MYSIDACEA AND EUPHAUSIACEA COLLECTED IN THE SOUTH-EAST OF HOKKAIDO, JAPAN

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The plankton samplings were made on board the training ship "Oshoro Maru" of Hokkaido University at a station Os 0801, 42°10′N, 142°41′E, at the south of Cape Erimo on May 22, 1964, at the 5 stations Os 1301–Os 1305 on a line, 42°00′N, 146°00′E–42°49′N, 144°33′E, in south-east of Kushiro on May 7–9, 1965 and at a station Os 2301 which was located at the same position as Os 1301 on April 23, 1967 (Fig. 1). The samples were obtained from 3–7 layers between the surface and a maximum depth about 3000 m by towing several numbers of 56 cm-ring closing nets horizontally for nearly one hour. General accounts of this net are given by Motoda (1967). Hydrography of the sampling area for each year and data of samplings are given in *Data Record of Oceanographic Observations and Exploratory Fishing, Hokkaido University*, Nos. 9–10 and 12 (1965, 1966, 1968).

In this paper 5 species of Mysidacea and 5 species of Euphausiacea are reported. Vertical distribution and vertical movement of these species are discussed.

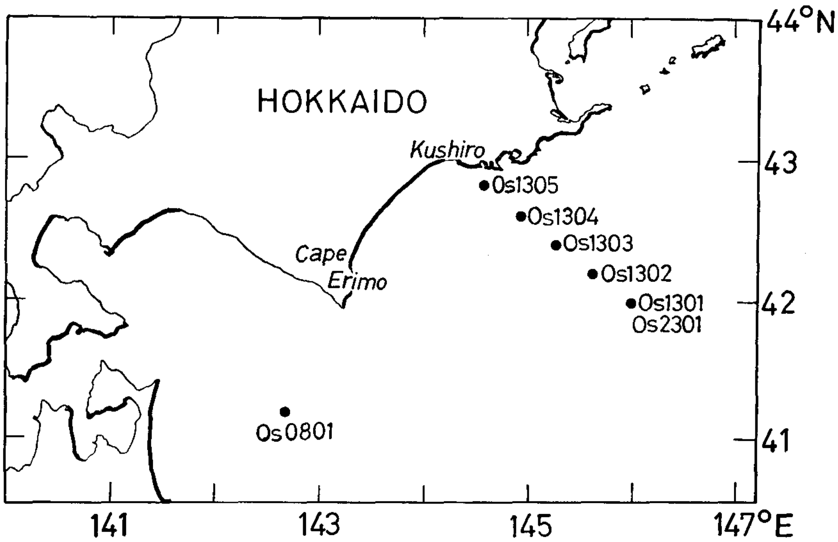

Fig. 1. Location of stations. Os 0801, May 22 1964: Os 1301- Os 1305, May 7–9 1965: Os 2301, April 23 1967

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Order Mysidacea

Family Lophogastridae

1. *Gnathophausia gigas* WILLEMOES-SUHM, 1873

(Fig. 2a–c)

Gnathophausia gigas, G.O. Sars, 1885, p. 33, pl. 3, figs. 1–7.
Gnathophausia drepanephora, Holt & Tattersall, 1905, p. 113, figs. 1–7.
Gnathophausia gigas, Ortmann, 1906, p. 36, pl. 2, figs. 1a-b.
Gnathophausia gigas, Zimmer, 1909, p. 33, figs. 48–51.
Gnathophausia gigas, Banner, 1948, p. 357, pl. 1, fig. 1a–c.

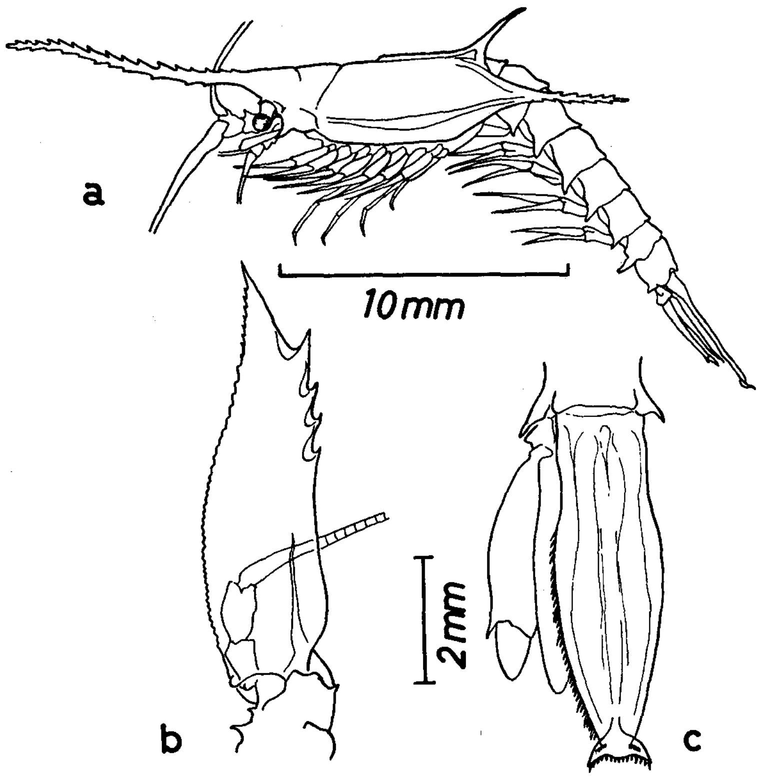

Fig. 2. *Gnathophausia gigas* W. -SUHM, **a**. juvenile from left side, **b**. right antennal scale, **c**. telson with left uropod

Gnathophausia gigas, O. S. Tattersall, 1955, p. 36.
Gnathophausia gigas, Pequegnat, 1965, p. 408, fig. 5.

