3.4 Micronekton of the Weddell Sea: Distribution and abundance

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Objectives

Recent studies on the zooplankton and micronekton distribution in the Weddell Sea have revealed three distinct communities which are closely related to bathymetric and hydrographic conditions (BOYSEN-ENNEN & PIATKOWSKI, 1988 among others). Although these communities have been described previously, their transition zones or boundary regions are not well known. A fine-scale transect or grid of sampling stations is necessary to reveal the changes in the community composition in these transition areas. Accordingly, in parallel with the hydrographic, benthic and ichthyological research during EPOS leg 3 two transects at right-angles to the coast line, one off Halley Bay, the other off Kapp Norvegia, were selected to investigate the transition zone between shelf and oceanic micronekton communities in more detail.

The pelagic communities are subject to diel changes in composition, structure and abundance. In an ideal sampling programme, this variable would be eliminated by collecting samples at the same time each day or by sampling at regular intervals throughout each 24 hour cycle. It was impractical to undertake this type of approach during of EPOS leg 3 but as means of identifying the magnitude of diel variations occurring within the pelagic community a time station was undertaken near Kapp Norvegia.

The objectives of the micronekton studies during EPOS leg 3 were:

- To describe the micronekton communities and their changes occurring in the eastern Weddell Sea, with particular attention to the transition from the neritic to the oceanic community;
- to interpret these results in relation to the physical and chemical structure of the water column, bathymetry and biotic factors, and to compare these observations with previous results from the Weddell Sea;
- to examine the changes in micronekton vertical distribution resulting from diel variations in the light environment;
- to obtain samples to study trophic interactions between the benthic and pelagic communities, particularly in relation to resource partitioning of demersal fish;
- to obtain samples of squid for life history analysis;
- to sample and maintain live micronekton organisms for investigations of behaviour and to identify species which can be readily kept.

Initial observations reported here relate only to the material from RMT8 net samples which were roughly sorted during the cruise. The RMT1 net samples require detailed laboratory treatments and will be processed in laboratories in Germany and UK before further analyses can be carried out.

Work at sea

Samples of micronekton were collected using a multiple rectangular midwater trawl (RMT8+1M) with net apertures of 1 m^2 (335 micron mesh) and 8 m^2 (4.5 mm mesh) deployed on a 18 mm coaxial conducting trawl wire. Information from the net and net commands to the net were recorded by an onboard computing system. Depth, water temperature, filtered water volume, tilt angle, time and status of the net were displayed in real time using software developed at the AWI. Altogether 30 RMT hauls were carried out (see station list).

At most locations the water column was stratified except along the Kapp Norvegia transect where the surface waters were well mixed due to a recent storm. RMT hauls were made to sample these layers as discretely as practical. The standard RMT8+1M haul sampled the upper 300 m of the water column in 300 to 200 m, 200 to 70 m and 70 to 0 m strata at the Halley Bay and Kapp Norvegia transects. Additional hauls from near the seafloor to 300 m were made at the outer 6 stations at the Halley Bay transect to obtain samples from the whole water column. A routine haul of 800 to 300 m, 300 to 100 m and 100 to 0 m was adopted at the time station to sample both the mesopelagic components and near-surface micronekton and to detect the vertical migration of the micronekton within the diel cycle. The RMT8+1M net was deployed to collect samples as an upward oblique haul. The descent rate was normally 0.4 m/sec, the ascent rate was 0.3 m/sec.

The samples were maintained in seawater at ambient temperatures before being processed in the laboratory. The approximate wet volume and major components were assessed, then the RMT8 net samples were rough sorted to extract the ichthyoplankton and squid for examination during the progress of EPOS leg 3. The remainder of each sample was fixed in buffered 4 % seawater-formaldehyde solution. In addition, length frequencies of euphausiid species were recorded from samples at the Halley Bay transect and 9 stations of this transect sorted completely during the cruise. The RMT1 samples were fixed without any preliminary processing.

In addition to the RMT sampling, 17 Bongo hauls were performed in the Halley Bay region. The Bongo nets (300 micron mesh) were hauled vertically through the upper 300 m water column directly after CTD casts. This equipment collected 34 zooplankton samples which will be evaluated in combination with the RMT samples.

Both the RMT8+1M and Bongo nets captured a large number of live micronekton specimens from which small sub-samples were separated, recorded and transferred into aquaria. These were kept in a constant temperature laboratory container (-1°C). The temperature of the seawater within the aquaria varied from -0.5° to -1.0°C. The water was exchanged approximately each third day, the animals were fed with various microalgae.

