DISTRIBUTION OF SOME GROUPS OF ZOOPLANKTON IN THE INNER WEDDELL SEA IN SUMMER 1979/80

First results of the 1979/80 "Polarsirkel" Expedition presented during the "Seminar of polar ecology", Univ. Kiel, May 1982

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Zusammenfassung

In der vorliegenden Arbeit wird über die Verteilung der juvenilen und adulten Euphausiaceen, Hyperiideen (Amphipoden), Copepoden und Fischlarven in der östlichen und südlichen Weddell See berichtet. Allgemein wurde festgestellt, daß sich die Artenzusammensetzung in der Westwinddrift bzw. im ozeanischen Bereich vom Artenspektrum entlang des Kontinentalschelfes unterscheidet. Euphausia frigida und die Amphipoden Vibilia propinqua, Cyllopus magellanicus und Themisto gaudichaudii, sowie die Larven des Fisches Electrona antarctica wurden nur im Bereich der Westwinddrift angetroffen. Die Euphausiaceen Euphausia superba und Thysanoessa macrura, der Amphipode Hyperiella dilatata und die Fische Notolepsis coatsi und Bathylagus antarcticus kamen sowohl im Bereich der West- als auch der Ostwinddrift vor. Euphausia crystallorophias, juvenile Thysanoessa macrura, die Copepoden Ctenocalus vanus und Metridia gerlachei, sowie die Amphipoden Cyllopus lucasii, Hyperiella dilatata und Hyperiella macronyx und der Fisch Pleuragramma antarcticum wurden regelmäßig und in größerer Zahl auf dem Kontinentalschelf gefunden. Larven von Euphausia crystallorophias wurden bis 65°S angetroffen; damit steht die teilweise ozeanische Verbreitung der Larven im Gegensatz zur obligatorisch neritischen Verbreitung der Adulten.

Summary

The species composition of euphausiids, amphipods, copepods, and fish larvae in the eastern and southern Weddell Sea showed some remarkable differences between the oceanic areas of the West Wind Drift on one hand and the Antarctic continental shelf waters on the other: Euphausia frigida and the amphipods Vibilia propinqua, Cyllopus magellanicus and Themisto gaudichaudii, as well as the larvae of the myctiphid fish Eletrona antarctica were found exclusively in the waters of the West Wind Drift. The euphausiids Euphausia superba and Thysanoessa macrura, the amphipod Hyperiella dilatata and the fishes Notolepsis coatsi and Bathylagus antarcticus were distributed in the West Wind Drift as well as in the East Wind Drift. Euphausia crystallorophias, juveniles of Thysanoessa macrura, the copepods Ctenocalanus vanus and Metridia gerlachei as well as the amphipods Cyllopus lucasii, Hyperiella dilatata and Hyperiella macronyx and the fish Pleuragramma antarcticum were found regularly and in considerable numbers over the continental shelf. The larvae of Euphausia crystallorophias appeared as far south as 65°S in oceanic waters contrarily to the strictly neritic distribution of the adults.

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First results of the 1979-80 "Polarsirkel" expedition presented during the "Seminar of Polar Ecology", University of Kiel, in May 1982

by I. Hempel, G. Hubold, B. Kaczmaruk, R. Keller, R. Weigmann-Haass

Introduction

The purpose of the first German expedition in the inner Weddell Sea in austral summer 1979/80 was the search for a suitable site for the German antarctic station. A second cruise in 1980/81 resulted in the establishment of the Georg von Neumayer station at Atka Bay. For both cruises the norwegian RV "Polarsirkel" was chartered. Due to favourable ice conditions 1979/80 the vessel proceeded all along the edge of the shelf ice of the eastern and southern Weddell Sea. Although site exploration and glaciological studies were the prime objectives of the cruises, biological work was carried out whenever possible. This included plankton sampling, bottom trawling and observations of seals and birds. Plankton hauls were carried out from Atka Bay to the Antarctic Peninsula along the shelf ice coast (fig. 1). The report of the cruise 1979/80 is given by Kohnen (1981) together with brief accounts of the research activities on board. The list of the micronekton and zooplankton hauls is given by Schneppenheim (1982). The present paper summarizes some preliminary results on zooplankton distribution which were presented as oral contributions during the seminar on polar ecology at Kiel University, May 1982.

Further results of more detailed studies of the expedition will be published separately (see V. Siegel on adult Euphausia superba (in press) and I. Hempel and G. Hempel on Euphausiid larvae; Meeresforsch., in press). Information will be given on the distribution of the following taxa in the region from Atka Bay to the Antarctic Peninsula:

- Euphausiids: V. Siegel, R. Weigmann-Haass
- Euphausiid larvae: I. Hempel
- Hyperiid amphipods: R. Weigmann-Haass
- Copepods: B. Kaczmaruk
- Fish larvae: R. Keller

The contributions on zooplankton taxa will be preceeded by a brief discription of the general hydrography (G. Hubold).

The cruise started from South Georgia on 26 December 1979 heading to C. Norwegia and was continued along the ice shelf to the Antarctic Peninsula. Then the cruise turned back eastwards and at 50°W, west of Berkner Island, members of the expedition explored a possible site for the antarctic station. During this time intensive plankton hauls in a limited area (box) in front of the ice shelf could be accomplished (stns 55 - 85, 124, 125). The ship travelled back along the same route up to Atka Bay so that in some cases the same stations could be sampled after a time intervall ranging from two to six weeks. The stations in the eastern Weddell Sea and Atka Bay were also worked in the following year. Those results will be published at a later date.

The programme was finished at Bouvet Island on 23 February 1980.

The distribution of zooplankton taxa in the inner Weddell Sea is determined by the complex hydrographic system of the area. The general clockwise circulation of the Weddell gyre as part of the Eastwind Drift may transport plankton in a westward direction. The Filchner Depression cuts deep into the shelf of the eastern Weddell Sea and may influence the circulation pattern and hence plankton distribution. So far published information on zooplankton abundance and composition in relation to the current system and water mass distribution in the inner Weddell Sea is almost lacking.

Material and methods

The main gear used for the plankton collections was the Bongo gear with nets of 300 and 500µ meshes respectively. From station 18 on, both nets were of 500µ mesh size. The nets were equipped with digital flowmeters (Hydrobios) and a time depth recorder (Benthos Corp.). A Nansen closing net of 70 cm diameter and 250µ meshes was used for vertical sampling. On two stations, a 100 cm Helgoland-Larva-Net with 250µ meshes was used.

Altogether, 270 plankton hauls were performed. Vertical nets and Bongo gear were used alternatively. On 102 stations, one Bongo tow each and on 24 stations, 165 vertical hauls were made. The vertical samples were mainly obtained on a time station in the "box" off the Rønne Ice Shelf (119 hauls on station 60). As a rule, 4 different water layers were sampled by the Nansen net between 250 m depth and surface.

The Bongo gear was hauled through the upper 140 m (mean depth: 141 m; s = 42.5 m; range: 215 m). The tow-path records of the time-depth-recorder reveal in general double oblique towing, with prolonged residence of the net in the maximum depth layer. A bias is thus introduced over-representing the deeper layers in the catches.
Mean towing velocity of the Bongo nets was 2.5 kn (s = 0.16 kn) and the mean duration was 26.8 min (s = 7.25 min).

The plankton was fixed and stored in 4% Borax buffered Formaldehyde solution in sea water. Subsamples were taken on board in case of extremely voluminous catches.

The plankton samples were obtained and preserved by the biologists in charge on MS "Polarsirkel" Dr. R. Schneppenheim and E. Marschoff, to whom the authors wish to express their gratitude.

General hydrography of the investigated area

The Weddell Sea is limited in the north by the Scotia Arc; the Antarctic Peninsula and Rønne and Filchner Ice Shelves are the borders to the west and south. The eastern boundary is considered arbitrarily as a straight line between South Sandwich Islands and Cape Norwegia at 20°W (Carmack and Foster, 1975). The central basin is 4000 m deep, with some deeps of over 5000 m. Water exchange with the Scotia Sea can take place down to depths of 3000 m. The antarctic continental shelf is approximately 400 km wide in the south of the Weddell Sea. To the east, the shelf becomes narrow and is almost absent off Cape Norwegia. In the south-western part of the Weddell Sea shelf, the Filchner Depression exceeds 1100 m depth.

The general circulation in the Weddell Sea is a slow moving cyclonic gyre over most of the oceanic basin. The current system is maintained by the atmospheric pressure system (Carmack and Foster, 1975). The westward flowing coastal current of the East Wind Drift enters the Weddell Sea near Cape

Norwegia following the contours of the continental slope southward. It is then deflected to the west near Halley Bay and later to the north at the Antarctic Peninsula. In the Weddell-Scotia Confluence in the West Wind Drift the water moves to the east (Mackintosh, 1973). Compensatory southward movement was found in the Warm Deep Water layer below 200 m depth as inflow of Atlantic Deep Water east of 20 - 30°E (Deacon, 1976).

Current velocity near Cape Norwegia was estimated as 10 - 30 cm sec^{-1} (Gill, 1973) or up to 40 cm sec^{-1} (Carmack and Foster, 1975). When the current leaves the coast near Halley Bay and follows the continental margin to the west and later to the north, average velocity is in the order of 10 cm sec^{-1} (Gill, 1973). The transport of a water mass from 4°E to 50°W takes about 7 - 8 months (Gill, 1973).

Part of the coastal current diverges from the main stream near Halley Bay at 75°30'S/27°30'W and follows the general trend of the coastline towards Filchner Ice Shelf, where it joins a cy- clonic gyre centered over the Filchner Depression (Carmack and Foster, 1975). In the gyre, the newly formed Ice Shelf Water with temperatures well below -2°C circulates. The Ice Shelf Water is mainly confined to the depression (Carmack and Foster, 1975), and only a certain portion flows out at depth of 400 to 500 m into the central Weddell Sea basin. The stability of the gyre and the resulting upwelling in its center may account for the high clorophyll values and primary production rates documented for the area by Balech et al. (1968) and El-Sayed (1970).