Three juvenile specimens are obtained. They have long rostrum and long post dorsal spine projected upwards, which are the characteristics of immature form of *Gnathophausia gigas*. Antennal scale is furnished with 44 hairs on the inner margin and 4 sharp denticles on the outer margin.

Length: 29–31 mm.

Distribution: Common in the deep water of almost whole areas of the world oceans, at a temperature of 4°C (Fage, 1941). Bering Sea and North Pacific Ocean (Ortmann, 1906; W.M. Tattersall, 1951; Pequegnat, 1965); Equatorial Pacific Ocean (Ortmann, 1906, 1908; Fage, 1941; W.M. Tattersall, 1951); South Pacific Ocean (Fage, 1941; Pequegnat, 1965); Kagoshima Bay (W.M. Tattersall, 1951); from South Atlantic Ocean to Greenland (G.O. Sars, 1885; Holt & Tattersall, 1905; Ortmann, 1906; W.M. Tattersall, 1951; Illig, 1930; Fage, 1941; O.S. Tattersall, 1955); Indian Ocean (G.O. Sars, 1885; W.M. Tattersall, 1939b; O.S. Tattersall, 1955); Antarctic Ocean (O.S. Tattersall, 1955).

Family Eucopiidae

2. *Eucopia unguiculata* (WILLEMOES-SUHM), 1875

(Fig. 3a–c)

Eucopia australis, (parts) G.O. Sars, 1885, p. 55, pls. 9–10, figs.
Eucopia unguiculata, Zimmer, 1909, p. 37, figs. 59–60.
Eucopia unguiculata, Hansen, 1910, p. 20, pl. 1, fig. 3a–b.
Eucopia hanseni, Fage, 1942, p. 47, figs. 28, 30, 32.
Eucopia unguiculata, Banner, 1948, p. 359, pl. 1, fig. 2a–c.
Eucopia unguiculata, O.S. Tattersall, 1955, p. 50, fig. 4a-b.

This species was separated by Willemoes-Suhm (1875, cited from O.S. Tattersall, 1955) from a closely allied species, *Eucopia australis* by the characteristics that in *E. unguiculata* eyes are smaller, setiferous lobe on the third segment of antennal peduncle is smaller, convexity of frontal margin of carapace is inferior, convexity of outer margin of antennal scale is also inferior and terminal segment of exopod of uropod is shorter than in *E. australis*. Banner (1954b) considered that *E. unguiculata* is synonymous with *E. australis* because there are large variations in the above all characters. In the present specimens there is no variation in size of eyes and setiferous lobe on antennal peduncle within the specimens of 16–35 mm in body length. Terminal segment of uropod is as long as or slightly longer than breadth, being identical with *E. unguiculata* described by O.S. Tattersall (1955).

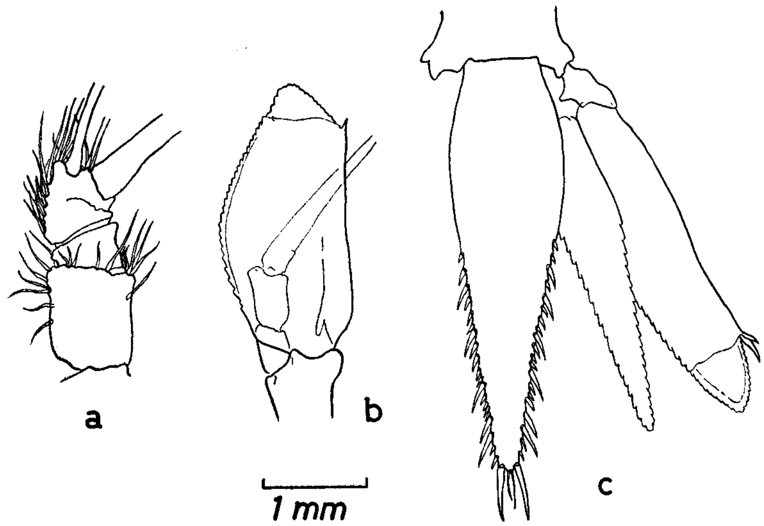

Fig. 3. *Eucopia unguiculata* (W. -SUHM), a. first antennal peduncle of male, b. antennal scale, c. telson with right uropod

However, ratio of breadth to length in convexed portion of frontal margin of carapace varies 3–5, and the convexity of outer margin of antennal scale is larger in large specimens than in small specimens.

Length: 16–35 mm.

Distribution: Common in the deep water from Bering Sea to off Peru. Sea of Okhotsk, Bering Sea and Nroth Pacific Ocean (Ortmann, 1906; Banner, 1948; W.M. Tattersall, 1951); Equatorial Pacific Ocean (Hansen, 1912); South Pacific Ocean (W.M. Tattersall, 1951); Central and subpolar regions of Atlantic and Indian Oceans (G.O. Sars, 1885; Hansen, 1910; Illig, 1930; Leavitt, 1938; W.M. Tattersall, 1939b, 1951; O.S. Tattersall, 1955).

Family Mysidae

3. *Boreomysis californica* ORTMANN, 1894

(Fig. 4a-d)

Boreomysis media, Hansen, 1912, p. 190, pl. 1, fig. 5a-i.
Boreomysis californica, Banner, 1948, p. 367, pl. 4, fig. 5a-i.
Boreomysis kincaidi, Banner, 1948, p. 362, pl. 2, fig. 3a-j.
Boreomysis californica, W.M. Tattersall, 1951, p. 52, figs. 9–10.

