Calman

1907. Cyclaspis cingulata, Calman, Trans. Zool. Soc. London, 18.1, pp.7, 15, pl.4, figs. 1-10.

1913. Cyclaspis cingulata, Stebbing, Das Tierreich, 37, pp.36-37.

1954. Cyclaspis cingulata, Kurian, Rec. Indian Mus., 52, parts 2-4, p.278.

Locality: Off Visakhapatnam, 40-60 m, grey sand and clay, 4 ♂♂ (3 ovigerous ♀♀) 3.7-4.3 mm.

Female. Resembles the type description. Characteristic collar like ridge well marked, pseudorostrum very short. Antero-lateral margin of carapace near the free end of collar ridge with a tooth projecting forward. Dorso-median keel extends from the fifth peraeon somite to fifth pleon somite. Telsonic somite well produced in between uropods and as long as peduncle (Kurian 1954, peduncle distinctly shorter than telsonic somite, Colman 1927). Endopod of uropod, longer than exopod and peduncle, with three spines as in type description (eight to eleven, Kurian 1954) and tapers to a sharp point. Exopod as long as peduncle with two short spines and two unequal terminal spines.

Distribution: Gulf of Siam, Kilakarai, Ramnad District, S. India.

Cyclaspis striglilis Hale

1944. Cyclaspis striglilis, Hale, Rec. S. Austral. Mus., 8, pp. 83-86, figs. 11-14.

1951. Cyclaspis striglilis, Kurian, Bull. Centr. Res. Inst. Univ. Travancore, (C), 2.1, pp.89-90.

Locality: ISRSE, Entedebir Island, Coralline fine sand, 13.3.1962, 1 ovigerous ♀ 3.1 mm, 1 immature ♂ 2.7 mm, Vizhinjam Bay, surface plankton, 15 m, 1/2 m net, 29.7.1982, 4 ♀♀ 1.2-2.5 mm.

Ovigerous female. Male described this species from an adult male and a non-ovigerous female specimens. But, in the present collection there is an ovigerous female which shows marked differences from the type description.

Carapace one-third of the total length with numerous oblique striae on the sides. A faint dorso median carina extends up to the last pleon somite. Dorsal edge of the carapace arched. Basis of first peraeopod slightly shorter than the combined length of the other segments (longer than rest of the limb-male).

Peduncle of uropod long, subequal in length to exopod, with seven short spines towards the posterior part (without spines or setae in the non-ovigerous female). Endopod of uropod slightly shorter than exopod, with nine spines on the inner margin and exopod with two spines (endopod with twelve spines and exopod with six tiny incisions in the non-ovigerous female).

The immature male obtained from Red Sea closely resembles the ovigerous female in the nature of the carapace and peraeopods, but the striation on the carapace

is not as clear as in the female. Peduncle of uropod with eleven inner marginal spines, endopod with nine and exopod with four spines on the inner margin. There is a short articulated terminal spine in the exopods of both immature male and ovigerous female which is absent in the previous records.

C. strigilis obtained from Vizhinjom Bay shows close affinity with the Australian type. Peduncle of uropod slightly shorter than the subequal exopod and endopod without any spines or setae. Endopod of uropod with five spines on the proximal end leaving the distal fourth of the ramus without spines. Exopod with three or four short plumose setae on the proximal inner margin (twelve spines on the exopod and six tiny incisions on the inner margin of the exopod-male).

Distribution: Queensland, Trivandrum.

Cyclaspis cretata Dale

1944. Cyclaspis cretata, Dale, Rec. S.Austral. Mus., 8, 1, pp.91-95, figs.19-20.

1954. Cyclaspis cretata, Kurian, Rec. Indian Mus., 52, parts 2-4, p.180.

Locality: Vizhinjom, open sea, surface plankton, 2 m, 1/2 net, 30.9.1981, 2 ♀♀ 4 and 4.1 mm.

ale. Closely resembles type description. Carapace less than one third of the total length of animal. Pseudorostral lobes barely meeting in front of the ocular lobe which is wide with nine lenses, the middle three are very dark and larger than the lateral pale ones. The four exposed pedigerous somites together constitute half of the carapace (more than half-Hale, less than half-Kurian). Fifth pleon somite swollen at its anterior portion and tapers to the rear end, dorsal notch on the telsonic somite is deep.

Peduncle of uropod more than twice as long as telsonic somite with nineteen plumose setae through out its length and seven slender spines towards the distal part. Exopod of uropod slightly longer than endopod, but shorter than peduncle, with five plumose setae on the inner margin, endopod with four proximal spines on the inner margin followed by a row of fifteen shorter and slender spines. Both the rami with the apex acute.

Distribution: New S. Wales, S. Australia, Andaman Islands.

Cyclaspis calmani Hale

1944. Cyclaspis calmani, Hale, Rec. S. Austral. Mus., 8, 1, pp.72,112.

1954. Cyclaspis calmani, Kurian, Rec. Indian Mus., 52, parts 2-4, pp.281-282.

Locality: [illegible], Intedal 1, Coralline fine sand, 13.3.1963, 0 + + (immature) 1-1.6 mm.

Female. Carapace finely reticulated. Pseudorostral lobes barely meet in front of the ocular lobe. Basis of third maxilliped as long as the other segments combined together, basis and merus expanded terminally with plumose setae. First peraeopod long, basis shorter than the other segments combined together; propodus little longer than carpus. Second peraeopod very short. Fifth pair of peraeopods not developed. Peduncle of uropod little longer than exopod and endopod and without serration. Endopod with three inner marginal spines, without distinct apical spine; exopod little longer than endopod with an inner marginal spine close to the apical spine.

Distribution: New Zealand, Andamans.

Cyclaspis juxta Hale

1948. Cyclaspis juxta, Hale, Rec. S. Aust. Mus., 9, 1, pp.6-7, figs. 3,4.

Locality: Vizhinjam Bay, surface plankton, 15 m, 29.7.1964, 1 ♂ 4.1 mm, 1 ovigerous ♀ 4.1 mm.

Male. Carapace with dorsal edge only slightly arched. On each side of the carapace there is a narrow depression. A thin median longitudinal carina reaches upto the last

telsonic somite. Sides of the carapace marked with numerous oblique striae which give a rese blance to Cyclas ia striqilis Hale. No such striae are seen in th type description. Basis of first peraeopod longer than the remaining segments combined together, carpus sh ter than propodus; propodus with four setae on the margin, dactylus with four setae on the margin and three or four terminal setae. Telsonic somite with a strong dorsal notch.

Peduncle of uropod with twenty one plumose setae on the whole length of the inner margin and a second series of slender serrate spines on the proximal and distal portion; proximal spines very short and five in number and distal spines comparatively long and eight in number. Endopod of uropod bears six slender serrated spines on the proximal part followed by sixteen shorter and slouter spines leaving the distal fourth of the ramus unarmed, exopod with nine plumose setae on the proximal half of the inner margin.

Ovigerous female. Ocular lenses shorter than those of male. Nature of carapace as in male, pleon subequal in length to carapace and pedigerous somites together. Peduncle of uropod with two short plumose setae towards the distal portion, endopod shorter than exopod with eight short and stout spines near the proximal end; the distal fourth of

the ramus without spines, exopod with four plumose setae on the proximal inner margin. Brood pouch is empty.

Distribution: W. Australia.

Genus Iphinoe Bate

Iphinoe brevipes Hansen

1905. Iphinoe brevipes, Hansen, Ergeb. der. plankton exped., 2, p.54, pl.6, figs.5-5L.

1913. Iphinoe brevipes, Stebbing, Das Tierreich, 39, p.45.

1951. Iphinoe brevipes, Kurian, Bull. Cent. Res. Inst. Univ. Travancore, (C), 2.1. p.87.

Locality: Portonovo, 30 m, Bay-June 1970, 4 ♀♀ 4.5-5.8 mm, Vizhinjom, 24 m, Dredge collection, 25.4.1959, 5 ♂♂ 4.5-5 mm, 5 ♀♀ 4.8-5.8 mm, 13.4.1983, 4 ♂♂ 5-6 mm, 6 ♀♀ (2 ovigerous) 4.6-7.5 mm, Vizhinjom Bay, 15 m, surface plankton, 5.9.1980, 1 ♀ 3 mm, 21.1.1981, 12.2.1981, 26.2.1981, 25.3.1981, 29.12.1981, 7.1.1982, 25.1.1982, 17.2.1982, 19.4.1982, 29.7.1982, 16 ♂♂ 5.3-6 mm, 8 ♀♀ (1 ovigerous) 3-7.3 mm, Vizhinjom open sea, 20 m, surface plankton, 8.1.1981, 21.1.1981, 21.1.1981, 26.3.1981, 2.1.1982, 5.2.1982, 4.3.1982, 11.3.1982, 25.3.1982, 28.3.1983, 14.2.1983, 872 ♂♂ 4.5-6.3 mm, 34 ♀♀ (12 ovigerous) 3-7.2 mm, Vizhinjom open sea 30 m, surface plankton, 22.1.1981, 26.2.1981, 26.3.1981, 14.5.1981, 29.12.1981, 2.1.1982, 21.1.1982, 25.2.1982, 4.3.1982, 5.4.1982, 743 ♂♂ 4.7-6.3 mm, 14 ♀♀ (2 ovigerous) 3-6.8 mm.

Male. Carapace very slender, twice as long as its width, antero-lateral margin provided with nine teeth. Mid-dorsal teeth absent. Eye lobe broad; lenses indistinct. Basis of third maxilliped more than twice as long as remaining segments combined together. Second peraeopod shorter than third, basis broad with plumose setae on either margin, ischium indistinct, merus with a stout terminal spine. Pleon longer than cephalothorax, fifth pleon somite narrow at its posterior part. Peduncle of uropod slightly longer than subequal exopod and endopod. Peduncle has numerous spines throughout its margin, arranged in two or three rows posteriorly; four plumose setae towards the distal part. First joint of endopod half of second, little longer than broad, with five or six spines. A long seta at its external distal part reaching more than three-quarters of the narrow second joint with eight spines successively long to the terminal spine. Exopod with eleven long plumose set on the inner margin, with four or five very long terminal spines.

Females closely resemble the males in many of the characters. The only difference noted is that the teeth on the antero-lateral margin of the carapace are more distinct than in male with thirteen to eighteen in numbers.

I. brevipes is a common species along the Trivandrum coast, Vizhinjom Bay and open sea within a 15–30 m depth. Very often males are seen in large numbers from January to April. 10–20 post larvae were observed in some of the ovigerous females.

Distribution: Gulf of Guinea, Great Fish Bay, S. Africa, Trivandrum, Vizhinjom.

Iphinoe calmani Page

1945. Iphinoe calmani, Page, Arch. Zool exp. gen., 84, 3, p.189, figs.15–19.

1954. Iphinoe calmani, Kurian, Rec. Indian Mus., 52, Parts 2–4, pp.276–277, fig.1 a and b.

Locality: Off Visakhapatnam 40–60 m, Ground-sand and clay, 5 ♂♂ ♀♀ 4.6–5 mm, Laccadives, 5 ♂♂ ♀ 4.1–4.5 mm, 2 ovigerous ♀♀ 3.2–4.2 mm, ICSC collection, Lat. 21°27'N, 69°24'E, 9.3.1963, 1 ♂ 4.2 mm and 1 ovigerous ♀ 3.2 mm, Vizhinjom Bay, 15 m, surface plankton, 7.8.1981, 1 ♂ 4.3 mm, Cochin, 15 m, plankton, 16.1.1982, 1 ♂ 4 mm, and 4 ♀♀ 2.4–3.5 mm, Cochin, 15 m, plankton, 25.2.1982, 3 ♂♂ 3.2–3.8 mm and 1 ♀ 2.8 mm.

Male. Cephalothorax more than three-fourths the pleon. No teeth on carapace. First peraeopod long and slender; basis half of the remaining segments combined together. Peduncle of uropod, less than twice as long as endopod and exopod, with eleven spines and two or three rows of short plumose

setae in the posterior region. Endopod two-jointed, first joint broad with four short and four long spines; the second joint with seven spines. Exopod with six or seven plumose setae on the inner margin and seven setae externally with four long apical setae.

Ovigerous female. Nine prominent teeth on the carapace, the first two large and separated from rest by a wide space. Eye lenses clearly visible. Peduncle of uropod longer than exopod and endopod with nine spines. Endopod slightly longer than exopod, first joint less than half of the second, with four spines, second joint slender with ten spines and three terminal setae.

Distribution: Annam, Andaman Islands.

Iphinoe serrata Norman

1867. Iphinoe serrata, Norman, Rep. Brit. Ass. Sci., 36, p.201.

1951. Iphinoe serrata, Fage, Faune de France, 54, Paris, pp.49-52, figs.43-45.

1955. Iphinoe serrata, Jones, Discovery Rep., 27, p.287.

Locality: Off Visakhapatnam, 40-60 m, Ground-sand and clay 1 ovigerous ♀ 3.5 mm, ISOC collection, Lat. 21°27'N, Long. 69°24'E, 9.5.1963, 1 ovigerous ♀ 3 mm, ISOC collection, Lat. 21°36'N, Long. 69°34'E, 9.5.1963, 1 ♀ 3.5 mm.

Female. Thirteen teeth present on the median carina of carapace. Basis of first peraeopod long and denticulated on the outer margin, carpus, propodus and dactylus sub-equal. Inner margin of bases of all peraeopods provided with numerous plumose setae. Peduncle of uropod with ten inner marginal spines; exopod and endopod sub-equal, three quarters the peduncle. First joint of endopod with three spines and one long apical spine; second with seven or eight plumose setae on the inner margin, two on the outer margin and four terminally.

Distribution: British Islands, Mediterranean, Bay of Naples.

Iphinoe inermis Sars

1878. *Iphinoe inermis*, Sars, Arch. Math.-Naturvid Kristiania, 1878, 3, p.508.

1951. *Iphinoe inermis* Fage, Faune de France, 54, Paris, p.46, fig.39.

1955. *Iphinoe inermis* Jones, Discovery Rep., 27, p.287.

Locality: Calicut, 0–20 m, Bongo net, 15.7.1975, 1 ♀ 3 mm, ff Cochin, 0–15 m, Bongo net, 26.7.1981, 1 ♂ 3.5 mm and 5 ♀♀ 2.5–3.5 mm.

Male. Closely resembles the type description. Peduncle of uropod longer than subequal exopod and endopod, with numerous spines and plumose setae arranged in two rows. First joint of endopod of uropod with four spines and four

spinules, second joint, slender and longer than first, with three short spines on the proximal part, five long spines on the distal part and one on the external margin. Exopod with seven plumose setae on the inner margin and five long terminal plumose setae on the flattened edge of exopod. Four setae on the external margin of exopod.

Female. Peduncle with only a single row of spines, without any plumose setae. The first joint of endopod with four spines, intermediate spinules absent.

Distribution: Goletta, Mediterranean.

Iphinoe fegei Jones

1955. Iphinoe fegei, Jones, Discovery Rep., 54, Paris, pp.285-287, figs.3,4.

1956. Iphinoe fegei, Jones, 'Atlantide' Report, Copenhagen, 4, p.109.

Locality: Indian, East Coast of Africa, Dredge seived as they floated off barrel of mud, 1 immature ♀ 3 mm.

Female. Basis of third maxilliped only one and a half times as long as other segments combined together. Basis of first pereopod with two or three plumose setae at its distal end. Peduncle of uropod with nine or ten spines; the proximal joint of endopod with three short and one long stout spine

and distal join with nine or ten spines on the inner margin. The exopod with five long plumose setae and three long terminal setae.

Distribution: South west Africa.

Iphinoe pigmenta Kurian

1961. Iphinoe pigmenta, Kurian, Bull. cent. Res. Inst. Trivandrum, 8, pp.59-60, figs.1-14.

Locality: Off Cochin, plankton 1979, 196 ♀♀ (17 ovigerous) 1.4-3.4 mm, 9 ♂♂ (immature) 1.4-1.7 mm.

Kurian's description of this species is based on two ovigerous female specimens, 2.3 mm. long from Cochin backwaters and one adult female from Veli lake. In the present collection there are a number of ovigerous females which have a maximum length of 3.4 mm. Male of this species has not yet been described, and here a few immature males are represented in the collection. Some additional facts observed in the ovigerous female and the description of immature male are given below.

Ovigerous female (fig.13). Carapace with dark patches of chromatophores and small forwardly directed teeth on the dorsal side in the anterior two-thirds; antero-lateral border with 12 teeth which are progressively smaller towards the inner part.

Third segment of the first antennal peduncle nearly twice as long as the second, main flagellum without segmentation, with two aesthetascs; accessory flagellum very minute.

Distal process of broad basis of third maxilliped reaches upto the level of merus which is also expanded distally.

Basis of first peraeopod slightly broad in the proximal part, the external margin bears numerous teeth through out its length; carpus longer than propodus which is sub-equal in length to dactylus.

Basis of second peraeopod shorter than the rest of the segments combined together, with plumose setae on both margins distally; merus with a seta terminally, carpus with a stout spine; dactylus sub-equal to the combined length of carpus and propodus.

Basis of third peraeopod longer than the other segments combined together, with plumose seta on the inner margin; ischium with two long and stout terminal setae.

Pleon, half of the total length of the animal, segments long and cylindrical. Telsonic somite half of the fifth pleon somite and produced in between the uropods. Peduncle of uropod twice as long as telsonic somite, with eight spines; spines towards the posterior part of the

FIG. 13.

Iphinoe pigmenta Kurian Ovigerous female

a. First antenna

b. Third maxilliped

c. First peraeopod

d. Second peraeopod

e. Third peraeopod

f. Fifth peraeopod

g. Uropod

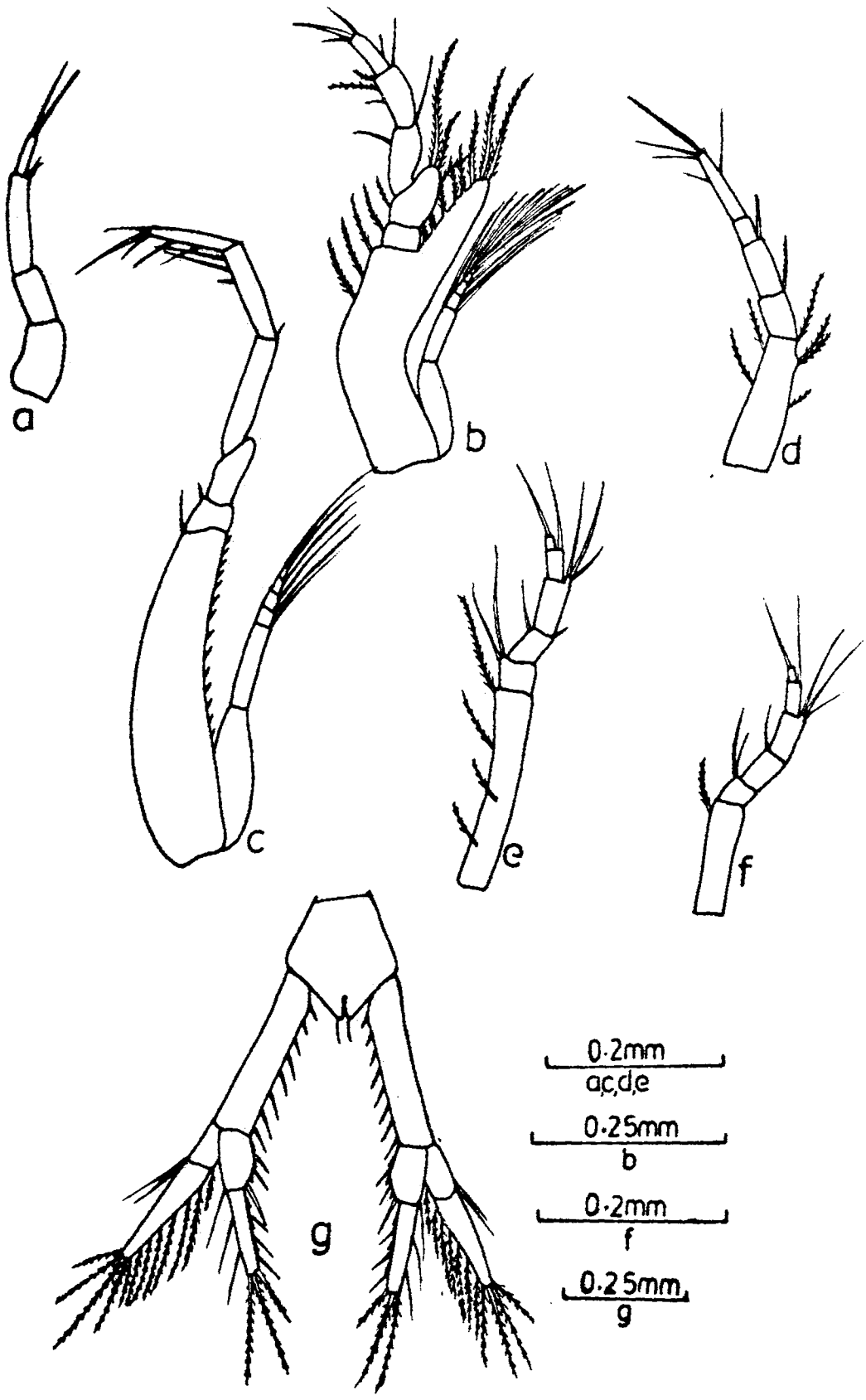


FIG. 13

peduncle larger. Exopod and endopod of uropod closely agree with the type description; the only difference noticed is that in between the spines on the inner margin of endopod there are short tubercles.

10-14 matured ova were present in some of the specimens examined.

Immature male (Figs. 14 and 15). Length 1.7 mm. Pseudorostrum very short, carapace with a thin dorso-median carina extending upto the fifth pleon somite. There is a mid-dorsal tooth on the carapace projecting forward (in some specimens 5 or 6 teeth were observed). Antennal notch very small; antero-lateral border with seven teeth. Flagellum of the second antenna not fully developed. Second pedigerous segment not as large as in female.

Basis of third maxilliped as long as the other segments combined together; merus not expanded terminally.

Basis of first peraeopod shorter than the rest of the segments combined together; external margin without teeth, a spine present at its inner margin. Peraeopods 2-5 similar to that of female.

Peduncle of uropod more than twice as long as the last pleon somite, with seven plumose spines and seven plumose setae. Exopod and endopod subequal and as long as peduncle. First joint of endopod three-fourths of the second

Fig. 14.