From the west, bottom water sinks into the Filchner Depression. On the continental shelf off the Rønne Ice Shelf, at 200 - 300 m depth, an "undefined water mass" (Gammelsrød and Slotsvik, 1981) was found. This water type may originate from outside the continental shelf, flowing onshore "along the isobaths of the western edge of the shallowest part of the continental shelf" (Gammelsrød and Slotsvik, 1981).

Just in front of the ice shelf, tidal currents dominate the water circulation. In a 12-hour rhythm, vertical mixing was observed connected with the outflow of water from below the ice (Gammelsrød and Slotsvik, 1981).

The total range of temperature and salinity in the southern and eastern Weddell Sea is small. A ten-years mean shows for the surface water layer ("Summer Water") average temperatures of -1.68°C and 34.45°/oo in the Gould Bay and -0.67°C and 33.91°/oo near Atka Ice Port. At 200 m depth, mean temperature of -1.93°C and salinity of 34.59°/oo can be expected in the Gould Bay and -0.68°C and 34.29°/oo near Atka (Gordon and Goldberg, 1970).

The oceanographic data of the 1979/80 "Polarsirkel" cruise (Gammelsrød and Slotsvik, 1981) agree with the general picture given above. The identified water masses can be briefly described as follows: East of the Filchner Depression, in depth of 100 to 400 m under the summer water layer, a homogeneous layer of "Eastern Shelf Water" of -1.8°C/34.40°/oo was present. A branch of the coastal current was detected over the shelf at 76°S/30°W as a core of warmer water of -0.45°C at 250 - 400 m depth. In the depression, the "Ice Shelf Water" was detected at an approximate depth of 500 m with below -2.0°C/34.60°/oo. The cyclonic water circulation centered above the depression was evident in the density structures and temperature distribution. To the west, the "Western Shelf Water" was found with bottom salinity of over 34.7°/oo. At 50°W, the onshore flowing warmer water from outside the shelf had over -1.5°C and 34.55°/oo salinity in 200 - 300 m depth. Near the Antarctic Peninsula, high salinity water of over 34.8°/oo moved northward as a geostrophic flow.

The rate of upwelling close to the ice edge was found to be in the order of 160 m in 12 hours, related to the tidal currents (Gammelsrød and Slotsvik, 1981). The high turbulence may have negative implications for the plankton organisms immediately at the ice front as they are transported into aphotic depths under the ice shelf periodically.

Euphausiids

Four species of Euphausiacea (adults and juveniles) were found:
Euphausia superba DANA 1850
Euphausia frigida HANSEN 1911
Euphausia crystallorophias HOLT & TATTERSALL 1906
Thysanoessa macrura G.O.SARS 1883

Krill (E. superba) were present in most of the catches north of 74°S. Only occasionally, 1 - 3 individuals per haul were caught south of 74°S in the southern Weddell Sea off the Filchner and Rønne Ice Shelves as far west as 49°06'W in January 1980. No krill were detected between 60°S and 69°S on the transect between the continent and Bouvet Island, and only immature specimen were found on one station off Bouvet Island at 59°S. A more comprehensive analysis of the distribution of adult krill of this expedition is given by Siegel 1982 (in press).

During the expedition Euphausia frigida was only found at two stations north of 60°S, and there it made up 4% of the euphausiids (fig. 2). From earlier cruises this species was reported in large quantities in the Subantarctic region (Weigmann-Haass & Haass, 1980). The range of the distribution lies between the Antarctic convergence and the northern boundary of the pack-ice (John, 1936).

Euphausia crystallorophias is a neritic species and was dominant in the shallow waters of the continental shelf. This species represents 56% of the population of Euphausiids (excl. E. superba) (49% adults, 51% juveniles). The species was absent north of 72°S (tab. 1). Very large numbers were found in the area 76-77°S / 48-50°W (St. 63-84, mean depth 290 m) and at 72°S/ 13-15°W (St. 96-101, mean depth 420 m). At the first position mentioned above 25 specimens/100m^3 were filtered from the water and at the second locality 41 specimens/100m^3. Euphausia crystallorophias shows a circumpolar distribution (Tattersall, 1924; John, 1936; Ponomareva & Drobysheva, 1978). Fevolden (1980) found the larvae dominant in the southern Weddell Sea. He concluded from a single haul from 2080 m depth that this species is not strictly confined to shallow water. We never found specimens of this species at stations with a depth exceeding 600 m. Thysanoessa macrura was second in abundance, representing 40% of the Euphausiids (excl. E. superba); (40%; 58% adults and 42% juveniles). It was found in large numbers north of 72°S (tab. 1). Only juveniles and larvae occurred in the samples south of 73°30'S. The southernmost locality was at 76°45'S. During the seasons 1975/76 and 1977/78 the species was found abundant in the northern Weddell Sea (Weigmann-Haass & Haass, 1980). Their ranges were extended to just north of the Antarctic convergence. Fevolden (1979, 1980) collected larvae and juveniles likewise in the inner Weddell Sea. T. macrura can also be described as a circumpolar species (Tattersall, 1924; Rustad, 1930).

Euphausiid larvae

The geographical sequence of euphausiid larvae was well reflected in the plankton samples taken en route from South Georgia to Cap Norwegia and back to Bouvet Island. Euphausia triacantha was absent from all catches as to be expected. The southern boundary for larvae of Euphausia frigida was found south of South Sandwich Islands at 65°S. At the eastern section to Bouvet Island no Euphausia frigida larvae were found just as at the same month and area in 1976 (fig. 3).

In the Weddell Sea only three species occur:
Thysanoessa macrura, Euphausia superba and Euphausia crystallorophias. Thysanoessa macrura was present in most samples between South Georgia respective Bouvet Island and 73°S, i.e. to the eastern entrance of Weddell Sea where this species has its southern boundary of larval distribution with the exception of one locality even further south near the Filchner Depression (fig. 3). The occurrence of Euphausia superba larvae en route was limited to the north eastern approaches of the Weddell Sea south of 67°S. The absence of Euphausia superba larvae in the area of South Sandwich Islands and eastward agrees with the results of the survey in March 1976. Into the Weddell Sea Euphausia superba larvae can be followed to 76°S with fair numbers of calyptopes southwest of Cape Norwegia, and fewer further south. Euphausia superba appeared only in the second half of February, while samples taken six weeks earlier in the same area were negative (tab. 2). Therefore we may conclude that Euphausia superba larvae occur late in the season and only in the eastern part of the southern Weddell Sea. The Filchner Depression is the south western boundary for the larvae of this species. The absence of nauplii of Euphausia superba from all samples might be due to the relatively shallow sampling depth.

Larvae of Euphausia crystallorophias occurred already north of the Antarctic Continent up to 65°S. The oceanic distribution of the larvae in this area is in contrast to the neritic distribution of adult Euphausia crystallorophias. Along the ice shelf, Euphausia crystallorophias had by far the widest distribution of all euphausiid larvae. They were present in considerable numbers in all samples, even to the far West near the Peninsula. Like Euphausia superba also the larvae of Euphausia crystallorophias were particularly abundant southwest of Cape Norwegia where the shelf is very narrow and the 2000 m isobath is near the ice shelf.

Hyperiid amphipods

For the first time it is possible to report the occurrence of the different species of hyperiids in this part of the Antarctic region. The figures show the distribution of the species in the investigated area. No quantitative indications are given, because the number of specimens was too small. The following genera and species were found:
Vibilia propinqua STEBBING 1888 (11 specimens)
Cyllopus magellanicus DANA 1853 (1 specimen)
Cyllopus lucasii BATE 1862 (69 specimens)
Hyperiella antarctica BOVALLIUS 1887 (223 specimens)
Hyperiella macronyx (WALKER 1906) (19 specimens)
Themisto gaudichaudii (GUERIN 1828) (113 specimens)
Scina sp. (7 specimens)
Lanceola sp. (1 specimen)
Hyperoche sp. (24 specimens)
Primno sp. (325 specimens)

Vibilia propinqua (fig. 4) was found only at 5 stations and the southern boundary of distribution was at 67°S. Information about the abundance of this species are rare. During the cruises of "Walther Herwig" in the northern Weddell Sea (1975/76 and 1977/78) V. propinqua was the second in total abundance and frequency (Weigmann-Haass, unpublished).

Cyllopus magellanicus and C. lucasii (fig. 5) are restricted to the Antarctic and are distributed circumpolarly. Only one female of C. magellanicus (with larvae of the pantochelis stage in the marsupium) was collected at st. 11 (60°40'S, 22°59'W). During earlier cruises C. magellanicus was caught in larger quantities up to 66°S (Weigmann-Haass, in press.). C. lucasii showed a wider distribution in this area. North of 69°S 22 females and 3 juveniles were collected. Only one female and 33 juveniles were sampled at 7 stations off the ice shelf in the southernmost part of Weddell Sea (76-77°S). The genus Hyperiella is restricted to the Antarctic Ocean like the genus Cyllopus. H. antarctica (fig. 6) was very abundant in the investigated area and was found in larger quantities within the East Wind Drift. H. macronyx was collected south of 68°S along the continental shelf. But the number of specimens was not large. These are the first records of this species in the inner Weddell Sea. So far the species was only known from the Ross Sea (Bowman, 1973).

Themisto gaudichaudii (fig. 7) was found only north of 61°S; all specimens were juveniles. Normally it is the most common species of hyperiids in the southern oceans. It shows a circumpolar distribution both in the Antarctic and Subantarctic zones (Kane, 1966). The spread to the south is limited by the boundary between the East and West Wind Drifts (Antarctic divergence).

Scina sp. (fig. 4) was sampled at two localities; all 7 specimens were juveniles.

Only one individual of Lanceola sp. (fig. 7) was found at St. 105. Hyperoche sp. (fig. 7) was distributed from 58°S up to the southern continental shelf (76-77°S).

Primno sp. (fig. 4) was caught near the South Sandwich Is. and Bouvet I. up to the continental shelf. The southernmost locality was off Cape Norwegia. We identified 10 adults and 342 juveniles from the samples.

For the hyperiids we can distinguish two different patterns of distribution in the area
- V. propinqua, C. magellanicus and T. gaudichaudii occurred within the West Wind Drift,
- C. lucasii, H. antarctica, H. macronyx, Hyperoche sp. and Primno sp. were found within both the West and the East Wind Drift. They occur widespread up to the ice shelf coast.