Preliminary results

Rough sorting of the RMT8 net samples yielded a total of at least 76 micronekton and ichthyoplankton species, copepods and ostracods excluded. More than 5200 larval and small juvenile fish which comprised 25 species (Table 3) were removed from the samples. Most of these were collected from the Halley Bay transect and the time station samples.

Table 3. Number and species of fish sampled using RMT8 during EPOS leg 3.

Species*	Number of specimens
Pleuragramma antarcticum	4176
Chionodraco myersi	307
Chionodraco hamatus	1
Chionodraco rastrospinosus	1
Chaenodraco wilsoni	3
Cryodraco antarcticus	1
Dacodraco hunteri	23
Pagetopsis sp.	206
Aethotaxis mitopteryx	234
Trematomus lepidorhinus	9
Trematomus sp.	3
Notolepis sp.**	55
Bathylagus sp.	59
Electrona antarctica	29
Gymnoscopelus opisthopterus	1
Gymnoscopelus braueri	1
Racovitzia glacialis	27
Akarotaxis nudiceps	2
Prionodraco evansi	19
Gerlachea australis	2
Bathydraco antarcticus	2
Bathydraconid sp.	1
Artedidraconid sp. a	2
Artedidraconid sp. b	1

* Species identifications are tentative.

** Specimens identified as *Notolepis* sp. are probably *Notolepis coatsi* since no other species of the genus *Notolepis* is reported from the Weddell Sea, however, the species can only be identified with confidence once specimens have attained a length of about 60 mm.

The Halley Bay transect

The presence of a very wide coastal polynya in February 1989 enabled sampling to be undertaken along a bathymetric transect to the 2000 m contour. Eleven stations were sampled at standard depths to 300 m and then 6 of the seaward stations were re-sampled to obtain material from the water column below the surface 300 m layer to near the seafloor.

The detailed sorting of 27 samples of the 9 standard RMT stations along the transect produced approximately 60,000 micronekton specimens of 46 species (copepods, ostracods and fish excluded). These species belonged to the following taxonomic groups: coelenterates (9 species), ctenophores (2), molluscs (6), polychaetes (5), euphausiids (3), larval decapods (3), amphipods (13), chaetognaths (4) and pelagic tunicates (1). In terms of numbers and biomass the predominant species was *Euphausia crystallorophias* (the ice-krill), with a maximum density of 6447 ind./1000 m^3 in the surface layer above the 400 m contour. The siphonophore *Dimophyes arctica* and the chaetognath *Eukrohnia hamata* were also very abundant with highest numbers at seaward stations (49 and 86 ind./1000 m^3, respectively).

A total of >4300 individual larval and juvenile fish of 19 species were collected. The identifications should be considered tentative, however, the most numerous species were readily recognizable. Members of the sub-order Notothenioidei dominated the samples with three species of channichthyids (ice-fish) and *Pleuragramma antarcticum* (Antarctic silver-side) being the most common.

Interpretation of the results must be viewed with some caution because of the lack of replicate samples but the observations suggest that there was a neritic community at the stations near to the ice-shelf dominated by large numbers of *E. crystallorophias*, a notothenid post-larva *Aethotaxis mitopteryx*, and an ice-fish, *Dacodraco hunteri*. A more oceanic community was observed at the seaward end of the transect where the larval stages of *P. antarcticum*, two ice-fish, *Chionodraco myersi* and *Pagetopsis* sp. occurred together with typically oceanic representatives such as *Notolepis* sp., *Bathylagus* sp., myctophids, the pteropod, *Clio pyramidata*, and the chaetognath, *Sagitta marri*, which were lacking at the stations near the ice-shelf. A rich sample of *Euphausia superba*, the Antarctic krill (56 ind./1000 m^3, SL=36-55 mm, mature females and males) (Fig.36a) was obtained in the surface layer of the most offshore station of the transect, whereas at all other stations this species appeared only sporadically.

At most locations the water column was stratified, comprising surface summer warm water, an underlying layer of cold Antarctic shelf water and then below this a layer of water with ascending temperature (see ROHARDT *et al.*, this volume). Hauls using the multiple RMT were made to approximately sample these layers in the upper 300 m by dividing this into 300 to 200 m, 200 to 70 m and 70 to 0 m depth intervals.

Except for coelenterate and chaetognath species at the majority of stations most specimens and highest biomass values were found in the upper 70 m

layer, however, at St. 252 over 2000 m, this pattern was inverted by an abundance of *P. antarcticum* in the 300 to 200 m layer.

