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Macrozooplankton in the southern Drake Passage and in the Bransfield Strait during BIOMASS-SIBEX (December 1983 — January 1984)*)

ABSTRACT: Macrozooplankton was collected at 63 stations by means of a Bongo sampler in the layer from the surface to a depth of 200 m. Wet formalin volume of siphonophors, polychaetes, pteropods, copepods, amphipods, euphausiids, chaetognaths, salps, and the remaining animals was determined; the distribution of major species was presented. Low diversity in macrozooplankton composition was observed in the study area. As far as biomass was concerned, salps predominated in the whole area; they occurred in exceptionally large quantities Large amounts of krill were also observed in some areas. Besides salps and krill, other euphausiids had the greatest share in the zooplankton; they were more abundant than copepods. Macrozooplankton biomass without salps and krill was low when compared with the values known from literature.

Key words: Antarctica, zooplankton

1. Introduction

Antarctic zooplankton is characterized by a low number of species (Mackintosh 1934, Hardy and Gunther 1935, Voronina 1977), circumpolar distribution of most of them (Mackintosh 1937, Baker 1954), seasonal vertical migrations of certain abundant species (Ommaney 1936, Mackintosh 1937, David 1955, 1958, Andrews 1966, Kane 1966, Timonin 1968, Voronina 1970, 1972, Voronina Vladimirskaja and Żmijewska 1978) as well as the relatively large biomass and its small seasonal

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changes (Foxton 1956, Voronina and Naumov 1968). Different water masses are inhabited by different plankton communities (Jażdżewski, Kittel and Łotocki 1982, Rakusa-Suszczewski 1983).

Relatively little is known about seasonal and long-term changes in the composition and biomass of Antarctic zooplankton. The SIBEX experiment, of which the present paper is a part, is to explain these problems.

2. Material and methods

Samples were taken between December 10, 1983 and January 8, 1984 at 63 stations (Fig. 1) whose characteristics are given by Rakusa-Suszczewski and Lipski 1985. A Bongo sampler was used; its mouths had a diameter of 60 cm, one of them was furnished with a 333 μm mesh gauze, the other — with a 505 μm mesh gauze. The tows were double oblique, made at the vessel's speed of 3 knots, from the surface to a depth of about 200 m and back; their depth more or less corresponded to the range of the Antarctic Surface Water. The maximum depth of tows was measured with a time depth recorder. There was a flowmeter inside each sampler mouth, enabling the calculation of the amount of water filtered. The samples were preserved in 4% formalin. They were usually preserved whole except for a few very abundant ones. The tows were made at various hours but because of the season and latitude, very few were made after dark.

The present paper is based only on samples collected with the 505 μm net. The samples were analysed on board the ship, in part during the investigations and in part on the way back. They were sorted out without a microscope; coelenterates, polychaetes, pteropods, amphipods, euphausiids, salps, chaetognaths, fish and other large animals were picked out. Wet formalin volume of each group and the volume of the remaining small plankton, in which the share of copepods was roughly estimated, were measured by the displacement method. Salps were dehydrated prior to volume measurement on a gauze, the remaining groups, with the exception of chaetognaths, being dehydrated on blotting-paper. Since chaetognaths were often in bad shape after being preserved, it was impossible to measure their volume so that it would be comparable; instead, their length was measured and their volume was calculated from the formula:

$$V(mm^3) = 0.003 \times L^3(mm)$$

This formula was established empirically by measuring the length and volume of well-preserved specimens of various size.

The animals were then determined under a steroscopic microscope and counted. Salps were not counted because there were too many of them and they came in various sizes; only their volume was measured. Very