Copepods

For a study of the horizontal distribution of copepods, 71 samples of approx. 50 meters of depth from 14 stations, were found comparable. Copepod material was taken with a vertical closing Nansen net of 0.253 mm mesh size.
The stations were located in the following regions of the Weddell Sea (fig. 8):

- western Filchner Ice Shelf - stations nos. 38,39,41,42,43,44
- west of Berkner Island ("Box") - stations nos. 55,60 (with 54 hauls), 80,124,125,
- off Belgrano II - station no. 32
- off Vestkapp - stations nos. 25,95.

Copepods were identified and counted. Copepod naupliar stages were recorded. Copepods density is given per 1 cubic meter. The identified copepods are listed in tab. 3.

Copepods of 13 taxonomic units were found in the western parts of the Weddell Sea, 10 in the Belgrano area, and 16 in the Vestkapp region. The largest variety, however, was noticed in the relatively small "Box" area, where the collection of samples is more representative and stations are more numerous.

As shown in tab. 4, the density of copepods is variable from one region to another. An extremely low concentration (2.91 org/m^3) was noticed in the "Box" area (fig. 9). Going east an increase of the amount of copepods is observed (up to 79.68 org/m^3).

The copepod fauna consisted mainly of adult specimen, with only one exception in the eastern Vestkapp area, where copepodids dominated.
Specimen of Calanus sp., Ctenocalanus vanus, Metridia gerlachei and Oithona sp. constituted the largest part of the copepod concentration in each area (tab. 5).

Oithona sp. was the most abundant and common species (fig. 10) in the western and medium parts of the studied area. In the eastern stations young Calanus sp. were dominating.

To summarize, all identified copepods are typical forms for antarctic waters. No characteristic species is occurring only in one area of the Weddell Sea. There is a quantitative difference between the copepod fauna of the south-western areas and the fauna of the eastern stations. Copepods of the south-west occurred in much lower number, with adults dominating. The amount of copepods was much higher in the east with predominating copepodids.

Fish larvae

Out of 272 hauls (oblique and vertical hauls) 112 contained a total of more than 14 000 larvae and young fishes and 21 eggs. The number of larvae ranged from 1 to 3920 larvae/haul (mean volume filtered:656 m^3/haul). Fig. 11 shows the distribution and relative abundance of larvae.

The highest numbers of larvae (> 1000/haul) were caught on the shelf of the Antarctic Continent, mainly in the Gould Bay in the southern Weddell Sea and south of Cape Norwegia. About 100 larvae/haul were found at stations in the open sea, e.g. in the northern Weddell Sea adjacent to the Scotia Sea and in the region around the South Sandwich Islands. Samples on the section to Bouvet Island contained only few or no larvae.

Pleuragramma antarcticum Boul. 1902 was the most abundant species. It contributed 95% to the total number of fish larvae.
Pleuragramma is the only true pelagic form among the notothenoid family. There are no quantitative estimates of the biomass of Pleuragramma stocks.

Pleuragramma is distributed around the Antarctic Continent (Andriashev 1964) over the shelf and adjacent oceanic waters.
The occurrence of Pleuragramma larvae was found to be confined to shelf waters (fig. 12) in the investigated area.

Main larvae concentrations were located in the southern Weddell Sea off the Filchner Ice Shelf and in the south eastern Weddell Sea (3-4 l./m³).

Dewitt (1970) cited Pleuragramma antarcticum as the "overwhelming dominant species of mid water fish" of the Ross Sea. Considering the high larval abundance Pleuragramma may be equally abundant in the Weddell Sea.

The remaining 5% of fish larvae represented 10 species and 4 genera of 7 families.
The oceanic fish fauna, typical for offshore oceanic waters, consisted of Myctophidae (n = 507), Paralepididae (n = 52) and Bathylagidae (n = 17). Within the families the species Electrona antarctica (Günther 1878), Notolepis coatsi Dollo 1908 and Bathylagus antarcticus Günther 1878 were identified.

The distribution of meso-pelagic families, most evidently the myctophids, was confined to the open sea (fig. 13). Dewitt (1968) observed, that the 3 families mentioned above are nearly entirely excluded from the shelf of the Ross Sea. He considers supercooled shelf water to be the explanation for the absence of meso-pelagic fishes over the shelf.

Co-occurring with Pleuragramma, 108 larvae of Nototheniidae, 39 larvae of Chaenichthyidae and 35 larvae of Bathydraconidae were found over the continental shelf.
Larvae of Notothenidae were represented by 3 species Notothenia kempi (Norman 1937), Trematomus eulepidotus Regan 1914 and Notothenia hansoni Boul. 1902 (fig. 14). Larvae which could not be identified to generic level are designated as Notothenidae unident. 2 larvae of N. hansoni were caught in the area around the South Sandwich Islands.
Among the Chaenichthyidae Pagetopsis maculatus Barsukov & Permitin 1958 was the only species which could be identified (fig. 14). The species is only known from one specimen found in the East Antarctic (Barsukov & Permitin 1958). The present record indicates a circumpolar distribution.
The remaining larvae of Chaenichthyidae of the genera Pagetopsis, Chinodraco and Cryodraco possibly belong to the species Pagetopsis macropterus Boul. 1902, Pagetopsis maculatus (Barsukov & Permitin 1958), Cyrodraco antarcticus Dollo 1900 and Chinodraco hamatus (Lönnberg 1905) when considering the species composition of adult catches (Kock, Schneppenheim & Siegel in prep.) (fig. 15).

The Bathydraconids Prionodraco evansii Regan 1914, Parachaenichthys charcoti Vaillant 1906 and Racovitzia glacialis Dollo 1900 and 1 larva of the genus Artedidraco (family Harpagiferidae) were found in the southern Weddell Sea (fig. 16).
With the exception of Parachaenichthys charcoti - which was only found in the western antarctic region (Everson 1969, Norman 1938) - all other species mentioned above are distributed all around the Antarctic Continent.

Conclusions

The 1979/80 "Polarsirkel" expedition yielded for the first time an extensive plankton material from the inner Weddell Sea up to the basis of the Antarctic Peninsula. Different hydrological regimes were sampled during the cruise: The deep oceanic waters of the West Wind Drift (WWD) between South Georgia, antarctic continent, and Bouvet Island; the shallower shelf waters within the East Wind Drift (EWD); and the extremely cold Ice Shelf Water overwide the shelf in the southern Weddell Sea. Boundaries in the geographical distribution of plankton organisms were to be expected in the course of such an extended investigation area.

In general, the species composition of the WWD and open oceanic deep waters differed markedly from the continental shelf. Occurrence of the euphausiid E. frigida was limited to the waters north of 60°S; Thysanoessa macrura was found between 60°S and 76°45'S in the WWD and EWD over deep water. E. crystallorophias was the dominating euphausiid over the continental shelf. Within the hyperiid amphipods, some species were confined to the WWD (Vibilia propinqua, Cyllopus magellanicus, Themisto gaudichaudii), whereas others occurred widespread in the shelf waters. (Hyperiella dilatata, H. macronyx). Clear differences were found in the fish larvae, where the oceanic fauna comprised the Myctophids, Paralepidids and Bathylagidae, whereas in shallow water the Nototheniidae with the most abundant species Pleuragramma antarcticum were distributed. Channichthyidae and Bathylagidae were found in small numbers close to the continent.

The distribution pattern along the ice shelf edge in the inner Weddell Sea did not show clear zoogeographic boundaries for most of the species of fish larvae as well as for copepods. A certain limit towards the south and west represents the Filchner Depression. On its east side a branch of the EWD coastal current was present in the hydrographic sections. The presence of adult Krill (E. superba) was limited to the south at 74°S where the EWD current leaves the coast. Only single specimen were found to the south in the SE Weddell Sea. A similar distribution pattern was observed for the hyperiid Primno sp.

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Tab. 1 Number of individuals per 100 m^3 water of E. frigida, E. crystallorophias and T. macrura.

Station n°	E. frigida	T. macrura	E. crystallorophias
north of 59°S			
8	41	2	
116	8	76	
north of 72°S			
10		32	
14		51	
15		500	
16		270	
17		10	
18		9	
19		10	
20		26	
21		2	
105		219	
107		9	
108		10	
109		17	
110		63	
continental shelf			
23			3
24		1	1
27		23	2
28		2	30
29		2	30
31			4
33			1
63		1	20
65			6
66		1	27
67			6
68			7
72			103
74		1	19
75		1	39
77			20
83			11
84		1	17
91		1	
93			32
95		7	23
96			47
97			25
98			137
99			27
100		3	4
101		1	3

Tab. 2 Abundance of Euphausia crystallorophias and Euphausia superba larvae. The paired stations represent catches of the same positions but different dates.

station no.	gear	date	depth m fishing	depth m water	E. cryst. n/1000 m^3	E. sup. n/1000 m^3
23	BO	31.12	280	400	849	0
101	BO	15.05.	150	330	23.500	1.852
25+26	HEN	01.01.	100	550	2.238	0
95	HEN	14.02.	225	2.300	5.490	3.047
30	HLN	02.01.	160	260	7.470	0
93	BO	13.02.	130	460	1.880	275
34	BO	04.01.	160	750	42	0
88	BO	10.02.	130	500	2.830	0
37	HEN	04.01.	130	250	6.380	0
83	BO	02.02.	150	300	2.030	0
50	BO	06.01.	140	450	1.564	0
55	BO	15.01.	140	250	3.047	0
60	HEN	22.01.	250	260	3.770	0
124	HEN	06.02.	300	250	6.040	0

Tab. 3 The Occurrence of copepods in the upper layer (0-50 m) in different areas of the Weddell Sea