In the present specimens, rostrum is acute and well developed, projecting upwards. The eyes in grown specimens are slightly smaller than those reported by

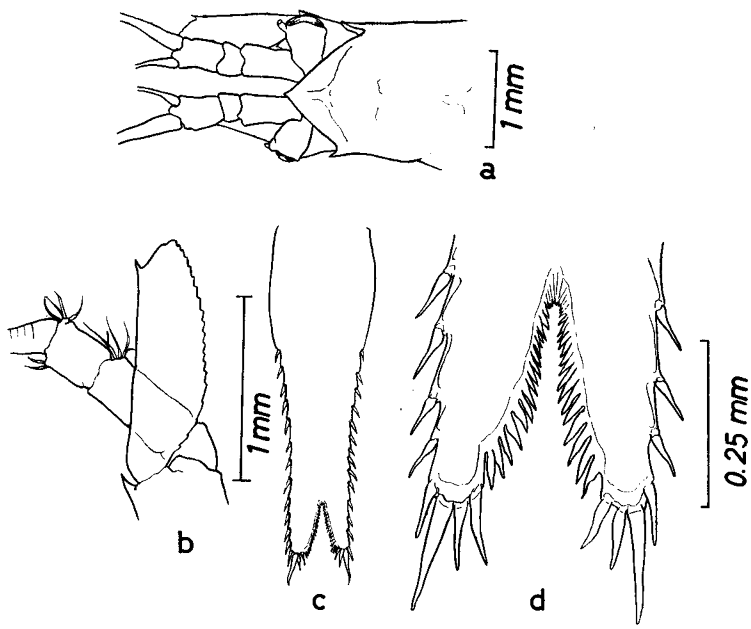

Fig. 4. *Boreomysis californica* ORTMANN, a. anterior part of male from above, b. left antennal scale, c. telson, d. tip of the telson

W.M. Tattersall (1951). Number of spines on telson varies between 12–23. The length of antennal scale is as long as first antennal peduncle, shorter than in figures of W.M. Tattersall (1951).

Length; 12 mm (largest specimen).

Distribution: Common in Pacific Ocean from 13°S to Bering Sea. Sea of Okhotsk, Bering Sea and North Pacific Ocean (Hansen, 1912; Banner, 1948, 1954b); South Pacific Ocean (Hansen, 1912; W.M. Tattersall, 1951); scarce in Atlantic and Indian Oceans (Illig, 1930).

4. *Meterythrops robusta* SMITH, 1879

(Fig. 5a-e)

Meterythrops robusta, Zimmer, 1904, p. 445, figs. 90–93.
Meterythrops robusta, Banner, 1948, p. 377.
Meterythrops robusta, W.M. Tattersall, 1951, p. 113, fig. 35a-d.

Banner (1948) examined the veriations in size and shape of eyes of *Meterythrops robusta* and found great individual variation which has no specific significance. Further, he considered that *M. microphthalma* reported by W.M. Tattersall (1951) as a new species may be synonymous with *M. robusta* (Banner,

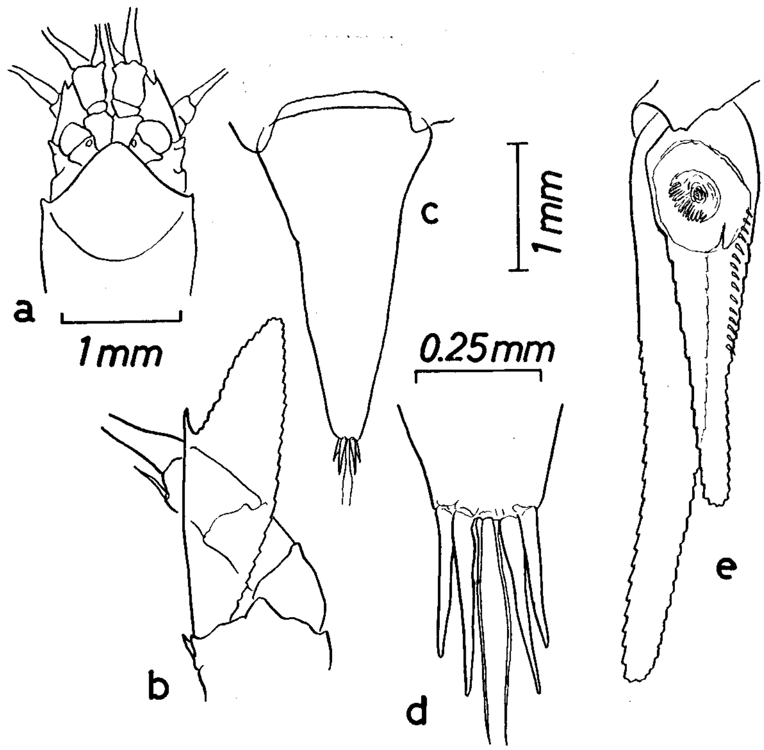

Fig. 5. *Meterythrops robusta* SMITH, a. anterior part of female from above, b. antennal scale, c. telson, d. tip of the telson, e. left uropod

1954c). Although in the present seven adults, eyes are very small and antennal scale is slender like *M. microphthalma* discribed by W.M. Tattersall (1951), there are spines on the inner margin of inner uropod varying the number from 15 to 34, that is identical with *M. robusta*. No specimen having no spine on inner uropod as observed by W.M. Tattersall (1951) is found in the present collections.

Length: 11–18 mm.

Distribution: Mainly in polar and subpolar regions of Pacific Ocean near Unimak, Aleutian Islands and west coast of America (W.M. Tattersall, 1939a, 1951; Banner, 1948); North and Arctic parts of Atlantic Ocean (Zimmer, 1904). W. M. Tattersall (1951) recorded *M. microphthalma* from western North Pacific Ocean around Japan.

5. *Acanthomysis dimorpha* Ii, 1936

(Fig. 6a-c)

Acanthomysis dimorpha Ii, 1936, p. 593, figs. 33–46.
Acanthomysis dimorpha, Ii, 1964, p. 473, fig. 120a-g.

