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Euphausiid larvae in the Scotia Front west of Elephant Island (BIOMASS III, October—November 1986)

ABSTRACT: In the planktonic material collected using a Nansen net (vertical hauls) larvae of two euphausiid species were found. The dominant and occurring in all stations were larvae of *Thysanoessa macrura*. Following larval stages were encountered: nauplius, metanauplius, calyptopis I and calyptopis II. The most numerous and occurring in the widest depth spectrum were calyptopes I. Only twice furcilia VI of *Euphausia superba* were found. The distribution of euphausiid larvae was influenced by the stratification and circulation of water masses in the investigated area.

Key words: Antarctica, Euphausiacea larvae, BIOMASS III.

1. Introduction

Studies of larval stages of Euphausiacea belonged to main goals of the BIOMASS III zooplankton investigations. Studies were carried out in two areas. The first was situated to the south-west of the Elephant Island, the second one — in the Bransfield Strait (Fig. 1). The present results concern the studies in the area 1. Many authors have treated the problem of vertical and horizontal distribution of Euphausiacea larvae. Most papers, however, were devoted to the *Euphausia superba* Dana larvae. Larvae of *Thysanoessa macrura* G. O. Sars were discussed in few papers only (Makarov 1979a; Fevolden 1979, 1980; I. Hempel and Marschoff 1980; I. Hempel 1981; I. Hempel and G. Hempel 1982).

The present paper adds some information to the problem of the quantitative and vertical distribution of *T. macrura* larvae in the area under influence of the Scotia Front.

2. Material and methods

Material was collected in 9 stations of the area 1 during the cruise of r/v "Profesor Siedlecki" from 31 October to 3 November 1986 in the framework of BIOMASS III Program (Fig. 1). Detailed data characterizing particular stations are to be found in the papers by Grelowski and Wojewódzki (1988) and by Rakusa-Suszczewski (1988a and b). Samples were taken using a Nansen planktonic net of the mouth opening surface of 0.4 m^2 and of 200 μm mesh size. Hauls were taken in particular layers from the bottom to the surface. The number, depth and thickness of each layer varied and depended on the temperature characteristics of particular station determined earlier by the Bisset-Berman sounder. Usually 3 or 4 layers were sampled.

Samples were preserved in 4% formaline solution. In the laboratory euphausiid larvae and their stages were determined and counted; numbers were calculated for 1000 m^3 of sea water for each water layer.

During the larvae determination following papers were consulted: Fraser (1936), Percova (1976), Makarov (1979b), Fevolden (1980) and Kirkwood (1982).

3. Results

In the material there were encountered larvae of only two species: *Thysanoessa macrura* and *Euphausia superba* (Tab. 1).

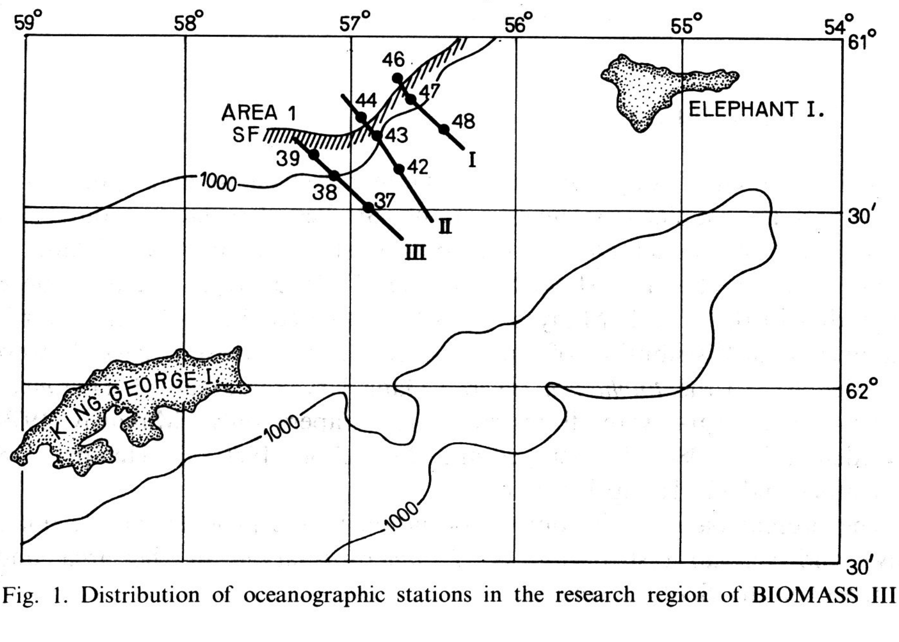

Fig. 1. Distribution of oceanographic stations in the research region of BIOMASS III