No.	Identified taxa	Western Filchner	"Box"	Belgrano II area	Vest-kapp
1.	Calanoida spp.		+		+
2.	Calanus sp.	+	+	+	+
3.	Calanus simillimus Brady, 1883				+
4.	Calanus propinquus, Giesbrecht 1902	+	+	+	+
5.	Calanoides acutus, (Giesbrecht 1902)	+	+	+	+
6.	Eucalanus sp.			+	
7.	Pseudocalanidae		+		
8.	Ctenocalanus vanus, Giesbrecht 1883	+	+	+	+
9.	Microcalanus pygmeus, (G.O. Sars 1900)	+	+		+
10.	Stephus Longipes Giesbrecht 1902	+	+	+	+
11.	Mimocalanus sp.		+		
12.	Aetideidae			+	
13.	Euchaeta sp.	+	+	+	+
14.	Paraeuchaeta antarctica Giesbrecht 1902		+		
15.	Onchocalanus sp.		+		
16.	Centropages sp.		+		
17.	Temora sp. (longicornis?)		+		+
18.	Metridia sp.	+	+		
19.	Metridia gerlachei (Giesbrecht 1902)	+	+	+	+
20.	Paralabidocera antarctica (I.C. Thompson 1902)		+		
21.	Acartia sp.	+	+		+
22.	Oithona sp.	+	+	+	+
23.	Oncaea sp.	+	+	+	+
24.	Harpacticoida spp.	+	+		+
25.	Copepod naupliar stages	+	+		+

Tab. 4 Copepods density in different areas of the Weddell Sea

Region	Total No./m³	% Adults	Cope-podids
Western Filchner Ice Shelf	19.58	87.08	12.92
"Box" area	2.91	62.54	37.46
Belgrano II area	38.69	76.71	23.28
Vestkapp area	79.68	36.89	63.89

Tab. 5 The density of some Copepod species in different areas of the Weddell Sea (No/m³)

Region	Calanus sp.	Cteno-calanus vanus	Metridia gerlachei	Oithona sp.
Western Filchner Ice Shelf	0.98	5.21	0.82	11.5
"Box" area	0.56	0.024	0.15	0.96
Belgrano II area	5.46	12.03	2.5	17.39
Vestkapp area	49.74	4.17	5.59	18.04

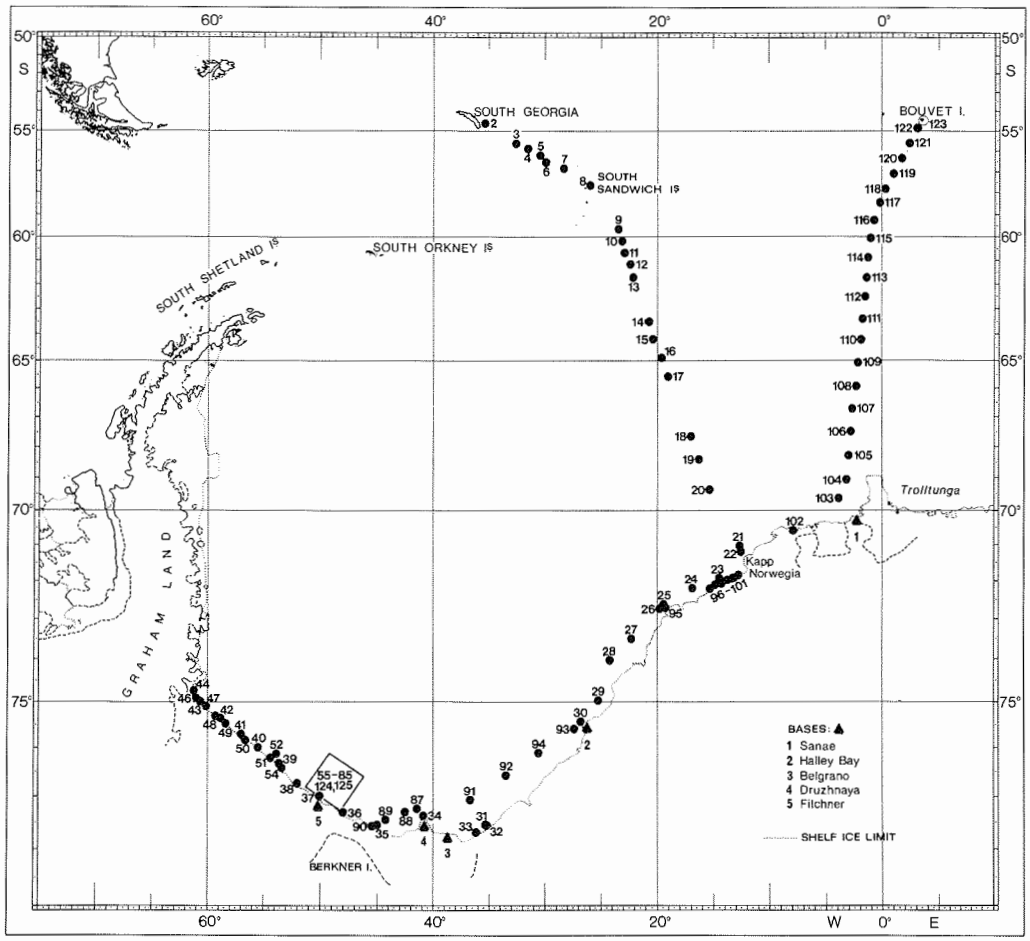

Fig. 1 German Antarctic Expedition into the inner Weddell Sea in austral summer 1979/80

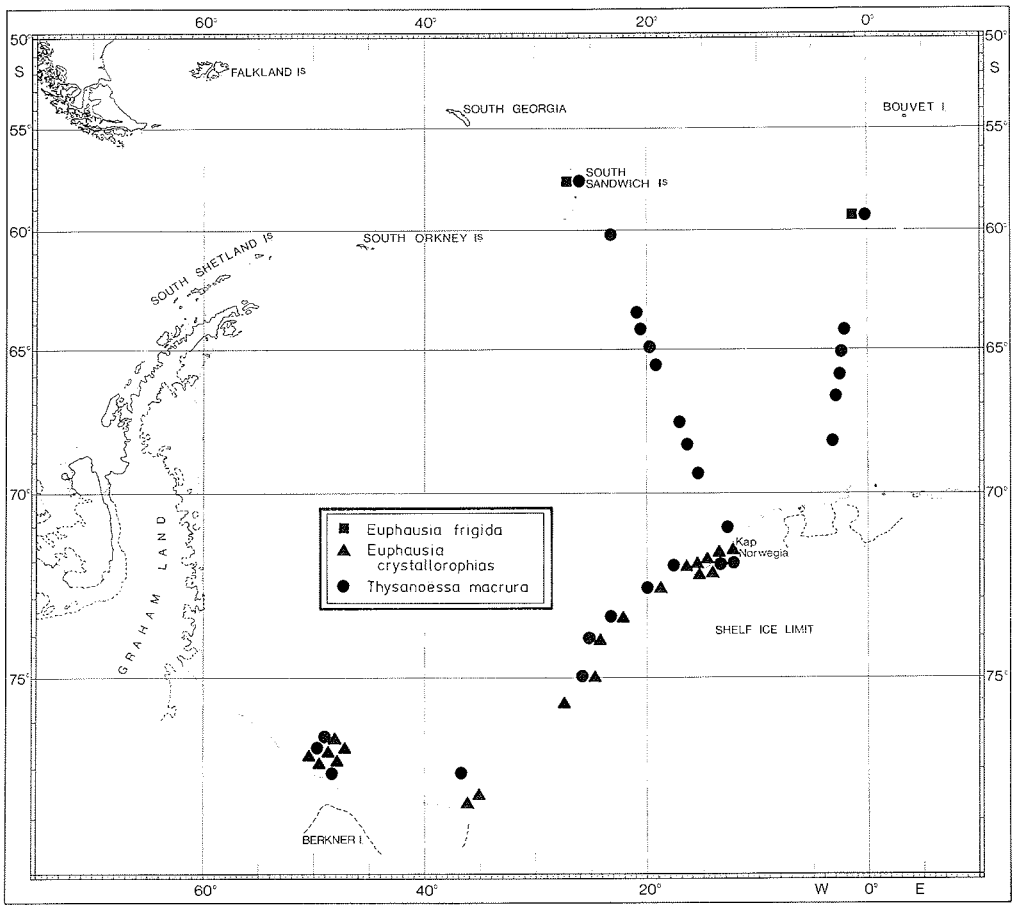

Fig. 2 Horizontal distribution of Euphausia frigida, Euphausia crystallorophias and Thysanoessa macrura

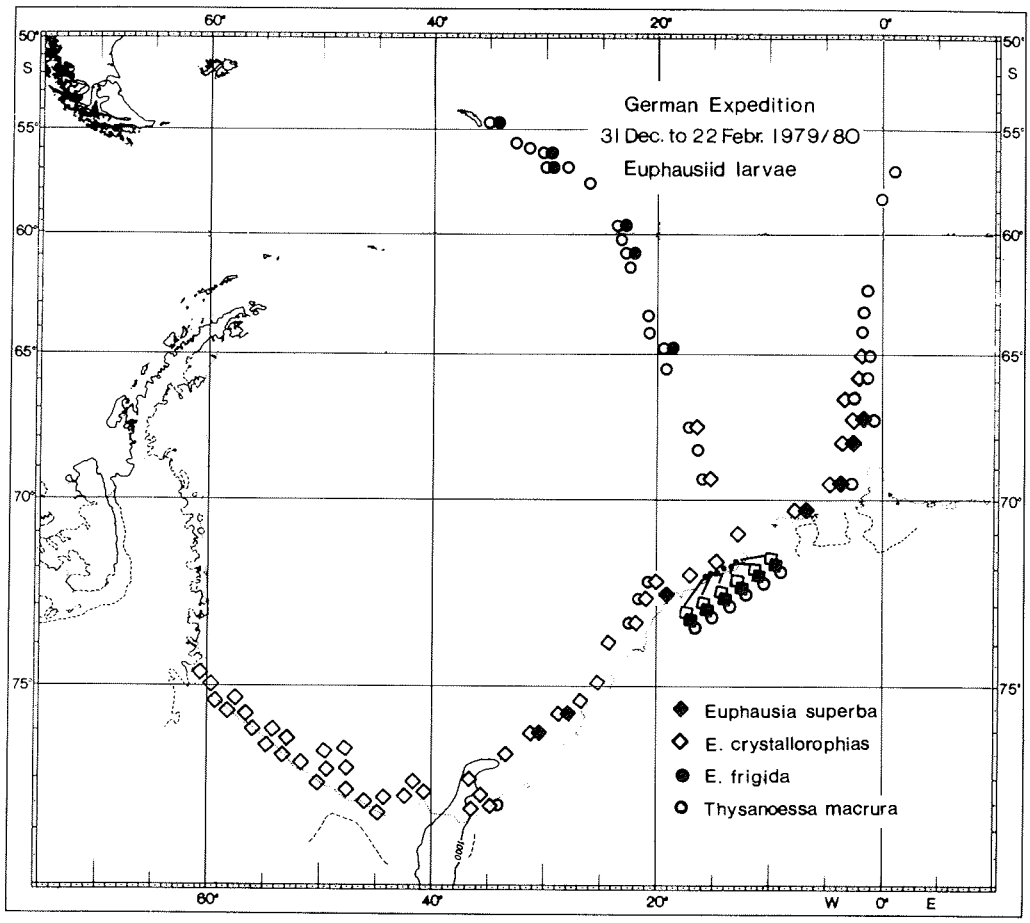

Fig. 3 German Expedition 31 Dec. 1979 to 22 Febr. 1980. Euphausiid larvae, Bongo net 500 oblique hauls n = 79 Nansen net 250 vertical hauls n = 23

