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MYSIDS AND EUPHAUSIDS IN THE EASTERN INDIAN OCEAN WITH PARTICULAR REFERENCE TO INVASION OF SPECIES FROM THE BANDA SEA*

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ABSTRACT

Fifteen species of Mysidacea and thirty-two species of Euphausiacea were identified from 164 samples collected during the four cruises of T. S. *Oshoro Maru* of the Hokkaido University in the northern part of the Eastern Sector of the Indian Ocean and the Great Australian Bight in southern summer, 1962-1965. Samplings were made by vertical hauls with an IOS net or a Norpac net, and by simultaneous horizontal tows with several numbers of 50 cm square or 56 cm ring closing nets.

Among these 47 species, *Paranchialina angustus*, *Nyctiphanes australis* and *Euphausia sibogae* showed characteristically limited regionality in distribution. The former two species occurred only in the Great Australian Bight. *E. sibogae* occurred at 21 stations located in the northern part of the Eastern Sector of the Indian Ocean, specially at that in the south of Java Island. This species, however, was found from 430 m to 2976 m depth in daytime, while it was captured in upper 200 m at night. *E. sibogae* has never been recorded in literature from the Indian Ocean but only from neighbouring waters of East Indies (Hansen 1910) and of Great Barrier Reef (W. M. Tattersall, 1936). This suggests that the occurrence of *E. sibogae* in the present area is due to prevailing inflow of the Banda Intermediate Water (Rochford, 1964, 1966) from the north of the Lesser Sunda Islands into the eastern Indian Ocean.

INTRODUCTION

THE area of northern part of the eastern sector of the Indian Ocean is under remarkably complicated hydrographic condition. Rochford (1964, 1966) mentioned the existence of prevailing inflow current from the Banda Sea to the Indian Ocean in the Sunda Islands at the depths of 150-300 metres and 900-1100 metres. One could expect, accordingly, that pelagic fauna within rather small area of the northern part of the eastern sector of the Indian Ocean is rich where common Indian Ocean fauna are mixed with certain Pacific fauna transported by this inflow current.

The author examined mysids and euphausiids in the plankton samples collected on the T. S. *Oshoro Maru* of the Hokkaido University, in the northern part of the eastern sector of the Indian Ocean or the Great Australian Bight during four cruises in successive southern summers from 1962 to 1965 (Fig. 1). In the present paper, regional distribution of these planktonic animals in these areas are described, and some emigrant species from the Banda Sea and the western tropical Pacific Ocean to the northern part of the eastern sector of the Indian Ocean are mentioned.

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MATERIAL

One hundred and sixty-four plankton samples in total were collected by vertical hauls and horizontal tows in the eastern sector of the Indian Ocean during the above mentioned cruises. The vertical hauls with an IOS net were carried out in the south of Java Island, west of Sumatra and west of western Australia, and those with a Norpac net were used in the Great Australian Bight. The simultaneous horizontal tows with 50 cm square closing nets at seven layers from the surface to 2976 metre depth were carried out south of Java Island and those with 56 cm ring closing nets at six layers down to 2970 metres were used west of Sumatra (Table 1). Time of samplings were not fixed for the time of day in all the regions except west of Sumatra where the samplings were made in day-time only. More detailed descriptions on material and methods are given in the *Data Record of Oceanographic Observations and Exploratory Fishing*, Nos. 8-11 (Faculty of Fisheries, Hokkaido University, 1964-1967).

TABLE 1. Plankton samplings collected by vertical hauls and horizontal tows on four southern summer cruises of the T. S. *Oshoro Maru* from 1962 to 1965 in the northern part of the eastern sector of the Indian Ocean and the Great Australian Bight.

Cruise number	Period	Methods of samplings	Number of samples	Regions
1	Dec. 12, 1962 – Jan. 19, 1963	200-0 m vertical hauls with an IOS net	48	South of Java Island, and west of western Australia
7	Dec. 13-25, 1963	Simultaneous horizontal tows down to 2976 m with 50 cm square nets	22	South of Java Island
,,	,,	200-0 m vertical hauls with an IOS net	13	,,
11	Dec. 15, 1964 – Jan. 2, 1965	Simultaneous horizontal tows down to 2970 m with 56 cm ring nets	41	West of Sumatra
,,	,,	200-0 m vertical hauls with an IOS net	23	,,
16	Dec. 19-24, 1965	Vertical hauls from near the bottom to the surface	17	Great Australian Bight

The border of sea areas between off south of Java Island and off west of western Australia was tentatively settled along 20° S lat. which is the southern edge of the Banda Intermediate Waters (Rochford, 1966).

