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EUPHAUSIID LARVAE COLLECTED FROM THE PRYDZ BAY REGION DURING THE NELLA DAN CRUISE (SIBEX I)

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Abstract: The larvae of four euphausiid species were collected from the Prydz Bay region, Antarctica, between 14 January and 6 February 1984, *Thysanoëssa macrura, Euphausia crystallorophias, E. frigida* and *E. superba.* The most common species was *T. macrura,* occurring in all but one station. All larval stages from metanauplius to furcilia VI were recorded. *E. crystallorophias* was common in most inshore stations. The particularly high proportion of calyptopis I suggested that *E. crystallorophias* had only just started to reproduce, whereas the large numbers of *T. macrura* furcilia indicated that this species had been breeding for some time. Data also suggests that either the breeding season or growth rates of *T. macrura* varies within the locality. Although specimens of *E. superba* and *E. frigida,* mainly calyptopis larvae, were collected, neither species was particularly abundant.

1. Introduction

The bulk of the information on the larval ecology of Antarctic euphausiids comes from the Atlantic sector of the Southern Ocean, *i.e.* Weddell and Scotia Seas, and from waters immediately west of the Antarctic Peninsula (*e.g.* FEVOLDEN, 1979, 1980; MAKAROV, 1979; HEMPEL *et al.*, 1979; HEMPEL, 1981; HEMPEL and HEMPEL, 1982; BRINTON and TOWNSEND, 1984; RAKUSA-SUSZCZEWSKI, 1984). At the beginning of 1984 the Australian Antarctic Division carried out a krill/zooplankton sampling programme within the Prydz Bay region of Antarctica. This programme was initially scheduled as part of SIBEX I, however due to logistic contraints Australia withdrew from SIBEX and the programme was subsequently reduced and renamed ADBEX II (Antarctic Division BIOMASS Experiment II). ADBEX I occurred at the end of 1982. This paper presents data on the distribution and abundance of euphausiid larvae collected during the ADBEX II cruise. For further details of the sampling programme as well as results for other zooplankton see IKEDA *et al.* (1984).

2. Methods

Larvae were collected between 14 January and 6 February 1984 during the supply cruise of the M. S. NELLA DAN to the Australian Antarctic stations, Davis and Mawson. Sampling stations were located along three longitudinal transects (58°, 60°, 73°E) between 63° and 67°40′S. Oblique hauls were made from 200 m to the surface using a bongo net of 0.5 m^2 total mouth area and 300 μm mesh. A TSK flowmeter was mounted in the mouth of one net to estimate the volume of water filtered, while a TSK depth-distance meter was mounted in the other net to confirm the depth and course of the net. The catches were preserved in Steedman's solution (STEEDMAN, 1976). Larvae were later sorted from the catches on return to Australia and identified according to MAKAROV (1980).

3. Results and Discussion

The larvae of four species of euphausiids were observed, *Thysanoëssa macrura*, *Euphausia crystallorophias*, *E. frigida* and *E. superba*. The most abundant species was *T. macrura*, occurring in all but one station (Fig. 1). Two naupliar stages of this species, nauplius I and II, were not observed: and specimens of the metanauplius stage were few (Fig. 2). MAKAROV (1979) noted that within the Scotia Sea the nauplius and metanauplius stages of *T. macrura* were mainly found in deep water layers between 200 and 1000 m as this species exhibits a developmental ascent similar to *E. superba* (MARR, 1962). It is likely, therefore, that the sampling method employed in the present study precluded the efficient collection of the early stages of *T. macrura*. The most common stages observed were the furcilia I and the three calyptopis stages. However, the other furcilia stages II to V were also fairly abundant, suggesting that *T. macrura* had been breeding for some time. This is consistent with MAKAROV (1979) who noted an early start to spawning in September with an associated protracted season in the Scotia Sea. High abundances of *T. macrura* larvae have also been observed within this region (MARSCHALL and MIZDALSKI, 1985), at times dominating other euphausiid species (HEMPEL, 1981).