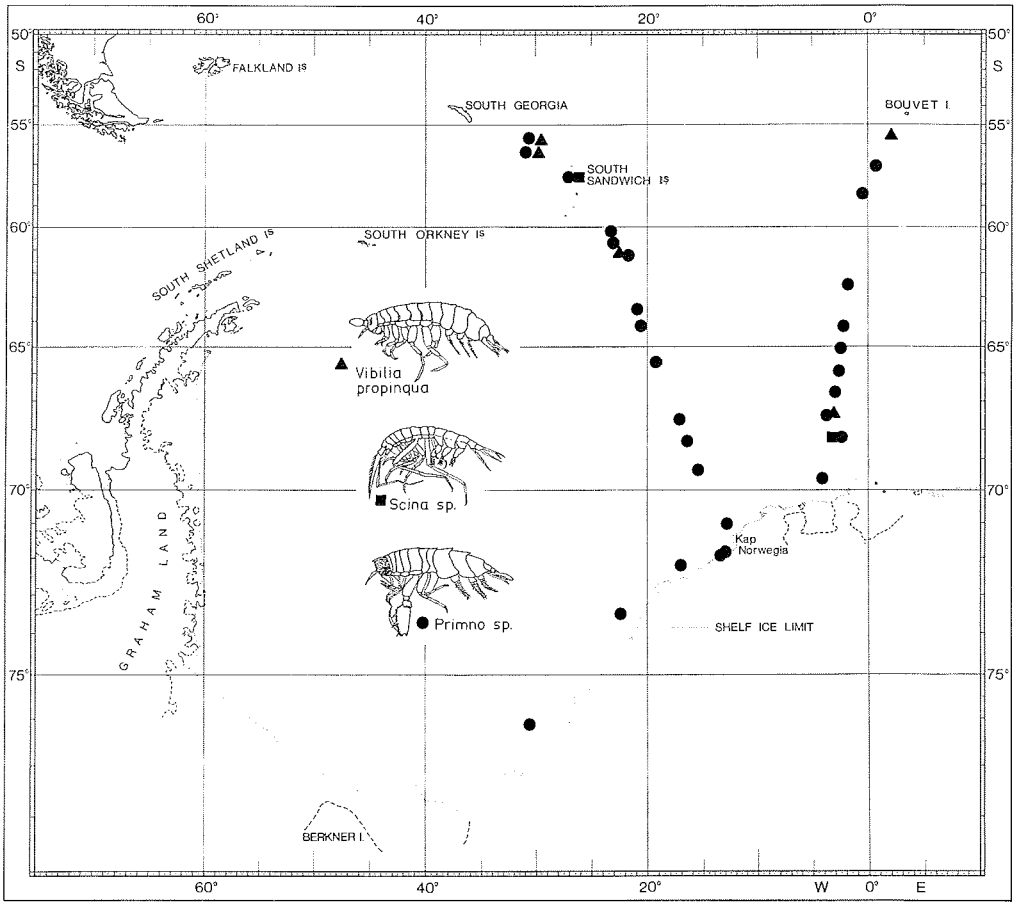

Fig. 4 Horizontal distribution of Vilibia propinqua, Scina sp. and Primno sp.