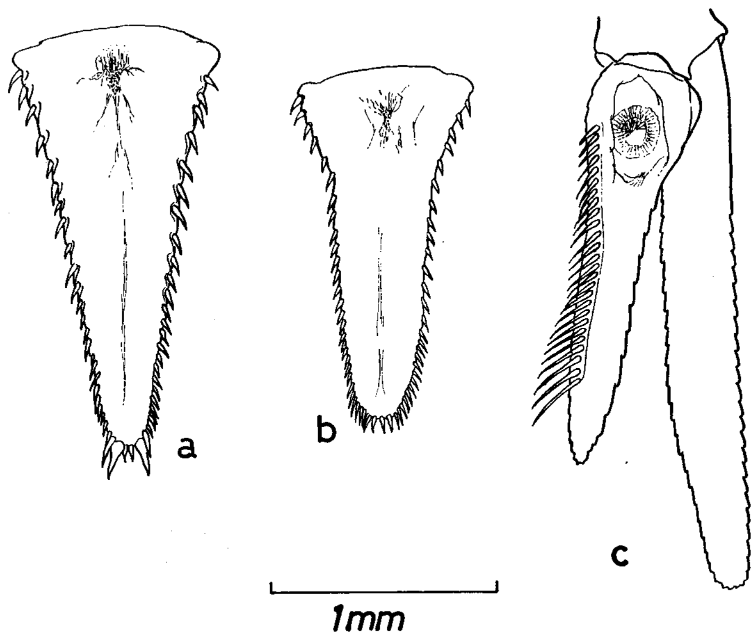

Fig. 6. *Acanthomysis dimorpha* II, a. telson of male, b. telson of female, c. right uropod of male

A long row of spines consisting of 25 spines on female, 26 spines on male, along inner margin of the inner uropod is a characteristic of this species. Sexual dimorphism of telson is distinct.

Length: Male, 12 mm; female, 10 mm

Distribution: This species was reported by Ii (1936) from east coast of Korea for the first time.

Order Euphausiacea

Family Euphausiidae

6. *Euphausia pacifica* HANSEN, 1911

Euphausia pacifica Hansen, 1911, p. 28, fig. 10a-b.
Euphausia pacifica, Hansen, 1912, p. 241, pl. 7, fig. 5a-b.
Euphausia pacifica, Hansen, 1915, p. 81, pl. 1, fig. 2a-g.
Euphausia pacifica, Banner, 1949, p. 33, pl. 3, fig. 24a-d.
Euphausia pacifica, Boden *et al.*, 1955, p. 333, fig. 24a-c.
Euphausia pacifica, Komaki & Matsue, 1958, p. 140, fig. 8a-c.
Euphausia pacifica, Komaki, 1960, p. 191, fig. 5a-e.
Euphausia pacifica, Ponomareva, 1963, p. 52, fig. 13 (in English transrated edition in 1966).

Distribution: Very common between approximately 50°N and 40°N, recorded also at 25°N (Boden *et al.*, 1955; Brinton, 1962), along the east and west coast of Pacific Ocean spreading to Bering Sea and near Wakayama, Japan (Hansen, 1911, 1912, 1915; Banner, 1949, 1954b; Boden *et al.*, 1955; Honjo, 1957; Komaki, 1960; Tsuruta, 1963); Sea of Japan (Motoda & Anraku, 1954; Ponomarev, 1957; Komaki & Matsue, 1958; Ponomareva, 1963). Sometimes a swarm of *E. pacifica* causes DSL in northern North Pacific Ocean (Boden, 1950, 1962; Barham, 1957; Suzuki, 1963a, 1963b; Boden & Kampa, 1965; Suzuki & Ito, 1967).

7. *Thysanoessa longipes* BRANDT, 1851

Thysanoessa longipes, Hansen, 1911, p. 38, 40.
Thysanoessa longipes, Hansen, 1915, p. 87, pl. 1, fig. 3a-d, pl. 2, fig. 1a-e.
Thysanoessa armata, Marukawa, 1928, p. 5, pl. 2, figs. 19–22.
Thysanoessa longipes, Banner, 1949, pl. 21.
Thysanoessa longipes, Boden *et al.*, 1955, p. 352, fig. 34a-c.
Thysanoessa longipes, Komaki & Matsue, 1958, p. 148, fig. 10a-c.
Thysanoessa longipes, Komaki, 1960, p. 129, figs. 6a, 6d.
Thysanoessa longipes, Ponomareva, 1963, p. 48, fig. 10 (in English translated edition in 1966).

Distribution: Common in North Pacific Ocean, Bering Sea and Sea of Japan (Hansen, 1911, 1915; Marukawa, 1928 as *Thy. armata*; Banner, 1949, 1954a; Boden *et al.*, 1955; Ponomarev, 1957; Komaki & Matsue, 1958; Komaki, 1960; Brinton, 1962; Ponomareva, 1963; Nemoto, 1962, 1966; Suzuki & Ito, 1967).

8. *Thysanoessa inspinata* NEMOTO, 1963

Thysanoessa inspinata Nemoto, 1963, p. 41, fig. 2a-c.
Thysanoessa longipes (spineless form), Komaki, 1960, p. 192, fig. 6b-c.

Recently this species was separated from *Thysanoessa longipes* by differences in position of lateral denticle on lower margin of carapace and size of terminal and proximal processes of male copulatory organ (Nemoto, 1963), i.e., in *Thy. inspinata* lateral denticle is located far on posterior part of carapace, and terminal and proximal porcesses of male copulatory organ are equal in size and shorter than those of *Thy. longipes*. According to Nemoto (1963), spineless form of *Thy. longipes* also exists, which is distinguished easily from *Thy. inspinata* by the distinct differences in above mentioned characteristics between these two species. In the present collection, this species exceeds *Thy. longipes* in individual number and no spineless form of *Thy. longipes* is found.