Lehinge pigmenta Kurian : immature male

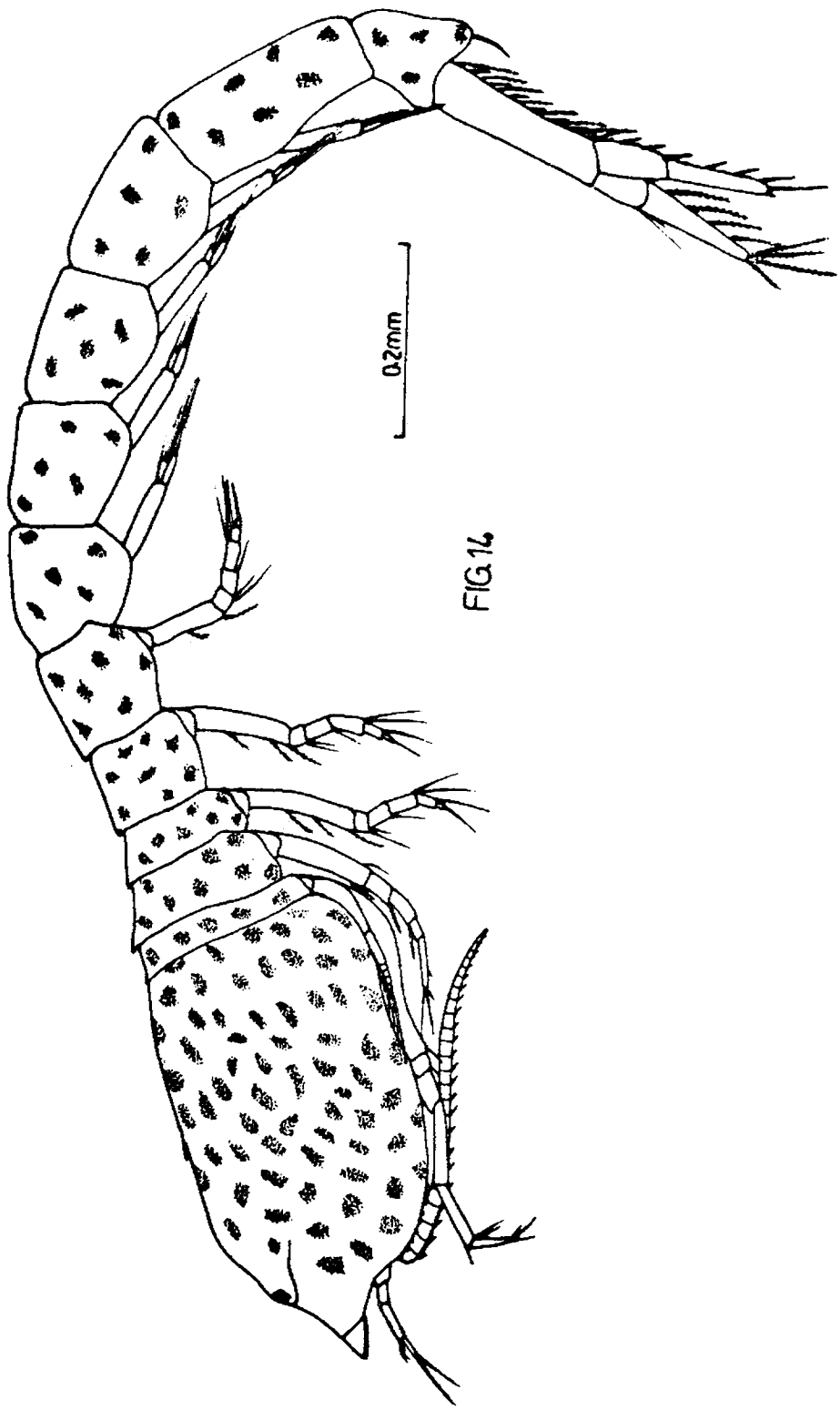


FIG 14

Fig. 19.

Iphinoe plumenta Kurian : Immature male

a. Third maxilliped

b. First peraeopod

c. Second peraeopod

d. Third peraeopod

e. Fifth peraeopod

f. Uropod

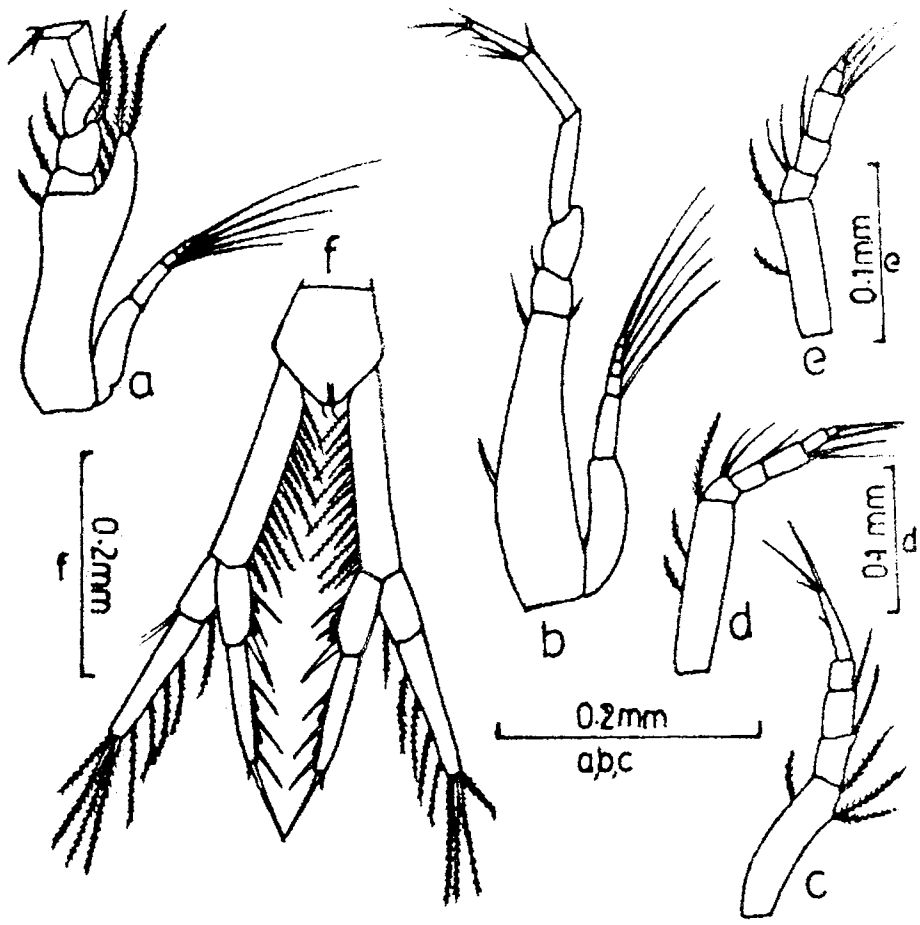


FIG.15

joint, with three stout spines on the inner margin; second joint also with three spines on the inner margin and a terminal seta. In between the spines there are short spinules. Exopod with five plumose setae on the inner margin and four at the distal end.

The species has been previously recorded only from backwaters in Kerala. The present record of immature and ovigerous specimens from the open sea off Cochin reveals the capacity of the species to survive in wide ranges of salinity.

Distribution: Veli lake, Cochin backwaters.

Iphinoe macrobrachium Calman

1904. Iphinoe macrobrachium, Calman, Rev. Pearl Sea. Fish. Rep., 12, p.173, pl.4, figs.72-75.

1955. Iphinoe macrobrachium Jones, Discovery Rep., 27, p.287.

Locality: Vizhinjom, St.No.145, 25.4.1955, 7 ♀♀ (4 ovigerous ♀♀) 3.3-4 mm, Off Visakhapatnam, 40-50 m, Ground-sand and clay 1 ovigerous ♀ 3.3 mm.

Female (Fig.16). Calman's description of this species is based on an immature specimen and hence certain details observed in the adult female are included here.

Carapace comparatively short, smooth and granular. Pseudorostrum little upturned. Dorsal carina distinct unto last pleon somite. Eye lenses clearly visible. First antennal peduncle three-segmented, the third being the longest. Basis of third maxilliped broad and shorter than the other segments combined together, produced terminally with two long plumose setae at its apex and three or five short plumose setae on the inner margin, merus expanded into a broad lobe, with numerous plumose setae on its outer margin, propodus, much longer than carpus.

First peraeopod very long and slender; basis less than half the length of the remaining segments combined together, ischium very short; carpus more than twice as long as the merus; carpus and propodus subequal, carpus with two setae terminally; dactylus slender. Second peraeopod with numerous setae on its margins, dactylus longer than the carpus and propodus combined together, with five unequal terminal setae at its apex and three or four marginal setae.

Abdominal segments long; fifth pleon somite the longest. Telsonic somite well produced in between the uropods. Peduncle of uropod with six spines on the inner margin, endopod longer than exopod, three fourths the

Fig. 16

Iphinoe macrobrachium Salman : Female

a. Third maxilliped

b. First peraeopod

c. Uropod

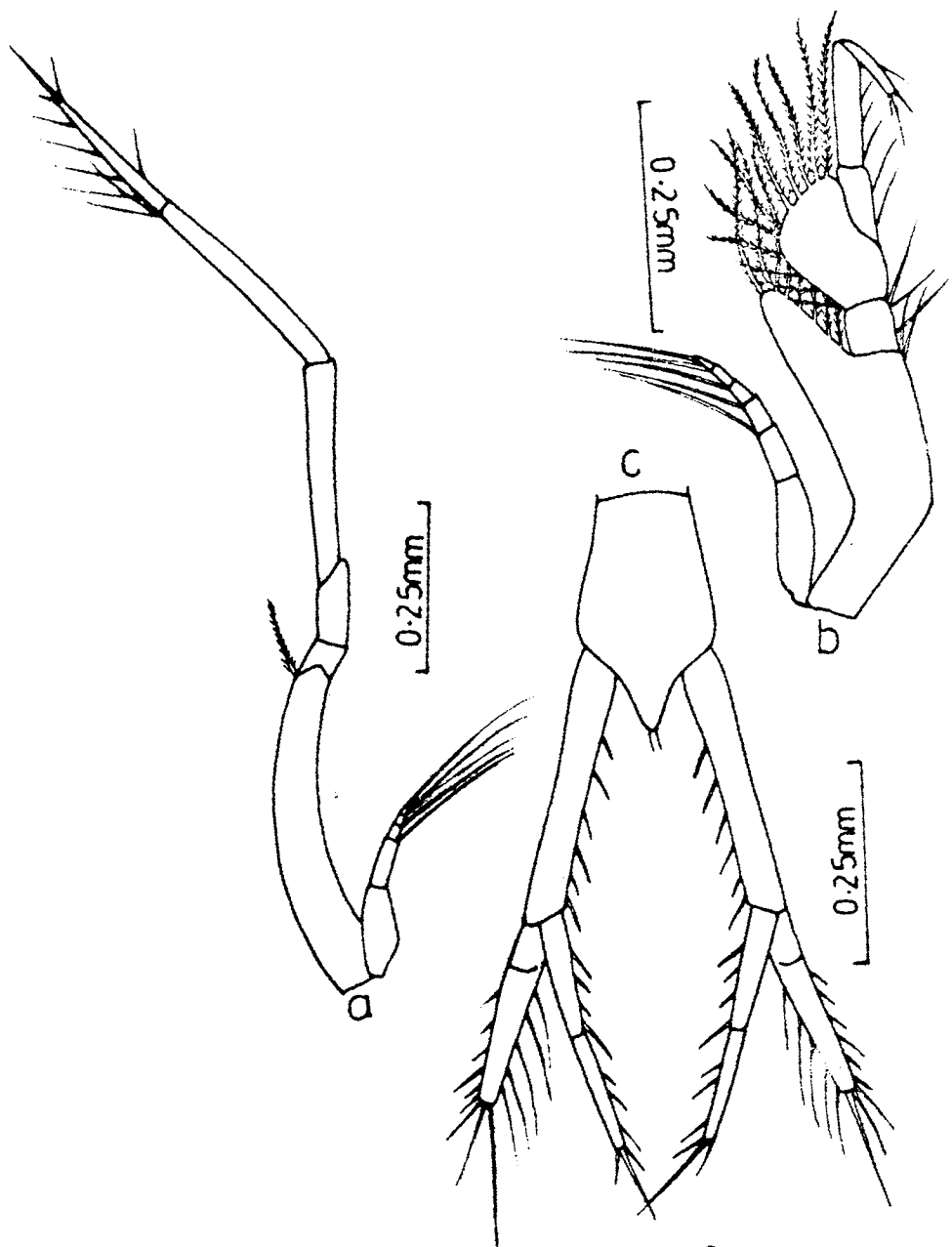


FIG. 16

peduncle, 2-jointed and the two joints subequal (proximal joint nearly half as long again as the distal segment - Calman). The proximal joint with four spines, the terminal being the longest; distal joint slightly narrower with three marginal spines and three unequal terminal spines. Exopod with fine setae on the inner margin and four long terminal spines. Five setae are seen on the external margin.

Calman's immature specimen has a close resemblance to L. crassipes Hansen. But the adult specimens of L. macrobrachium obtained from the Vizhinjam coast show that it is a distinct species having many dissimilarities in the nature of the maxilliped, peraeopod and uropod when compared to L. crassipes Hansen.

Distribution: Gulf of Manaar, Cheval Paar, Kombuttoni Paar.

Family Leuconidae

Genus Leucon Kroyer

Leucon longirostris Sars

1871. Leucon longirostris, Sars, Forh. Ak. Forh., 2, Stokholm, p.73.

1913. Leucon longirostris, Stebbing, Das Tierreich, 37, p.73.

Locality: Gulf, Adu Pan bay, Kon Boss, 1 immature ♀ 2.8 mm.

Immature male. Pseudorostrum horizontal. Carapace one-fourth the total length; median carina with seven teeth. Last pleon somite well reduced in between the uropods. Peduncle of uropod shorter than the first joint of endopod, with five slender spines. First joint of endopod, three times as long as the second, with seven spines; second joint with three spines. Exopod broken.

Distribution: W. Atlantic, Mediterranean.

Leucon acutirostris Sars

1877. Leucon acutirostris, Sars, Crust. Norway, 2, p.34, fig.26.

1913. Leucon acutirostris, Stebbing, Das Tierreich, 32, p.73.

1951. Leucon acutirostris, Jones, Fiches d'identification du zooplankton, fasc. Copenhagen, p.2.

Locality: Gulf of Mexico, Lat. 19°5..5'N, Long. 81°49.5'W, 1 ♀ 3 mm.

Male. Pseudorostrum horizontal with setiferous margins. Eye absent. Peraeopods 1-4 with broad bases which are as long as other segments combined together. Dactylus of first peraeopod not much short as in type description. Second peraeopod with third segment indistinct; propodus very short,

dactylus with three unequal spines. Peduncle of uropod broad, equals to endopod, with long setae and short spines. Endopod two-jointed, first joint long with eleven spines, second with five marginal spines and a long apical spine, exopod longer than endopod with eight long plumose setae and a long apical spine.

Distribution: Coast of Norway.

Leucon sp.

Locality: Ilen, Durban bay, Ken Moss, 1 damaged ♀ 2.2 mm.

Female. Pseudorostrum turned upwards and more than half the length of the rest of the carapace; the lower lateral margin of the pseudorostrum bears four or five teeth. Carapace less than one-fourth the total length. Each antero-lateral margin of the carapace is serrated. First pereaeopod long; basis shorter than the remaining segments combined together; carpus more than twice as long as merus, propodus three-fourths the carpus. Pleon long, fifth pleon somite about twice as long as the telsonic somite which is produced in between uropods. Peduncle of uropod longer than telsonic somite. Exopod and endopod broken.

Genus Hemileucon Calman

Hemileucon laevis Hale

1945. Hemileucon laevis, Hale, Trans. Roy. Soc. S. Austral., 69, 1, pp.81-92, figs.3,4.

Locality: [illegible], Indian Ocean, Durban bay, on Boss, 1 ♂ 3 mm.

Male. Pseudorostrum well produced and horizontal, median carina of carapace bears anteriorly three teeth separated from another three behind. Antennal notch not clearly visible. Anterolateral margin of carapace provided with short teeth. Third maxilliped with broad basis and terminal portion expanded with three long plumose setae. Carpus of second pereopod thrice the propodus; dactylus twice as long as propodus. Telsonic somite short and produced in between uropods. Peduncle of uropod longer than telsonic somite, but shorter than exopod and endopod and with three spines on the inner margin.

Distribution: New South Wales.

Family Hamiidae

Genus Schizotrema Calman

Schizotrema sordidum Calman

1911. Schizotrema sordidum, Calman, Trans. Zool. Soc. London, 18,4, pp.341, 363, figs.22-24.

1913. Schizotrema sordidum, Stebbing, Das Tierreich, 32, p.167.

Locality: Sulu Arch. Proj. Philippines, Lat. 5°05', Long. 119°56'E, 23.9.1967, 2 ♀ ♀ (ovigerous) 1.5 mm, Lat. 11°15', Long. 125°39'E, 1 ♀ 1.3 mm.

Female. Pseudorostral lobes short and upturned, carapace with three convexities; one an ero-median and two stero-lateral, serrated with spines. First and second pedigerous segments with expanded lateral plates, first and second peraeopods with inflated bases. Carpus of all peraeopods long; as long as basis. Lateral plates of pedigerous and pleon segments provided with spines. Pleon with pleon somites subequal to telsonic somite. Peduncle very short, endopod broad and long, nearly thrice as long as peduncle. Peduncle with a single spine posteriorly; endopod nearly thrice as peduncle, with four inner marginal spines and numerous spinules in between, exopod one-seventh of endopod; terminal spine reaches nearly upto endopod.

Distribution: Gulf of Siam, depth 2 m.

Schizotrema aculeata Hale

1945. Schizotrema aculeata, Hale, Rec. S. Austral. Mus. 8,2, pp.163-17 , fig.1 .

Locality: [illegible], Lat. 7°16' , Long. 33°48' E, sandy bottom 2-2', 5.1.1965, 2 ♂ ♂ 1.3 mm, 2 ♀ ♀ 1.1 mm.

Male. Pseudorostral lobes little upturned, whole carapace covered with numerous short spines and stout paired spines on the pleon segments. Endopod of uropod nearly twice as long as exopod and inner margin highly serrated; a long

terminal spine and a short stout spine near the terminal one.

Female specimens resemble males in all essential characters. Uropod relatively shorter; terminal spine of exopod reaches beyond the endopod without spine.

Distribution: S. and W. Australia, Queensland.

Genus Jannastacus Bate

Jannastacus zimmeri Calman

1911. Jannastacus zimmeri, Calman, Trans. Zool. Soc. London, 18,4, pp.341,352, figs.4-15.

1913. Jannastacus zimmeri, Stebbing, Das Tierreich, 31, p.169.

Locality: Moty St Proj., Philippines, Lat. 15° 5' , Long. 119°58' , 29.V.1967, 1 ♀ 1.8 mm.

Male. Carapace granular, pseudorostrum short, peraeopods 1-4 with broad bases. Fifth peraeopod slender and its carpus not long as the previous record of Calman, but longer than propodus or dactylus. Peduncle of uropod little shorter than telsonic somite; endopod nearly thrice as long as peduncle and provided with seven inner marginal spines, the space in between the spines highly serrated. Exopod one-seventh of endopod and its terminal spine long and reaches beyond three-fourth of endopod without spine.

Distribution: Trincomali, Ceylon surface.

Lannastacus gibbosus Calman

1911. *Lannastacus globosus*, Calman, Trans. Zool. Soc. London, 18,4, pp.355-356, figs.16-21.

1954. *Lannastacus gibbosus*, Kurian, Rec. Ind. Mus., 52, parts 2-4, p.311.

1963. *Lannastacus gibbosus*, Gamo, Sci. Rep. Yokohama Nat. Univ., Sec.2, pp.45-48, figs.11,12.

Locality: [illegible], Lat.11°16', Long.103°45', 3-4 mm, 33 ♀♀ 1.7-2 mm, Lat. 11°16'N, Long.103°43', 1 ♀ 1.5 mm, Lat. 06°12'S, Long. 105°37'E, 4 ♀♀ (ovigerous) 1.6-2 mm and 1 ♂ 1.8 mm, Lat. 13°24' Long. 48°17'E, 3 ♀♀ (2 ovigerous) 1.6-1.7 mm, Bony S I Proj., Philippines, Lat. 06°56'N, Long. 122°11'E, 14.9.1967, 9 ♀♀ (5 ovigerous) 1.6-1.9 mm.

Female. Specimen closely agrees with the description of Calman. Pseudorostrum short, antero-lateral margin of carapace deeply concave and provided with spines. Two or three long hairs are seen on the surface of carapace, first and second pleraeopods with inflated bases. The scattered hairs on the surface of body are lesser in number compared to previous records. Peduncle of uropod short, endopod more than twice as long as peduncle with four or five inner marginal spines and a long terminal spine. Exopod with terminal spine reaching upto three fourth of endopod without spine.

Male. Body longer than in female and covered with lesser number of hairs. All the other structures closely agree with the description of Gamo (1963).

Distribution: Madagascar, Andamans, Gulf of Siam, Japan.

Nannastacus reptans Calman

1911. Nannastacus reptans, Calman, Trans. Zool. Soc. London, 18,4, pp.356-357, figs.22-28.

Locality: IIOE, Lat. 06°12'S, Long. 105°37'E, 10.9.1963, 1 ♀ 1.2 mm, Lat. 13°26'S, Long. 48°22'E, 1.5 m, hand intertidal, 15.1.1964, 1 ♀ (ovigerous) 2.5 mm, Doty S I Proj., Philippines, Lat. 6°52'00"N, Long. 122° 4'22"E, 18.9.1967, 1 ♀ 1 mm.

Female. Seta at the branchial region or tooth on the thoracic or abdominal somite absent. Basis of second leg inflated and broad. Telsonic somite half the length of peduncle of uropod. Endopod of uropod more than twice as long as peduncle, with four or five inner marginal spines (three in type description) and highly serrated in between spines, exopod only one-eighth of endopod and its terminal spine reaches half the length of endopod without spine.

Distribution: Gulf of Siam.

Nannastacus minor Calman

1911. Nannastacus minor, Calman, Trans. Zool. Soc. London, 18,4, pp.341,351, figs.1-3.

1913. Nannastacus minor, Stebbing, Das Tierreich, 39, p.171.

Locality: [illegible], Lat. 06°1[illegible]'S, Long. 105°37'[illegible], 1[illegible].9.1963, 1 ♀ 1 mm.

Female. Very small specimen, closely agrees with the description of Calman. First and second peraeopods with exopod not well developed. Peduncle of uropod short, endopod twice as long as peduncle, with three marginal spines, exopod one-third of endopod and terminal spine reaches beyond endopod without spine.

Distribution: Gulf of Siam.

Jannes tacus tardus Calman

1911. Jannestacus tardus, Calman, Trans. Zool. Soc. London, 18.4, pp.359-360, figs.4-11.

Locality: Cotty's I Proj., Philippines, Lat. 06°56', Long. 122°11', 10.9.1967, 1 ♀ (ovigerous) 1.7 mm.

Female. Carapace broad, highly granular, lower edge of antero-lateral corner serrated. Basis of first peraeopod not long, propodus longer than carpus, basis of second peraeopod as long as the other segments combined together. Th lateral plates of pedigerous somites and first four pleon somites provided with long hairs. Peduncle of uropod little shorter than telsonic somite; inner margin highly serrated, endopod of uropod twice as long as peduncle with four marginal spines, exopod very short.

Distribution: Gulf of Siam.

Mannastacus lepturus Calman

1911. Mannastacus lepturus, Calman, Trans. Zool. Soc. London, 18,4, pp.341,352, figs.1-3.

1913. Mannastacus lepturus, Nobbing, Mas Akerreich, p.171.

Locality: Ito , Lat. 31°1?'N, Long. 13°45'., 3-1 m Ca, 1 ↑ 1.7 mm, Gotz S I Roj., Philippines, Lat. 6°52' .., Long.122°34'22 ., 18.9.1967, 2 ↑ ↑ 1.1 and 1.7 mm, CP.., Mexico, Lat. 19°33.6'N, Long. 91°37'W, 11.8.1972, 1 ↑ 2.2 mm, Lat. 19° 5..3'N, Long. 91°45.4'W, 12.3.1972, 1 ↑ 2 mm, La.. 26°..'N, Long. 81°57'W, 1 ↑ 2 mm, Lat. 29°4..'N, Long. 83°51'W, 5.5.1974, ↑ ↑ 2 mm, Israel, horizontal plankton, assawa channel, 7.4.1962, 1 ↑ mm, Vizhinjom, plankton, 25.4.1959, 1 ↑ 1.7 mm.

Male. M. lepturus collected from Indian ocean closel agrees with the type description, but that of other collections from Red Sea, Philippines and Gulf of Mexico show slight differences. The telsonic somite is not so short as described earlier. Peduncle of uropod less than twice as long as telsonic somite and not twice as endopod, with five marginal spines and in between these spines peduncle is highly serrated. Endopod of uropod with five inner marginal spines and a long terminal spine; exopod

about four-fifths of endopod with a terminal spine of its own length. Female is unknown in this species.

Distribution: Suez Canal.

Nannastacus longirostris Sars

1879. Nannastacus longirostris, Sars, Arch. Math. Naturvid. Kristiania, 1878, p.119, figs.58,59.

1913. Nannastacus longirostris, Stebbing, Das Tierreic 32, pp.171-172, fig.116.

Locality: IIOE, Lat. 06°12'S, Long. 105°37'E, 10.9.1963, 1 ♂ 1.1 mm, Lat. 13°24'S, Long. 48°17'E, 2 ♀ (ovigerous), 1.5-1.8 mm, Lat. 13°24'S, Long. 48°18'E, 0.3 m , 4 ♀ ♀ 1.3-1.5 mm, Lat. 13°26'S, Long. 48°22'E, 0-0.4 m, 1 ♂ 1.5 mm, Nosse-Be, Madagascar, 5 ♀ ♀ 1.5-1.7 mm, 2 ♂ ♂ 1.4 mm.