Commonly a sharp demarcation is noted between neritic and oceanic micronekton communities at the junction of the continental shelf and slope. This was not well defined on the Halley Bay transect because, although the community became more oceanic towards the seaward end of the transect, neritic components such as the ice-fish, the ice-krill and meroplanktonic larvae like the larvae of the shrimp *Notocrangon antarcticus* and a larval stage of a benthic gastropod (Echinospira) were still a significant part of the catches. The seaward extension of this neritic community is probably a result of the wide shelf in the south-eastern Weddell Sea and this results in a poorly demarcated transition zone.

The Kapp Norvegia transect

Bad weather conditions hampered the sampling along this transect and RMT standard hauls could be conducted at only five scattered stations.

In contrast to the Halley Bay transect the upper 200 m of the water column was not stratified due to the mixing caused by a previous storm. The two nearshore stations were very poor in terms of numbers and biomass of micronekton except for the surface haul of the station above the 600 m contour where a moderate concentration of adult and juvenile *E. superba* was sampled (160 ml/1000 m^3, displacement volume).

The three offshore stations yielded typical oceanic zooplankton and micronekton. A vertical stratification of these communities within the upper 300 m was not as pronounced as at the offshore stations at the Halley Bay transect. The most seaward station above the 2000 m depth contour was accompanied by marked krill echoes on the 30 kz echosounder and yielded a moderate sample of juvenile *E. superba* (150 ml/1000 m^3) (Fig.36b) in the surface layer. The ichthyonekton exhibited a similar neritic to oceanic transition along the Kapp Norvegia transect as the Halley Bay transect. These samples were dominated in terms of numbers and biomass by *Pleuragramma antarcticum* accompanied by the larval stages of ice-fish at the stations near to the ice shelf and by oceanic representatives such as *Notolepis* sp. and *Electrona antarctica* at the seaward end of the transect.

Time Station

The time station was conducted as an experiment to examine the order of magnitude of variation in the micronekton numbers and species likely to result from factors such as net avoidance and vertical migration during the diel cycle. Such processes can radically affect the catches resulting from sampling in the water column and on the seafloor with the majority of types of nets.

The time station at 71° 00´S, 12°15´W was occupied for a 24 hr period during which 6 RMT8+1M samples were collected at 4 hr intervals accompanied by CTD casts. The physical oceanographic data collected during the experiment indicated that the water mass was essentially the same throughout the duration of the sampling. The water column had the characteristics of the Antarctic

Coastal Current flowing parallel to the continental slope. Variations in the chemical and microbiological characteristics of the water column were noticed during the experiment and are reported elsewhere (RABITTI *et al.*, this volume) but of particular interest was the marked increase in ammonium measured near the surface during the night accompanied by a decrease in ATP/ETS activity and phytoplankton abundance. This has been tentatively interpreted as being due to zooplankton activity near the surface after dark and was associated with a large catch of *E. superba* (691 ml/1000 m^3) in the sample during the "midnight" station. Zooplankton and ichthyoplankton were largely composed of oceanic species and the abundances were low in comparison with the numbers found along the Halley Bay transect.

Only 193 specimens of 14 ichthyoplankton species were represented in the RMT8 catches. The zooplankton was dominated by chaetognaths and gelatinous zooplankton. In addition some mysids, a mesopelagic shrimp and 8 juvenile squids of 3 species (*Galiteuthis glacialis, Alluroteuthis antarcticus, Psychroteuthis glacialis*) were captured mostly in the deeper strata. The ichthyoplankton caught at the time station exhibited a distinct diel pattern in the total numbers of specimens caught at each time interval, there being about a 50 % reduction in numbers during "daylight". (Fig.37). Mesopelagic fish were represented by three species of myctophid and a *Bathylagus* species. All of these displayed distinctive patterns of vertical distribution. They were normally found in the deepest net (800 to 300 m) except for the early larval stages of *Electrona antarctica* which were found at all levels sampled. These four species also exhibited an increase in abundance and an ascent to shallower depths at night.

The differences noted in the micronekton abundance and distribution during the time station experiment demonstrated how important such a procedure is as a control for assessing the diel variations of the biological components in the water column and indicate that conclusions based on the result of single samples should be considered with caution.

Squid

Altogether 180 specimens of 3 squid species were collected during the cruise. These were *Psychroteuthis glacialis* (n = 154), *Galiteuthis glacialis* (n = 19) and *Alluroteuthis antarcticus* (n = 7).

A bottom trawl (GSN) and semipelagic trawl (BPN) (see HUREAU *et al.*, this volume) yielded the majority of the large specimens while their early life stages were sampled by the RMT8.