Distribution: Similar to *Thy. longipes*, somewhat spreading further to southern area (Brinton, 1962 as "Unspine form of *Thy. longipes*"; Ponomareva, 1963 as "Small form without dorsal spine of *Thy. longipes*"; Komaki, 1960 as "Spineless form of *Thy. longipes*"; Nemoto, 1962 as "Spineless form of *Thy. longipes*", 1963, 1966).

9. ? *Thysanoessa inermis* (KRØYER), 1846

Only one heavily damaged female specimen is obtained at 50–65 m depth at station Os 2301. This specimen is identified as *Thysanoessa inermis* by a post dorsal spine on the sixth abdominal segment.

10. *Tessarabrachion oculatus* HANSEN, 1911

Tessarabrachion oculata Hansen, 1911, p. 47.
Tessarabrachion oculatum, Hansen, 1915, p. 103, pl. 4, fig. 1a-m.
Tessarabrachion oculatum, Banner, 1949, p. 32.
Tessarabrachion oculatus, Boden *et al.*, 1955, p. 362, fig. 39a-c.
Tessarabrachion oculatus, Komaki, 1960, p. 194, figs. 7a-e, 8a-e.
Length: 18–25 mm.
Distribution: Boreal North Pacific Ocean except Sea of Okhotsk and Sea of Japan (Hansen, 1911, 1915; Banner, 1949; Boden *et al.*, 1955; Penomareva, 1963; Nemoto, 1962; Komaki, 1960).

Vertical Distribution

Reliable quantitative data are available on the collection at station Os 2301 (Tables 1–4). In this sampling, the volume of water filtered by the net and the depth at which the net was towed were recorded with a depth-distance meter mounted at a net positioned at the deepest layer. The number of euphausiids counted is converted to the value per 1000 m^3 of water. In other samplings, no depth-distance meter was used, so that the absolute number of animals per unit volume of water is not accurately known, only the ratio of occurrence of animals at each different depth in one tow is being available.

Areal and annual variation:

There is a great variation in the total catches of euphausiids in the stations, and the number of years at the same station. Station Os 0801 quite differes from the other stations in euphausiid population, i.e., no adult specimen appears at this station (Table 5). In the south-east of Kushiro, great numbers of adults were caputured at station Os 2301 in May 1967. Contrary to the 1967 catch, it is poor at the same position (Station Os 1301) (Table 5) in April 1965. In 1965, swarming of euphausiids is observed at station Os 1303. Hydrographic data indicate that stations Os 2301 (1967) and Os 1303 (1965) are located at the boundary of the currents (*Data Rec. Oceanogr. Obs. Expl. Fish.*, Nos. 10, 12). Suzuki (1963b) mentioned that there is a swarming of *E. pacifica* around the east coast of Hokkaido, causing marked DSL, and that the area corresponds to the current boundary between Tsugaru Warm Current and Oyashio Current. The station Os 0801 where euphausiid larvae are abundant, no adults were found (Table 5), the station probably has shifted from the boundary and is located in a gyre of the Tsugaru Warm Current Extension having about 400 m thickness with temperature of 10.3°C–3.2°C, which is higher than in Oyashio Current (*Data Rec. Oceanogr. Obs. Expl. Fish.*, No. 9).

Mysidacea species do not show any marked areal and annual variations due to their bathypelagic habit.

Euphausia pacifica (Table 1):

Daily migration of this species is clear in both adults and juveniles.

The maximum number occurs at a 100–135 m depth in daytime and at the surface at night, although a certain number of adults remain in deeper water than 150 m at night. The distribution of this species as a whole ranges from the surface to a 150 m depth so far as the present observations are concerned. Number integrated in 0 m through 400 m in daytime is small compared with that at night. This might be partly caused by the net avoidance, though Brinton (1967) mentioned the net avoidance of this species in shallow layer is negligible. The net avoidance can not be neglected when the sampling is made with a relative small net towed rather slowly as in the present samplings. Even though, day-night difference of vartical distribution is too great, it suggests that there is a real vertical migration of this species.

Table 1. Occurrence of adults and juveniles of *Euphausia pacifica* at station Os 2301 in the south-east of Kushiro in daytime and at night (individual number/1000 m³)

Depth of sampling (m)	Day		Night	
	Adult	Juvenile	Adult	Juvenile
7			3573	544
50- 65			58	12
100-135	531	50	8	
150-200	33			
200-265	33	33	8	
245-335	12	4	8	
295-400	4	8	8	
Total	613	95	3663	556

The preceding investigators also observed the daily vertical migration of this species. Their reports indicate that the animals go down to or exceed 1000 m depth in daytime, though major population still appears in upper 200 m (Hansen, 1915; Banner, 1949; Brinton, 1962; Ponomareva, 1963).

Motoda & Anraku (1954) and Brinton (1962, 1967) observed noticeable diel vertical migration of *E. pacifica* in the Sea of Japan and in the northern North

Pacific Ocean. Suzuki & Ito (1967) mentioned that *E. pacifica* is distributed only at the first layer of DSL and migrates vartically with a rise and down of isolumes of 10^{-5}–10^{-7} lux in the northwestern area of the North Pacific Ocean.

It is summarized that *E. pacifica* is distributed mainly in 100–150 m layer in daytime and rises to 0–100 m layer at night in western part of the northern North Pacific Ocean (Ponomareva 1963; Suzuki 1963a, 1963b; Suzuki & Ito, 1967), while it is distributed in 200–300 m layer in daytime and in 0–100 m layer at night in the eastern North Pacific Ocean especially in its southern part such as in the California Current (Brinton, 1962, 1967). The difference of vertical distribution of this species between the northern and southern areas will be caused by difference of intensity of underwater illumination or other factors, though this is not examined in the present study.