Regional Distribution

From the samples collected by six series of plankton samplings in a rather small area of the eastern sector of the Indian Ocean, fifteen species of Mysidacea and thirty-two species of Euphausiacea were identified. Regional and vertical distribution of these forty-seven species in the west of Sumatra, south of Java Island, west of western Australia and Great Australian Bight is summarised in Table 2. Among these forty-seven species, euphausiids viz. *Thysanopoda tricuspidata, Euphausia diomedeae, E. tenera, Nematoscelis microps* and *Stylocheiron affine* were the most common and *T. monacantha, T. aequalis, Pseudeuphausia latifrons, E. mutica, E. sibogae, E. hemigibba* and *N. tenella* were also common in the former three regions, while no common species of mysids was found.

In the shelf waters in the Great Australian Bight, only two species, *Paranchialina angustus* (Mysidacea) and *Nyctiphanes australis* (Euphausiacea) occurred numerously. These two species have not been reported anywhere other than the coastal water of south-eastern Australia and New Zealand (Sars, 1885; Dakin and Colefax, 1940; Bary, 1956). Because of the common occurrence of various developmental stages of both species in the Great Australian Bight, they are considered to be endemic species. Since no other species of mysids and euphausiids was captured, it is suggested that pelagic fauna in the shelf water of the Bight is certainly isolated from other regions of the eastern sector of the Indian Ocean.

South of Java Island and west of Sumatra, both of which are influenced by the inflow current from the Banda Sea and the western tropical Pacific Ocean, are rich in the number of species and individuals of mysids and euphausiids.

On the contrary, species composition of these animals west of western Australia which is separated by the southern edge of the Banda Intermediate Waters from the former two northern regions was comparably simple. This simple fauna west of western Australia may be partly due to lack of deep sampling, missing the meso and bathy-pelagic species from catches. It is noticed that the catches did not contain some epipelagic species and vertical migrants which occurred in the neighbouring areas, south of Java Island and west of Sumatra (Table 2). This indicates that the simple fauna are brought by rather simple hydrographic conditions; there is no inflow current from the Banda Sea and the western tropical Pacific Ocean.

Referring to Sebastian (1965) Silas and Mathew (1967) and Mauchline and Fisher (1969), it is expected that thirty-one species of euphausiids be found in the northern part of the eastern sector of the Indian Ocean excluding the southern species (Table 2). Among these thirty-one species, *Bentheuphausia amblyops, Thysanopoda cristata, T. cornuta* and *Nematobrachion sexspinosum* were not captured in the present investigation. They might be of sporadic and bathypelagic habit. Five species of euphausiids *T. orientalis, E. recurva, E. sibogae, Nb. flexipes* and *Stylocheiron maximum* were collected during the investigation in the northern part of the eastern sector of the Indian Ocean exclusive of the Great Australian Bight. They have not been reported from this area. They were reported from the water among the East Indies and the western tropical Pacific Ocean, and also in the central and western sectors of the Indian Ocean except *E. sibogae* which is confined to the East Indies and the Great Barrier Reef (Hansen, 1910; Tattersall, 1936). On the other hand, species such as *T. microphthalma, E. distinguenda* and *S. indicum* which are found only in the central and western sectors of the Indian Ocean but not in the western tropical Pacific

TABLE 2. Occurrence, and vertical distribution in daytime of mysids and euphausiids observed in four regions of the northern part of the eastern sector of the Indian Ocean and the Great Australian Bight in southern summers (+++: very common, ++: common, +: present,—: absent in the samples).