Table 1

Vertical distribution of euphausiid larvae (ind. 1000 m^{-3})

Nauplius, metanauplius, calyptopis I, calyptopis II — larval stages of *Thysanoessa macrura*; furcilia VI — larval stage of *Euphausia superba*

Transect I

Station No	46				47				48		
Layer (m)	0—75	75—200	200—600	600—1800	0—100	100—350	350—500	500—880	0—100	100—300	300—400
Nauplius			13				117	237			25
Metanauplius			38				100	184			
Calyptopis I		100	225			230	650	1184		50	300
Calyptopis II											
Furcilia VI											

Transect II

Station No	42			43				44			
Layer (m)	0—100	100—250	250—400	0—100	100—300	300—500	500—1200	0—75	75—200	200—700	700—1500
Nauplius			50				7				
Metanauplius			16								
Calyptopis I		350	533		13	77	4		357	161	34
Calyptopis II											
Furcilia VI		17		50							

Transect III

Station No	37				38				39			
Layer (m)	0—100	100—300	300—375	375—450	0—150	150—300	300—400	400—680	0—100	100—400	400—700	700—1400
Nauplius												
Metanauplius			33									
Calyptopis I	25	25			150	183		90		225	183	
Calyptopis II	50					16						
Furcilia VI									50		16	

Thysanoessa macrura

Larvae of this species were found in all stations investigated. Their abundance distinctly increased in the direction from SW to NE in the studied area. Four stages were recorded: nauplius, metanauplius, calyptopis I and calyptopis II. Nauplii were found in 5 stations situated in central and northern part of the area. Their highest abundance (300 ind. 1000 m^{-3}) was noted at the station 47. Metanauplii occurred in 4 stations only. Their abundance ranged from 20 to 280 ind. 1000 m^{-3} (st. 47).

The most abundant and occurring in all stations were larvae in the stage of calyptopis I. Their abundance ranged from 50 to 2060 ind. 1000 m^{-3}

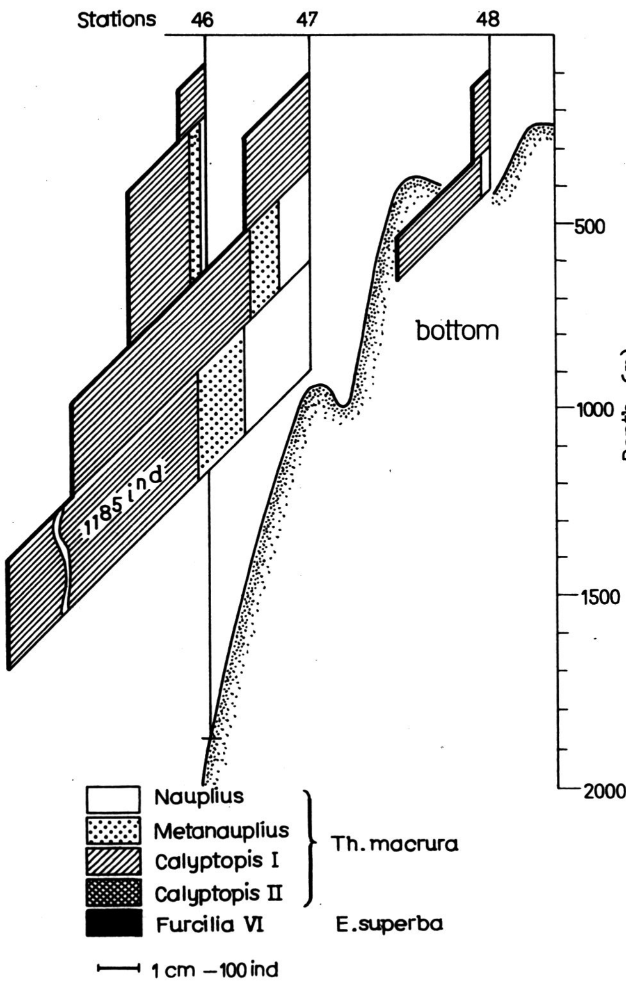

Fig. 2. Vertical distribution of larvae in transect I

Larvae in the stage of calyptopis II were encountered in two stations only (37 and 38) situated in the southern part of the studied area.