Thysanoessa longipes, Thy. inspinata (Tables 2, 3):

Although the number of collected specimens is small, the vertical migration is observed in both species similarly to that of *E. pacifica*. Brinton (1962) mentioned

Table 2. Occurrence of adults and juveniles of *Thysanoessa longipes* at station Os 2301 in the south-east of Kushiro in daytime and at night (individual number/1000 m^3)

Depth of sampling (m)	Day		Night	
	Adult	Juvenile	Adult	Juvenile
7			33	21
50- 65	33	50	12	
100-135	17	66	21	8
150-200	17		8	
200-265			8	
245-335				
295-400				
Total	67	116	82	29

Table 3. Occurrence of adults and juveniles of *Thysanoessa inspinata* at station Os 2301 in the south-east of Kushiro in daytime and at night (individual number/1000 m^3)

Depth of sampling (m)	Day		Night	
	Adult	Juvenile	Adult	Juvenile
7			25	25
50- 65	17	17	37	
100-135			21	
150-200			12	
200-265			12	
245-335	17		8	
295-400	17			
Total	51	17	115	25

that *Thy. longipes* (Spine form) migrates upwards from 140–280 m to 0–140 m at night, while no vertical movement of Unspine form (*Thy. inspinata*) is observed.

Thy. longipes seems to inhabit a shallower layer than in *Thy. inspinata* in the present observations as reported by Nemoto (1966). The depth of distribution of the latter species goes down to a 1000 m depth in daytime (Os 1301) (Table 5). According to several authors, both species mainly live in the upper 500 m layer and their maximum depth is 1000 m (Hansen, 1915; Banner, 1949; Brinton, 1962; Nemoto, 1962, 1966; Ponomareva, 1963).

Day-night difference in integrated number of *Thy. inspinata* through upper 400 m is greater than that of *Thy. longipes*. This might mean that net avoidance capability of *Thy. inspinata* is higher than that of *Thy. longipes* despite the smaller size of the former species.

Tessarabrachion oculatus (Table 4):

Night movement of adults and juveniles to upper water is observed. However, the greatest number of adults appears in 295–400 m layer at night, suggesting that the distribution extends further to a deeper water level than 400 m. Brinton (1962) illustrated the vertical distribution of this species in daytime and at night, and suggested that the comparable numbers of specimens in the upper layer remain in deeper water (700–1000 m) at night. Banner (1949) also recorded this species from a level as deep as 100–1500 m, off Alaska. Thus the distribution of this species likely extends to deep water, 1000 m or more, although Ponomareva (1963) reported that *T. oculatus* is not found below 500 m depth. The scarcity in distribution might cause the missing in samples from the deep water.

Table 4. Occurrence of adults and juveniles of *Tessarabrachion oculatus* at station Os 2301 in the south-east of Kushiro in daytime and at night (individual number/1000 m³)

Depth of Sampling (m)	Day		Night	
	Adult	Juvenile	Adult	Juvenile
7			8	21
50- 65				8
100-135			8	
150-200			8	
200-265	8	8	12	
245-335	4		12	
295-400			50	
Total	12	8	98	29

Mysidacea:

All species collected in the present study belong to meso- and bathy-pelagic forms except *Acanthomysis dimorpha* which is recognized as a coastal and semi-benthic species (Os 1305) (Table 5). Pelagic forms other than *A. dimorpha* do not

Table 5. Occurrence of Mysidacea and Euphausiacea at 7 stations in the south-east of Hokkaido. The *italic type* means occurrence of juveniles (individual number/tow)

Station		Depth of sampling (m)	Mysidacea *Gnathophausia gigas*	*Eucopia unguiculata*	*Boreomysis californica*	*Meterythrops robusta*	*Acanthomysis dimorpha*	Euphausiacea *Euphausia pacifica*	*Thysanoessa longipes*	*Thy. inspinata*	*Tessarabrachion oculatus*	Furcilia larvae	Caryptopis larvae
Os 0801	Day	0										*29*	*2*
		70										*86*	*9*
		140										*128*	
		210										*104*	
		350				*1* 3						*13*	
		700		*5* 2	*1* 3							*8*	
		1050			1							*7*	
Os 1301	Day	0								1		*1*	
		45-48						1				*6*	
		90-98										*4*	
		455-490										*4*	
		906-980			1						1	*1*	
		1812-1960											
		2718-2940											
	Night	0										*1*	
		60-72										*1*	
		94-112											
		362-432	*1*		*1* 1	*6* 1							
		695-832		*1*									
		1370-1638			*2*								
		2040-2430			*1*								
Os 1302	Day	0											
		38											
		77							1				
		385	*2*			*17* 1		3			*6*		
		766		5									
Os 1303	Night	0						*91* 1688	*1* 1	*1* 2	*2* 1		
		49						*7*				*45*	*4*
		98						2		*1* 2	1	*3*	
		490						2		2			
		980											

Table 5. Continued

Station		Depth of sampling (m)	Mysidacea	*Gn. gigas*	*E. unguiculata*	*B. californica*	*M. robusta*	*A. dimorpha*	Euphausiacea	*E. pacifica*	*Thy. longipes*	*Thy. inspinata*	*T. oculatus*	Furcilia larvae	Caryptopis larvae
Os 1304 Night		0								*10* 42	*2*	*80* 52			
		48–49								*3* 1	2	*14* 12			
		97–98					*1* 2			6		*7* 45	*1* 1		
		483–490			2	*1* 2									
Os 1305 Dawn		5–10													
		35–67										*1*			
		Bottom (75)						4							
Os 2301	Day	7													*1732*
		60									*12* 8	*4* 4		*56*	*564*
		115–125								*12* 128	*16* 4			*8*	*60*
		175–185								8	4				*32*
		235–245								*8* 8			*2* 2		*4*
		290–310					*2* 1			*1* 3		4	1	*1*	
		350–370				*1*	*8*			*2* 1		4			
	Night	7								*84* 552	*3* 5	*4* 4	*3* 1		*100*
		50–65								*2* 9	2	6	*1*	*12*	*332*
		100–135								1	*1* 3	3	1	*4*	*20*
		150–200									1	2	1	*1*	*6*
		200–265			1		*2*			1	1	2	2		*5*
		245–335					*2* 1			1		1	2		
		295–400			*2* 1	1	10			1			8		

show a perceivable vertical migration and are absent from the upper 200 m if the depth at the bottom is sufficiently large. Murano* noted that there is no evidence for vertical migration in the 15 species of mysids in Sagami Bay.