Male. Resembles type description, pseudorostrum long and horizontal. Basis of first pereopod with three spines on the inner margin; propodus longer than carpus or dactylus. Pleon shorter than cephalothorax; fifth pleon somite twice as long as telsonic somite. Endopod of uropod little longe than exopod, with four inner marginal spines and a terminal spine.

Female. Integument more hairy than the male, eyes smaller, and peduncle of uropod little shorter than male with four thin spines on the inner margin. Endopod of uropod with

three inner marginal spines. One of the ovigerous females contains 12 eggs in the brood pouch.

Distribution: Mediterranean.

Nannastacus sheardi Hale

1945. Nannastacus sheardi Hale, Rec. S. Austral. Mus., 8,2, pp.156-159, figs.8,9.

Locality: II.E, Lat. 13°24'S, Long. 48°17' , 1 ♀ 1.5 mm.

Male. Carapace more than one-third of total length. Peraeopods 1-4 with broad bases and well developed exopods, fifth peraeopod short; merus and carpus subequal (carpus nearly twice as long as merus - Hale). Peduncle of uropod more than one-third as long as telsonic somite, exopod three-fourth as long as endopod without a distal spine, endopod with four spines on the inner margin and two unequal terminal spines, terminal spine of exopod longer than its own length.

Distribution: S. Australia.

Nannastacus inflatus Hale

1945. Nannastacus inflatus, Hale, Rec. S. Austral. Mus. 8,2, pp.159-162, figs.10,11.

1954. Nannastacus inflatus, Kurian, Rec. Indian Mus., 53, parts 2-4, p.310.

Locality: IIOE, Lat. 01°10' S, Long. 103°45' E, 0-1 m Ca, 1 ♂ 2.4 mm, Grand Comoro Island, 2 ♂+♀ 1.2 mm Andromancho Reef, 1 ovigerous ♀ 2.1 mm.

Male. Closely resembles Hale's description. Carapace highly granular, pseudorostral lobes project upwards. Endopod of uropod more than twice as long as peduncle with eight marginal spines and space in between the spines highly serrated, exopod very short, terminal spine reaches beyond half the length of endopod without spine.

Female. Body shorter than that of male, uropod resembles the type description; terminal spine of exopod reaches to half of the endopod. Ovigerous female bears 18 eggs in the brood pouch.

Distribution: S. Australia, Kilakarai (S. India).

Iannastacus subinflatus Hale

1945. Iannastacus subinflatus, Hale, Rec. S. Austral. M 8,2, pp.163-165, figs.12,13.

Locality: IIOE, Lat. 02°24' S, Long. 101°51' E, 0-1 m Ca, 1 ♀ 1.1 mm, Dana S I Proj., Philipines, Lat. 11°0 Long. 125°41' E, 11.9.1967, 1 ovigerous ♀ 1.9 mm, Lat. 09°14'N, Long. 123°28' E, 28.9.1967, 1 ♀ 2.

Female. Carapace oval, pseudorostrum short, first three pedigerous segments concealed by the overhanging cephalothe

Antero-lateral margin of carapace acute and serrated. First and second peraeopods provided with broad bases; last pedigerous segment and first pleon segment provided with a pair of dorsal spines. Endopod of uropod more than twice as long as peduncle, with five inner marginal spines, exopod very short; its terminal spine reaches three-fourth the endopod without spine (only half in the case of Hale's description).

Description: S and W. Australia.

Nannastacus johnstoni Hale

1945. Nannastacus johnstoni, Hale, Rec. S. Austral. Mus., 8,2, pp.165-168, figs.14,15.

1954. Nannastacus johnstoni, Kurian, Rec. Indian Mus., 52, parts 2-4, p.310.

Locality: Aden, Lat. 13°23'S, Long. 48°13'E, 1.5 m, 11.1.1964, 4 ♀♀ 1.2-2.3 mm, Lat. 11°42'S, Long. 167°51'E, 1 ovigerous ♀ 1.4 mm, Doty S I Proj., Philippines, Lat. 10°24'N, Long. 124°30'E, 8.9.1967, 1 ♀ 1.7 mm, Lat. 05°05'N, Long. 119°58'E, 23.9.1967, 3 ♀♀ (1 ovigerous) 1.8-1.9 mm, Lat. 16°22'N, Long. 120°00'E, 1 ♀ 1.6 mm.

Female. Closely resembles the published descriptions. Body highly transparent, eyes wide apart, antero-lateral margin

of carapace highly concave. Basis of first peraeopod shorter than other segments combined together; propodus longer than carpus. All peraeopods end in claw like spines. Fifth pedigerous segment provided with a mid-dorsal spine in the specimen from Philippines. Uropods with endopod more than twice as long as peduncle, with three inner marginal spines arranged with definite gaps, the space in between highly serrated; exopod one-eighth of endopod, reaches more than half the length of endopod with out spine. No males are found in any of these collections.

Distribution: New South Wales, Sidney, Queensland, Andamans.

Genus Cumella Sars

Cumella clavicauda Calman

1911. Cumella clavicaude, Calman, Trans. Zool. Soc. London, 18,4, pp.341,344,345, figs.7-10.

1913. Cumella clavicauda, Stebbing, Das Tierreich, 39, p.181.

1977. Cumella clavicauda, Bacescu and Muradian, Trav. Mus. Hist. Nat. 'Gr. Antipa', 18, pp.95-98, figs.5,6.

Locality: CMFRI, Mexico, Lat. 20°13.4'N, Long. 91°23.6'W, 2 ♂♂ 1.8 mm, Lat. 28°30'N, Long. 83°39'W, 6.5.1974, 1 ♂ 1.9 mm, Lat. 25°30'N, Long. 82°00'W, 8.3.1974, 1 ♂ 2.1 mm.

Male. Carapace one-fourth of the total length. The two lateral pigmented eyespots appear to be paired eyes and so this species can be easily mistaken for a Iphinastacus species. Antero-lateral margin of carapace straight, first four abdominal somites with lateral grooves and the antennal flagellum extends to the end of the groove. Fifth pleon somite slightly longer than preceeding one, inflated, increasing its width posteriorly. Peduncle of uropod two-thirds of telsonic somite, with six spinules interspersed with five setae. Endopod of uropod half of peduncle, with four spinules, exopod shorter than endopod.

Distribution: West Indies, Gulf of Mexico.

Cumella hispida Calman

1911. Cumella hispida, Calman, Trans. Zool. Soc. London, 18,4, pp.341,347, figs.15-18.

1913. Cumella hispida, Stebbing, Das Tierreich, 39, pp.181-182.

1945. Cumella hispida, Hale, Rec. S. Austral. Mus., 8,2, p.176, fig.21.

Locality: Sibuyan Sea, Lat. 13°05'N, Long. 125°39'E, 1 ♀ 1.9 mm, Navy S E Asia Proj., Philippines, Lat. 06°56'N, Long. 122°11'E, 19.9.1967, 1 ovigerous ♀ 2 mm, Lat. 11°05'N, Long. 125°39'E, 1 ♀ 1.9 mm, Lat. 05°05'N Long. 119°58'E, 23.9.1967, 2 ovigerous ♀♀ 1.3-1.7 mm, Israel (ISRSE), Massawe channel, horizontal plankton, 7.4.1962, 9 ♀♀ 1.8-2.5 mm,

Near Dehlakkebir 1, 6 m, 26.3.1962, 2 ♀♀ (1 ovigerous) 2.3 and 2.2 mm, Entedebir, outside landing bay, 6 m, 26.3.1962, 2 ♀♀ (1 ovigerous) 2 and 2.3 mm.

Female. Cephalothorax of C. hispida collected from Philippines granular with cluster of thorn like hairs which clumb together just below the median eye on either side. But granules and hairs are less or completely absent in the specimens collected from Indian Ocean and Red Sea. The mid-dorsal spine on carapace present in the type description is also absent. First and second peraeopods with broad bases and third to fifth are slender. Carpus of fifth peraeopod longer than propodus but not as long as basis or thrice as propodus as described by Calman. Telsonic somite little shorter than the fifth pleon somite or as long as the same. Peduncle of uropod shorter than telsonic somite in the specimens collected from Philippines, but as long as telsonic somite in the specimens from Indian Ocean and Red Sea. Peduncle of uropod with four marginal spines, (two in previous records) endopod with two marginal spines and a terminal spine, exopod three-fourth of endopod with a long terminal spine. C. hispida collected from Philippines are comparatively shorter than others and previous records.

Some of the ovigerous females examined show 3-24 eggs.

Distribution: Gulf of Siam, S. Australia.

Cumella pygmaea Sars

1865. Cumella pygmaea, Sars, Forh. Vid. Selsk. Christiania, Vol. 1864, p.199.

1911. Cumella pygmaea, Calman, Trans. Zool. Soc. London, 18,4, p.344.

1913. Cumella pygmaea, Stebbing, Das Tierreich, 32, p.183, fig.123.

Locality: Gulf of Mexico, Lat. 27°3..'N, Long. 83°12'W, 7.3.1974, 1 ♀ 1.8 mm, Lat. 27°..'N, Long. 83°14'W, 7.5.1974, 1 ♀ 2 mm, Lat. 28°..'N, Long. 82°52'W, 4.5.1974, 1 ♂ 1.8 mm, Lat. 23°3..'N, Long. 83°39'W, 6.5.1974, 1 ♀ 2.3 m..

Male. Carapace one-third the total length with numerous hairs on the surface. Eye conspicuous and circular. Paraeopods 1-4 with broad bases, carpus of first peraeopod longer than propodus and dactylus combined together, carpus elongates successively in peraeopods 3-5; in third it is slightly longer than propodus, in fourth, propodus one-third of carpus and in fifth, carpus more than twice as long as propodus. Dactylus short in all peraeopods and ends in claw-like spines. Peduncle of uropod with spinules on the inner margin, endopod three-fourths the peduncle, with six spinules on the serrated margin and a stout terminal spine, exopod three-fourths the endopod, with a long endspine of its own length.

Distribution: Norway, Mediterranean.

Cumella limicola Sars

1879. Cumella limicola, Sars, Arch. Math. Naturvid. Kristiania, 4, p.103, figs.53,54.

1913. Cumella limicola, Stebbing, Das Tierreich, 32, p.183.

1951. Cumella limicola, Bacescu, Fauna R.P.R., 4, pp.82-84, fig.177.

Locality: IIOC, Lat. 06°12'S, Long. 105°37'E, 10.9.1963, 1 immature ♀ 1.8 mm, Lat. 13°23'S, Long. 48°13'E, 1.5 m, 11.1.1964, 3 immature ♂♂ 1.7-2.2 mm, Lat. 13°21'S, Long. 48°11', 2.3 m, 13.1.1964, 2 ♀♀ (1 ovigerous) 1.8-2 mm, Lat. 13°24'S, Long. 48°18'E, 2.30 m, 20.1.1964, 1 ovigerous ♀ 2 mm, Lat. 13°20'S, Long. 48°22'E, 3-4 m, 1 ovigerous ♀ 2.4 mm, Lat. 13°26'S, Long. 48°22'E, 1.0 m, 15.1.1964, 4 ♀♀ (2 ovigerous) 2-2.5 mm.

Ovigerous female. Pseudorostrum rather long, acute and somewhat upturned. Carapace highly granular and hairy; thorn-like hairs thorough out the surface of the body which clump together around the branchial region. Eye very distinct. Anterior half of the carapace with three or four teeth on the mid-dorsal region. First and second peraeopods with inflated bases; exopod slender. Pleon slightly shorter than cephalothorax, telsonic somite longer than peduncle of

uropod. Four marginal spines on the peduncle, endopod as long as peduncle with two marginal spines, exopod very shor with its terminal spine reaching more than three-fourths the endopod with out spine.

Immature male. Anterior half of the carapace with two teeth projecting forward on the mid-dorsal region which are absent in the type description. Males less hairy than female. Bases of peraeopod 1-4 strongly developed. Peduncle of uropod not longer than telsonic somite unlike the type description. Uropods similar to that of female.

Distribution: Mediterranean, 11-13 m; Morocco.

Cumella munroi Hale

1945. Cumella munroi, Hale, Rec. S. Austral. Mus., 8,2, pp.171-172, figs.17,18.

Locality: Gulf of Mexico, Lat. 19°32'4, Long. 92°19.3'6, 9.8.1972, 4 ♂♂ 1.7-1.8 mm, LARSE, Antedebir Island, High tide level, 11.3.1969, 1 ♀ 1.5 mm (damaged).

Male. Carapace with out spines and hairs, eye distinct with 9 corneal lenses. Pleon longer than cephalothorax; peduncle of uropod, one and a half times longer than telsonic somite, with six inner marginal spines. Endopod of uropod with eight marginal spines, exopod slightly shorter than

endopod, with a long terminal spine reaching well beyond the endopod.

Distribution: Queensland, Moreton Bay, Green Island.

Cumella turgidula Hale

1945. Cumella turgidula, Hale, Rec. S. Austral. Mus., 8,2, pp.174-175, figs.19,20.

Locality: IOE, Lat. 13°33'S, Long. 43°[illegible]'E, 1.5-[illegible] m, 1 ♂ 2.3 mm, IOBC collection, Lat. [illegible]°13'N, Long. 97°51'E, 56 m, 23.3.1963, 1 ♂ 2 mm, Lat. 10°14'N, Long. 75°43'[illegible], 61 m, 27.3.1965, immature ♂ 1.6 m.

Male. Integument highly granular, no hairs on the carapace eye with seven corneal lenses. Peraeopods 1-4 with broad bases. Telsonic somite as long as the pleon somite and projects in between the uropods. Peduncle of uropod slightly longer than telsonic somite, with seven inner marginal spines (IOE collection) and as long as telsonic somite with four spines (IOBC collection), endopod longer than exopod with five inner marginal spines.

Distribution: S. Australia.

Genus Campylaspis Sars

Campylaspis orientalis Calman

1911. Campylaspis orientalis, Calman, Trans. Zool. Soc. London, 18,4, pp.341, figs.1-5.

1913. Campylaspis orientalis, Stebbing, Das Tierreich, 39, p.190.

Locality: IIOE, Lat. 18°24'S, Long. 42°11'E, 2125 m, 13.10.1964, 1 ♂ 6.5 mm.

Male. Almost agrees with type description. Pseudorostral lobes short, carapace covered with thorn-like spines. Basis of third maxilliped longer than the rest of the segments combined together and basis of first peraeopod as long as the other joints combined together. Peduncle of uropod long, twice as long as endopod and serrated on its inner margin, endopod slightly longer than exopod, with four inner marginal spines.

Distribution: Korea, 66 m.

Campylaspis rubicunda (Lilljeborg)

1855. Cuma rubicunda, Lilljeborg, Öfv. Ak. Förh., 12, p.121.

1913. Campylaspis rubicunda, Stebbing, Das Tierreich, 39, pp.190-191.

Locality: IIOE, Lat. 18°24'S, Long. 42°11'E, 2125 m, 13.10.1964, 1 ♀ 4 mm.

Female. Carapace granular, eye obsolete. Basis of the first peraeopod more than three-fourth the length of the remaining segments combined together, dactylus of second peraeopod long. Peraeopods 3–5 slender, telsonic somite half of the fifth pleon somite and produced in between the uropods. Peduncle of uropod four times as long as the telsonic somite, with six or seven inner marginal spines; endopod little longer than exopod but only half as long as the peduncle, inner margin serrated, with a long terminal spine and two end spines.

Distribution: Green land, Norway, Atlantic coast of N. America.

Campylaspis glabra Sars

1879. Campylaspis glabra, Sars, Arch. Math. Naturvid. Kristiania, 4, p.77, figs. 44–47.

1913. Campylaspis glabra, Stebbing, Das Tierreich, 32, pp.191–192, fig.128.

1974. Campylaspis glabra, Jones, Bull. Brit. Mus. (Natural History) Zool. London, 27,6, pp.252,261.

Locality: ..OE, lat. 24°49'S, Long. 35°13'E, 73 m, Near-Rock Dredge, 18.8.1964 1 ♂ 2 mm (immature)

Immature male. Body transparent, peraeopods 1–4 with broad bases, telsonic somite produced in between uropods. Peduncl of uropod thrice as long as telsonic somite with ten short

plumose setae, endopod three-fourths the peduncle with seven inner marginal spines and three unequal terminal spines.

This species shows a slight resemblance to C. amblyoda Gamo in the nature of the uropods, but it can be easily distinguished from C. amblyoda Gamo by the structure of the carapace.

Distribution: Mediterranean, N. of England, Norway, W. Africa

Campylaspis minor Hale

1945. Campylaspis minor, Hale, Rec. S. Austral. Mus., 8,2, pp.197-199, figs.35,36.

1951. Campylaspis minor, Kurian, Bull. Centr. Res. Inst. Univ. Travancore, (C), 2,1, pp.110-111.

Locality: Doty S I Proj., Philippines, Lat. 16°56'N, Long. 122°11'E, 19.9.1967, 1 ♀ 1.4 mm, Vizhinjom, St. No.145, 25.4.1953, 1 ♀ 1.6 mm.

Female. Closely agrees with type description. Carapace as wide as long and ovoid in shape with well marked lateral folds on the sides and with a faint reticulate pattern. Peduncle of uropod twice as long as telsonic somite, without spines or setae in the specimens obtained from Vizhinjom but finely serrated in the specimen from Philippines. Endopod of uropod with two marginal spines and two unequal

terminal spines in the specimen from Vizhinjam while the Philippine specimen with three marginal spines, exopod with two unequal terminal spines; longer one as long as exopod itself.

Distribution: Queensland, Moreton Bay, Trivandrum.

Campylaspis thomsoni Hale

1945. Campylaspis thomsoni, Hale, Rec. S. Austral. Mus., 8,2, pp.183-186, figs.24,25.

Locality: IIOE, Lat. 24°49'S, Long. 35°13'E, 73 m, Gear-Rock Dredge, 18.5.1964, 1 ♂ 2.8 mm.

Male. Resembles the type description. Carapace transparent without granules but with short hair, flagellum of second antenna reaches beyond the length of pleon. Carpus of third maxilliped broad, dactylus of second peraeopod as long as the carpus and propodus combined together. Peduncle of uropod long with plumose setae arranged in two rows, endopod and exopod three-fourths the peduncle, endopod with six spines on the inner margin and exopod with two unequal terminal spines and two setae on the outer margin.

Distribution: Tasmania.

Campylaspis minuta sp. nov.

Locality: Vellar estuary, Benthos, 2/3-10-1982, 14 ♀♀ (11 ovigerous) 0.7-1.3 mm.

Ovigerous female: (Figs.17 and 18) Body short, anterior part highly dilated. Carapace granular, one-third the total length of the body. Pseudorostral lobes short, truncated anteriorly meeting for a distance equal to the length of ocular lobe, which is broad with very distinct dark lenses. A curved carina present on each side, running from the antennal notch to the dorsal region of the carapace. Carapace bears a prominent but thin dorso-median carina, which does not extend to the pedigerous and pleon segments. In the distal part of the carapace a transverse carina beginning from the dorsal side extends side ways and ends blindly.

All the five pedigerous segments distinct, broad and elevated dorsally.

Pleon short, fifth somite the longest with a constriction in the middle region, which gives the appearance of two separate segments. Telsonic somite half of fifth pleon somite and produced in between the uropods.

First segment of the first antennal peduncle longer than second, second and third segments subequal. Main

Fig. 17

Campylaspis minuta sp.nov. ovigerous female

a. Dorsal view

b. Lateral view

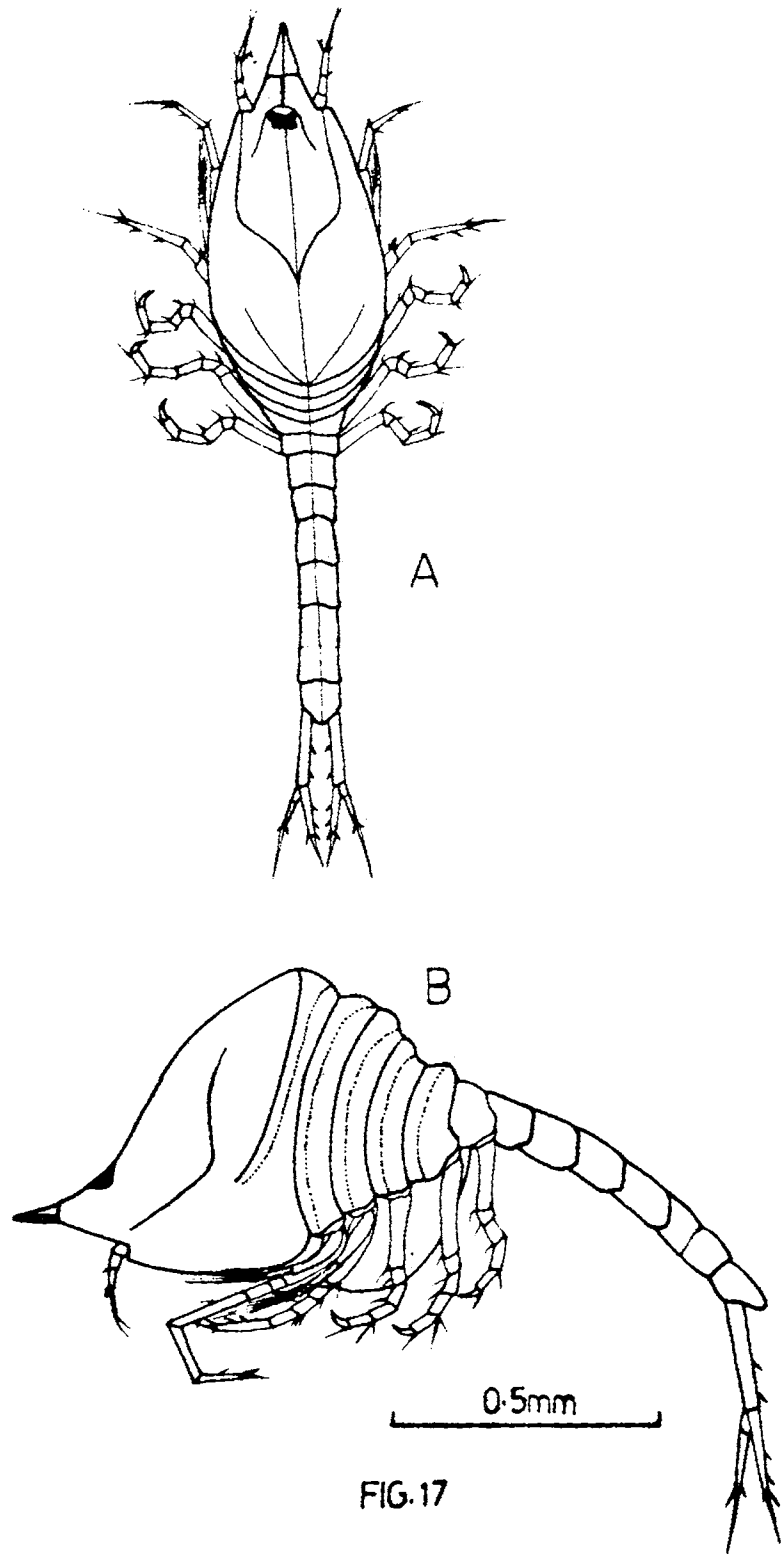


FIG. 17

flagellum two-segmented and accessory flagellum single segmented and very small.

Basis of third maxilliped broad and subequal to rest of the segments combined together, with two long plumose setae terminally; ischium very short, merus prolonged terminally beyond the level of carpus, with a long plumose seta; carpus shorter than propodus, also with a long plumose seta terminally.

Basis of first peraeopod only half or less than half of total length of other segments combined together; carpus long, twice as long as merus; propodus longer than merus.

Basis of second peraeopod broad and shorter than th remaining segments combined together, merus and carpus subequal; carpus with three spines terminally, dactylus twice as long as propodus with four unequal terminal spines and two marginal spines.

Basis of third peraeopod broad and shorter than rest of the segments combined together, basis, ischium and merus each with a terminal seta and carpus with two - one short and the other long; carpus and propodus subequal in length, dactylus very short.