While the larvae *T. mucrura* were relatively abundant in all stations, the distribution of the various developmental stages was not geographically uniform. The dotted line shown in Fig. 1 separates stations where calyptopis larvae predominated (*i.e.* $>50\%$ of the total number of larvae) from those where furcilia larvae predominated ($>50\%$). That is, while the densities of calyptopis larvae were similar north and south of this line, a far greater proportion of the furcilia larvae were found in the north (Fig. 3). Surface water temperatures between stations were variable with no clear discernible pattern and while there was a small variation in salinity at the surface, at depths below 50 m there was virtually no difference between stations (Drs. K. KERRY and R. EDWARDS, personal communication). The dotted line, however, closely coincides with a boundary between northern stations where water temperatures were $>1°C$ (max. 1.5°C) between 100 and 1000 m and southern stations with temperatures $<-1°C$ (min. $-1.8°C$) between 50 and 1000 m or the bottom (Drs. K. KERRY and R. EDWARDS, personal communication). This large difference in water temperature may therefore directly account for the differences in the composition of developmental stages between northern and southern stations. The growth rate of larvae in the warmer outer stations was probably faster than that of larvae in the colder inner stations. Alternatively the temperature difference may be indicative of two different water masses with different times for spawning, *e.g.* the colder waters may have delayed the onset of spawning at inshore stations. The phenomenon of earlier spawning in northern latitudes is well known for Southern Ocean zooplankton (MAKAROV, 1979). The stations at 64° and 65°S on the 58°E transect,