Among Mysidacea, *Boreomysis californica* shows the widest range of vertical distribution, covering form 350 m to 2430 m in depth. This species is recorded from a 400–600 m depth and also from a 100–1500 m layer (Banner, 1948). W.M. Tattersall (1951) mentioned that this species occurs mainly at 200–400 fathoms (360–720 m) depth.

Eucopia unguiculata is caputured from shallow layer, even though this species has been reported as a typical bathypelagic species. Although this species is sometimes collected from shallow layer, 287–395 fathoms (517–711 m) (Ortmann, 1906), its main range of vertical distribution is probably between 400–1500 m in the Pacific Ocean (Ortmann, 1906; Banner, 1948; W. M. Tattersall, 1951) and about 2000 m in the South Atlantic and Indian Oceans (O. S. Tattersall, 1955). The deepest record was made by O. S. Tattersall (1955) from 2000–2500 m in the South Atlantic Ocean.

Meterythrops robusta is distributed at 97–432 m (Table 5). Banner (1948) reported that this species mainly lives within 30–150 fathoms (54–270 m) and its distribution ranges from 50 m to 900 m depth. According to W. M. Tattersall (1951), the maximum depth of vertical distribution of this species never exceeds 130 fathoms (234 m), while *M. microphthalma* lives between 200 and 1000 fathoms (360–1800 m). Furthermore, he suggested that the size of the eyes of the latter species being small may be correlated with its bathypelagic inhabit.

In spite of sufficient depth of sampling, no adult *Gnathophausia gigas* is caputured probably due to high capability of the net avoidance or low density of the population. According to the previous records, regardless of the developmental stages, *Gn. gigas* inhabits the water at very wide range of depth from 600 m to 4000 m, sometimes deeper than 5000 m (Fage, 1941), in the whole area of world oceans (Ortmann, 1905, 1906, 1908; Fage, 1941; W. M. Tattersall, 1939b, 1951; O. S. Tattersall, 1955; Pequegnat, 1965).

Summary

1. Five species of Mysidacea and 5 species of Euphausiacea are identified from the samples collected in the south-east of Hokkaido.

2. Comparing the samples from various depths, the vertical distribution and vertical movement of each species are discussed. Four species of euphausiids exhibit daily vertical migration, while no perceivable vertical migration is observed in all species of the mysids which are primarily bathypelagic forms.

* Lecture at the Symposium of Oceanographic Society of Japan, Tokyo, April 1969. These 15 species are referable to Tribe Erythropini of Mysidacea.

Literature Cited

Anonymous (1965). *Data Record of Oceanographic Observations and Exploratory Fishing, Faculty of Fisheries, Hokkaido University*, (9), 106–127.

——— (1966). *Ibid.*, (10), 98–153.

——— (1968). *Ibid.*, (12), 116–171.

Banner, A.H. (1948). A taxonomic study of the Mysidacea and Euphausiacea (Crustacea) of the Northeastern Pacific: I. Mysidacea, from Family Lophogastridae through Tribe Erythropini. *Trans. Roy. Canad. Inst.*, **26** 345–397.

——— (1949). A taxonomic study of the Mysidacea and Euphausiacea (Crustacea) of the Northeastern Pacific: II. Euphausiacea. *Ibid.* **28** 2–63.

——— (1954a). Some "Schizopod" crustaceans from the deeper water off California. *Allen Hancock Found. Pub.*, **13** 1–45 (Occasional paper).

——— (1954b). New records of Mysidacea and Euphausiacea from the Northeastern Pacific and adjacent areas. *Pacif. Sci.*, **8** 125–139.

——— (1954c). A supplement to W. M. Tattersall's review of the Mysidacea of the United States National Museum. *Proc. U.S. Nat. Mus.*, **103** 575–583.

Barham, E.G. (1957). The ecology of sonic scattering layers in the Monterey Bay area. *Hopkins Mar. Sta., Stanford Univ., Tech. Rep.*, (1), 183.

Boden, B.P. (1950). Plankton organisms in the deep scattering layer. *U.S. Navy Electr. Lab., Rep.*, (186), 29.

——— (1962). Plankton and sonic scattering. *Rapp. Cons. Explor. Mer*, **153** 171–177.

———, M.W. Johnson & E. Brinton (1955). The Euphausiacea (Crustacea) of the North Pacific. *Bull. Scripps Inst. Oceanogr.*, **6** 283–400.

——— & E.M. Kampa (1965). An aspect of euphausiid ecology revealed by echosounding in a fjord. *Crustaceana*, **9** 155–173.

Brinton, E. (1962). The distribution of Pacific euphausiids. *Bull. Scripps Inst. Oceanogr.*, **8** 51–276.

——— (1967). Vertical migration and avodiance capability of euphausiids in the California Current. *Limnol. Oceanogr.*, **12** 451–483.

Fage, L. (1941). Mysidacea: Lophogastrida I. *Dana Rep.*, (19), 1–58.

——— (1942). Mysidacea: Lophogastrida II. *Ibid.*, (23), 1–67.

Hansen, H.J. (1911). The genera and species of the order Euphausiacea, with an account of remarkable variation. *Bull. Inst. Oceanogr. Monaco*, (210), 1–54.

——— (1912). Report on the scientific results of the expedition to the tropical Pacific .... by the U.S. Fish Commission Steamer *Albatross*. The Schizopoda. *Mem. Mus. Comp. Zool.*, **35** 175–296.