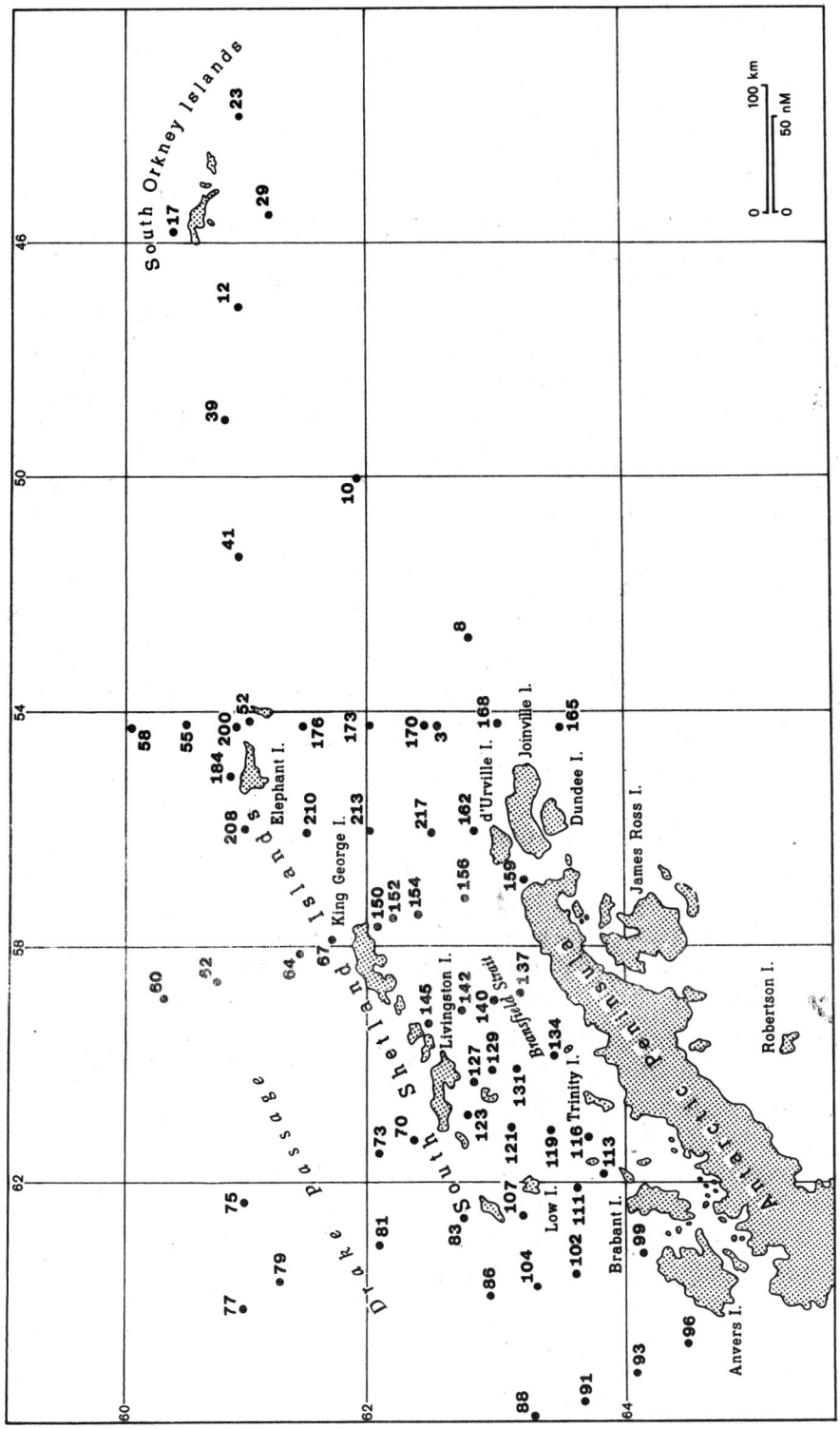

Fig. 1. Bongo sampling stations during BIOMASS-SIBEX cruise of r/v "Profesor Siedlecki"

small organisms, which could not have been collected by the net used in any representative manner (eg. *Pelagobia longicirrata*) were not counted; only their presence was noted. The following papers were used for species determination: Alvarino (1981) for *Siphonophora;* Oransans Ramirez and Dinofrio 1974 (1974) and Stöp-Bovitz (1981) for *Polychaeta*; Massy (1932), Van der Spoel and Boltovskoy (1981) for *Pteropoda;* Mauchline and Fisher (1969), Dzik and Jażdżewski (1978) for *Euphausiacea*; Barnard (1969) Dinofrio (1977) Bowman and Gruner (1973) for *Amphipoda;* Boltovskoy (1981), O'Sulivan (1982) for *Chaetognatha.*

3. Results

Salps had the greatest volume at the majority of stations. Their greatest quantities — over 1000 ml in 1000 m^3 of water — were encountered in the Elephant I. area; great quantities of salps were also observed in the Drake Passage — several hundred ml in 1000 m^3 of water. The few stations where salps were not found were situated within the range of waters from the Weddell Sea (Fig. 2) Besides salps, large amounts of krill *Euphausia superba* were found at some stations; in the Palmer Archipelago area, their amount also exceeded 1000 ml in 1000 m^3 of water. The volume of the remaining plankton was more or less equal in the whole of the study area — several tens of ml in 1000 m^3 of water (Fig. 2) euphausids, copepods, and chaetognaths predominated (Table I). The largest quantities of plankton (excluding salps and krill) were found at stations 99 in the Palmer Archipelago area and at stations 8 and 10 in the Weddell Sea, the smallest — at stations 113, 119, 134, 137, and 140 in the Bransfield Strait (Fig. 2) Mean volume of plankton for the whole study area was 319.9 ml/1000 m^3, for plankton without salps it was 77.7 ml/1000 m^3, and for plankton without salps and krill — 23.5 ml/1000 m^3 of water.

In the material collected, 53 taxons, including 24 species, were distinguished besides Copepoda (app.).

Among siphonophors, the most aboundant in the whole of the study area were probably *Dimophyes arctica* but since there were problems with differentiating it from other species of similar size, it was included in the group of "other *Calycophorae*" (app.). *Diphyes antarctica* was a large and easily recognizable species; it was encountered within the whole study area but was most aboundant east of the Bransfield Strait. Siphonophors from the group of *Physonectae*, most likely *Pyrostephos vanhoeffeni* were less frequent than the above-mentioned species: they were characterized by a tendency to occur where no *D. antarctica* was observed (app).