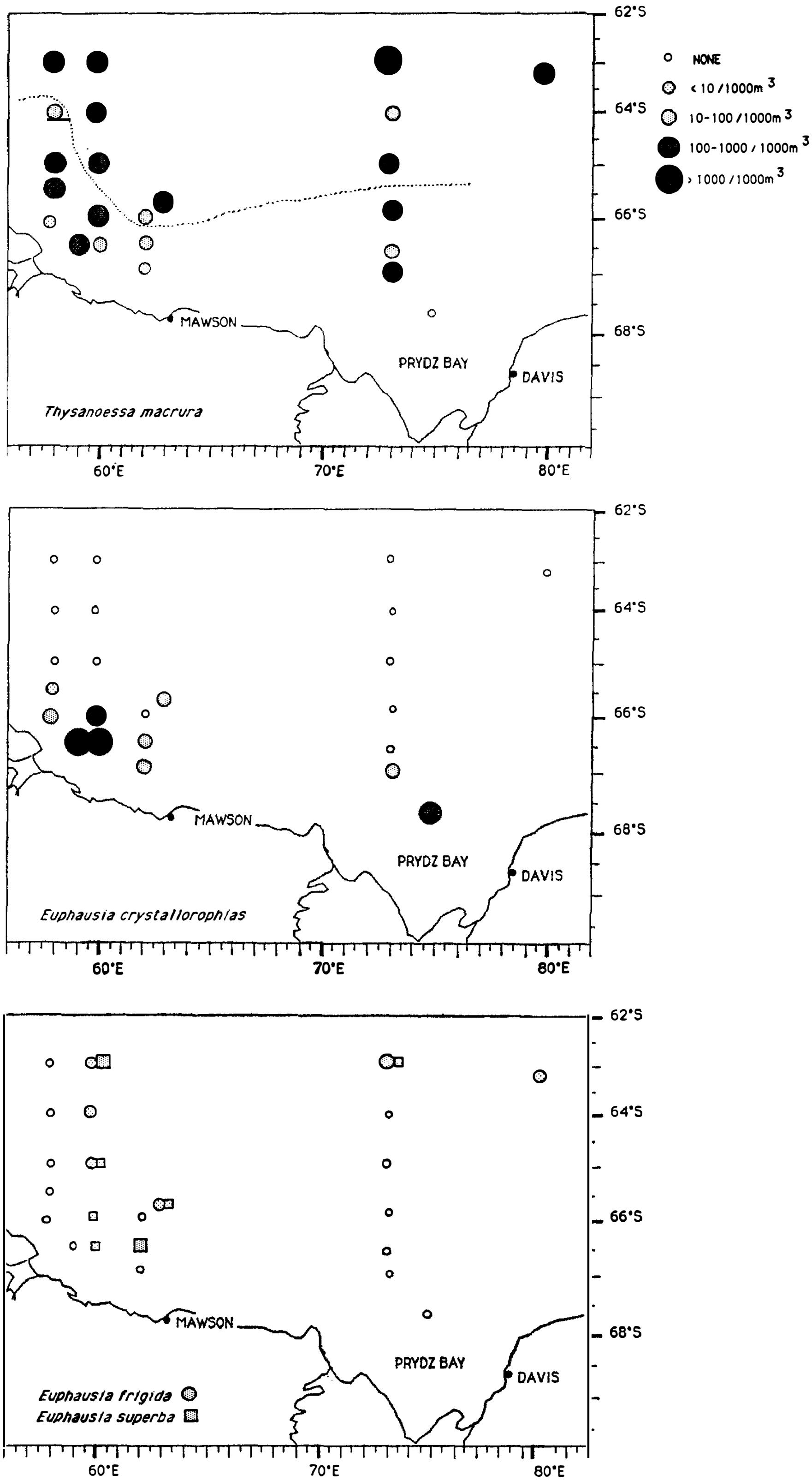

Fig. 1. Distribution and abundance of larvae of the four euphausiid species observed. The dotted line on the T. macrura *distribution shows the boundary between stations with a mostly calyptopis component (south) from those with mainly furcilia (north).*