	Occurrence, and depth range of vertical distribution in daytime				Previous record in the northern part of the eastern sector of the Indian Ocean
	Regions investigated				
	West of Sumatra	South of Java Island	West of western Australia	Great Australian Bight	
Mysidacea					
*Gnathophausia gracilis**	+746-836,	—	—	—	+
*Eucopia unguiculata**	+593-1998m	—	—	—	+
*Eucopia australis**	—	+	—	—	+
*Eucopia scalpticauda**	—	+1596m	—	—	+
*Eucopia grimaldii**	—	+2970m	—	—	+
Siriella thompsoni	+57-1968m	+	—	—	+
Siriella gracilis	+921-956m	—	—	—	+
Hemisiriella pulchra	+	=86m	—	—	—
Hemisiriella parva	+	+86m	—	—	+
Paranchialina angustus	—	—	—	+	—
Pseudanchialina pusilla	+	—	—	—	+
Euchaetomera typica	—	+172m	—	—	+
*Euchaetomera tenuis**	—	+430m	—	—	+
Euchaetomeropsis merolepis	+	—	+	—	+
Doxomysis quadrispinosa	+	+838m	—	—	+
Euphausiacea					
Bentheuphausia amblyops	—	—	—	—	+
Thysanopoda monacantha	+1980-1998m	+430-1596m	+	—	+
Thysanopoda cristata	—	—	—	—	+
Thysanopoda tricuspidata	+593-1968m	+798-998m	+	—	+
Thysanopoda aequalis	+492-1479m	+430-2514m	=	—	+
Thysanopoda subaequalis	+	+	—	—	+
Thysanopoda obtusifrons	—	+	+	—	+
Thysanopoda pectinata	—	+	—	—	+
Thysanopoda orientalis	—	+	—	—	—
Thysanopoda cornuta	—	—	—	—	+
Nyctiphanes australis	—	—	—	+	+
Pseudeuphausia latifrons	+1842-1912m	+8-838m	+	—	+
*Euphausia recurva**	+1500-1590	—	—	—	—
Euphausia mutica	+92-1998m	+	+	—	+
Euphausia brevis	+296-1479m	+430m	—	—	+
Euphausia diomedeae	+92-1998m	+399-2514m	+	—	+
Euphausia tenera	+296-1998m	+438-2514m	+	—	+
Euphausia similis	+593-1998m	+	—	—	+
Euphausia sibogae	+1320-1479m	+430-2970m	+	—	—
*Euphausia paragibba**	+461-1912m	+838m	—	—	+
Euphausia pseudogibba	+461-1479m	+	—	—	+
Euphausia hemigibba	+461-530m	+399-860m	+	—	+
Nematoscelis tenella	+461-1479m	+399-2970m	+	—	+
Nematoscelis microps	+50-1678m	+399-2514m	+	—	+
Nematoscelis gracilis	+50-1590m	+399-2970m	—	—	+
*Nematobrachion flexipes**	+296-299m	—	—	—	—
Nematobrachion sexspinosum	—	—	—	—	+
Nematobrachion boopis	—	+798-838m	—	—	+
Stylocheiron carinatum	=82-100m	+86-430m	—	—	+
Stylocheiron affine	+57-1968m	+86-2514m	+	—	+
Stylocheiron shumii	—	+86-2970m	—	—	+
Stylocheiron microphthalma	+82-984m	+86-992m	—	—	+
*Stylocheiron elongatum**	+424m	—	—	—	+
Stylocheiron longicorne	+250-1590m	+86-2970m	—	—	+
Stylocheiron abbreviatum	—	+86-2514m	—	—	+
Stylocheiron maximum	—	+172-2514m	—	—	—

*Species which were not captured in upper 200 m depth.

(Sebastian, 1956 ; Silas and Mathew, 1967 ; Mauchline and Fisher, 1969) were not found in this investigation. In addition, a mysid, *Hemisiriella pulchra*, which was reported similarly to *E. sibogae* as the confined species to the East Indies and the Great Barrier Reef also occurred commonly in this study.

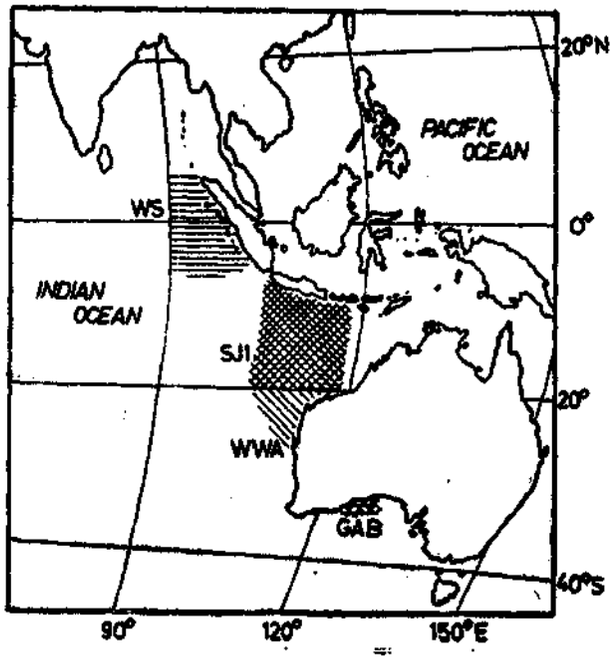

Fig. 1. Regions where plankton samplings were made on four southern summer cruises of the T. S. *Oshoro Maru* from 1962 to 1965 (WS : west of Sumatra, SJI: south of Java Island, WWA: west of Western Australia, GAB: Great Australian Bight).