Fig. 18

Campylaspis minuta sp.nov. Ovigerous female

a. First antenna

b. Third maxilliped

c. First peraeopod

d. Second peraeopod

e. Third peraeopod

f. Fifth peraeopod

g. Uropod

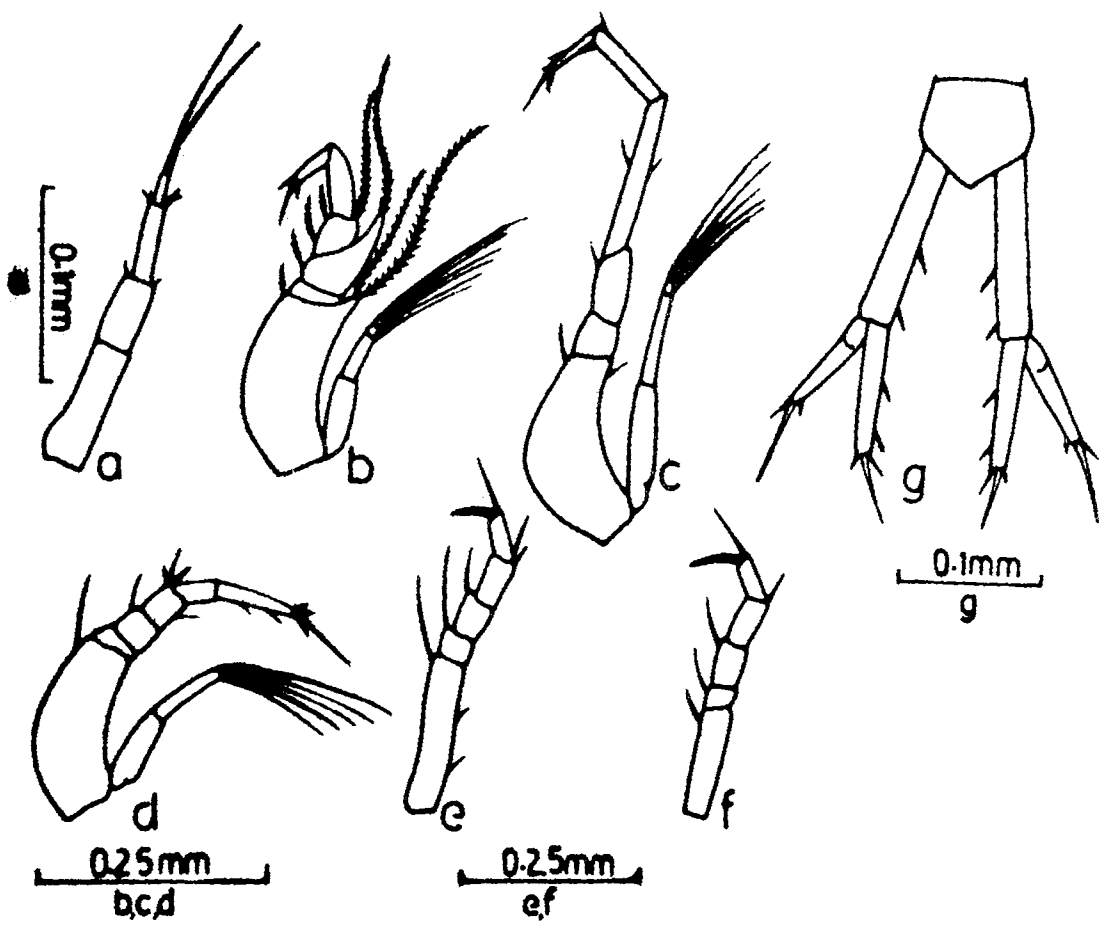


FIG. 18

Fourth peraeopod similar to third, but slightly longer.

Fifth peraeopod similar to the third and fourth peraeopods, but shorter.

Peduncle of uropod twice as long as telsonic somite, with two short spines on inner margin; one in the middle and other towards the distal part. Endopod three-fourths the peduncle, with two short marginal spines and three unequal terminal spines and a very short spine on the inner distal margin.

The present species is represented only by female specimens and these can be distinguished from all other species of the genus by the very short size of specimen, the nature of eye lobe and lenses, the curved and transverse carinae on the carapace, the long first peraeopod and constricted nature of the fifth pleon somite. The only other small species known is C. minor Hale, the females of which measure 1.2-1.4 mm. But it can be easily distinguished by the well marked lateral groove-like depression on the side of the carapace, which is absent in the present species. There are also marked differences in the nature of peraeopods and uropods.

Campylaspis robusta sp.nov.

Locality: Off Cochin, Plankton, 1979, 1 ♀ 1.1 mm.

Female. (Fig.19). Carapace half of the total length of the body; pseudorostral lobes elongated. A broad lateral furrow on each side of the carapace margined above by a distinct carina. There are patches of dark pigments in these furrows which extend well into the posterior half. A carina originates from the posterior region of each furrow and ends near the middle of the carapace. Ocular lobe distinct; lenses not clear.

Third segment of the peduncle of first antenna short, main flagellum two-segmented and accessory flagellum very short.

Third maxilliped wide; basis about four-fifths as long as rest of limb with two terminal plumose setae; merus wide, distally with a terminal plumose seta; carpus and propodus also broad, each with an external marginal plumose seta; dactylus short.

Basis of first pereopod shorter than rest of limb; carpus little longer than merus; propodus and dactylus subequal in length.

FIG. 19

Campylaspis robusta sp.nov. Female

a. First antenna

b. Third maxilliped

c. First peraeopod

d. Second peraeopod

e. Third peraeopod

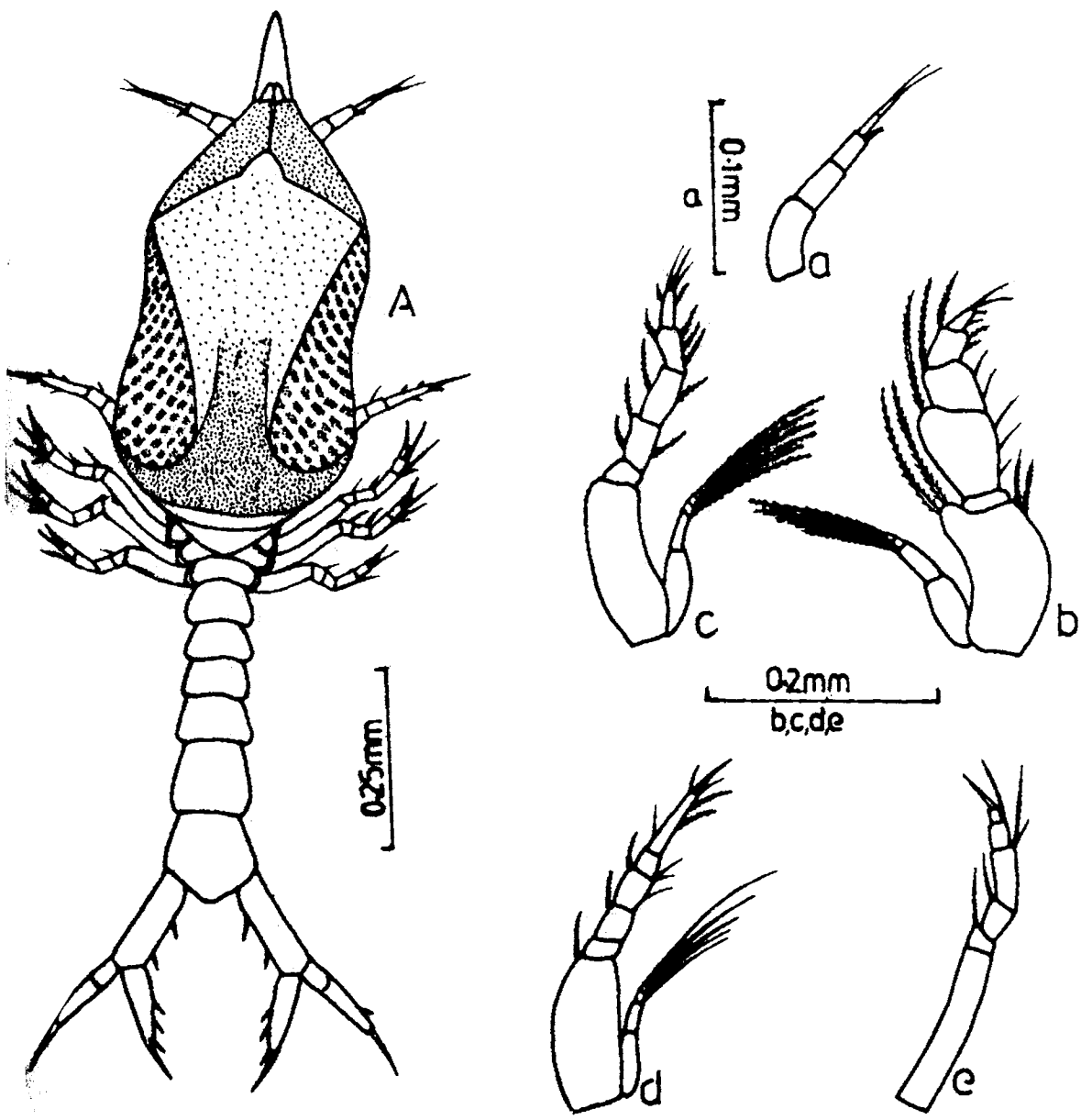


FIG. 19

Second peraeopod with broad basis shorter than rest of the limb; dactylus long, tapering towards the distal end; thrice as long as propodus.

First four pleon segments short; fifth and sixth broader than the previous segments.

Peduncle of uropod slightly longer than the telsonic somite, with two slender spines on the inner margin, endopod of uropod three-fourths the peduncle; its inner margin highly serrated with two marginal spines and two unequal terminal spines; exopod slightly longer than endopod with a long terminal spine.

This species agrees with C. latidactyla Hale in the presence of a deep and broad furrow on each side of the carapace. But there is difference in the nature of the furrow which is margined above and below with a fold in C. latidactyla, where as in the present species the furrow is margined above by a distinct carina. C. robusta also resembles C. minor Hale in the nature of the third maxilliped and the peraeopods but differs in the nature of carapace and uropods. This species can be easily distinguished from all other allied species by the presence of a carina originating from the posterior region of each furrow which runs towards the middle of the carapace and by the dark patches of pigments present in the furrows.

Family Lampropidae

Genus Hemilamprops Sars

Hemilamprops pellucida Zimmer

1908. Hemilamprops pellucida, Zimmer, Wiss. Erg. deutschen Tiefsee-Exp. 8, pp.171-172, pl.39, figs.53,54, pl.40, figs.55-59.

1913. Hemilamprops pellucida, Stebbing, Das Tierreich, 37, p.57, fig.27.

1963. Hemilamprops pellucida, Jones, N.Z. Dept. Sci. Industr. Res. Bull., 152, pp.52-53, fig.192.

Locality: IIOE, Indian Ocean, Durban Bay, Ken Boss, 2 ovigerous females, 6-11 mm.

Female. Closely resembles H. pellucida from New Zealand (Jones 1963). Integument pellucid, pseudorostrum short and blunt. Eye lobe without lenses, carapace with five teeth on its mid-dorsal line projecting forward followed by a row of denticles reaching backwards to about the middle of the carapace. Antero-lateral boarders of the carapace serrated. Basis of first peraeopod with twelve-fourteen spines on its anterior convex side; peraeopods 3 and 4 with two segmented rudimentary exopods. Telsonic somite less than half of the fifth pleon somite.

Distribution: Antarctic, S. Africa, New Zealand.

Hemilamprops diversa Hale

1946. Hemilamprops diversa, Hale, Trans. Roy. S. Austral., 7., 1, pp.183-188, figs.3,4.

Locality: NSW, Indian Ocean, Durban Bay, Kenboss, 3 ♂♀ 3.6-5.5 mm, 1 immature ♂ 6 mm.

Female. Carapace less than one-fourths the total length of the animal with reticulate pattern. The median carina runs from the ocular lobe to about three-fourths the length of carapace. Pleon longer than cephalothorax. Telson considerably longer than the peduncle of uropod. Peduncle with five slender spines on the distal half of the inner margin. Telson with five terminal spines and three pairs of slender lateral spines.

The immature male specimen closely resembles the type description.

Distribution: New South Wales, Tasmania.

Family Diastylidae

Genus Diastylis Say

Diastylis planifrons Calman

1912. Diastylis planifrons, Calman, Proc. U.S. Nat. Mus., 41, pp.635,643, figs. 58-61.

1913. Diastylis planifrons, Stebbing, Das Tierreich, 32, pp.91-92.

Locality: IIOE, Indian Ocean, Durban Bay, Ken Boss, 1 immature ♀ 3.2 mm.

Female. Carapace inflated, antero-lateral angle slightly indicated. Basis of third maxilliped distally expanded, propodus and dactylus subequal. First and second peraeopods with well developed exopods and third and fourth with rudimentary exopods. Carpus of second peraeopod long, one and a half times longer than propodus and dactylus combined together (twice in Calman's description). Posterior part of telson long, with five pairs of rather slender lateral spines and two terminal spines.

Distribution: S. America, Straits of Magellan.

Genus Makrokylindrus Stebbing

Makrokylindrus (Coalescuma) fistularis (Calman)

1911. Diastylis fistularis, Calman, Trans. Zool. Soc. London, 18,4, pp.383-385, figs.26-36.

Calman (1911) divided the family Diastylidae into 9 genera mainly on the basis of the length of the telson. Stebbing (1912) classified the species coming under Diastylidae considering the length of the post-anal part of the telson and he created a new genus Makrokylindrus which has very short post-anal part. Bacescu (1962) identified a subgenus Coalescuma under Makrokylindrus depending up on the union of

the third and fourth pedigerous segments, which are free in the subgenus Makrokylindrus. The present species which was originally described by Calman as Diastylis fistularis comes under the subgenus Coalescuma. Calman identified only one immature male specimen, where as in the present collection both immature males and ovigerous females are present.

Locality: Off Visakhapatnam, ground-sand and clay, 40-60 m, 1980, 4 ♂♂ (immature) 3.8-4.7 mm and 3 ♀♀ (ovigerous) 4.5 mm.

Immature male. Carapace one-third of the total length. Antennal notch hardly indicated, antero-lateral angle highly concave. The carapace has a superficial resemblance to that of Dimorphostylis. The pseudorostrum acutely pointed. Longitudinal ridges faintly marked. Anteriorly on each side is a vertical ridge forming 'a marked shoulder when viewed from above' (Calman 1911). Ocular lobe with corneal lenses distinct.

The first pedigerous segment short, partly concealed laterally. The third and fourth coalesced dorsally which is characteristic of the subgenus. The first antenna closely resembles the type description. Basis of third maxilliped

expanded distally and produced into a lobe which reaches up to the carpus, with numerous thickly packed plumose setae. Exopod present as a knob with a few setae.

Basis of first peraeopod slightly broad at its proximal end and distally provided with numerous long plumose setae. Carpus, propodus and dactylus slender, propodus longer than carpus and thrice as long as the dactylus.

Basis of second peraeopod broad at the middle, slightly shorter than the other segments combined together, with numerous short setae on the convex margin; ischium very short, propodus one-seventh of the carpus.

Third and fourth peraeopods similar in structure, basis slightly shorter than the remaining segments combined together. Merus half of basis, carpus less than half of merus, dactylus very short. Carpus has four or five plumose setae terminally and propodus has one.

Basis of fifth peraeopod short, merus longer than carpus, with three terminal setae and propodus with one.

Telson very long, longer than the last four pleon segments combined together, cylindrical in form, bluntly pointed at the tip, with out any spines or setae.

Peduncle of uropod only half of the telson with four very short spines. Exopod more than half of the peduncle. Endopod slightly longer than exopod, three-jointed, first joint longer than the other two combined together. The spines are arranged in the order 3,1 and 1 and one terminal spine. Exopod, broader than endopod, has five spines in the external margin and two unequal terminal spines and two short setae on the inner margin at the distal part, both exopod and endopod are highly serrated on both margins.

Ovigerous female (Figs.20 and 21). The longitudinal ridges on the lateral side of the carapace more distinct than in male. The dorso-ventral longitudinal ridges lying in between the lateral ridges are short and thin and they do not reach the anterior half. When viewed from above the vertical ridges form a marked shoulder as in the males.

First segment of the peduncle of the antennule longer than second or third. Main flagellum two-jointed and accessory single. Third maxilliped without an exopod, carpus terminally has a long plumose seta. The extended lobe of the basis has five long plumose setae.

Third and fourth pedigerous segments united. Peraeopods similar to that of male. Pleon longer than cephalothorax including the telson. The dorso-median keel

FIG. 20.

Makrokylindrus (*Coalescuma*) *fistularis* (Calman)

Ovigerous female

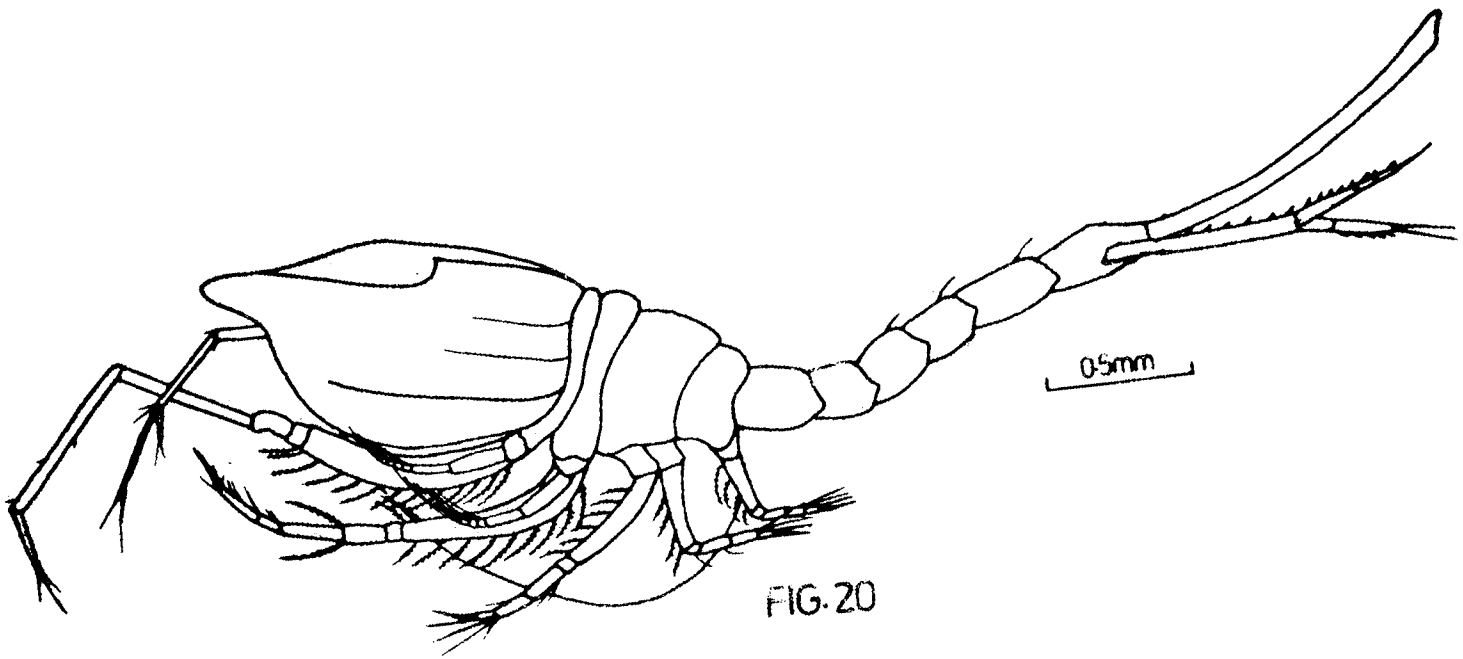


FIG. 20

FIG. 21

Makrokylindrus (*Coalescuma*) *fistularis* (Calman): ovigerous female

a. Dorsal view of carapace

b. First antenna

c. Third maxilliped

d. First peraeopod

e. Second peraeopod

f. Third peraeopod

g. Fifth peraeopod

h. Uropod with telson

i. Egg

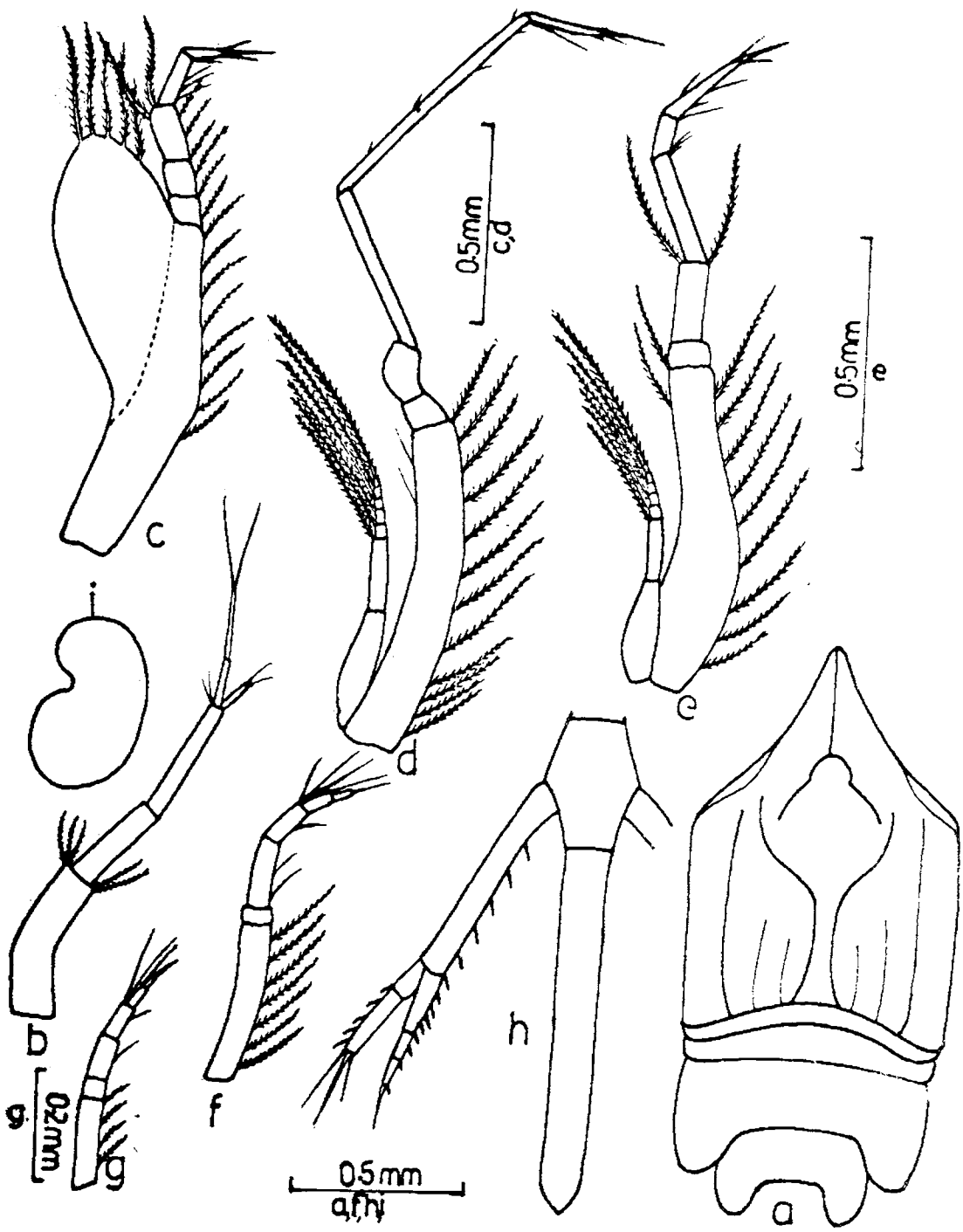


FIG. 21

is seen on the first to fifth pleon somites. Fifth pleon somite slightly longer than the telsonic somite which is in turn slightly widened at the posterolateral side.

Telson twice as long as the peduncle of the uropod, bluntly pointed at the tip, without any spines. Peduncle has six spines on the inner margin. Endopod of uropod more than half of the peduncle, first joint longer than the other two, the spines are arranged in the order 5,2, and 1 and a long terminal spine. Exopod little shorter than endopod with two long terminal spines and five spines on the external margin.