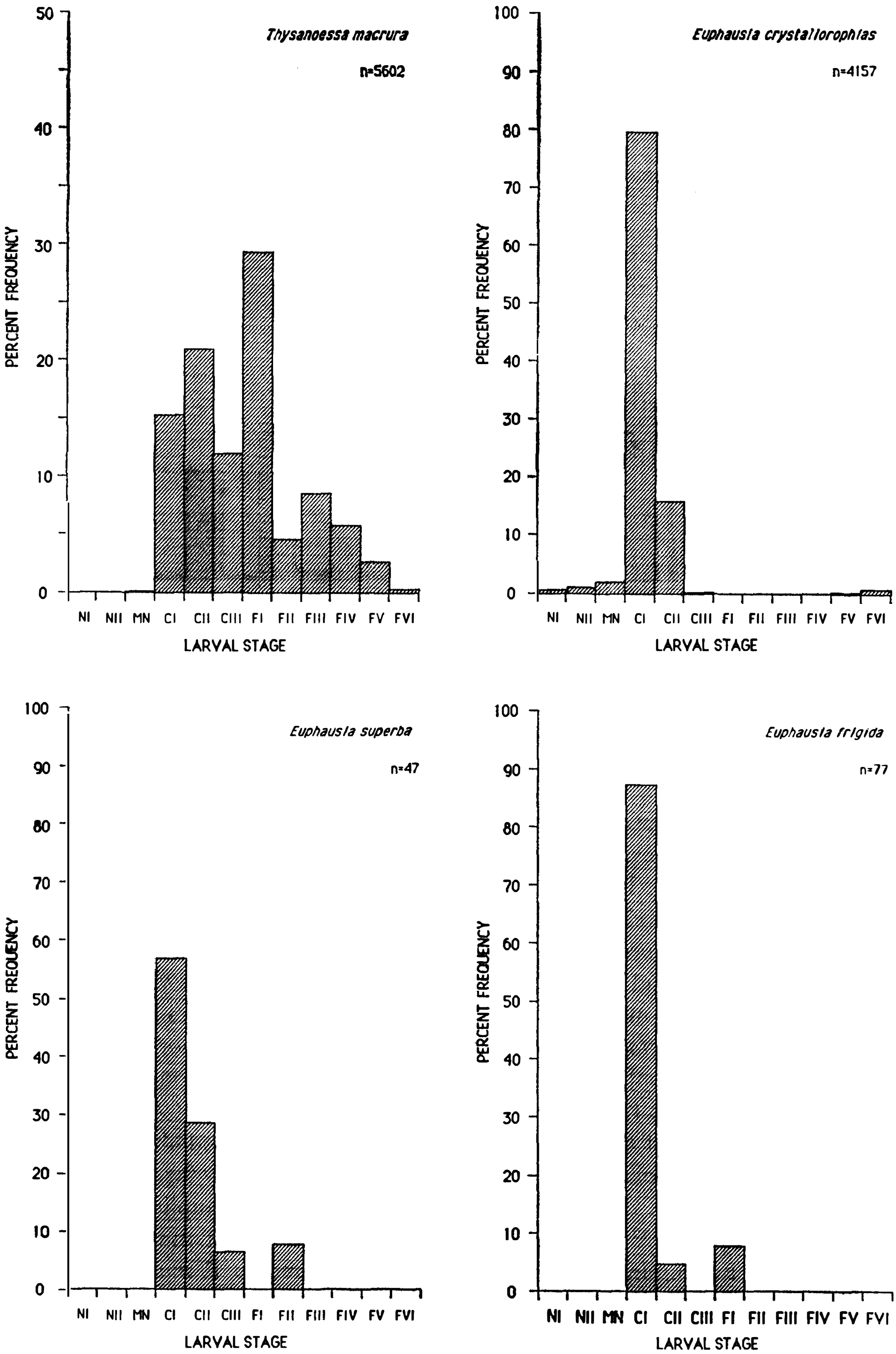

Fig. 2. Frequency distribution of developmental stages within each species. Nauplius I and II (NI, NII), metanauplius (MN), calyptopis I, II, III (CI, CII, CIII), furcilia I to VI (FI to FVI).

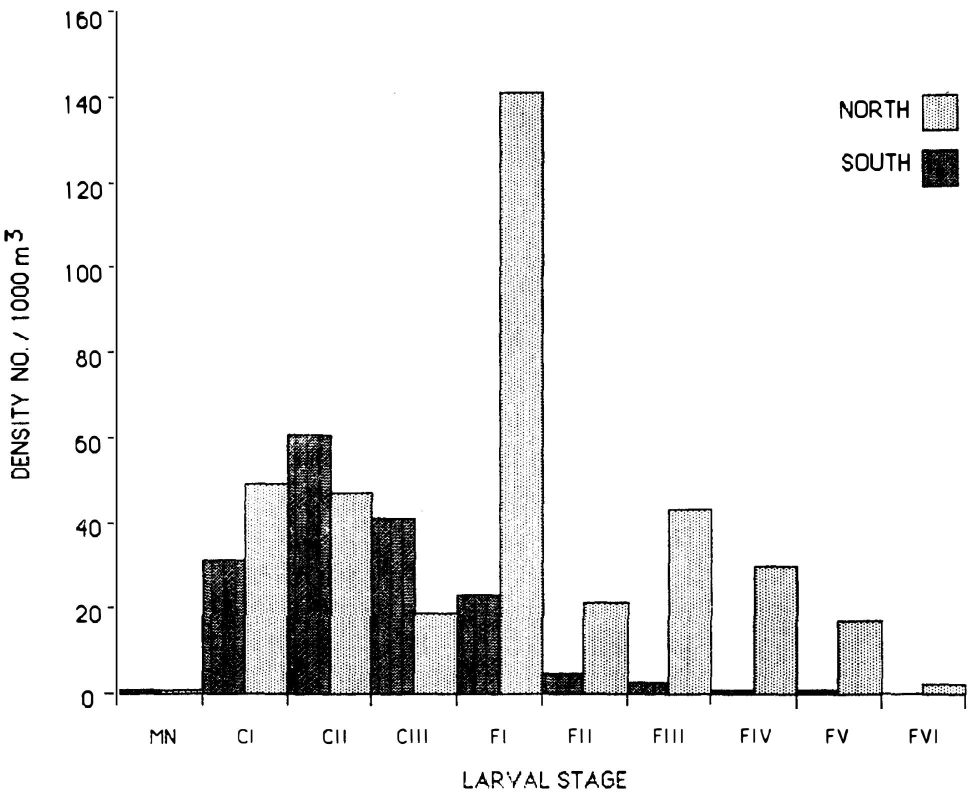

Fig. 3. Frequency distribution of developmental stages of T. macrura, *showing the difference in composition and abundnace between northern and southern stations.*