——— (1915). The Crustacea Euphausiacea of the United States National Museum. *Proc. U.S. Nat. Mus.*, **48** 59–114.

Holt, E.W.L. & W.M. Tattersall (1905). Schizopodus Crustacea from the North-east Atlantic slope. *Ann. Rep. Fish. Ireland, 1902–1903*, Pt. 2(4), 99–151.

Honjo, D. (1957). Distribution of Euphausiacea in the "Kuroshio"area, south of Honshu, May 1955. *Rec. Oceanogr. Work. Japan*, **12** 130–133 (Spec. No.).

Ii, N. (1936). Studies on Japanese Mysidacea I. Descriptions of new and some already known species belonging to the genera *Neomysis*, *Acanthomysis* and *Proneomysis*. *Japanese J. Zool.*, **6** 577–619.

——— (1964). Mysidae. *Fauna Japonica*. Biogeogr. Soc. Japan, Tokyo, 610 pp.

Illig, G. (1930). Die Schizopoden der Deutschen Tiefsee-Expedition. *Deutsch. Tiefsee-Exp. 1898–1899*. Bd. 22, H. 6, 400–625.

Komaki, Y. (1960). On euphausiids collected on the second cruise of the Japanese Expedition of Deep Sea (JEDS-2). *J. Oceanogr. Soc. Japan*, **16** 185–197.

——— & Y. Matsue (1958). Ecological studies on the Euphausiacea distributed in the

Japan Sea. *Rep. Surv. War. Tsushima Curr. Reg. Expl. Mar. Resour.*, **2** 146–162 (in Japanese).

Leavitt, B.B. (1938). The quantitative vertical distribution of macrozooplankton in the Atlantic Ocean basin. *Biol. Bull.*, **74** 376–394.

Marukawa, H. (1928). Über neue 5 Arten der Schizopoden. *Annot. Oceanogr. Res.*, **2** 1–6.

Motoda, S. (1967). Devices of simple plankton apparatus III. *Bull. Fac. Fish., Hokkaido Univ.*, **18** 3–8.

——— & M. Anraku (1954). Daily change of vertical distribution of plankton animals near western enterance to the Tsugaru Strait, Northern Japan. *Ibid.* **5** 15–19.

Nemoto, T. (1962). Distribution of five main euphausiids in the Bering and the northern part of the North Pacific. *J. Oceanogr. Soc. Japan*, 20th Anniv. Vol., 615–627.

——— (1963). A new species of Euphausiacea, *Thysanoessa inspinata*, from the North Pacific. *Ibid.* **19** 41–47.

——— (1966). *Thysanoessa* euphausiids, comparative morphology allomorphosis and ecology. *Sci. Rep. Whales Res. Inst.*, (20), 109–155.

Ortmann, A.E. (1905). Schizopods of the Hawaiian Islands collected by the Steamer *Albatross* in 1902. *U.S. Fish. Comm., Bull.*, Pt. 3, 961–973.

——— (1906). Schizopod Crustaceans in the United States National Museum. The families Lophogastridae and Eucopidae. *Proc. U.S. Nat. Mus.*, **31** 23–54.

——— (1908). Shizopod Crustaceans in the United States National Museum. Schizopods from Alaska. *Ibid.* **34** 1–10.

Pequegnat, L.H. (1965). The bathypelagic mysid *Gnathophausia* (Crustacea) and its distribution in the Eastern Pacific Ocean. *Pacif. Sci.*, **19** 399–421.

Ponomarev, L.A. (1957). Distribution of zooplankton in the southern half of the Tartary Strait (from collection of May 1951). *in* Marine Biology (Nikitin ed.), *Trans. Inst. Oceanol.*, **20** 200–205 (in English translated edition in 1959).

Ponomareva, L.A. (1963). Euphausiids of the North Pacific. *AN USSR Inst. Oceanol.*, 154 pp. (English translated edition in 1966).

Sars, G.O. (1885). Report on the Schizopoda collected by *H.M.S. Challenger* during the years 1873–1876. *Challenger Rep., Zool.*, **13**(3), 1–228.

Suzuki, T. (1963a). Vertical shift of deep scattering layer induced by diurnal change of underwater light intensities and migration of zooplankton, observed off Cape Erimo, Hokkaido. *Bull. Japanese Soc. Sci. Fish.*, **29** 1000–1004.

——— (1963b). Studies on the relationship between current boundary zone in waters to the southeast of Hokkaido and migration of the squid, *Ommastrephes sloani pacificas* (STEENSTRUP). *Mem. Fac. Fish. Hokkaido Univ.*, **11** 75–153.

———& J. Ito (1967). On the DSL in the northwestern area of the North Pacific Ocean — I. Relationship between vertical migration of DSL, submarine illumination and plankton biomass. *Bull. Japanese Soc. Sci. Fish.*, **33** 325–336.

Tattersall, O.S. (1955). Mysidacea. *Descovery Rep.*, **28** 1–190.

Tattersall, W.M. (1939a). The Mysidacea of eastern Canadian waters. *J. Fish. Res. Bd. Canad.*, **4** 281–286.

——— (1939b). The Euphausiacea and Mysidacea of the John Murray Expedition to the Indian Ocean. *John Murray Exp. 1933–34, Sci. Rep.*, **5** 203–246.

——— (1951). A review of the Mysidacea of the United States National Museum. *U.S. Nat. Mus.*, Bull. 201, 292 pp.

Tsuruta, A. (1953). Distribution of plankton and characteristics in the oceanic fishing grounds, with special reference to their relation to fishery. *J. Shimonoseki Univ. Fish.*, **12** 13–214.

Zimmer, C. (1904). Die Nordischen Schizopoden. *Nordisches Plankton, Zool.* 3, *Malacostraca* 6, 1–178.