15 matured ova of 0.3 mm long are seen in one of the ovigerous female.

Makrokylindrus sp.

Locality: 1♀, Indian Ocean, Durban Bay, Ken Boss, 1 damaged ♀.

Female. The whole body is covered with numerous tubercles and spines. Pseudorostrum short, with two or three long spines and numerous short spines on its border. The lateral sides of the carapace are also provided with

numerous spines. All the five pedigerous segments free, third, fourth and fifth with paired mid-dorsal blunt spines.

Peraeopods slender, basis of first peraeopod shorter than the combined length of others, with numerous spines on its convex margin and plumose setae on either side; carpus, propodus and dactylus sub-equal. Carpus of second peraeopod longer than propodus and dactylus combined together. Bases of peraeopods 2-4 with spines on outer margin and plumose setae on the inner margin; basis of fifth peraeopod devoid of spines and plumose setae. The first five pleon somite with paired mid-dorsal blunt spines as in pedigerous segments. Uropods broken.

Genus Paradiastylis Calman

Paradiastylis culicoides Kemp

1916. Paradiastylis culicoides, Kemp, Mem. Indian Mus., 5,4, pp.398-402, figs.3-5.

1951. Paradiastylis culicoides, Kurian, Bull. centr. Res. Inst. Univ. Travancore, (C), 2,1, pp.106-107.

1954. Paradiastylis culicoides, Kurian, Rec. Indian Mus., Parts 2-4, p.305.

Locality: RoBC collection, Lat. 09°30'N, Long. 76°22'E, 50 m, 4.11.1963, 1 ♂ 3.5 mm, Vizhinjom, dredge collection, 24 m, 25.4.1959, 1 ♂ 2.5 mm,

Off Cochin, plankton, 15 m, 2.4.1982,
5 ♂♂ ♀♀ (3 ovigerous) 1.9–2.2 mm, 3 immature
♂♂ 1.5–1.6 mm, 30 m, 1 ovigerous ♀ 2.1 mm,
Off Cochin, plankton, 30 m, 5.3.1982, 1 ovigerous
♀ 2 mm, 15 m, 22.3.1982, 1 ♀ 2 mm.

Ovigerous female. Carapace with out any oblique lateral ridge as in type description. Short hairs are seen on the surface of the carapace which is slightly uneven and there is a short longitudinal ridge in the mid-dorsal region. Third and fourth pedigerous segments combined together. Telson two-third the length of peduncle. Peduncle with eight spines. Uropods closely resemble the type description. The brood pouch revealed 16 eggs.

Male. Peduncle of uropod with sixteen spines, first joint of endopod with eight spines, second with three and third with two spines. Exopod little shorter than endopod, with out spines or setae on the margin; terminal spines present.

Distribution: Chilka lake 2–4 m, Trivandrum 30 m.

Genus Oxyurostylis Calman

Oxyurostylis smithi Calman

1912. Oxyurostylis smithi, Calman, Proc. U.S. Nat. Mus., 41, pp.605,667, figs.91–99.

1912. Oxyurostylis smithi, Stebbing, Ann. South African Mus., 10,5, p.146.

1913. Oxyurostylis smithi, Stebbing, Das Tierreich, 32, pp.132-133, fig.88.

Locality: CP04, Lat. 19°16.5'N, Long. 91°17.5'W, 13.8.1972, 2 ♂♂ 4 mm, Lat. 26°[illegible]'N, Long. 81°49'W, 4 ♂♂ 4-6.4 mm.

Male. Pereopods 1-4 with broad bases and well developed exopod. Pre-anal portion of the telson shorter than post-anal portion. Post anal portion with seven pairs of lateral spines. Peduncle of uropod long with twenty four - twenty six spines on the inner margin, the posterior spines being arranged very closely. Telson three-fourths the peduncle, exopod and endopod of uropod more than half of the peduncle, 3-segmented, endopod longer than exopod, the spines arranged in the order 9,5,5. Exopod with four inner marginal spines and three unequal terminal spines. Four short setae are seen on the external margin.

Distribution: U.S. America, Casco Bay, Vineyard Sound, Florida.

Oxyurostylis atlantica Radha and Kurian

1981. Oxyurostylis atlantica, Bull. Dept. Mar. Sci. Univ. Cochin, 12,1, pp.59-63, figs.5,6.

Locality: CPOM, Lat. 19°06.8'N, Long. 91°16.2'W, 13.8.1972 1 ♀ 2.2 mm, Lat. 20°[illegible]'N, Long. 81°57'W, 2 ♀♀ 1.4 and 2.6 mm, Lat. 25°30'N, Long. 81°35'W, 2 ♀♀ 2.8 mm, Lat. 29°[illegible]'N, Long. 83°2[illegible]'W, 2 ♀♀ 2 and 3.8 mm.

Female. Carapace more or less hexagonal in dorsal view, about one-third of the total length, highly granular, pseudorostral lobes produced horizontally. Ocular lobes distinct, visual elements indistinct. Basis of third maxilliped expanded distally. First peraeopod very long, basis less than three-quarters of the remaining segments combined. Basis of second peraeopod broad with short setae on either side; carpus with seven or eight teeth on its margin. Telson slightly longer than peduncle of uropod, anterior portion broad and posterior portion narrowed with two pairs of lateral spines, peduncle of uropod with four spines. Endopod three jointed, little longer than exopod, first joint longer than the rest; spines are arranged in the order 2,1 and 1 and a stout terminal spine. The external margin of endopod with two short spines one on each of the second and third segments, exopod with three unequal terminal spines.

The species has been collected from the Gulf of Mexico.

4. DISTRIBUTION

4. DISTRIBUTION

4.1. Geographical distribution

Cumacea occur in all seas, and in some estuaries and also in brackish water. The majority inhabit the shelf waters in less than 200 m depth and some are found above low-water mark. They have been recorded from all latitudes, probably the largest number of species occur in tropical coastal waters. Studies on the distribution of Cumacea (Jones 1969) show that the shallow water forms are very common in the Pacific coast especially in the Japanese waters.

Cumaceans form an important faunal component of the deep sea benthos of Atlantic Ocean. They have been collected from depths extending down to 7657 m predominantly from the temperate North-Atlantic and across the equator. A good number of species are distributed in the East-Atlantic especially off N.W. Africa and Mediterranean Sea and also in Southern Atlantic off S.W. Africa and American tropical waters of Florida (Caribbean Sea).

Very little is known about the distribution of Cumacea in the Antarctic region. But a number of species have been recorded from the shallow regions north of

NewZealand, South Georgia and Ross Sea. In the Indian Ocean they are common in the inshore waters of East coast of Africa, West and east coasts of India and Pakistan, Malaya coast, Singapore straight and west and south coasts of Australia.

The comprehensive survey on the distribution of Cumacea by Jones (1969) reveals that the South Atlantic and South Pacific are the two major areas from where large collections of Cumacea have been obtained. Even with the rich collections of Cumacea from the coasts of India, Pacific and Atlantic Oceans now examined, only an incomplete picture of the distribution of cumacean fauna is available.

The distribution of 77 species of Cumacea in the present collections are given in Tables 1 and 2. Of these, 41 belong to the family Bodotriidae with the genera Iocuma, Bodotria, Cyclaspis and Iphinoe well represented, 3 belong to the family Leuconidae, 26 belong to the Nannastacidae with the prominent genera Nannastacus, Cumella and Campylaspis, 2 to Lampropidae and the rest to Diastylidae. The present studies reveal that the highest density of cumacean population is along the East Coast of Africa, Indian coasts, Philippine coasts and Mid-Atlantic coasts (Gulf of Mexico). The family Bodotriidae, characteristic

of low latitudes seems to be well represented in the Indian coasts and East Coast of Africa. Heterocuma armata Kurian, Pseudosympodomma indica Kurian, Gigacuma halei Kurian, Cocuma taprobanica Calman, C. travancoricum Kurian, Bodotria platybasis Radha and Kurian, Iphinoe pigmenta Kurian, I. macrobrachium Calman and Paradiastylis culicoides Kemp are restricted only to Indian coasts and their abundance is in the coastal areas. Most of the species, which are found along the Indian coasts show their closest affinities with those from the Gulf of Siam. B. stellifera Calman, B. sublevis Calman, B. siamensis Calman, Cyclaspis herdmani Calman, C. uniplicata Calman, C. cingulata Calman, I. calmani Fage and Makrokylindrus (Coalescuma) fistularis (Calman) which had been previously recorded from the Gulf of Siam are found to be distributed along the west and east coasts of India. Of these C. herdmani, C. uniplicat and I. calmani have been recorded from Andaman Islands also. B. sublevis, previously known from Gulf of Siam and Kerala coast and B. parva Calman known from the Gulf of Siam are now recorded from the Red Sea.

Only very few species which had a previous distributio in Japanese waters and Pacific coast of Australia are observe from the Indian coasts. B. lata Calman and B. similis Calman with a wide distribution along Japan, Vietnam coast, Burma

coast, Gulf of Siam and Andaman Islands are now recorded from the S.W. coast of India while *C. oulex* (Simmer) previously recorded only from Japan coast is now recorded from the S.W. coast of India. *C. strigilis* Hale, *C. cretata* Hale and *Campylaspis minor* Hale found in the Pacific coast of Australia, are observed in the collections from the Kerala coast.

The Cumacea of the E. African coast showed close affinities with the cumacean fauna of Australian and Philippine coasts. Many of the species which were previously recorded from the Pacific and Indian Ocean coasts of Australia are found to be distributed along the E. African coast and also to the Red Sea. *Glyphocuma inaequalis* Hale, *Hemileucon laevis* Hale, *Campylaspis thomsoni* Hale and *Hemilamprops diversa* Hale which were previously distributed in New South Wales and Tasmania are now found to occur in the Durban Bay (East coast of Africa) while *Nannastacus johnstoni* Hale previously known from New South Wales and Queensland has a wide distribution having recorded from Malaya coast, east coast of Africa, and Philippine coasts. *C. sheardi* Hale, *C. inflatus* Hale and *Cumella turgidula* Hale which were previously known only from the Australian coasts have now been recorded from

East coast of Africa, (Comoro Island, Madegascar) Singapore Straight and Thailand coast. J. supinfletus Hale found previously distributed along the S. Australian coast is recorded from Malaya and Philippine coasts. Schizotrema aculeata Hale and Cumella gunnoi Hale, both Indo-Pacific species occurring in S. Australia and Queensland are observed from Red sea also, while C. hispida Calman which was known from the Gulf of Siam and S. Australia is now found distributed widely in the Red Sea and along the Philippine coasts.

The previous records of Cumacea of the family Nannastacidae show that it is poorly represented in the Indian Ocean. But the present collections yielded a number of species from Indian Ocean which show affinities with those of the western part of the Pacific Ocean especially from Philippines, Gulf of Siam and East coast of Australia. Most of the representatives of the genus Nannastacus in the present collections were formerly distributed only in the Gulf of Siam in shallow depth. From the present studies it is observed that many of them have their distribution extended for some distance eastward to the Philippine coasts. They are also observed from the Malaya coast, Singapore Straight, East Coast of Africa and Red Sea. Schizotrema sordidum Calman and S. tardus Calman known previously from

the Gulf of Siam are now observed along the Philippine coasts where as L. zimmeri Calman, L. gibbosus Calman, L. reptans Calman and L. minor Calman also recorded from the Gulf of Siam are at present obtained from the east and west of the Indian Ocean. L. lepturus Calman, previously observed only from the Suez Canal (Indian Ocean) is now found to be distributed along the coasts of Singapore Island, Philippines and Gulf of Mexico.

Cyclaspis levis Thomson, C. calmani Hale and Hemilamprops pellucida Zimmer previously recorded from NewZealand are now found to be distributed in the East Coast of India, Red Sea and East Coast of Africa respectively. Camptolaspis orientalis Calman and C. rubicunda (Lilljeborg) which were distributed at 14-2178 m depth off N.W. Pacific are now recorded from the East Coast of Africa (Madagascar) at 2125 m.

The present studies reveal that some of the cumacean species previously recorded from the Atlantic coasts, now have a wide distribution along the Indian Ocean coasts. It is also noted that most of the species previously described from Atlantic region were from the North Atlantic coasts, Mediterranean and West coast of Africa. Some of the species in the present collections especially those from the Indian

Ocean coasts show certain resemblances to the cumacean fauna of Atlantic Ocean especially those from the Mediterranean Sea. Bodotria pulchella (Sars), Cyclaspis longicaudata Sars, Iphinoe serrata Norman and I. inermis Sars are found to have an extended distribution from Mediterranean - North Atlantic region to S.W. coast of India where as B. scorpioides (Montagu) Leucon longirostris Sars, Nannastacus longirostris Sars, Cumella limicola Sars, Campylaspis rubicunda (Lilljeborg) and C. glabra Sars are found to be distributed along the East Coast of Africa especially off Nossi-Be-Madagascar and Durban Bay.

A few species recorded from the Indian Ocean in the present collections show certain affinities with those of the South West coast of Africa. Heterocuma africana Zimmer, Bodotria pulchella and Iphinoe brevipes are now observed from South Indian coasts. I. fagei, Cumella limicola and Campylaspis glabra previously recorded from the South West coast of Africa are now observed from the East Coast of Africa.

Cumacean fauna is rich in the western part of the Atlantic Ocean especially off West Indies and Gulf of Mexico. The present collections yielded some species from this region. Cyclaspis longipes Calman, C. unicornis Calman, Cumella clavicauda Calman and Xyrostylis smithi Calman

which were distributed formerly in the West Indies and Caribbean Sea are now recorded from the Gulf of Mexico showing an extended distribution towards the west. Leucon acutirostris Sars and Cumella pygmaea Sars previously known from the Norwegian coast are now recorded from the Gulf of Mexico. Pseudocyclaspis granulata Radha and Kurian, P. mexicensis Radha and Kurian and Oxyurostylis atlantica Radha and Kurian are the new species recorded from the Gulf of Mexico. Only Cyclaspis varians Calman which had its distribution in the North West Atlantic (Woodhole) is now collected from the West Coast of India (Gulf of Kutch). Similarly Diastylis planifrons Calman previously known from the Straits of Magellan (S. America, Atlantic coast) is now collected from Durban Bay (East coast of South Africa).

Besides the three new species recorded from Gulf of Mexico six new species are recorded from the Indian coasts. They are Leucon striata, Campylaspis minuta and Bodotria platybasis from the East coast of India (Visakhapatnam and Portonovo); B. biocellata, B. cochinensis and Campylaspis robusta from South West coast of India (off Cochin).

Out of the 77 species described, 66 species occur in the Indian ocean, 37 in the Pacific and 26 in the Atlantic

Ocean; 31 species are Indo-Pacific and 13 occur both in Indian Ocean and Atlantic Ocean; 32 species are newly recorded from the Indian Ocean; 18 species are restricted to the Indian Ocean alone. The Indian Ocean species are Heterocuma armata Kurian, Pseudosympodomma indica Kurian, Gigacuma halei Kurian, Eocuma taprobanica Calman, E. travancoricum Kurian, E. striata sp. nov., Bodotria platybasis Radha and Kurian, B. biocellata sp. nov., B. cochinensis sp. nov., Cyclaspis juxta Hale, Iphinoe pigmenta Kurian, I. macrobrachium Calman, Nannastacus sheardi Hale, N. inflatus Hale, Cumella turgidula Hale, Campylaspis minuta sp. nov., C. robusta sp. nov. and Paradiastylis culicoides Kemp. The pattern of distribution of Cumacea along the Indian Coasts is given in Table 3.

Schizotrema sordidum Calman and Nannastacus tardus Calman are restricted to Pacific Ocean. Nine species are restricted to Atlantic Ocean of which 5 are new records. They are Pseudocyclaspis granulata Radha and Kurian, P. mexicanais Radha and Kurian, Cyclaspis longipes Calman, C. unicornis Calman, Leucon acutirostris Sars, Cumella clavicauda Calman, C. pygmaea Sars, Oxyurostylis smithi Calman and O. atlantica Radha and Kurian.

Only 4 species are found to be distributed in all the three oceans. They are Hannastacus lemurus Calman, Cumella munroi Hale, Campylaspis rubicunda (Lilljeborg) and C. glabra Sars.

To study the region wise distribution of Cumacea in the World Oceans, 5 zones namely Africa, Southern Asia, Australia and S. Pacific, East Asia (North Pacific Ocean) and Atlantic Ocean have been identified. Out of the 77 species in the present collections, 55 occur in the Southern Asia, 32 in the African Coasts, 22 in the Atlantic Coasts, 19 in the Australian and S. Pacific Coast and 17 in the East Asia (North Pacific Ocean).

In the African Coasts, the maximum number of species occur in the Eastern Coast and less in the Southern Coast. It is also noted that the majority of the species in the E. African Coast belong to the family Hannastacidae. In the Southern Asia, the maximum number of species occur in the Arabian Sea and Bay of Bengal. Majority of them are the representatives of the family Bodotriidae. Most of the species in this region show wide distribution along the Arabian Sea, Bay of Bengal and Indo-China region.

In the Australian Coasts and S. Pacific, there is a more or less uniform distribution of Cumacea. Family

Bodotriidae is less and Nannastacidae predominates. In the East Asia (W. Pacific Ocean) maximum number of species occur in the Philippine coasts. It is also noted that only the Nannastacus spp. occur in this region.

In the Atlantic Ocean majority of the species occur in the Gulf of Mexico and North Atlantic region. Only one species is present in the South of Argentina. Representatives of the families Bodotriidae, Nannastacidae and Diastylidae occur in these regions. The distribution of the species is given in Table 2.

Seventy one species of Cumacea have been described so far along the Indian Coasts. To study the regionwise distribution, 5 zones namely Northern Arabian Sea, Laccadive Sea (South of Goa), East Coast of India, Visakhapatnam and North; East Coast of India, South of Visakhapatnam and Andaman and Nicobar Islands have been identified. Three families namely Bodotriidae, Nannastacidae and Diastylidae are represented along the Indian Coasts. The maximum number of species (46) occurs along the Laccadive Sea (South of Goa), 13 along the coast South of Visakhapatnam, 17 in the Andaman and Nicobar Islands, 14 along the Visakhapatnam and North and 3 in the Northern Arabian Sea. Cyclaspis longicaudata occurs in all the regions except Northern Arabian Sea

while Iphinoe macrobrachium and Paradiastylis cuticolus occur in all the regions except Northern Arabian Sea and Andaman and Nicobar Islands. Out of the 71 species, hither to recorded, 46 species are represented in the present collections. The distribution of the species recorded from the Indian Coasts is given in Table 3.

The studies on the distribution pattern of the 77 species of Cumacea from the Indian, Pacific and Atlantic Oceans bring about the following significant factors.

(1) The cumacean fauna of the Indian coasts especially the members of the family Bodotriidae, show their affinity with those of the Gulf of Siam.

(2) The cumacea from the east coast of Africa show affinities with those of Australian and Philippine coasts.

(3) The species of the family Nannastacidae are scarce in the Indian coasts though they are widely distributed along east coast of Africa, Red Sea, Malaya Coast and Singapore Straight. They are most abundant along the Philippine coasts.

Table 1. General distribution of the different species of Dumacea in the collections in the World Oceans.

Sl. No.	Name of species	Indian Ocean	Pacific Ocean	Atlantic Ocean	Remarks
1	2	3	4	5	6
1.	Heterocuma africana Zimmer	Cape Comorin, Tuticorin*, Portonovo, Andaman Islands	-	West Coast of Africa	This is regarded as a steno thermal warm water species. The present record extends its distribution to the east and west coasts of India.
2.	Heterocuma armata Kurian	Off Puri - Orissa, Madras, Portonovo	-	-	H. armata has been previously recorded from the East Coast of India. The present record is also from the shore on the east coast.
3.	Glyphocuma inaequalis Hale	Durban Bay	New S. Wales Tasmania	-	It usually prefers a muddy bottom and has been collected in benthos. Previously known only from Pacific.
4.	Pseudocumoidoma indica Kurian	Kilakarai - S. India, Visakhapatnam	-	-	P. indica is a shallow water form found in the East Coast of India.

*The places underlined show present records

1	2	3	4	5	6
5.	Gigacuma halei Kurian	Trivandrum, Vizhinjom, Cape Comorin, Orissa Coast	-	-	G. halei is usually found in deposits formed of fine grey sand mixed with a small percentage of shells and mud. It is a common species in the Vizhinjom region and its maximum abundance in plankton is in September.
6.	Eocuma taprobanica Calman	Calicut, Cochin, Quilon, Vizhinjom, Gulf of Manaar, Andaman Islands	-	-	E. taprobanica is common in S.W. Coast of India especially near Trivandrum and Vizhinjom coasts. The maximum intensity is between 24-30 m.
7.	Eocuma stellifera Calman	Purakkad - Kerala Coast	Gulf of Siam	-	E. stellifera was previously recorded only from Gulf of Siam.
8.	Eocuma lata Calman	Cochin, Trivandrum, Visakhapatnam, Portonovo, Andaman Islands	Indo China (Vietnam), Burma (Tavoy), Gulf of Siam, Japan	-	E. lata is previously known from West Pacific and Trivandrum Coast. The present record extends the distribution to the East Coast of India.

1	2	3	4	5	6
9.	Eocuma travancoricum Kurian	Trivandrum, Visakhapatnam	-	-	E. travancoricum has been previously recorded from Trivandrum Coast from a bottom of fine sand and gravel mixed with a small percentage of silt. The present record extends its distribution to the East Coast of India as well.
10.	Eocuma striata sp. nov.	Visakhapatnam	-	-	E. striata resembles E. amakusensis from Japan.
11.	Sodotria pulchella (Sars)	Karwar, Calicut, Cochin	-	British Islands Mediterranean and W. Africa	S. pulchella from S.W. Coast of India resembles the W. African form. In the S.W. Coast the maximum abundance is observed at 15 m depth.
12.	Sodotria sublevis Calman	Entedebir Island (Red Sea), Cochin, Trivandrum	Annam (Vietnam Coast), Gulf of Siam	-	S. sublevis found in Red Sea shows difference from that of Gulf of Siam and Trivandrum in the armature of uropods.

1	2	3	4	5	6
13.	Bodotria scorpioides (Montagu)	Ghtedebir Island, Iossi-Be-Madagascar	-	Norway - Mediterranean	B. scorpioides is seen in considerable numbers in the Plankton Collection from Red Sea. It was previously recorded from Atlantic and Mediterranean Sea, now extends its distribution to Indian Ocean.
14.	Bodotria pulex (Zimmer)	Lourenco Marques, Quilon, Vizhinjom	Izu Peninsula Sagami Bay Tokyo Bay - Japan	-	B. pulex from Indian Ocean shows close resemblance to the specimens from Japan. It was previously recorded only from Pacific.
15.	Bodotria similis Calman	Laccadive, Cochin, Trivandrum, Vizhinjom, Andaman Island	Annam, Gulf of Siam Formosa - Japan	-	B. similis is rarely seen in Indian Ocean, but in Japanese waters it is seen in large numbers
16.	Bodotria siamensis Calman	Cochin, Quilon, Portonovo	Annam (Vietnam Coast) Gulf of Siam	-	B. siamensis previously distributed in the West Pacific, is now recorded from the Indian Coasts.
17.	Bodotria parva Calman	Massawa Channel (Red Sea)	Gulf of Siam	-	It was previously known only from Pacific. Present record extends the distribution to the Indian Ocean.

1	2	3	4	5	6
18.	Sodotria platybasis Radha and Kurian	Portonovo	-	-	S. platybasis is seen in large numbers in the intertidal sandy ground at Portonovo in association with the mysis Gastrosaccus simulans. The maximum intensity is in September.
19.	Sodotria biocellata sp. nov.	Off Cochin	-	-	This is seen in considereble numbers in the plankton off Cochin.
20.	Sodotria cochinensis sp. nov.	Cochin	-	-	It is rarely seen in the Plankton Collections from Cochin.
21.	Pseudocyclaspis granulata Radha and Kurian	-	-	Florida Coast (Gulf of Mexico)	Pseudocyclaspis shows close relationship with Sodotria and Cyclaspis. Both the species are rarely observed.
22.	Pseudocyclaspis mexicansis Radha and Kurian	-	-	Campeche Coast (Gulf of Campeche)	
23.	Cyclaspis longicaudata Sars	Gujarat Coast	-	N. Norway, S. Ireland, Bay of Biscay and Mediterranean	C. longicaudata is a deep water cumacean occupying a depth of 12 -3385 m in the Atlantic Ocean. In the present collection it is seen at 115 m depth along the West Coast of India. The present record is the first from the Indian Ocean.