however, appear to be exceptions in this matter. While the larvae at these stations were predominantly calyptopis, the water temperatures were more similar to that of the other northern stations, thus suggesting another factor influencing the distribution of developmental stages. It is possible that spawning may have occurred inshore and that the larvae have extended their distribution offshore with growth. However, this seems unlikely. *T. macrura* has a widespread circumpolar distribution extending south from 50°S (Mauchline and Fisher, 1969). There is no evidence as yet to suggest that *T. macrura* is capable of migrating large distances to inshore waters in order spawn.

The larvae of *E. crystallorophias* occurred in only the more inshore stations (Fig. 1), basically those on the continental shelf. Although this distribution is to be expected since the species is neritic (John, 1936; Mauchline and Fisher, 1969), the distribution may also be a function of the inshore colder water mass mentioned above. Within this region where *E. crystallorophias* dominated, the calyptopis I was by far the most common developmental stage with only a few nauplius I and II, metanauplius and calyptopis II and III, and furcilia V and VI (Fig. 2). This phenomenon may indicate only a recent onset of spawning in *E. crystallorophias* as compared to *T. macrura*. Fevolden (1979, 1980) also noted a large January peak of *E. crystallorophias* calyptopis larvae in the Atlantic sector and suggested that this was the result of a limited spawning season, possibly in December. The furcilia larvae recorded in the present study may have overwintered from the previous summer spawning. Ikeda (1986) has shown for *E. crystallorophias* that it takes 100 days and 8 months for the furcilia III and furcilia VI stages to develop from the egg, respectively. Therefore, it is unlikely that the furcilia V and VI stages of the present study were a result of the current spawning period.

Euphausia frigida and *E. superba* larvae were few and they were mainly calyptopis stage (Fig. 2). *E. frigida* is known to start spawning in early spring around the same time as *T. macrura* (FEVOLDEN, 1979; MAKAROV, 1979), therefore it is surprising that many furcilia were not collected in the present study. The small occurrence of *E. frigida* larvae is most likely a reflection of the overall low population biomass of this species within the study area. No *E. frigida* adults were recorded during ADBEX II (IKEDA *et al.*, 1984). Spawning in *E. superba* has been reported to occur in summer, *i.e.* December to January (MAKAROV, 1979; RAKUSA-SUSZCZEWSKI, 1984) and often occurred after the onset of *E. crystallorophias* spawning (FEVOLDEN, 1979, 1980; HEMPEL and HEMPEL, 1982). RAKUSA-SUSZCZEWSKI (1984) noted that the spawning period for *E. superba* may extend from November to April and that the time of maximum spawning is likely to vary considerably between years. The low numbers of *E. superba* larvae in this study suggests that sampling may have preceded the main period of spawning in the Prydz Bay region. The low proportion of gravid *E. superba* females observed during ADBEX II tends to confirm this (IKEDA *et al.*, 1984). If spawning had only just commenced in the region, then larvae, mainly at the nauplius and metanauplius stages, would most likely have been below the water depths sampled because of their ontogenetic migration (MARR, 1962; HEMPEL *et al.*, 1979).

Overall, the results of this study are consistent with those from the Atlantic sector mentioned above. That is, *T. macrura* begins spawning early, possibly for a protracted period. In turn, *E. crystallorophias*, with a totally inshore distribution, spawns after *T. macrura* but apparently before *E. superba*. While the Prydz Bay area was sampled too early to comment on the abundance of *E. superba*, *T. macrura* and *E. crystallorophias* are notably important euphausiids within the region.

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