It was the first time that such a large number of *P. glacialis* had been caught on a scientific cruise. Most of the specimens were juveniles, only a few adults were sampled. The dorsal mantle length (DML) of the animals collected varied from 10 to 37 cm (Fig.38). Nearly all of them were caught along the Halley Bay transect near the seafloor on the slope at a depth of 600 to 800 m.

G. glacialis and *A. antarcticus* are well known from Antarctic mid- and deepwater samples. However, it should be noticed that one specimen of

G. glacialis captured by the GSN in about 600 m depth was a very large animal with a dorsal mantle length of 41cm.

Live micronekton

In constant temperature aquaria (-0.5° to 1.0°C) we succeeded in maintaining some micronektonic organisms over periods of several days to weeks. The aim of this work was to study their behaviour and to obtain some information for future studies on living Antarctic micronekton species.

The following species could be kept alive and studied in the aquaria: *Euphausia superba* (n = 50), the hyperiid amphipod *Cyllopus lucasii* (n = 2), the polychaete *Tomopteris carpenteri* (n = 1) and the early life stages of the squids *Galiteuthis glacialis* (n = 1) and *Psychroteuthis glacialis* (n = 1). Only *E. superba* and *C. lucasii* survived several weeks, the other species died about 5 to 6 days after being captured mostly due to an inadequate supply of natural food.

In conclusion, although much work remains to be done in the home laboratories during the next months it is already evident that the results of the micronekton studies of the Weddell Sea will contribute to a better understanding of the complex Antarctic ecosystem.

References

BOYSEN-ENNEN, E. & PIATKOWSKI, U., 1988. Meso- and macrozooplankton communities in the Weddell Sea, Antarctica. Polar Biol 9, 17-35.