Rochford (1964, 1966) suggested that the Banda water penetrates into the northern part of the eastern sector of the Indian Ocean through the Bali-Lombok Strait and the Timor Trough. From this fact it could be understood that these new records of one species of mysid (*H. pulchra*) and five species of euphausiids (*T. orientalis, E. recurva, E. sibogae, Nb. flexipes* and *S. maximum*) in the eastern sector of the Indian Ocean is made by transportations of these species by prevailing inflow current from the Banda Sea and the western tropical Pacific Ocean to the northern part of the eastern sector of the Indian Ocean.

Conclusively, mysid and euphausiids fauna in the shelf water of the Great Australian Bight isolated from surrounding oceanic water is quite simplified. Only two species, *Paranchialina angustus* and *Nyctiphanes australis*, occur in this region. On the contrary, the west of Sumatra and the south of Java Island are quite rich in mysid and euphausiid fauna by the influence of the inflow current from the Banda Sea. This inflow current carries a certain species of Pacific fauna such as *Hemisiriella pulchra, Thysanopoda orientalis, Euphausia recurva, E. sibogae, Nematobrachion flexipes* and *Stylocheiron maximum* from the East Indies and the western tropical Pacific Ocean to the northern part of the eastern sector of the Indian Ocean. In the

region off the western Australia there is no influence of this inflow current, so that rather simple fauna of mysids and euphausiids are present. Above facts indicate that the inflow current from the Banda Sea plays an important role diversifying the pelagic fauna in the northern part of the eastern sector of the Indian Ocean.

Description of Species

Since systematic accounts on *Paranchialina angustus*, *Euchaetomelopsis melorepis*, *Doxomysis quadrispinosa* (Mysidacea) and *Euphausia sibogae* (Euphausiacea) are given in old and inaccessible publications, it is thought useful to make a brief mention here :

Paranchialina angustus (G. O. Sars), 1883 ; (Fig. 2)

Anchialus angustus, G. O. Sars, 1885, pp. 197-200, pl. 35, figs. 1-18.
Paranchialina angustus, Hansen, 1910, pp. 50-51.

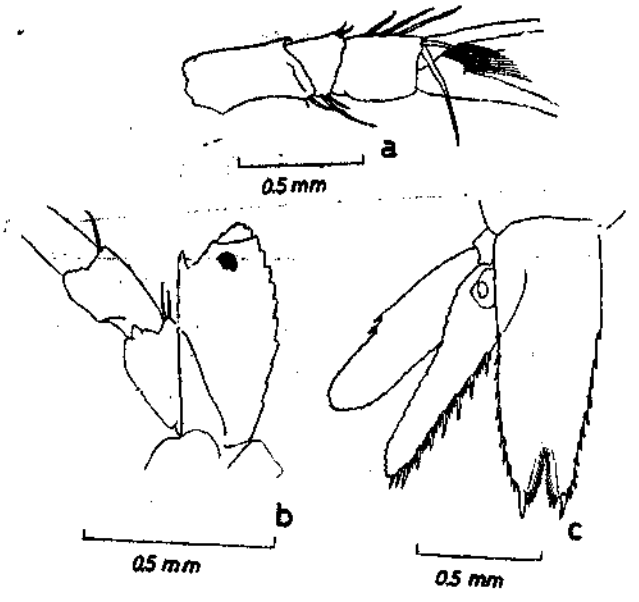

Fig. 2. *Paranchialina angustus* (G. O. Sars), 1883. ♂ a : antennal peduncle, b : antennal scale, c : telson with left uropods.

Description : Antennal scale with subarticulation and furnished with setae or inner margin and distal 1/4 of outer margin. Distal half of external margin of outer uropod carries setae and two spines. Telson bears 12 spines on each side and numerous spines on apical cleft densely.

Length : about 8 mm (male).

Remarks : Telson and antennal scale of the present specimens are slightly wider and longer than those described by G. O. Sars (1885) respectively.

Euchaetomeropsis merolepis (Illig), 1908 ; (Fig. 3)

Euchaetomeropsis merolepis, Illig, 1930, p. 450, figs. 97-103.