1	2	3	4	5	6
24.	Cyclaspis herdmani Calman	Vizhinjom, Gulf of Manaar, Andaman Islands	Annam (Vietnam Coast)	-	This usually occurs in the surface plankton collection.
25.	Cyclaspis levis Thomson	Visakhapatnam	New Zealand	-	C. levis obtained from Visakhapatnam is very small (2.3 mm) compared to the New Zealand form.
26.	Cyclaspis varians Calman	Gulf of Kutch	-	U.S.A., Vineyard sound, Woods Hole	This usually occurs in the surface Plankton Collection.
27.	Cyclaspis longipes Calman	-	-	West Indies, Florida Coast	A number of specimens of C. longipes were obtained from the coast of Florida and they show close affinity to the west Indies type.
28.	Cyclaspis uniplicata Calman	Vizhinjom, Gulf of Manaar, Andaman Islands	Annam, Gulf of Siam	-	It has been previously recorded from the Gulf of Siam. The specimens obtained from Vizhinjom Coast has close resemblance to the specimen from Gulf of Siam.
29.	Cyclaspis unicornis Calman	-	-	West Indies, Florida Coast	It is recorded only from Atlantic Ocean.

1	2	3	4	5	6
30.	Cyclaspis cingulata Calman	Kilakarai – S. India, Visakhapatnam	Gulf of Siam	–	C. cingulata from Vizag shows close affinity to the specimen from Gulf of Siam.
31.	Cyclaspis striqilis Hale	Trivandrum, Vizhinjom, Entedebir Island (Red Sea)	Queens land	–	C. striqilis from the surface plankton of S. India shows close resemblance to the type specimen obtained from Queensland.
32.	Cyclaspis cretata Hale	West Australia, New S. Wales, Andaman Islands, Queensland Vizhinjom		–	This has a wide distribution along the east and west coasts of Australia. The specimens obtained from S. India show close resemblance to Queensland and W. Australian specimens.
33.	Cyclaspis calmani Hale	Andaman Islands, New Zealand Entedebir Island (Red Sea)			C. calmani, collected from the coralline sand off Entedebir Island, shows certain morphological differences from that of New Zealand forms
34.	Cyclaspis juxta Hale	West Coast of Australia, Vizhinjom	–	–	C. juxta is recorded only from Indian Ocean. It was previously known from W. Coast of Australia and the present record extends the distribution to the S.W. Coast of India.

1	2	3	4	5	6
35.	Iphinoe brevipes Hansen	Trivandrum, Vizhinjom, Portonovo	-	Senegal - W. Coast of Africa	I. brevipes is a common species along the Trivandrum, Vizhinjom Bay and open sea within 15-30 m depth. Very often males are seen in large numbers from January to April. The present record extends the distribution to east coast of India as well.
36.	Iphinoe calmani Fage	Andaman Islands, Laccadive, Gujarat, Cochin, Vizhinjom, Visakhapatnam	Annam (Vietnam Coast)	-	It is widely distributed in the West Coast of India with in 10-60 m depth. Maximum intensity is in January-February with in 10-15 m off Cochin.
37.	Iphinoe serrata Norman	Gujarat, Visakhapatnam	-	British Islands, Mediterranean Bay of Naples	It was previously collected from Atlantic Ocean only. The present record is from the east coast of India.
38.	Iphinoe inermis Sars	Calicut, Cochin	-	Mediterranean	I. inermis was previously known only from Mediterranean Sea. The present record extends its distribution to E.C. Coast of India.

1	2	3	4	5	6
39.	Lohinoe fagei Jones	Durban Bay	-	S.W. Africa	L. fagei was previously known only from Atlantic Ocean.
40.	Lohinoe pigmenta Kurian	Cochin backwaters, off Cochin	-	-	L. pigmenta is seen in large numbers in the surface plankton collection off Cochin. This species is represented only in the Indian Ocean.
41.	Lohinoe macrobrachium Calman	Vizhinjam, Gulf of Manaar, Visakhapatnam	-	-	L. macrobrachium was previously known from Gulf of Manaar by an immature specimen. In the present collections adults have been obtained from the East and West Coasts of India.
42.	Leucon longirostris Sars	Durban Bay	-	Mediterranean	L. longirostris is a deep water cumacean and the specimen present in the Indian Ocean shows resemblance to that of Mediterranean.
43.	Leucon acutirostris Sars	-	-	Coast of Norway, Coast of Campeche (Gulf of Mexico)	L. acutirostris from Gulf of Mexico has close affinity with that from the coast of Norway.
44.	Hemileucon laevis Hale	Durban Bay	New South Wales	-	H. laevis was previously known from Pacific. The present record extends the distribution to the Indian Ocean also.

1	2	3	4	5	6
45.	Schizotreme sordidum Calman	-	Gulf of Siam, Samar, Tawi-Tawi, Sulu Archipelago (Philippines)	-	S. sordidum occurs in surface water. In Philippine region it has been recorded from sandy-muddy bottom with in mangrove area.
46.	Schizotreme aculeata Hale	JAR - Red Sea, W. Australia, S. Australia	Queensland	-	S. aculeata is common along the Australian Coasts. The present record extends its distribution to Red Sea.
47.	Iannastacus zimmeri Calman	Trincomali, Ceylon	Annam (Vietnam Coast), Tawi-Tawi, Sulu Archipelago (Philippines)		The previous collections were from surface plankton. The present record suggests that it prefers a sandy and muddy bottom of Philippine Islands.
48.	Iannastacus gibbosus Calman	Andaman Islands, Palau Bantu, Singapore Island, Comoro Island, Bougainville Island, Madagascar	Annam, Gulf of Siam - Zamboanga, Sacol Island, (Philippines)	-	It usually occurs in surface water and very rarely in shallow waters. From Philippine Islands it has been collected in large numbers, from a sandy bed with thin film of mud.
49.	Iannastacus reptans Calman	Bougainville Island, Comoro Island	Gulf of Siam, Zamboanga, Great Sanbecruz Island (Philippines)	-	It occurs in surface and shallow waters in the Indian Ocean while it is seen among coral reefs and algal masses in Philippine Islands.

1	2	3	4	5	6
50.	Nannastacus minor Calman	Bougainville Island	Annam, Gulf of Siam	-	Previously it was collected in surface plankton from Western Pacific and now recorded from shallow waters of Bougainville Island (Indian Ocean)
51.	Nannastacus tardus Calman		Gulf of Siam Sacol Island, Zamboanga (Philippines)	-	It is obtained from a sandy bottom with a thin film of mud from Philippine Islands. It is represented only in Pacific Ocean.
52.	Nannastacus lepturus Calman	Singapore Island, Kerala Coast, Suez Red Sea	Great Santacruz Island, Zamboanga (Philippines)	Coast of Florida, Coast of Campeche (Gulf of Mexico)	N. lepturus is found in Indian, Pacific and Atlantic Oceans. It occurs in large numbers in the Gulf of Mexico in the plankton collection and rarely occurs in coral reefs in Singapore and Philippine Islands. Specimen with maximum size of 2.3 mm occurs in the Gulf of Mexico.
53.	Nannastacus longirostris Sars	Comoro Island, Nossi-Be-Madagascar, Bougainville Island	-	Mediterranean	N. longirostris has been obtained from the Western part of Indian Ocean and shows close similarity to the Mediterranean forms.

1	2	3	4	5	6
54.	Jannaeacus sheardi Hale	Bougainville Island, Grand Comoro Island, S. Australia	-	-	It usually occurs in surface water and is represented only in the Indian Ocean.
55.	Jannastacus inflatus Hale	Nossi-Be-Madagascar, Grand Comoro Island, Andromanche Reef, Palau Bantu (Singapore Coast), Kilakarai Coast (S. India), W. Australia, S. Australia	-	-	J. inflatus is widely distributed along the Indian and Australian Coasts. The present record extends its distribution to E. African Coast and Singapore Coast.
56.	Jannastacus subinflatus Hale	Cape Rachado (Malaya), S. Australia	Guiuan, Siquijor Island Legaspi (Philippine)	-	In the Indian Ocean regions J. subinflatus occurs in the surface waters whereas in the Philippine Islands it occurs in the muddy bottom.
57.	Jannaeacus johnstoni Hale	Grand Comoro Island, Tanikoro Island, Andaman Islands	Cebu, Sulu, Archipelago, Lingayen (Philippines), New S. Wales, Queensland	-	J. johnstoni has a wide distribution along the Indian Ocean and Western Pacific Ocean.

58.	Cumella clavicauda Calman	-	-	West Indies, Gulf of Mexico, Florida Coast, Campeche Coast, Curaco Island (Carribbean Sea)	C. clavicauda is represented only by males and they are seen in large numbers in the Gulf of Mexico in the surface collection.
59.	Cumella hispida Calman	Nossi-Be-Madagascar, Entedebir Island, Dahlakkebir Island, Massawa Channel, S. Australia (Red Sea)	Annam, Gulf of Siam, Tawi-Tawi, Sulu Archipelago, Jolo Island, Zamboanga, Samar Island (Philippine Islands)	-	C. hispida is widely distributed along the Red Sea and Philip ine Islands.
60.	Cumella pygmaea Sars	-	-	Florida Coast (Mexico), Norway - Mediterranean	C. pygmaea is represented only by males and occurs in the Atlantic Ocean.
61.	Cumella limicola Sars	Nossi-Be-Madagascar, Bougainville Island	-	Mediterranean, Morocco	It is previously known from the Mediterranean Sea and W. Coast of Africa. The present record extends the distribution to the Indian Ocean.

1	2	3	4	5	6
62.	Cumella munroi Hale	Entecebir Island (Red Sea), S. Australia	Queensland	Gulf of Campeche	C. munroi occurs in all the three oceans. The specimens from the Gulf of Mexico shows close resemblance to that from S. Australia.
63.	Cumella turgidula Hale	Nossi-Be-Madagascar. Middle Island (Thailand Coast), Kranganur S. Australia	-	-	C. turgidula was previously collected only from S. Australian coast and the present record extends its distribution to E. African coast, Thailand Coast and S... coast of India.
64.	Camplylaspis orientalis Calman	Madagascar	Korea	-	C. orientalis was previously recorded from Pacific and the present record extends its distribution towards the Indian Ocean. This is collected from deep water (2125 m).
65.	Camplylaspis rubicunda (Lilljeborg)	Madagascar	Okhotsk Sea (N.Pacific)	Green land, Norway, Atlantic Coast of N. America	C. rubicunda occurs in all the three oceans in very shallow depth.

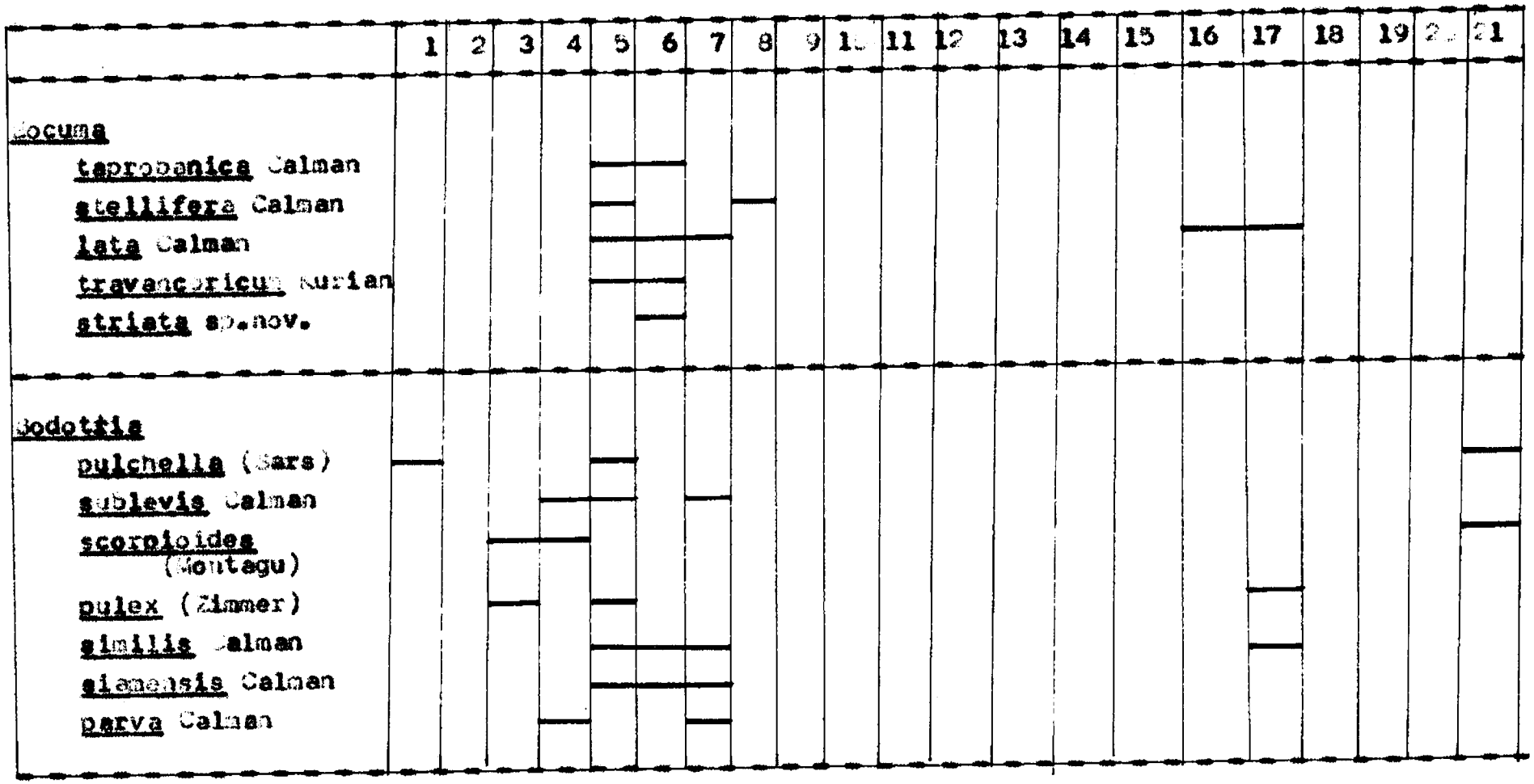
1	2	3	4	5	6
66.	Campylaspis glabra Sars	Durban Bay	Annam	Mediterranean, N. of England, Norway, W. Africa	C. glabra has been previously collected from the Pacific and Atlantic at varying depth 5–2886 m. The present record extends its distribution to Indian Ocean also.
67.	Campylaspis minor Hale	Trivandrum Coast, Vizhinjam	Sacol Island, Zamboanga (Philippines), Queensland	-	C. minor was collected from S.W. Coast of India and Philippine Islands from sandy beds with a thin film of mud. It is a common species in the Trivandrum region and appears in swarms during February–March.
68.	Campylaspis thomsoni Hale	Durban Bay	New S. Wales, Tasmania	-	The present record extends the distribution of this species from the Australian Coast to the African Coast.
69.	Campylaspis minuta sp.nov.	Vellar estuary (Portonovo)	-	-	It is a shallow water form, found in the estuary on the east coast of India.

2	3	4	5	6
70. Campylaspis robusta sp.nov.	Off Cochin	-	-	It is a rare species collected from the S.W. Coast of India.
71. Hemilamprops pellucida Zimmer	Durban Bay, S. Africa	New Zealand	-	H. pellucida is a deep water cumacean. The present record extends its distribution from the West Coast of Pacific to western Indian Ocean.
72. Hemilamprope diversa Hale	Durban Bay	New S. Wales, Tasmania	-	The present record shows the extended distribution of H. diversa from West of Pacific to East Coast of Africa.
73. Diastylis planifrons Calman	Durban Bay	-	Straits of Magellan S. America	This species has been recorded from the Atlantic as well as Indian Ocean.
74. Makrokylindrus (Coaleseuna) fistularis (Calman)	Visakhapatnam	Gulf of Siam	-	The present record from Visakhapatnam is from a ground of sand and clay at 40-50 m depth. It is previously known from Western Pacific.

1	2	3	4	5	6
75.	Paradiastylis culicoides Kemp	Chilka lake, Cochin, Trivandrum, Vizhinjam, Veraval	-	-	The species has been collected from the east and west coasts of India from the open sea at 10–15 m depth and also from the Chilka lake. The maximum intensity occurs at 10 m during April.
76.	Oxyurostylis smithi Calman	-	-	Campeche, Florida Coast (Gulf of Mexico), U.S.A. America, Casco-Bay, Vineyard Sound	O. smithi has been collected in the plankton from the Gulf of Mexico from many stations.
77.	Oxyurostylis atlantica Bedha and Nurien	-	-	Florida Coast, Campeche (Gulf of Mexico)	This is a rare species collected from the Gulf of Mexico.

Table 2. Distribution of Sumacea in the present collections in the different regions