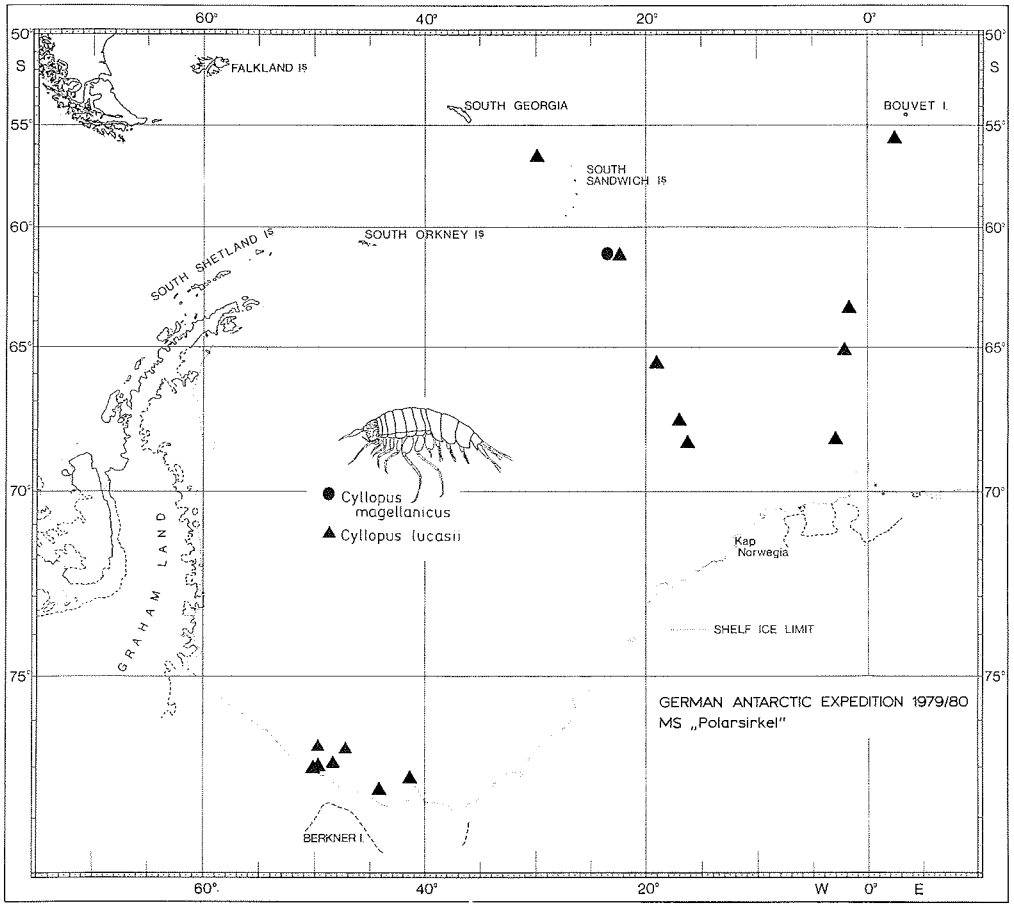

Fig. 5 Horizontal distribution of Cyllopus magellanicus and Cyllopus lucasii

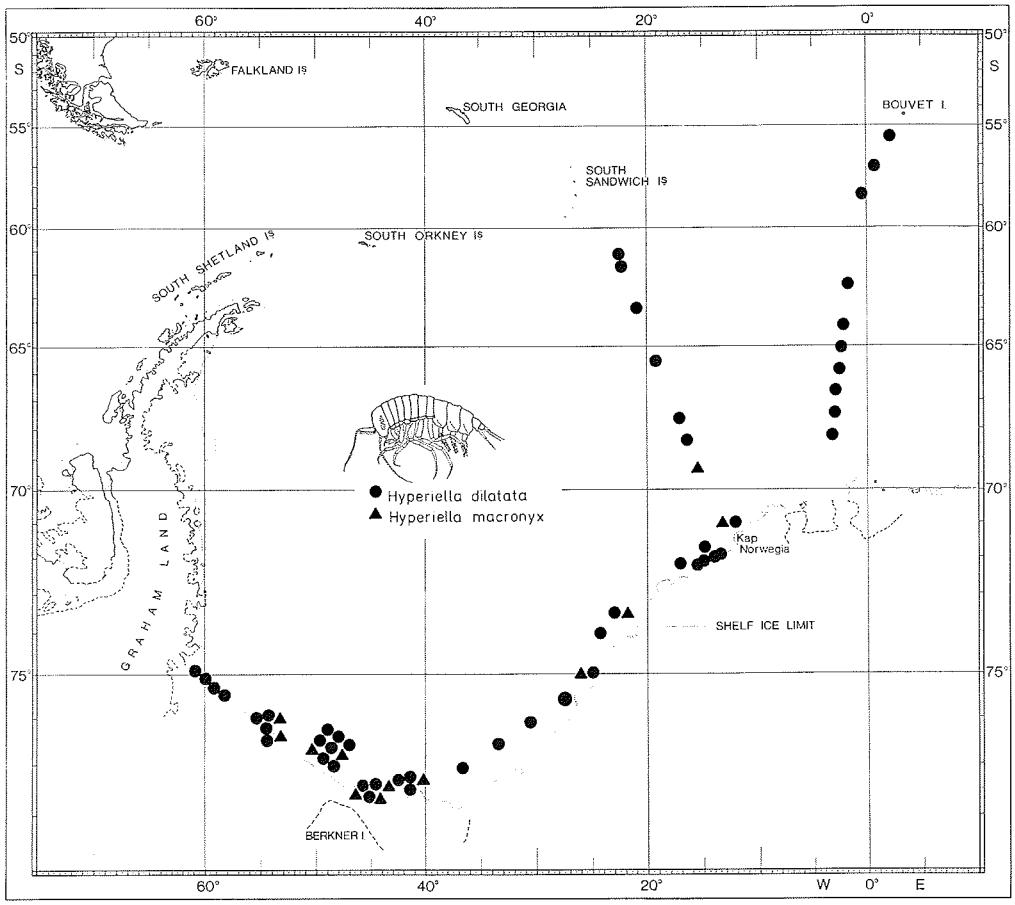

Fig. 6 Horizontal distribution of Hyperiella dilatata and Hyperiella macronyx

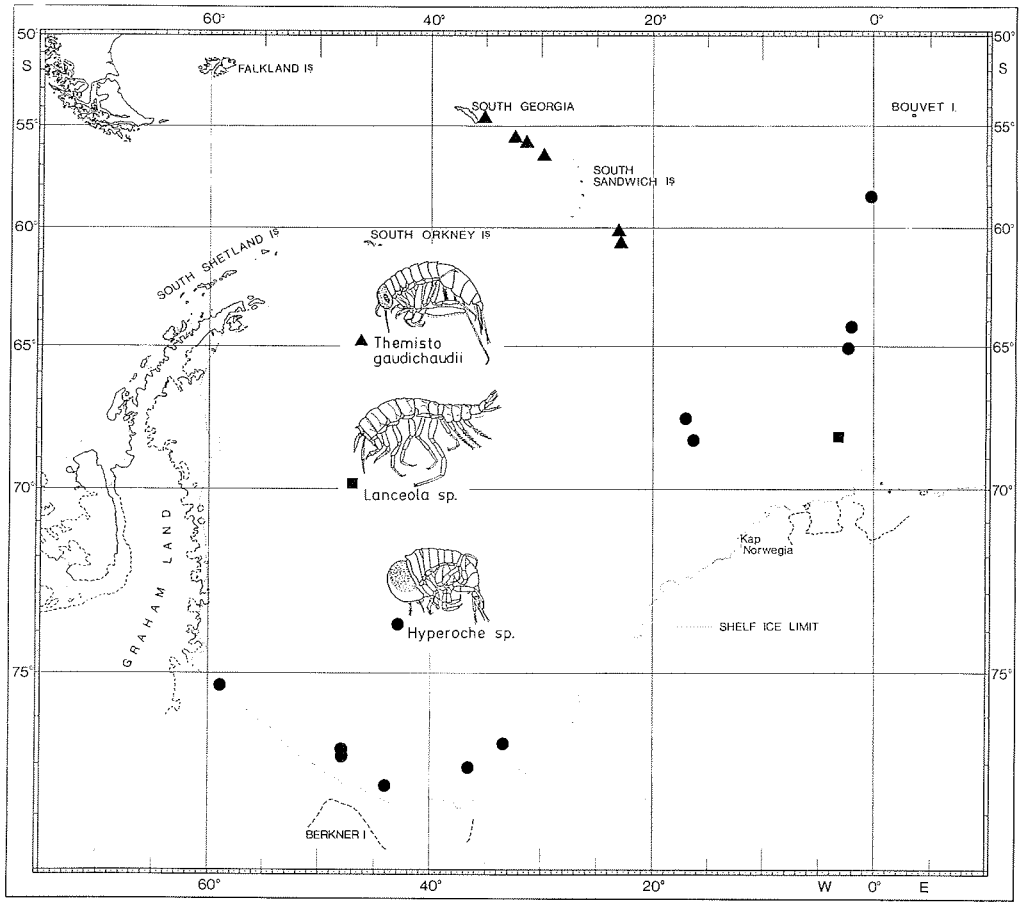

Fig. 7 Horizontal distribution of Themisto gaudichaudii, Lanceola sp. and Hyperoche sp.

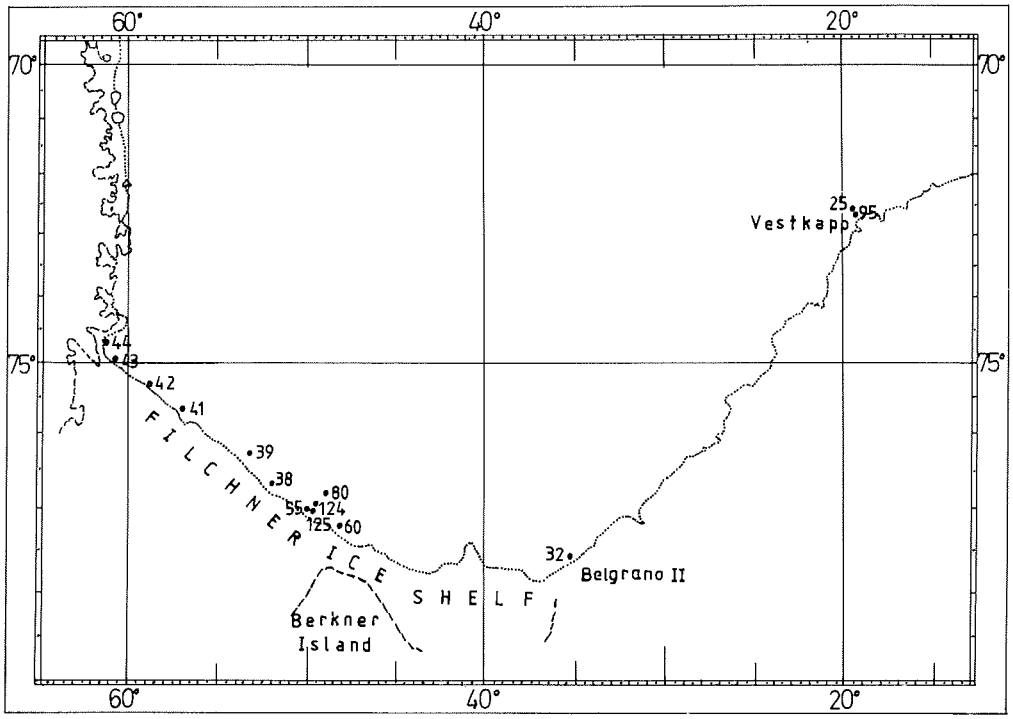

Fig. 8 Studied zooplankton stations in the southern Weddell Sea.

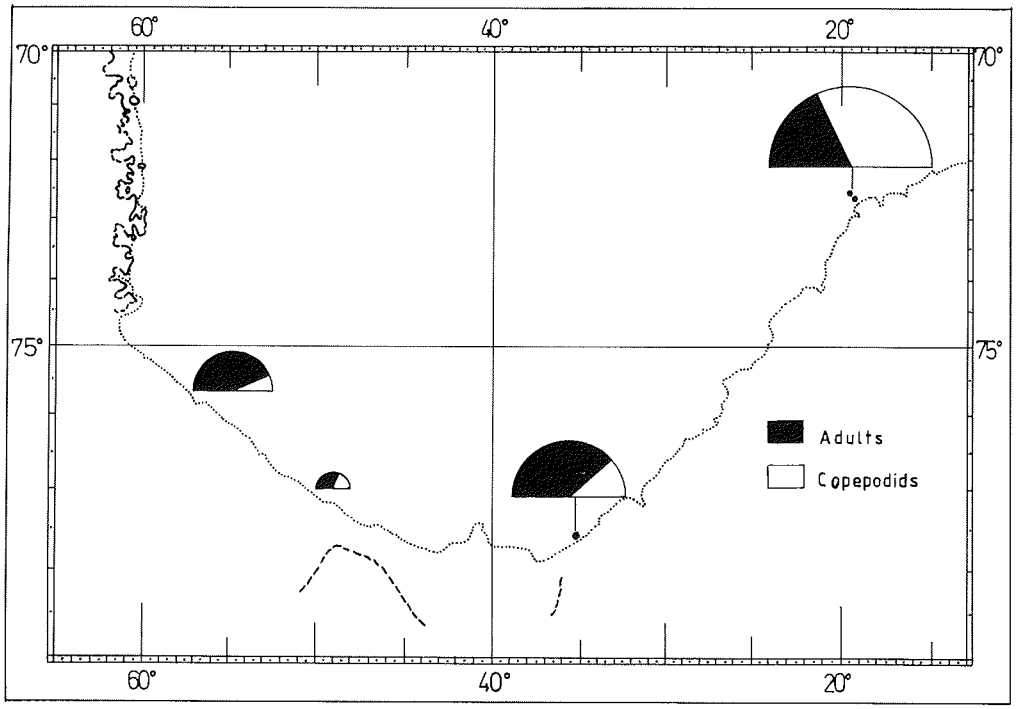

Fig. 9 Concentration of copepods in relation to copepod concentration of the "Box" area which was taken as a unit. Adults and copepodids are given in per cent within each area

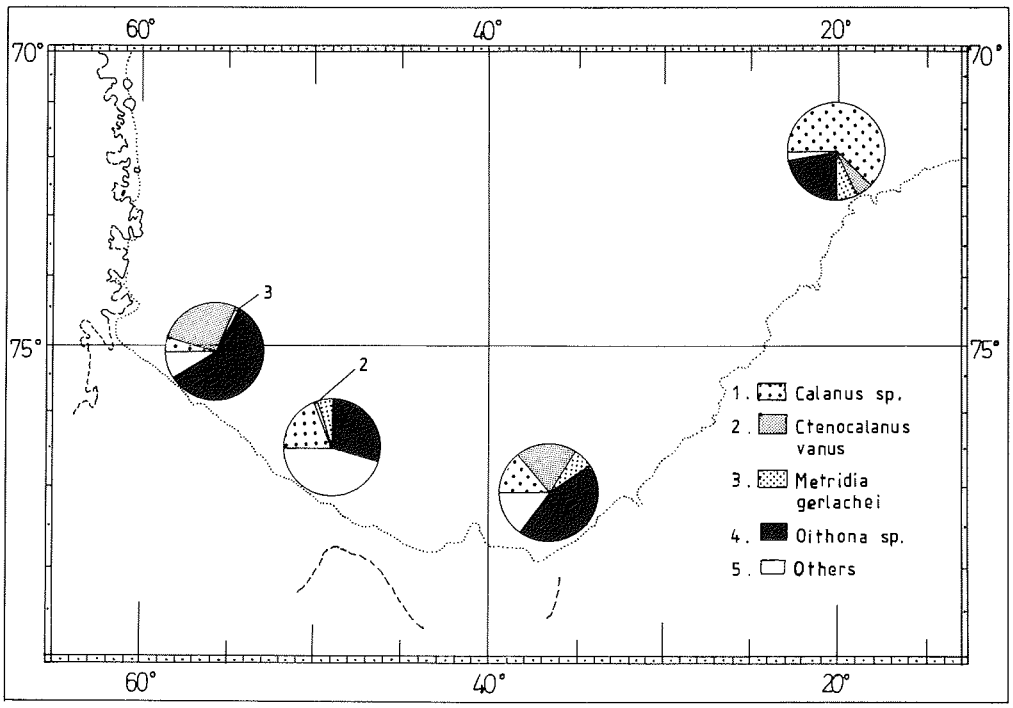

Fig. 10 Percentage of density of some copepod species.