Vertical distribution of larval stages of *T. macrura* is presented for three cross-sections of the area (Fig. 1), each section running from the shelf to the deep continental slope.

In section I (st. 46, 47 and 48; Fig. 2) the larvae of *T. macrura* were the most abundant, but they were not found in the uppermost layer (0—100 m). Larvae occurred in depths from 100 to 500 m, their highest abundance was noted in the layer from 300 to 900 m. Nauplii and metanauplii occurred in depths from 200 to 500 m, whereas calyptopes I were found from 100 to 900 m. All three larval stages were most abundant at station 47.

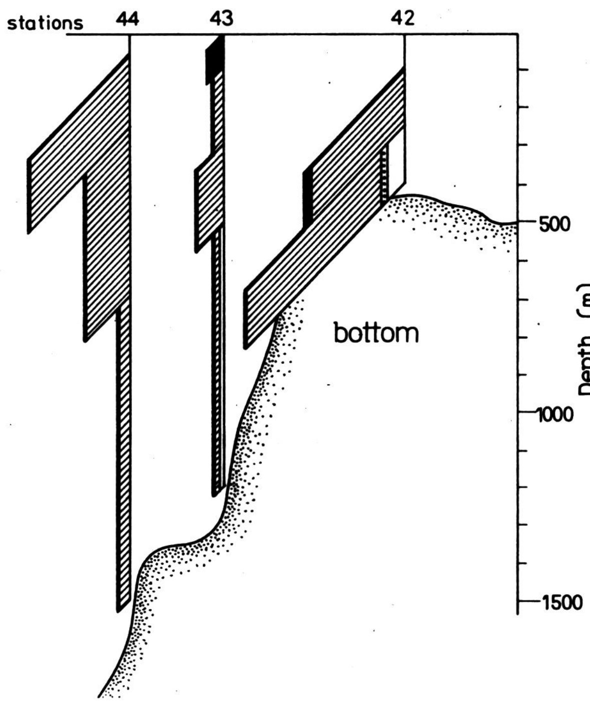

Fig. 3. Vertical distribution of larvae in transect II

In section II (st. 42, 43 and 44; Fig. 3) similarly as in section I, the larvae occurred in lower layers and were found as deep as 1500 m, with highest density in the layer 100—400 m, where calyptopes I distinctly dominated. Nauplii were encountered in depths from 250 to 1200 m, small numbers of metanauplii occurred in the layer of 250—400 m.

In section III (st. 37, 38 and 39; Fig. 4) larvae of *T. macrura* occurred from the surface down to the depth of 700 m. Calyptopis I stage dominated

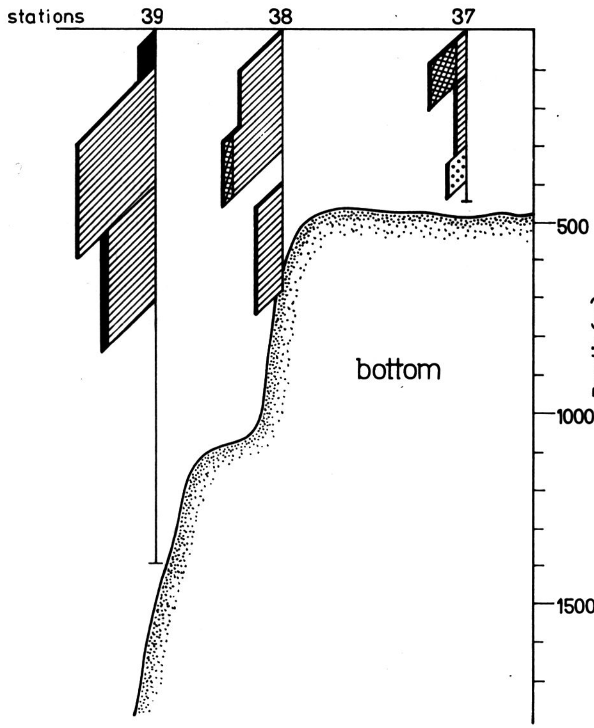

Fig. 4. Vertical distribution of larvae in transect III

and their highest abundance was observed in the layer 100—700 m. In this section only in two stations (37 and 38) calyptopes II occurred.