Species	AFRICA				SOUTHERN ASIA					AUSTRALIA AND S. PACIFIC					EAST ASIA (N. PACIFIC OCEAN)			ATLANTIC OCEAN			
	Western Africa	Southern Africa	Eastern Africa	Red Sea	Arabian Sea	Bay of Bengal	Indo-China	Indonesia	Western Australia	South Australia	Tasmania	New South Wales	Queensland	New Zealand	Philippines	Southern China	Japanese Islands	South of Argentina	Caribbean Sea	Gulf of Mexico	North Atlantic
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Heterocuma africana Zimmer armata Kurian	—	—			—	—															
Glyphocuma inaequalis Hale			—								—	—									
Pseudosympodomma indica Kurian						—															
Gigacuma halei Kurian					—	—															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taprobanica Calman
stellifera Calman
lata Calman
travancoricus Kurian
striata sp.nov.
Bodottia
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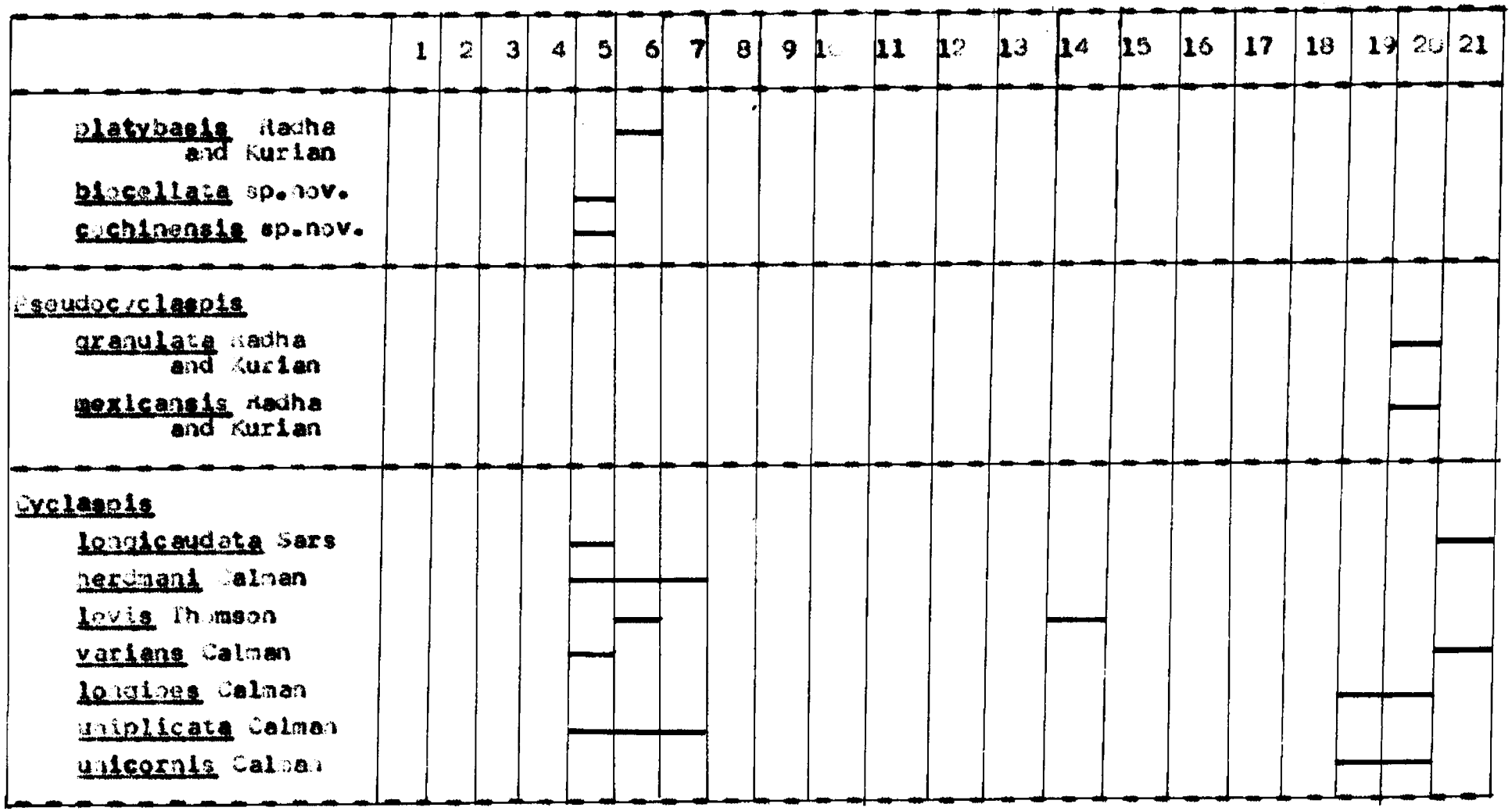
sublevis Calman
scorpioides (Montagu)
pulex (Zimmer)
similis Calman
siamensis Calman
parva Calman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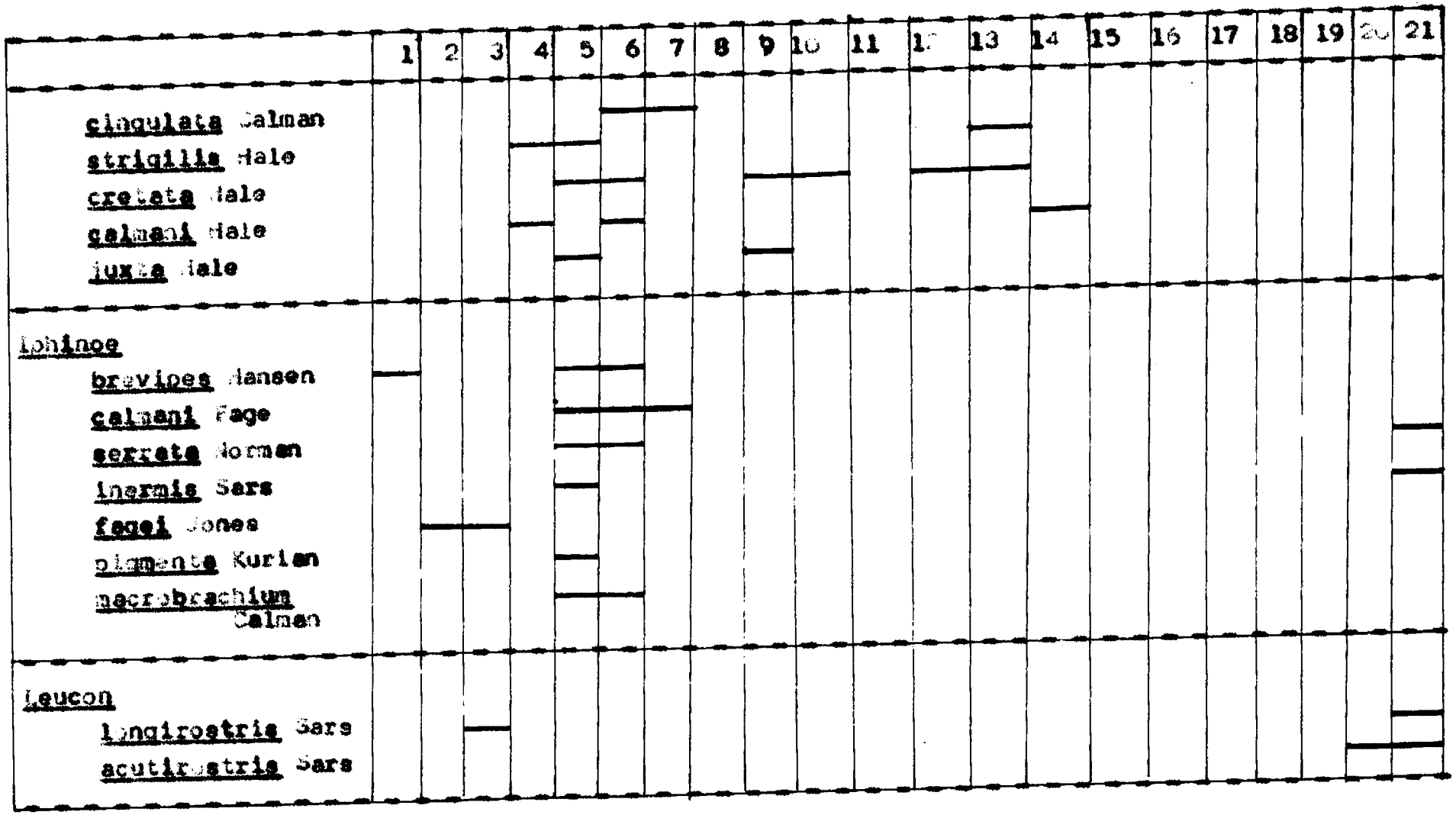
levis Thomson
variens Calman
longipes Calman
triplicata Calman
unicornis Calman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calmani Fage
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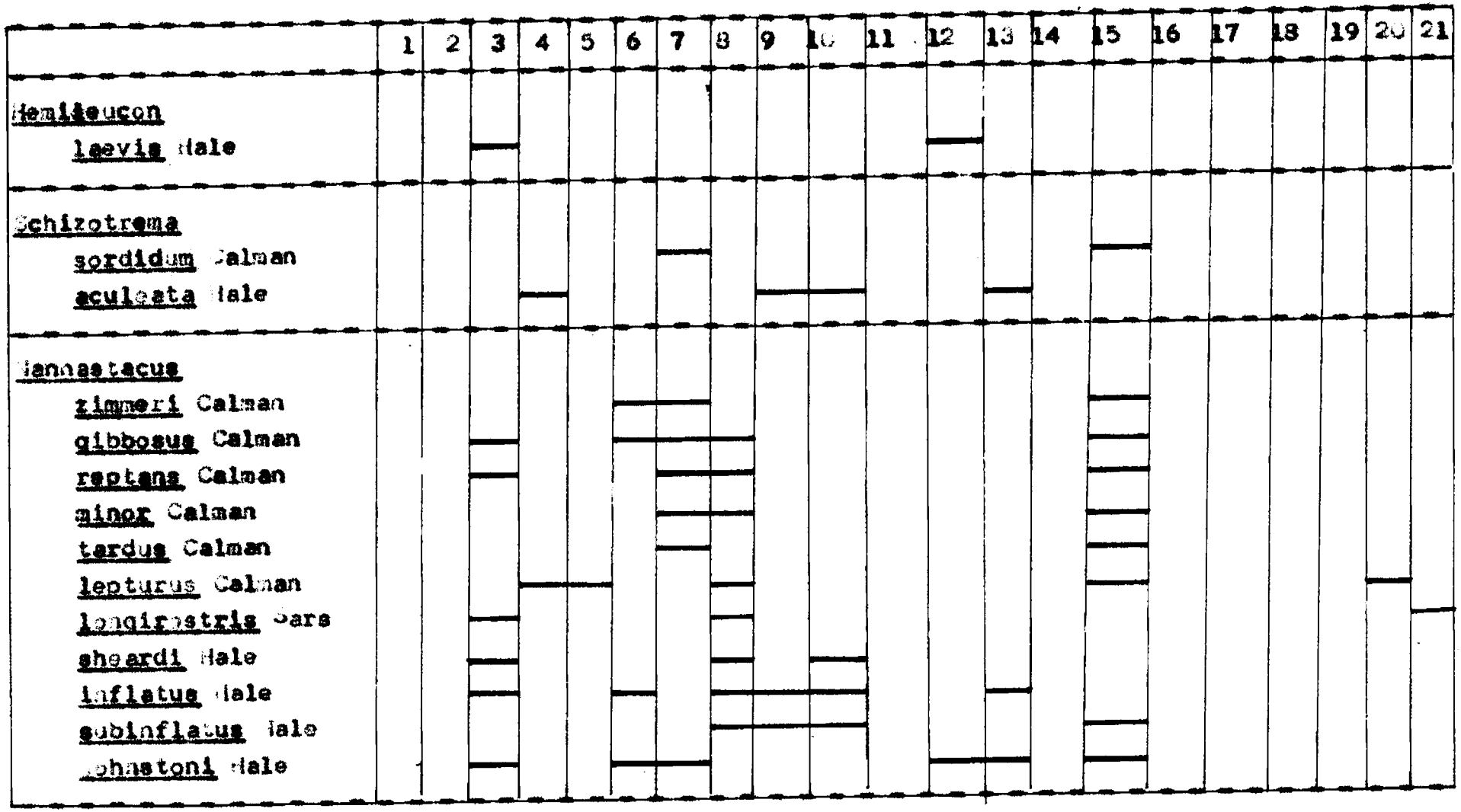
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Hemilæucon
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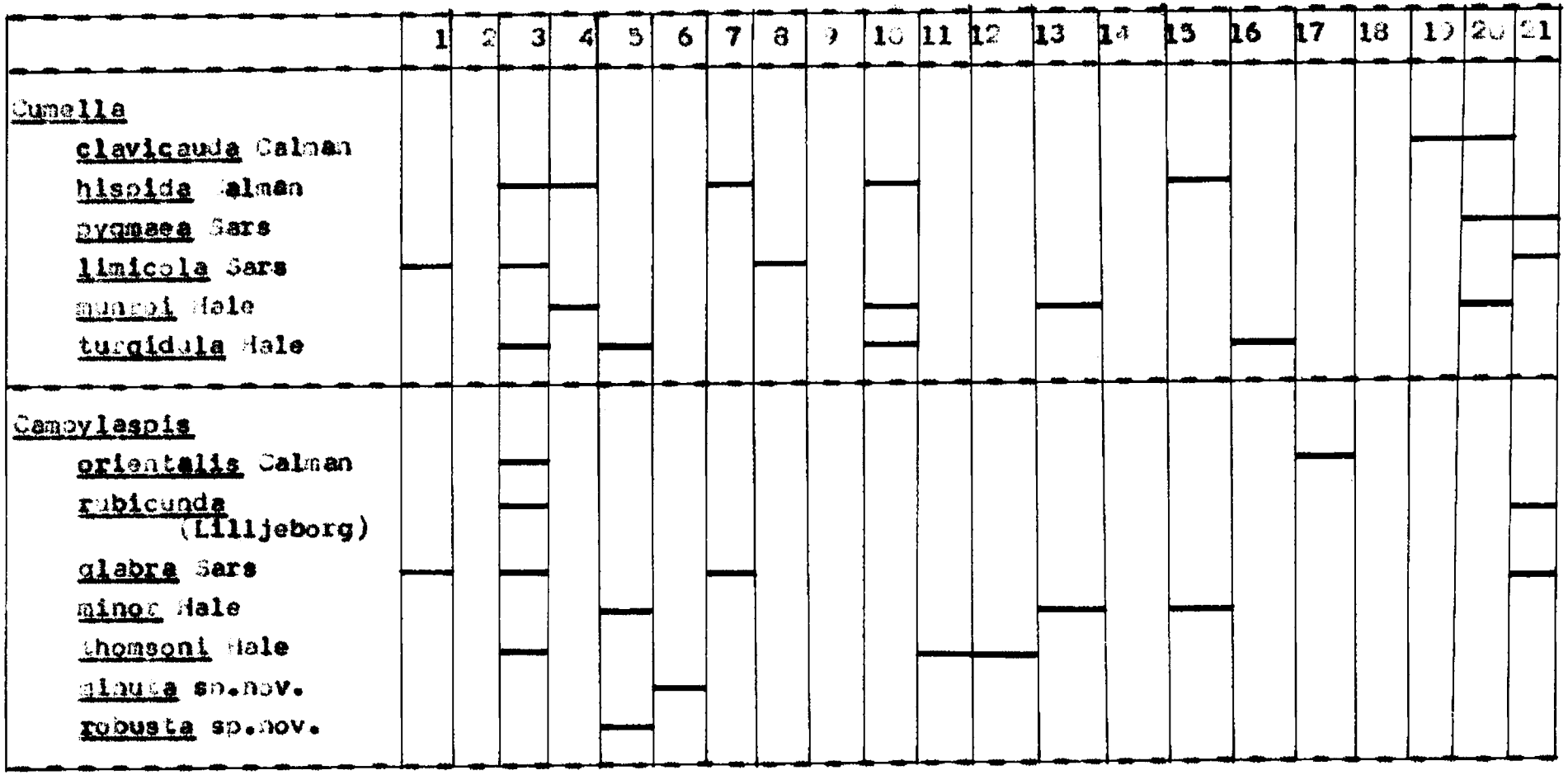
subinflatus Hale
johnstoni Hale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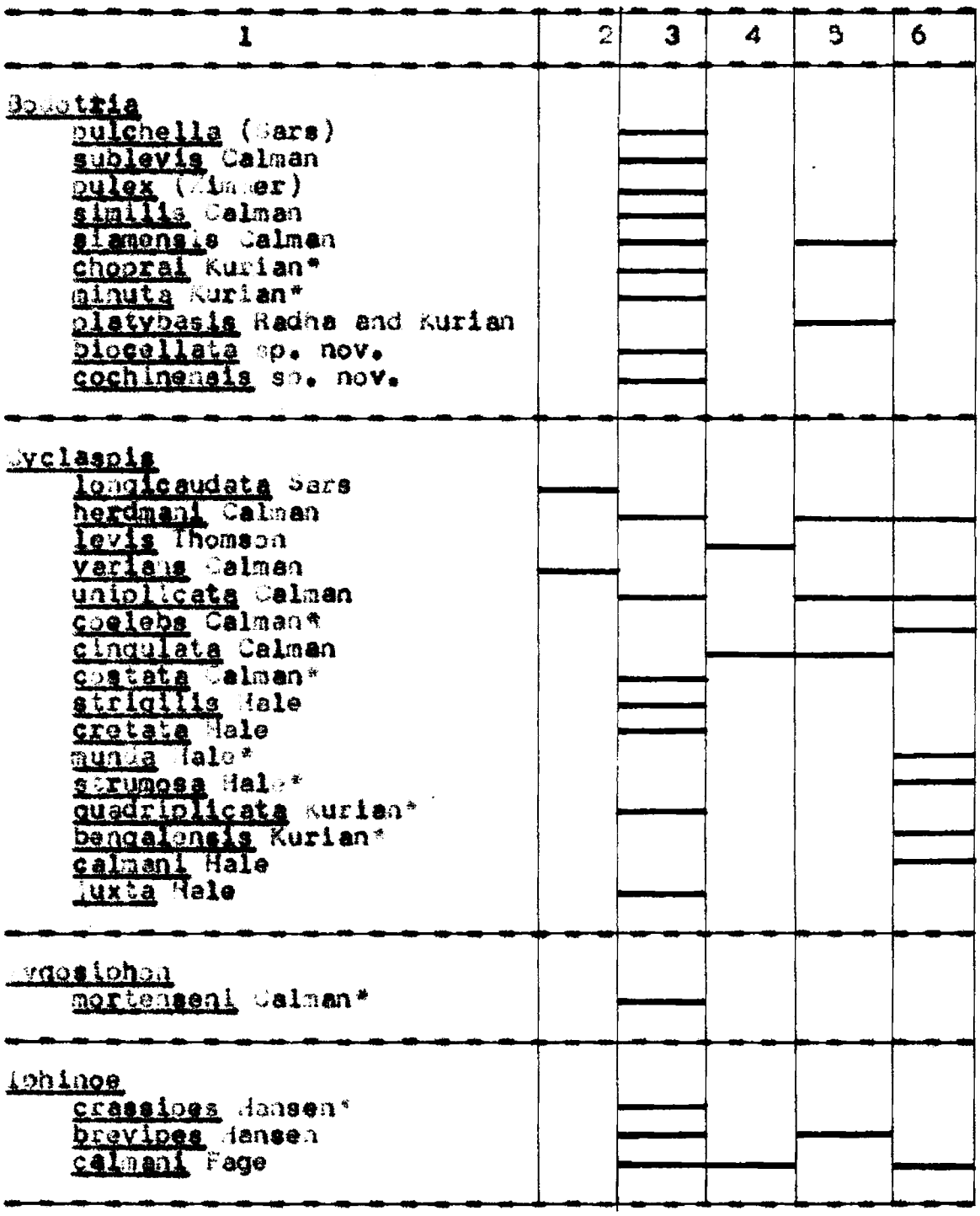
pygmaea Sars
limicola Sars
munroi Hale
turgidula Hale
Campylaspis
orientalis Calman
rubicunda (Lilljeborg)
glabra Sars
minor Hale
thomsoni Hale
minuta sp.nov.
robusta sp.nov.

Table - 3.

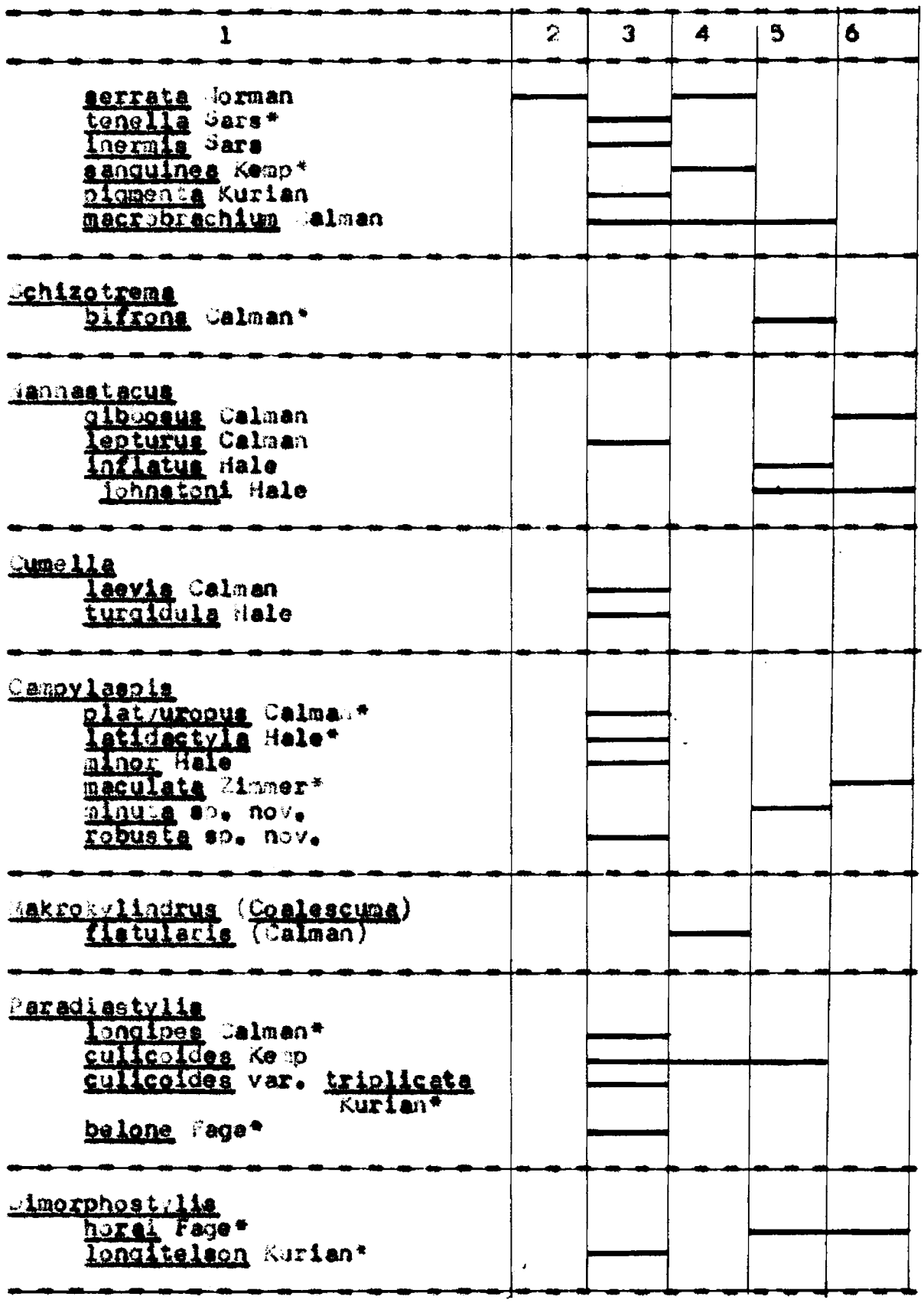
Distribution of Cumacea along the Indian Coasts

Species	Northern Arabian Sea	Laccadive Sea (South of Goa)	East Coast of India (Visakhapatnam & North)	East Coast of India (S. of Visakhapatnam)	Andaman and Nicobar Islands
1	2	3	4	5	6
Veunthompsonia arabica Calman*					—
Pseudosympodomma indica Kurian			—	—	
Heterocuma sarsi Kiere*		—			
africana Zimmer		—		—	—
andamani Kurian		—			—
armata Kurian			—	—	
Bigacuma helei Kurian		—	—		
Cyclocuma taprobanica Calman		—		—	
longicornis Calman*		—			
hilgendorfi Marcusen*		—			
stellifera Calman		—			
lata Calman		—	—	—	—
travancoricum Kurian		—	—		
striata sp. nov.			—		
kempi Kurian			—		

*Not represented in the present collections



*Not represented in the present collections.



*Not represented in the present collections.

4.2. Bathymetrical distribution

The studies on the bathymetrical distribution of the present collections reveal that majority of the species of Cumacea live in the shallow waters and near the bottom. Most of the species collected from the Indian coasts are from 10–60 m depth, while a good number of specimens collected from East Coast of Africa are from still shallower depth (0.3–10 m). Bodotria platybasis was collected in large numbers from the intertidal sandy coast of Portonovo (East Coast of India). Only ten species have been got from a depth more than 60 m. The family Bodotriidae, well represented in the present collections, occupies an average depth of 10–50 m. The representatives of the genus Nannastacus of the family Nannastacidae generally occur at very shallow depth (0.3–15 m). But N. sheardi Hale occupies a greater depth compared to the previous records. The Cumacea distributed in the Red Sea also occupy shallow depths. In the present collections only a very few species are restricted to deeper regions. Campylaspis orientalis Calman and C. rubicunda (Lilljeborg) are distributed at 2125 m depth in the African Coast (east coast). C. orientalis had a previous record of 66–145 m depth from N. Pacific while C. rubicunda was collected from various depths between 9–2178 m and is considered to be an inhabitant of the

shelf and slope. Though Makrokylindrus spp. are generally distributed in the deep sea, the single species Makrokylindrus (coalescuma) fistularis (Calman) represented in the present collection is from a depth of 40–60 m.

4.3. Ecological distribution

Cumacea are true bottom forms, though the adult males and rarely females of some species may be found at times swarming near the surface, especially at night. Many of the forms are littoral or sub-littoral in their occurrence; but some of them are observed from deep water also, descending to the greatest depth explored. But in general, they are benthic in habit. They spend most of their time at the bottom, where they burrow into the surface of the sediment. Most of them are confined to the soft deposits, but some species occur in sands of various grades and a few are found even in fine gravel. In recent years there have been controversy as to whether cumaceans are essentially planktonic or benthic organisms, as many specimens have been collected in plankton hauls from many parts of the world. But many zoologists are of the opinion that they become planktonic only during hours of darkness and may even rise to the surface layers. This is proved by the fact that during day time they remain buried in the substratum, but

towards night fall they leave their burrows and swim about near the surface of the sea, when they are often caught in plankton nets.

The study of the ecology of the cumacean specimens obtained by the International Indian Ocean Expedition deposited in the Smithsonian Institution suggests that they are mostly benthic and obtained from the inshore waters of the east coast of Africa, Red Sea, Malaya Coast and Singapore Straight. They are abundant in a fine sandy bottom with a small percentage of silt and are rare in coarse and fine muddy deposits. Sometimes they occur in sand which contains soft and hard corals, sponges, Sargassum etc. Nannastacus gibbosus Calman in the present collections is distributed in large numbers in such areas like Palau Hantu (S.W. Singapore). The benthic collections from the Red Sea (Schizotrema aculeata Hale) show that it prefers a sandy bottom in a very shallow depth when the water temperature is 28.5°C. The area is covered with patches of Sargassum. The cumacean fauna of east coast of Africa (Nossi-be-Madagascar, Durban Bay, Grand Comoro Island) is comparatively rich and its ecological habitats are 'intertidal rocks, large masses of compacted mud rock, coral and rock patches on the hard sandy bottom, sand flat, dead coral and coral reefs'. In most cases the type of shore is

sandy, muddy, rocky or with mangroves. Most of the specimens are obtained from a very shallow depth (Nossi-Be-Madagascar area) and they are very small in size also. But some of them are capable of living at great depths and in the present collections species - Campylaspis orientalis Calman, C. rubicunda (Lilljeborg) were discovered from 2125 m, off Madagascar. However, from the present data it is clear that the number of specimens decreased with increase in depth. The taxonomic studies reveal that the family Nannastacidae predominates in these areas especially in the Bougainville Island (Arawa Bay). Nannastacus gibbosus Calman is observed in maximum abundance in Palau Harbour while N. longirostris Sars and Cumella limicola Sars are seen in large numbers in Nossi-Be-Madagascar areas.

The Cumacea obtained from the plankton collections during the International Indian Ocean Expedition from the West Coast of India, Pakistan and Malaya Coasts show that they occur in plankton only in the night collections from the inshore areas. The total absence of Cumacea in the Indian Ocean Standard Collections (200-0 m) in the open sea during day as well as night shows that they may not survive in the upper waters for considerable length of time.

The areas of greater abundance of Cumacea is noticed along the West Coast of India, extending from Gujarat to

Cape Comorin. Family Bodotriidae predominates here. Cocuma taprobanica Calman is seen in its maximu abundance along the S.W. Coast of India. Bodotria pulex (Zimmer) is also well represented along this coast.

A study of the cumacean fauna of the Vizhinjom-Trivandrum region (Kerala Coast) shows that along the S.W. Coast of India no other ground is so suitable for these organisms. The bottom deposit of Vizhinjom-Trivandrum inshore region is composed of fine sand mixed with a small percentage of silt and calcareous fragments. Gigacuma halei Kurian, Cocuma taprobanica Calman and Iphinoe brevipes Hansen are the common species of Cumacea along the Trivandrum-Vizhinjom region. They occur almost through out the year both in plankton and benthos. G. halei is common in the Vizhinjom region from August to October with a maximum abundance in September. C. taprobanica has a maximum intensity in the Vizhinjom Bay and open sea between 15-30 m. It is a common Cumacea with a wide range of distribution in the S.W. Coast of India; the maximum abundance being during January between 20-30 m depth.

The diurnal variation in abundance is very much prominent in I. brevipes and very often males are seen in large numbers from January-April. The males and young

females of *A. brevipes* swim about close to the surface of the sea and float especially during night, but during day they swim towards the bottom and remain buried in the fine silty sand. *B. similis* Calman and *L. macrobrachium* Calman are also observed in large numbers in the Vizhinjom region.

Representatives of the genera *Lucifer*, *Sergestes* and *Sphinge* are found in shallow water regions off Cochin. *L. taprobanica* Calman, *L. calmani* Fage and *L. pigmenta* Kurian are seen in large numbers. *L. taprobanica* is a common species along the Cochin coast with a maximum number in November. *L. calmani* is seen abundant during January-February while *L. pigmenta* appears throughout the year. *Paradiaptomus culicoides* Kemp, first collected from Chilka lake when the 'specific gravity was 1.000 to 1.015' and later from the sea off Trivandrum (Kurian 1951) has been now obtained from off Cochin during March-April within 1-2 m and from Vizhinjom during April within 24 m when the salinity was ca. 35‰. *L. pigmenta* was previously recorded from Vell lake and now it has been collected from the plankton samples off Cochin. This indicates that *P. culicoides* and *L. pigmenta* can survive in the estuarine and marine conditions and they can tolerate a wide range of salinity.