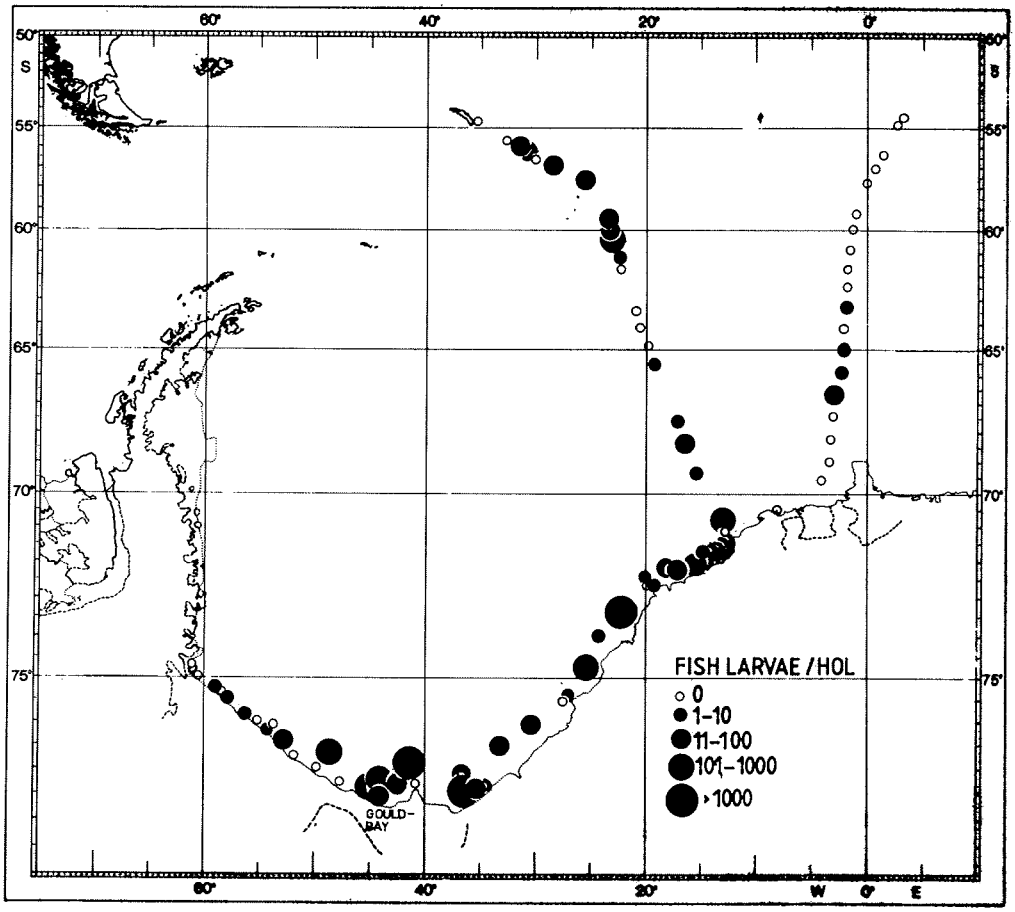

Fig. 11 Distribution and relative abundance of fish larvae

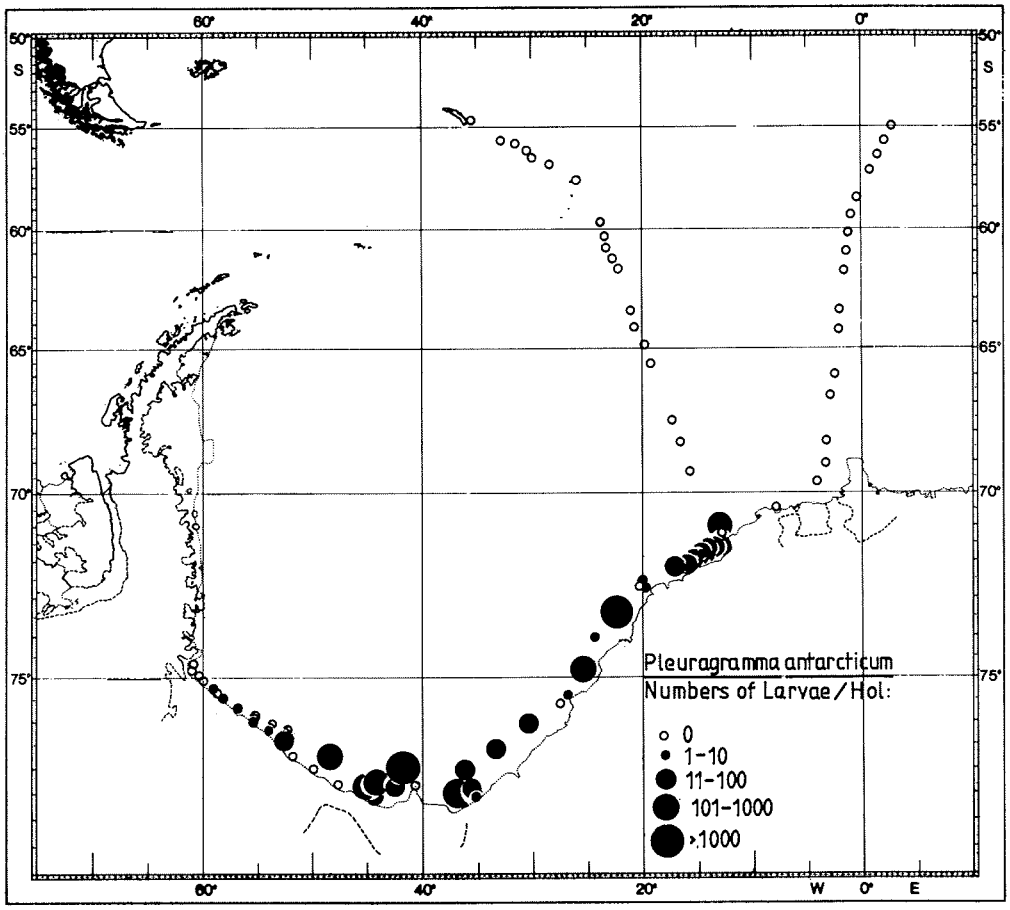

Fig. 12 Distribution and relative abundance of larvae of Pleuragramma antarcticum Boul. 1902

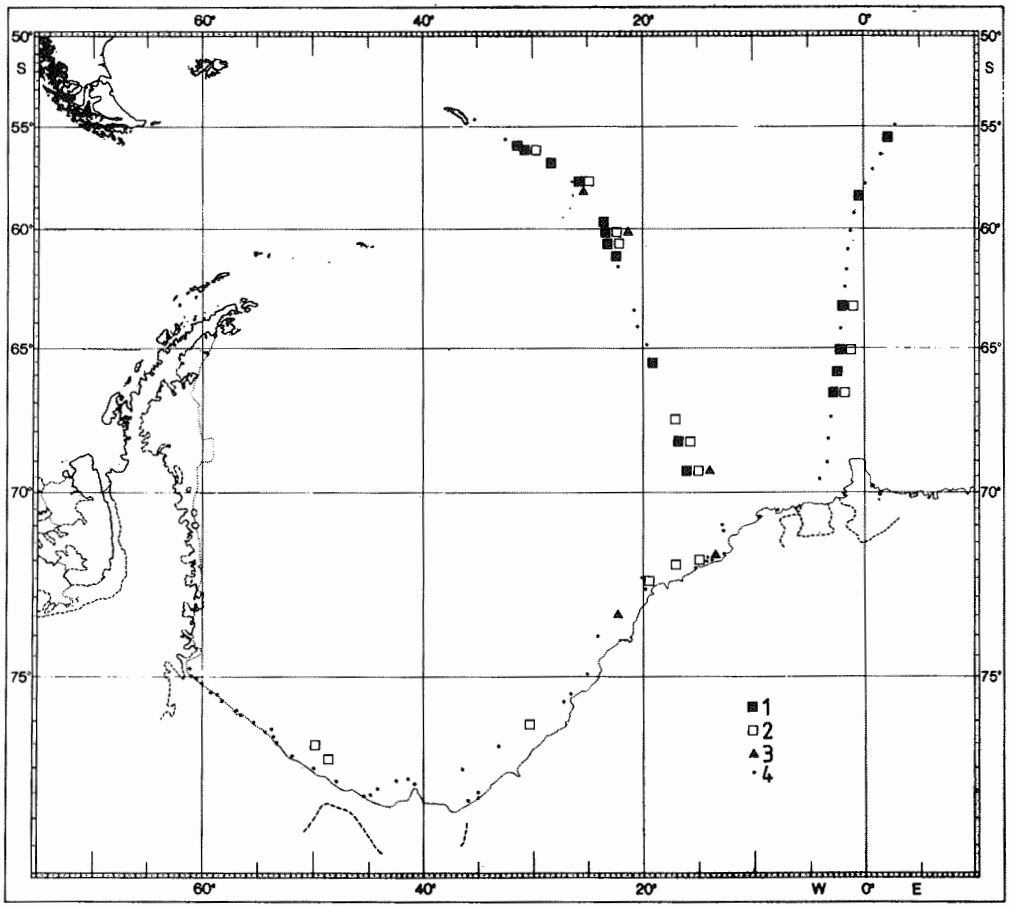

Fig. 13 Distribution of larval Myctophidae, Paralepididae, Bathylagidae:
1. Electrona antarctica, Myctophidae indet.
2. Notolepsis coatsi, Paralepididae indet.
3. Bathylagus antarcticus
4. no larvae