As a rule, as it could be expected, in all sections the younger larvae (nauplii and metanauplii) occurred in lower layers — below the depths of 200, 250 or 300 m.

Euphausia superba

Only the stage furcilia VI of this species was found and only in three stations (37, 42 and 43) with rather low abundance of 20 to 70 ind. 100 m^{-3}.

4. Discussion

Larvae of *T. macrura* were caught in many earlier studies (Makarov 1979a; Fevolden 1979, 1980; I. Hempel and Marschoff 1980; I. Hempel 1981; I. Hempel and G. Hempel 1982). They were collected, however, mostly in the period from January to March, i.e. in full Antarctic summer, whereas the present investigations were carried out in early austral spring (at the turn of October and November). Moreover most of the above mentioned authors have used RMT or Bongo nets, that are more efficient than the Nansen net, however the water layer sampled by these authors was usually an upper one only (0—200 m). Therefore our results are difficult to be compared with the above mentioned data. Only Makarov's (1979a) results can be used for closer comparison since he has collected his material in the Scotia Sea using a vertically hauled Juday net in particular water layers beginning from the depth of 1000 m and his studies were performed in September and October 1971 and in December 1974 and January 1975. In early Antarctic spring of 1971 Makarov (1979a) has observed nauplii, metanauplii and calyptopes I and II of *T. macrura* — so the same stages that were found in the present study. Makarov observed these larvae in low abundance in depths from 100 to 500 m. In December and January of the 1974/75 season the same author observed already all larval stages of *T. macrura* with clear dominance of calyptopis stages, especially in northern parts of his study area, where furciliae were also found. In southern part of the area studied by Makarov (1979a) the total abundance of larval stages of *T. macrura* was high with distinct dominance of younger larval stages (nauplius, metanauplius and calyptopis); furciliae were very scarce. Nauplii and metanauplii were encountered in the layer 200—1000 m; calyptopes — mainly in the layer 100—500 m. These results of Makarov (1979a) correspond well to the results of present investigations that were carried out approximately in the same region as the southern part of the Makarov's study area. In our study, in the turn of October and November, the same larval stages were observed as it was found somewhat earlier by Makarov; vertical distribution of particular larval stages was also similar in both studies. In the uppermost 100—200 m water layer larvae were found very rarely and in low abundance. Both studies indicate that in the austral spring the main layer of the occurrence of *T. macrura* larvae is that of 200—1000 m. Furciliae were not yet to be found. I. Hempel (1981) who has searched only the uppermost 200 m water layer near the Elephant Island in November and December of 1977 has found only calyptopis stages. Furciliae were observed in this area by I. Hempel (1981) only in January 1978, whereas in this period in the nearby area of the Scotia Sea both calyptopes and furciliae did occur, I. Hempel (1981) is of the opinion that in west Antarctic waters in early spring larvae of *T. macrura* are the most abundant euphausiid larvae in the plankton. High abundance of *T. macrura* larvae in the Scotia Sea in November 1975 (mean of about 3000 ind. 1000 m^{-3}) was also observed by I. Hempel and Marschoff (1980) however the information which particular larval stages were in question is lacking. The available information on the periods of the occurrence of particular larval stages of *T. macrura* are presented in Fig. 5.