The abundance of Cumacea along the S.E. Coast of India is not less. The sandy and clay$^{ey}_{\wedge}$ grounds off Visakhapatnam within 4 -60 m depth yielded a good number of specimens. Iphinoe calmani Page and Makrokylindrus (Coalescuma) fistularis (Calman) are the most common.

The intertidal sandy ground of Portonovo shows the maximum abundance of Cumacea. Bodotria plathybasis Radha and Murian is the common species and it has been observed in abundance in a sandy substratum in association with the mysis Gastrosaccus simulans during September when the temperature is 28.5°C and salinity 33.7‰. A maximum number of 754 specimens/m^2 has been collected when the species occurred at its peak. The least number is noticed in November when only 15 specimens/m^2 has been obtained.

It is also noted that Cumacea can survive in brackish water area also though they are considered to be essentially marine. The Cumacea of the benthos collection from Vellar estuary at Portonovo suggests that it is a good habitat for them where there is a salinity variation of only 26.43-27.77‰.

Very little is known about the cumacean fauna of Red Sea. The previous records are by Paulson (1875), Kossman (1880), Lomakina (1967) and Jacescu and Muradian (1973). From the present collection it is seen that almost

all species collected from Red Sea are from shallow depths and they have an Indo-West Pacific affinity. The plankton collections using light trap from 1.5 m depth near Entedebir Island (Red Sea) and horizontal plankton from Massawa Channel (Red Sea) yielded a good number of specimens. The Coralline fine sand in Mersat Abiad and landing bay off Entedebir Island (Red Sea) have yielded a considerable number of specimens. Families Bodotriidae and Iannastacidae predominate in the collections. Bodotria scorpioides (Montagu) has its maximum abundance during March in the plankton from 1.5 m depth off Entedebir Island.

The Cumacea from the Philippine coasts are essentially benthic forms from a substratum of corals and under mangrove vegetation. The Great Santacruz Island and Zamboanga where Cumacea are distributed in large numbers, are filled with algal masses, whereas in Sacol Island, certain parts of Zamboanga and Sulu Archipelago the substratum is predominantly sand with thin film of mud and rich growth of mangrove plants. Only a single family, Iannastacidae, is observed from the Philippine coasts in the present study and the representatives of the genera Iannastacus and Cumella dominate. In the Philippine coasts the number of specimens is lesser when compared to the Indian Ocean coasts and the moderate

abundance is observed in Sulu Archipelago, and Great Santacruz Island. Iannastacus johnstoni Gale and Cumella hispida Calman are represented in many of Philippine Islands.

The Cumacean fauna of Mexico region is restricted chiefly to two main coasts - off Florida and Campeche. They are mainly planktonic and distributed near the shore. The maximum abundance is noticed along the Florida coast. Cyclaspis longipes Calman and Iannastacus lepturus Calman are observed in large numbers from this coast.

4.4. Seasonal distribution of Cumacea

Seasonal distribution of Cumacea was studied at Vizhinjom (South of Trivandrum) and at Portonovo (east coast of India) based on regular collections during 1981-1983 and 1980 respectively. At Vizhinjom, plankton collections were taken from two stations. The first station was in the Vizhinjom bay (15 m depth) and the second station outside the bay in the open sea at 20-30 m depth. A $^{1}/_{2}$ m 0.33 mesh plankton net was towed in the surface waters at 6 AM for 10 minutes at each station. The Cumacea obtained were sorted out and the monthly average of each species for each station was recorded.

Sixty nine collections were made from January to December in 1981. A total of 99 specimens of Cumacea under

7 species were obtained during this period. Out of this 50 were Iphinoe brevipes. The maximum intensity was noticed during January to March. It was also noted that this species was less in number at bay when compared to the open sea. A decreasing trend was evident from April to November. Forty nine collections were made in 1982 from January to December. A total of 737 specimens of all species were obtained. Here also I. brevipes was seen in large numbers. The maximum intensity was noticed during January to March in the open sea at 20-30 m depth with abundance in February. This is the pre-monsoon season with high temperature and salinity in the area.

It was also noted that the males of I. brevipes predominated in all the plankton collections in which they were present. Out of the 737 specimens in the 1982 collections, only 27 females were present, 19 of them were ovigerous, each with 10-20 matured eggs in its brood pouch.

Benthic collections of Cumacea from Portonovo and Vizhinjom were studied during 1982 and 1983 respectively. Weekly collections of intertidal sand samples from an area of 25 cm^2 and to a depth of 2-3 cm were made from about 0.5 km south from the mouth of Vellar estuary at Portonovo.

The collections were made at mid-tide level, in the morning around 7 hours. The Cumacea along with other benthic animals were sieved out of the fine sandy deposit.

It was observed that Iodotea platybasis was present in all the collections throughout the year except in November. In November three other species namely E. siamensis, Iphinoe serrata and Paradiastylis culicoides were obtained. A large number of E. platybasis obtained were ovigerous females, with eggs or embryo in their brood pouches and they occurred in all the collections showing that the species breeds throughout the year. Out of 2..3 specimens of this species obtained during January-December 1..., only 13 were males and the were all in immature condition. E. platybasis occurred abundantly during July-September, the maximum intensity being in September. Other organisms like amphipods, isopods, decapods, mysids, polychaetes, gastropods and bivalves occurred in association with E. platybasis. The temperature in the region varied from 26.55°C to 28.5°C and salinity from 3...3 to 35.3... The abundance of the species cannot be correlated with the hydrographical changes which are not considerable.

During April 1983, benthic samples from three stations were taken from depths ranging from (24-28 m) in the offshore

Table 4a. Distribution of Cumacea at Vizhinjam - Plankton Collections - 1981

Species	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II
1. Bigacuma halei																	4					1		
2. Cocuma taprobanica															1									
3. Bodotria cochinensis																	4	1						
4. Cyclaspis heardmani																	5							
5. Cyclaspis cretata																		2						
6. Iphinoe brevipes	-	23	1	21	4	26				1													2	2
7. Iphinoe calmani															1									

Table 4b. Distribution of Cumacea at Vizhinjam - Plankton Collections - 1982

Species	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II
1. Heterocuma andamani				1																				
2. Gigacuma halei				1								1								2				
3. Iodotria sublevis						1																		
4. Iodotria scorpioides														1										
5. Iodotria similis												2												
6. Iodotria platybasis														3										
7. Iodotria cochinensis														3										
8. Cyclaspis s pinilis												4												
9. Cyclaspis juxta												2												
10. Iphinoe brevipes	5	155	4	4.7	-	159	1	2				4												
11. Lamella laevis				1																				

Table 5. Monthly data showing Cumacea collected from Portonovo (Intertidal sand) during 198.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bodotria siamensis											1	
Bodotria platybasis	46	34	18	7	35	5	111	175	1328	54	-	152
Iphinoe serrata											2	
Paradiastylis collinsiae											2	

5. B I O L O G Y

5. B I O L O G Y

5.1. Food and feeding of Cumacea

The Cumacea are essentially burrowing animals and as such their food is constituted mainly of bottom dwelling organisms. Along the Kerala coast they are found abundant at a bottom formed of fine sand with a small percentage of silt and shell fragments. Examination of the stomach contents of Iphinoe brevipes and Eocuma taprobanica, collected from Trivandrum and Vizhinjom coasts show the presence of diatoms, crustacean larvae and detritus.

Feeding habits of only a few species have been studied. Kaestner (1959) studied the feeding habits of Lamprops fasciata, Iphinoe trispinosa and Cyanonsis goodsiri. In situ, the anterior part of the body projects from the bottom of a pit in the sand. The long first peraeopods pick up the sand grain and passes it to the maxillipeds. The maxillipeds turn it, while the first maxillae and the mandibles brush it and their setae remove the algae and detritus. The cleaned grain is then dropped and a fresh grain is again brought by the first peraeopod. Kaestner (1959) also noticed that Lamprops handles particles as large as its Carapace. Diastylis rathkei rasps off parts of free living plants.

The feeding of Eocuma lata has been watched in a glass through in the laboratory. The current of water that is

produced by the setae of the maxillipeds and first peraeopods is found to channel small diatoms and crustacean larvae into the oral appendages. Usually at the time of feeding, the Cumacea rests the cephalothorax over the mud surface and extends the three pairs of maxillipeds, forming a water filled funnel between the appendages and the ventral body wall. The endopodites of the third maxillipeds reach to the sides and gather mud particles which contain microorganisms or organic detritus. The mud is brought into the funnel along with some water and taken up with the mouth parts and engulfed. When the mud consists only of inorganic particles, it is expelled between the basal articles of the first antennae. The first antennae and the first peraeopods also participate in collecting food. When the food supply at a particular place is exhausted, it moves to the adjacent regions through the substratum.

Filter feeding is probably the normal and general method among cumaceans. It consists of filtering suspended particles of organic matter, either detritus or microscopic planktonic organisms, brought to the animal by incoming currents produced as a result of the movements of the exopods of the thoracic limbs. Usually the Cumacea spend a considerable portion of the day time buried in the soil or

swimming a few inches above the bottom. By the continuous movements of the exopods, they stir up detritus into the supernatant water, from where in due course it is filtered.

Feeding of I. brevipes collected from the plankton samples of Vizhinjom during January-December 1982 has been studied. The stomach contents of 10 specimens from each month were examined. It was noted that the food of I. brevipes constituted detritus, diatoms, flagellates, ciliates and very small crustacean larvae. Flagellates dominated during January and February while ciliates during February and March. Detritus was seen almost throughout the year.

The Table 6 shows the monthly average of the food substances of I. brevipes collected from the plankton samples of Vizhinjom during January-December 1982.

5.2. Locomotion

Cumaceans move about by swimming. Females swim by paddling motions of the pereaeopods or by bending and extending the abdomen. Males use their pleopods also for movement. The movements of the exopods of the thoracic limbs and pleopods in male result in powerful backwardly directed lateral currents of water which provide the motive force for locomotion. Some of the water in these currents is filtered

Table 6. Monthly average of the food in the gut of *L. brevipes* collected from the plankton samples off Vizhinjam during 1982

Items	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flagellates	8	6	-	-	-	-	-	-	-	-	-	-
Ciliates	-	4	6	-	-	-	-	-	-	-	-	-
Crustacean larvae	4	-	-	-	-	-	3	-	-	-	-	-
Diatoms	-	x	x	-	-	-	-	-	-	-	-	-
Detritus	x	x	x	x	x	x	x	x	x	x	x	x

Numbers indicate the number of organism present
x indicates presence.

for food particles and thus the exopods are responsible not only for locomotion but for the catching of food and producing respiratory currents as well.

When the cumaceans are disturbed, the abdomen with the tail, is immediately flexed strongly downward under the thorax and suddenly straightened again. The water lying beneath the abdomen and thorax is thus violently ejected forwards causing the animal to spring backwards with extreme rapidity. This movement is so powerful that they can leap for a considerable distance.

Burrowing is accomplished by lateral shoveling of the substrate using the last three pairs of peraeopods while holding the abdomen bent over. The animal sinks into the hole and enlarges it by flexing and extending the abdomen into it. The sticky mud particles are stirred up with the abdomen which bends backwards and brushes it. All cumacean species thus remain buried during the day and protected from many of the predators. When the night falls they move out of the holes and swim upwards.

5.3. Sexual dimorphism

The sexual dimorphism in Cumacea is very pronounced. The sexual differences include small details such as the

sculpturing and degree of armature of the exoskeleton, but other more basic differences can be attributed to characters allowing greater swimming capacity in the male, and the presence of a brood pouch in the mature female. The adult males look very different from the females, whereas the young, not yet sexually developed males on the whole closely resemble the sub-adult females. So determination of sex is not always easy, especially in immature animal. Sexual dimorphism is pronounced in many genera such as Paunthompsonia, Glyphocuma, Pseudosympodomma and Iphinoe. Females of Paunthomosonia cristata and Iphinoe trispinosa possess a median carina on the carapace armed with teeth, but the carapace of male is quite smooth above. The ovigerous females and immature males of Glyphocuma inaequalis and Pseudosympodomma indica possess a dentate crest on the carapace, whereas in the adult male the crest is smooth and devoid of serrations.

The adult male except in Bodotriidae has 1-5 pairs of pleopods and the flagellum of second antenna extends a considerable distance along the body. The sub-adult male has a full complement of pleopods, though the second antennae are still developing. The ovigerous female is distinguished by the presence of a brood pouch. The adult female differs from an ovigerous one only in the absence of a brood pouch.

the 'manca' stage, at which the animals are released from the brood pouch is characterised by the absence of the last pair of peraeopods. The sex can not be differentiated in the juveniles.

However, no adequate criterion has been given so far to answer for the questions in what stage the sexes are detectable externally. But the sex is clearly differentiated by the development of the second antennae and pleopods in most species in the male and of the brood pouch in all the mature females. Harada (1967) paid special attention to the morphological differentiation of the above appendages, which goes on collaterally with the periodic growth of the animal and found that this growth is due to ecdysis which is a common phenomenon in Crustacea.

5.4. Breeding

Very little is known about the breeding of cumaceans. The majority of species are probably annual and reproduction occurs only once, or perhaps several times in an year. It is suggested that mating probably occurs in many species during nocturnal swarming (Kaestner 1959). With the help of the pleopods, the males become more active and swim towards the female. In male the antennae are specially

modified as clasping organs.

The eggs are carried in the brood pouch, where development takes place. They are laid immediately after the moult of maturity and are held in the incubatory pouch by the long setae on the rudimentary oostegites of the second maxillae. The number of eggs depends on the size of the mother. In Diastylis rathkei up to 2[illegible] eggs are found in the brood pouch (Zimmer 1933). The number of eggs in the brood pouch in some of the most common species in the present collection has been noted. The brood pouch of Dodecria platybasis, a common species in the intertidal sandy beach of Porakkavo, revealed 18-31 eggs. The ovigerous females of this species occur throughout the year; the maximum intensity being in September. In some cases even young ones (manca stage) are seen in the brood pouch. An ovigerous female of Eocuma travancoricum collected from Visakhapatnam region shows 25 eggs. Sphinx brevipes which is the most common species in the Vizhinjam region shows 16-24 eggs. Some of the ovigerous females of L. calmani from Cochin waters contain upto 2[illegible] eggs in their brood pouches, while Paradiastylis culicoides from off Cochin has 16 eggs. Females of L. leprobanica and L. pigmenta, common in the S.W. coast of India, especially off Cochin show 5-20 and 16-24 eggs respectively. Tennastacus gibbosus,

which is common in the west and east of the Indian Ocean and Cumella hispida which occurs in Red Sea and Philippine Islands bear 3-24 eggs.

The larval development of Cumacea has not been studied in detail. However Jones (1963) observes four larval stages after hatching a nauplius stage, two post-nauplius stages and a 'manca' stage which resembles the adult in most respects, but lacks the last pair of peraeopods. After leaving the brood pouch there are several further moults before the subadult stage is reached. The secondary sexual characters become more apparent during this period. When the subadult stage undergoes further moult to the adult, the sexual characters get fully developed and reproduction takes place. In some species the females moult again after the liberation of the juveniles; the oostegites become reduced and further moult leads to a second reproductive period. This process is repeated up to four times and in such cases there is only one reproductive stage each year. Thus the female lives for a maximum of four years.

Harada (1967) studied the developmental stages of Symposdomma diomedeae (Calman) collected from the coastal waters of Izu Peninsula, Japan. He found that the post

larval development in the above species was composed of five distinct growth stages associated with the morphological differentiations, ranging from the 'manca' stage to the adult stage.

It is not known how long the larval forms remain the the brood pouch, but it was noted that the young Diastylis rathkei leaves the brood pouch only after 55–60 days at aquarium temperatures of 1–3°C (Kaestner 1959).

5.5. Night and Day movements

Very little work has been done on the vertical distribution and diurnal migration of Cumacea. But there is considerable evidence to show the during hours of darkness they undertake definite vertical migration upwards. They are truely benthic and their occurrence in the plankton collections is only accidental. At night they make short trips to the upper waters. Most of the individuals collected at night with plankton nets are adult males. But it is not known whether vertical migration occurs in all species at all seasons. Some plankton collections from off Cochin yielded a number of ovigerous females of Iphinoe pigmenta along with some adult females and a very few immature males.

The studies on the Cumacea of Vizhinjom region show that the males of I. brevipes is found in plenty at surface during the early hours of morning. Detailed observations on the vertical distribution and diurnal migrations of the above species also suggest that they are completely absent in the surface collections from dawn to sunset and very rarely represented in the mid-water collections during day time (Kurian 1951).

There have been instances of mass migration of Cumacea on the West Coast of Africa in the Benguela Current as reported by Jones (1955). The presence of Cumacea in large numbers - upto about 7700 individuals in a single plankton haul - raised certain doubts since they are normally bottom living forms. According to Jones (1955) the presence of the animals in the upper layers was not due to the normal vertical migration, but due to the low oxygen concentration in the bottom water. But in the Kerala coast it has been observed that the Cumacea occur even when the dissolved oxygen content is as low as 0.8 ml/l.

It is known that Cumacea are attracted by artificial light at night (Page 1933,1945; Foxon 1936; Hale 1943). The use of a submerged light of low intensity during the hours of darkness has proved a useful method of collecting these minute crustacean (Page 1933, Sheard 1941). They are

attracted towards diffused light, and often avoid bright light. This is proved by the fact that during day they remain buried in the fine silty sand, but towards night fall, they leave their burrows and swim about near the surface of the sea, when they are often caught in tow-nets.

6. S U M M A R Y

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The present studies on Cumacea are based on a few International collections from the Indian, Atlantic and Pacific Oceans taken during 1962-1974 and some collections from the Indian Coasts obtained during 1945-1983. The International collections constitute 120 specimens obtained from 25 stations in the Indian Ocean during IIOE and deposited in the Smithsonian Institution, Washington; 64 specimens from 6 stations also from the Indian Ocean collected by IIOE and deposited at the Indian Ocean Biological Centre at Cochin; 45 specimens from 8 stations in the Philippine Islands collected by 'SI-Doty Philippine Project'; 77 specimens from 21 stations in the Gulf of Mexico received from Mexico Oceanic Sorting Centre and 91 specimens from 9 stations from Red Sea collected by Israel South Red Sea Expedition. The specimens from the Indian Coasts were collected from 29 stations at Visakhapatnam, Tuticorin, Portonovo, Cape Comorin, Vizhinjom, Trivandrum, Quilon, Cochin, Calicut, Karwar and Laccadive Islands.

A brief account of the importance of Cumacea, the previous works on Cumacea from different oceans and regions and the scope and purpose of study are given in the introductory chapter.

The second chapter deals with the materials collected and methodology involved in collecting the cumacean specimens. Maps are given to show the stations from where the specimens were collected.

The chapter on taxonomic study deals with the systematic position of Cumacea and classification. Taxonomic features of 77 species of Cumacea belonging to 5 families and 20 genera identified in the present collections are given. The number of specimens, locality, salient differences from the previous records with illustrations are also included. Out of the 77 species, 9 species namely Bocuma striata, Bodotria platybasis, B. biocellata, B. cochinensis, Pseudocyclaspis granulata, P. mexicanensis, Campylaspis minuta, C. robusta and Oxyurostylis atlantica have been described as new species. A new genus Pseudocyclaspis under the family Bodotriidae has been created for accommodating two species collected from the Gulf of Mexico. The males of Heterocuma armata and Iphinoe pigmenta and females of Makrokylindrus (Coalecuma) fistularis are newly recorded.

The fourth chapter deals with the distribution of Cumacea. The comprehensive survey on the distribution of Cumacea reveals that the South Atlantic and South Pacific

are the two major areas where Cumacea are seen in large numbers. In the present work, the distribution of 77 species of Cumacea in the present collections is given. Of these, the majority of the species belong to the family Bodotriidae, characteristic of low latitude and seems to be well represented in the Indian Coasts and East Coast of Africa. In the Indian Coasts their abundance is noticed along the coastal areas and they show close affinities with those of the West Pacific Coast, especially those from the Gulf of Siam. The family Nannastacidae is common along the East African Coast and Philippine Coasts and it shows affinities with those of the Australian Coasts. The distribution studies also suggests that most of the representatives of the family Nannastacidae have a wider distribution from Australian Coasts and Gulf of Siam eastwards to Philipoine Coastsand also to East African and Indonesian Coasts.

Some cumacean species especially under the families Bodotriidae and Nannastacidae collected from East African and South Indian Coasts show certain affinities to those of South West Coast of Africa and North Atlantic Coasts. Cumacean fauna is rich in the western part of the Atlantic Ocean especially off West Indies and Gulf of Mexico. The

collections from Gulf of Mexico yielded some species which were distributed formerly in the West Indies and Caribbean Sea, showing an extended distribution towards the West.

The present observation suggests that out of the 77 species, 66 species occur in the Indian Ocean, 37 in the Pacific and 26 in the Atlantic Ocean; 31 species are Indo-Pacific. Thirty two species are newly recorded from the Indian Ocean; 18 species are restricted to the Indian Ocean alone. Only 4 species are found to be distributed in all the three oceans. They are Nannastacus lepturus, Cumella munroi Campylaspis rubicunda and C. glabra.

The results of the bathymetrical studies of Cumacea suggest that the representatives of the family Bodotriidae occupy an average depth of 1-50 m while Nannastacidae occur at very shallow depth of 0.3-15 m. Only two species Campylaspis orientalis and C. rubicunda are distributed at 2125 m depth, in the East African Coast. The ecological studies of Cumacea obtained from East Coast of Africa, Red Sea, Indonesian Coasts and Philippine Coasts show that they are mostly benthic and occur in the inshore waters. They are abundant in the fine sandy bottom with small

percentage of silt and are rare in coarse or fine muddy deposit. Cumacea obtained in the plankton were mostly collected during night.

Along the Indian Coasts, Vizhinjom (South west Coast) and Portonovo (East Coast) are the two areas from where large number of cumaceans are obtained. Iphinoe brevipes occurs in large numbers in the plankton collections and also in the benthos which contains silt and calcareous fragments. Its seasonal distribution reveals that a maximum intensity of this species is during January to March and a decreasing trend is noticed from April to November. Dodotria platypoasis occurs in large numbers in the intertidal sandy deposits of Portonovo through out the year with the maximum intensity during September. The presence of ovigerous female through out the year suggests that it is a continuous breeder in the locality.

The salinity tolerance of two species of Cumacea has been studied. Paradiastylis cuticoides and Iphinoe pigmenta can survive in the estuarine and marine conditions. P. cuticoides was first recorded from Chilka lake (Orissa Coast) when the 'specific gravity was 1.000 to 1.015'. But it has also been collected from the sea off Cochin, Trivandrum and Vizhinjom where the salinity is about 35‰.

I. pigmenta, previously recorded from Veli lake, is now obtained in large numbers in the plankton collections off Cochin.

The fifth chapter deals with the biology of Cumacea. Food and feeding has been studied; filter feeding is found to be common. Examination of the stomach contents of *I. brevipes* collected from the plankton samples off Vizhinjom showed the presence of diatoms, detritus, flagellates, ciliates and very small crustacean larvae.

Movements of cumaceans studied in the laboratory show that the females move by paddling motions of peraeopods and males by pleopods. Burrowing is accomplished by lateral shovelling of the substrate using the last three pairs of peraeopods.

Sexual dimorphism is very pronounced in the cumacean genera *Vaunthompsonia*, *Glyphocuma*, *Pseudosympodomma* and *Iphinoe*. The sex is clearly differentiated by the development of the second antennae and pleopods in most species in the male and brood pouch in all the mature females.

Reproduction in Cumacea occur only once and very rarely several times in an year. The number of eggs depends

on the size of the mother varying from 12–31 in Bodotria plathoasis, 16–24 in Iphinoe brevipes and 10–24 in I. pigmentia. Development takes place in the brood pouch and there are 4 larval stages. Four moults occur before the sub-adult stage is reached.

Vertical distribution and diurnal migration are exhibited by cumaceans. During hours of darkness they undertake vertical migration upwards and during day they remain buried in the fine silty sand. They are attracted towards diffused light and avoid bright light.

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