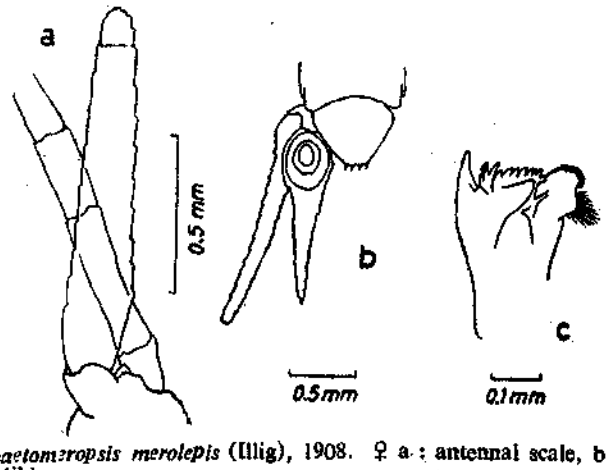

Fig. 3. *Euchaetomeropsis merolepis* (Illig), 1908. ♀ a : antennal scale, b : telson with left uropods, c : mandible.

Description : Eyes elongate and separated into two parts. Antennal scale with subarticulation and furnished with setae all around. Mandible with teeth-armed and setose morlar portion.

Length : 10 mm (female).

Remarks : Banner (1948) mentioned that teeth-armed morlar portion of mandible is the most important character of this species, when he distinguished his new species *Euchaetomeropsis pacifica* from this species, *E. merolepis*.

Doxomysis quadrispinosa (Illig), 1906 ; (Fig. 4)

Doxomysis quadrispinosa, Hansen, 1912, pp. 205-206, pl. 3, fig. 3 ; Illig, 1930, pp. 480-482, figs. 163-166.

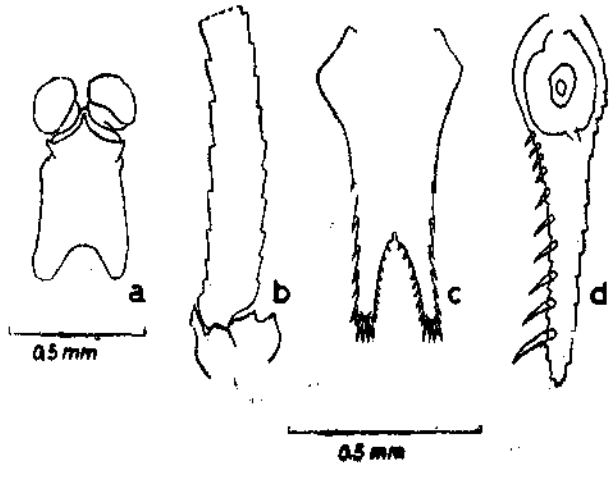

Fig. 4. *Doxomysis quadrispinosa* (Illig), 1906. ♀ a : anterior part, b : antennal scale without terminal lobe, c : telson, d: inner uropod.

Description : Eyes large. Body covered with small spinules. Antennal scale slender and furnished with long setae all around. Inner uropod carries 10 robust spines along inner margin. Telson furnished with 7 lateral spines on posterior half and carries spinous cleft on tip.

Length : 3-4 mm.

Euphausia sibogae Hansen, 1908 ; (Fig. 5)

Euphausia sibogae, Hansen, 1910, p. 101, pl. 14, fig. 7.

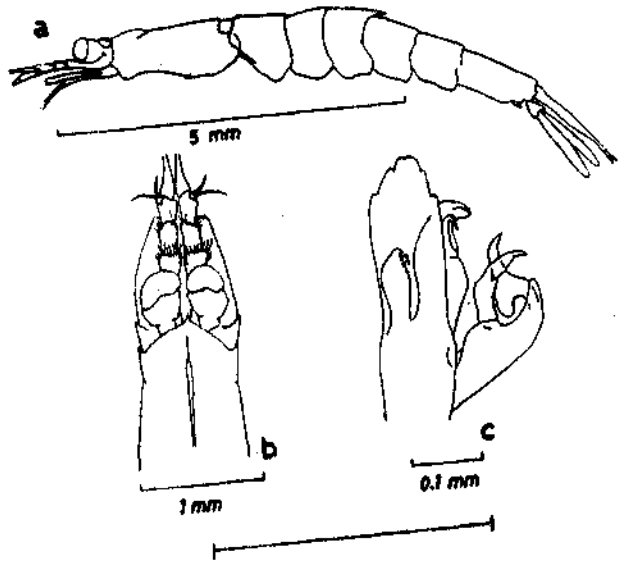

Fig. 5. *Euphausia sibogae* Hansen, 1908. ♂ a : total body without thoracic and abdominal appendages, b : anterior part, c : male copulatory organ.

Description : One rather short spine on 3rd abdominal segment but none on others. No process on dorsal surface of 1st antennal peduncle.

Length : 8-9 mm.

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