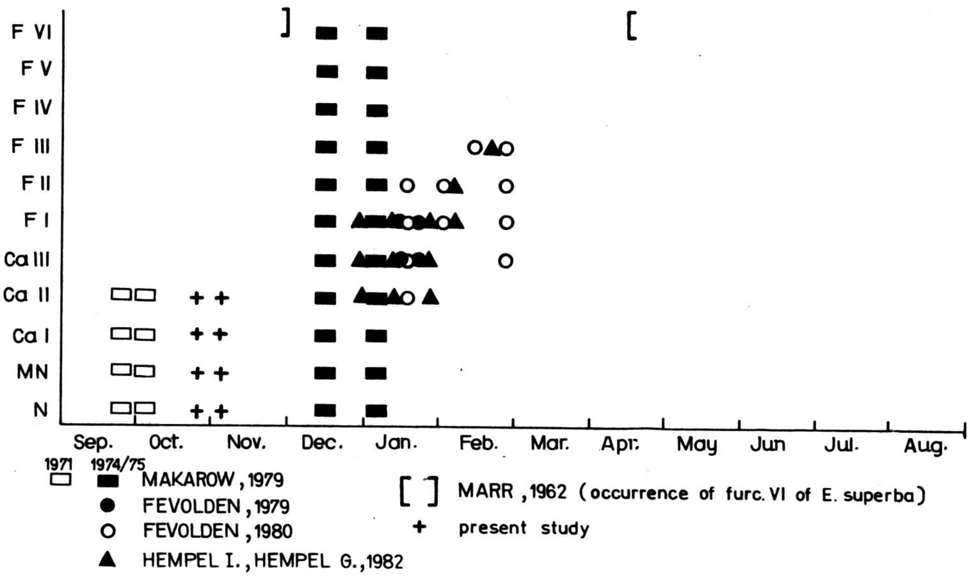

Fig. 5. Periods of the occurrence of larvae of *Thysanoessa macrura* and *Euphausia superba* according to various authors

The presence of furciliae VI of *E. superba* in our October/November material fits well to the data of Marr (1962) and Witek, Koronkiewicz and Soszka (1980); according to these authors the period of occurrence of the furciliae VI of *E. superba* lasts from April to December.

The studied area is a small water sector of Antarctica influenced by the Scotia Front running between stations 46 and 47 as well as between stations 44 and 43, and to the north of station 39 (Rakusa-Suszczewski 1988b).

From the present results (Fig. 2—4) it can be concluded that the distribution of euphausiid larvae, in fact *T. macrura* larvae, was influenced by the specific stratification and circulation of water masses of the study area (Grelowski and Wojewódzki 1988, Rakusa-Suszczewski 1988b). In the surface waters of winter modification (0—100 m) the generally not abundant larvae were encountered only in stations of the IIIrd section and in one station of section II (st. 43). Euphausiid larvae occurred mainly in warmer, deeper waters below 100 m and down to several hundred meters. The phenomena connected with water mixing distinctly influenced the abundance distribution of larvae in the water column. It was especially clearly seen in northern part of the area and particularly in station 47, where very high abundance of larvae observed in a comparatively deep water layer of 400—900 m corresponded well to the special hydrological situation (downwelling) observed in this very station by Grelowski and Wojewódzki (1988). Lipski and Zieliński (1988) and Rakusa-Suszczewski (1988b).

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6. Streszczenie

Badania prowadzono na 9 stacjach trzech przekrojów poligonu I w ramach programu BIOMASS III, usytuowanych w rejonie Frontu Scotia (rys. 1). Próby pobierano za pomocą siatki Nansena w okresie od 31 października do 3 listopada 1986 r. Zaciągi wykonywano warstwowo. Liczba i głębokość poszczególnych warstw uzależniona była od wykresu temperaturowego każdej stacji.

W pracy omówiono rozmieszczenie horyzontalne i głębokościowe larw *Thysanoessa macrura* G. O. Sars i *Euphausia superba* Dana (tab. 1; rys. 2—4). Dominującymi i występującymi we wszystkich stacjach były larwy *T. macrura*. Stwierdzono je w czterech stadiach: nauplius, metanauplius, calyptopis I, calyptopis II. Najliczniej i w najszerszym spektrum głębokościowym łowiono larwy calyptopis I. Larwy w stadium nauplius stwierdzono w pięciu stacjach; metanauplius w trzech; a calyptopis II tylko w dwóch stacjach III przekroju. Larwy *E. superba* w stadium furcilia VI stwierdzono dwukrotnie. W oparciu o uzyskane wyniki badań częściowo uzupełniono fenologię larw *T. macrura* (rys. 5).

Na rozmieszczenie larw Euphausiacea miały wpływ: szczególna stratyfikacja i cyrkulacja wód badanego akwenu. Larwy występowały tylko nielicznie w górnej (0—100 m) warstwie wody, natomiast najliczniej były łowione w głębszych, cieplejszych warstwach wody, do głębokości kilkuset metrów. Szczególnie licznie larwy Euphausiacea występowały w rejonie zstępowania (downwelling) wód (st. 47).