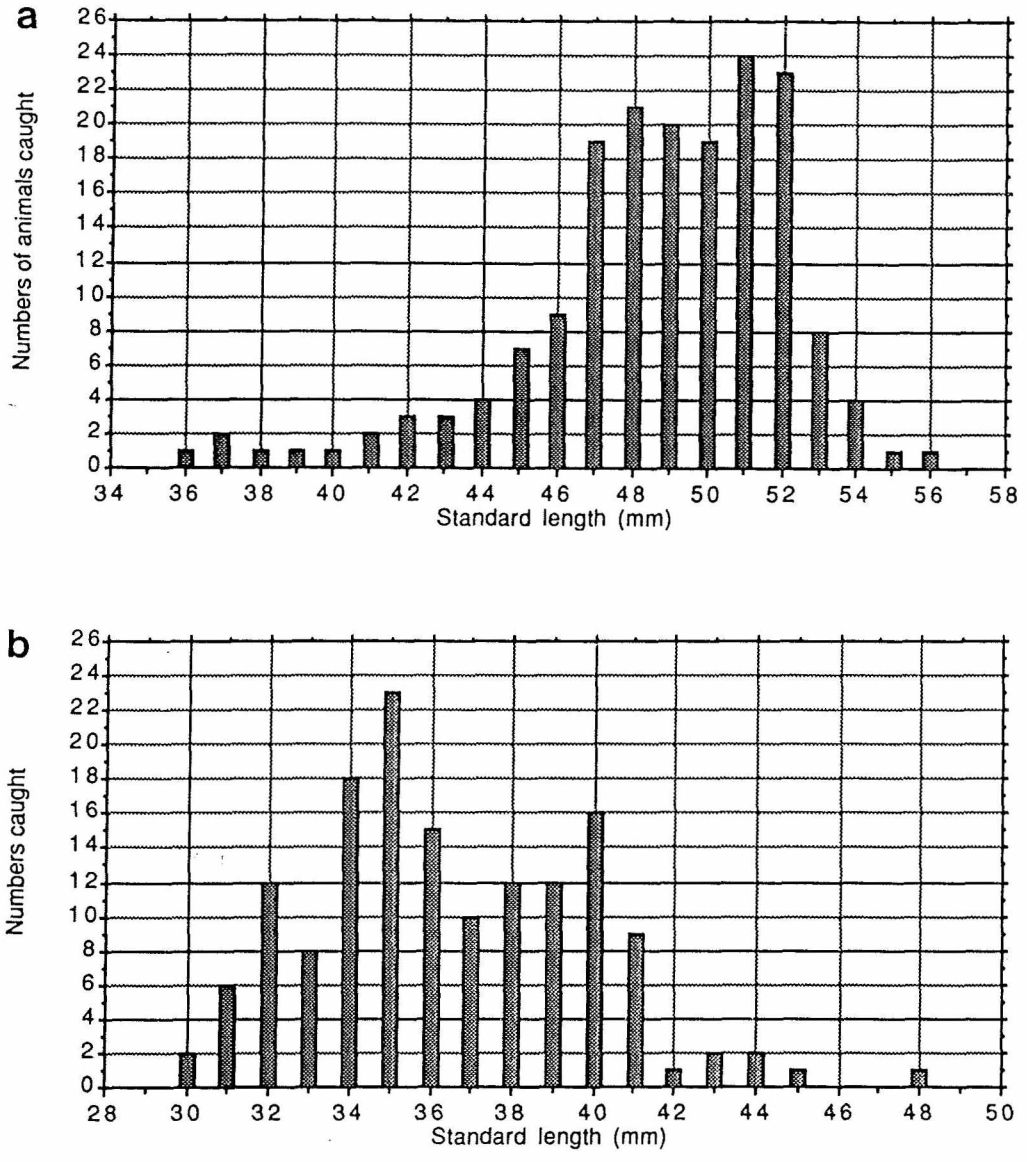

Figure 36: (a) *Euphausia superba*, size classes, Station 253, RMT8-3 (70 - 0 m), n=173.
(b) *Euphausia superba*, size classes, Station 295, RMT8-3 (70 - 0 m), n=150 (subsample) of 850 (total).

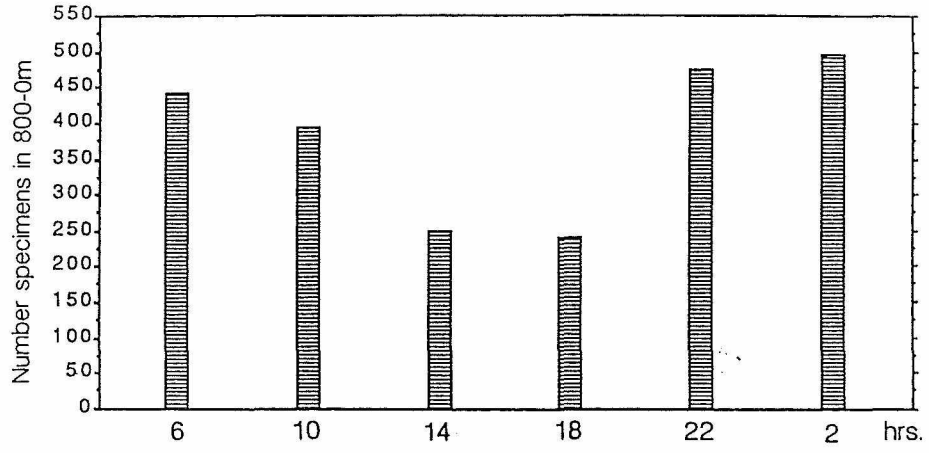

Figure 37: 24 hr time station. Number of ichthyoplankton specimens caught by RMT in the 800 - 0 m range.

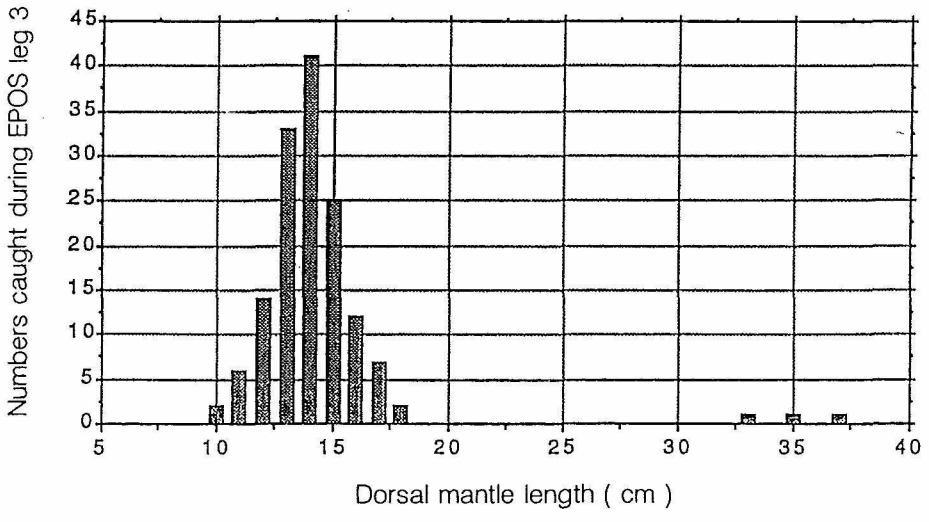

Figure 38: *Psychroteuthis glacialis*, size classes, n=154.

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