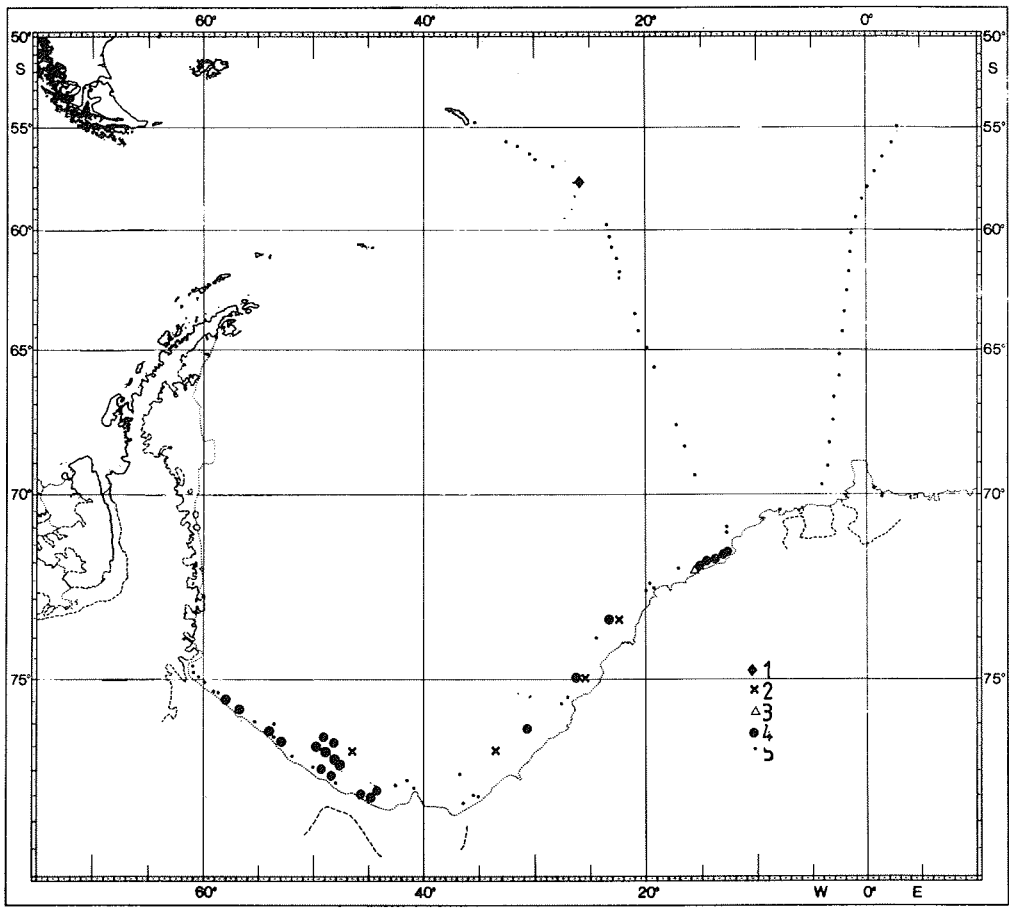

Fig. 14 Distribution of larval Notothenidae
1. Notothenia hansoni
2. Notothenia kempi
3. Trematomus eulepidotus
4. Nototheniidae indet.
5. no larvae

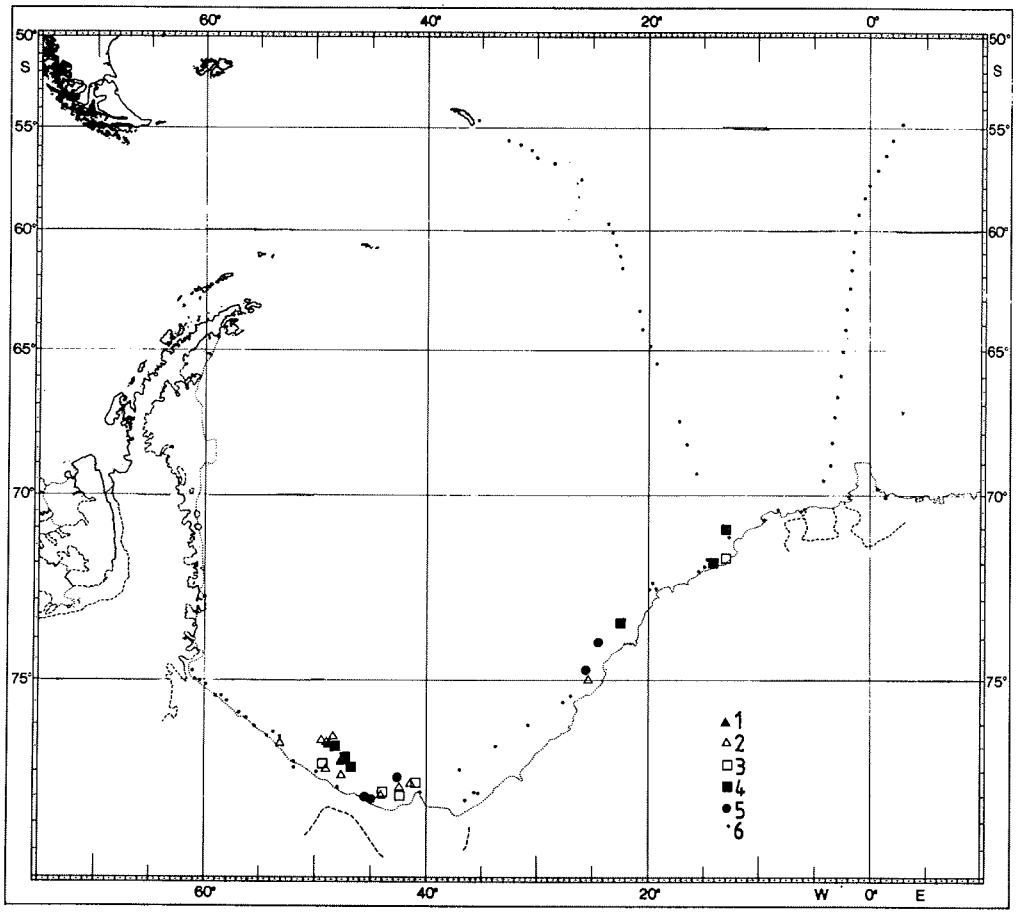

Fig. 15 Distribution of larval Chaenichthyidae:
1. Pagetopsis maculatus
2. Pagetopsis spec.
3. Cryodraco spec.
4. Chinodraco spec.
5. Chaenichthyidae indet.
6. no larvae

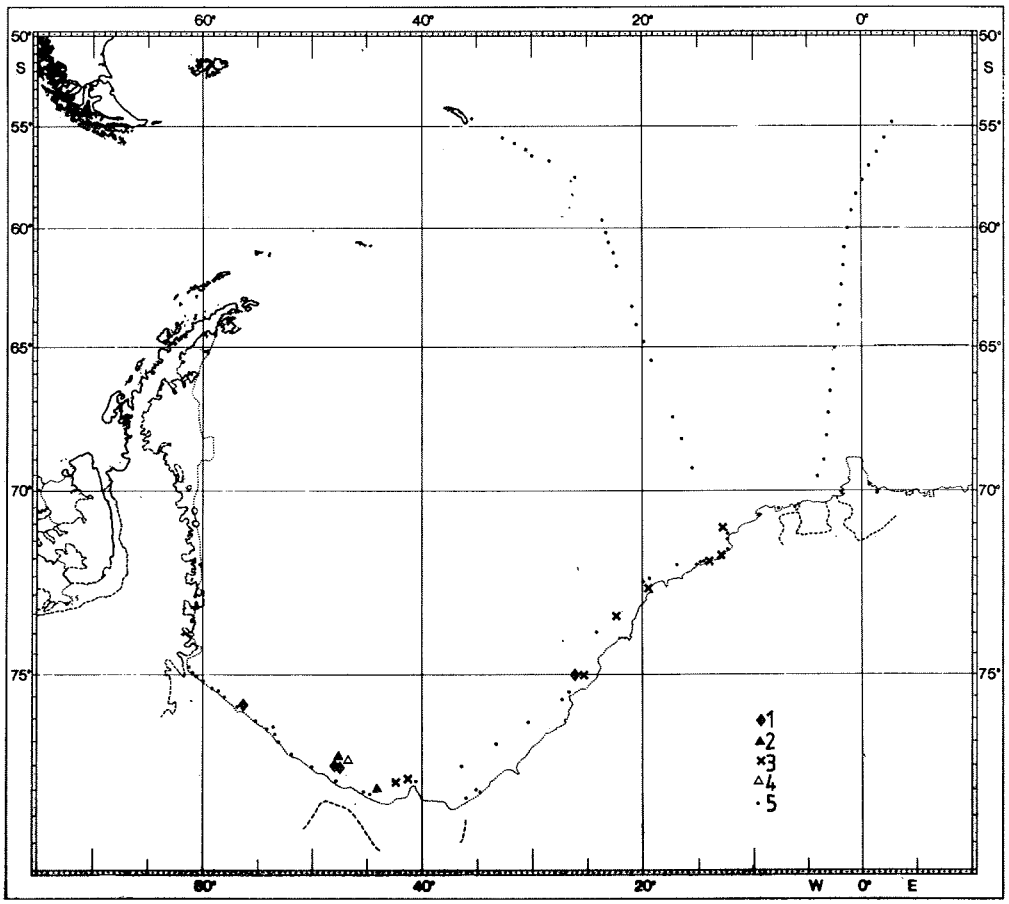

Fig. 16 Distribution of larval Bathydraconidae
1. Prionodraco evansii
2. Parachaenichthys charcoti
3. Racovitzia glacialis
4. Harpagiferidae, Artedidraco spec.
5. no larvae

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