Polychaetes were represented by several forms, out of which only *Rhynchonereella bongraini, Vanadis antarctica* and adult *Tomopteris carpenteri* were identified. *Rhynchonereella bongraini* was the most often encountered

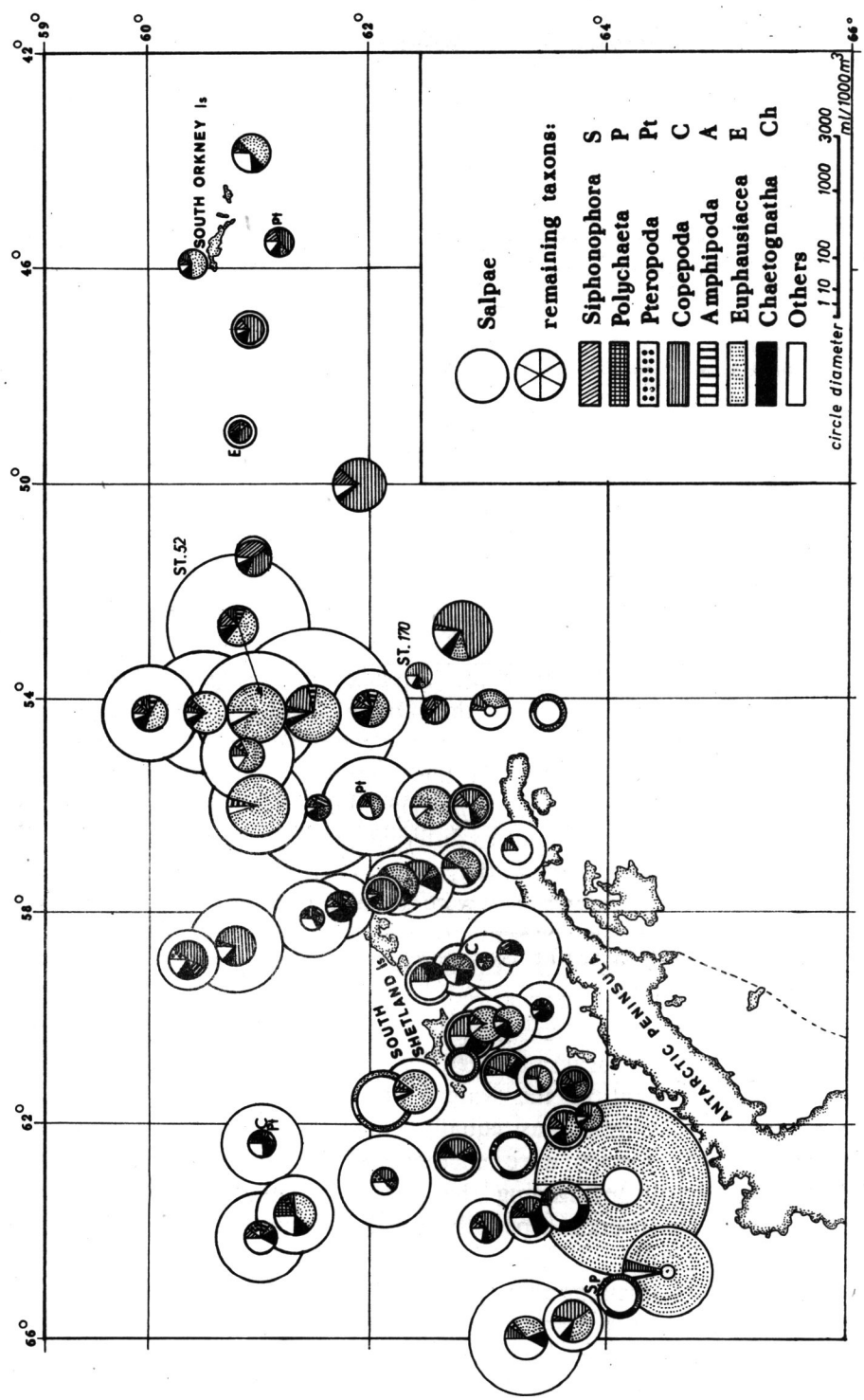

Fig. 2. Volume of salps and volume and composition of remaining macrozooplankton at stations
The circle diameter is directly proportional to cube root of plankton volume.

Table I.

Mean macrozooplankton composition (%, per volume)

	% share in the whole macrozooplankton	% share in macrozooplankton; *Salpae* and *E. superba* excluded
Siphonophora	0.3	4.5
Polychaeta	0.1	1.6
Pteropoda	0.2	2.7
Copepoda	1.9	25.8
Amphipoda	0.2	3.0
E. superba	16.9	
other *Euphausiacea*	2.7	36.0
Chaetognatha	0.8	11.2
Salpae	75.7	
others	1.1	15.2

species — it was found at most stations, occurring in greatest quantities in the southern and eastern part of the study area, i.e., in the waters under the influence of the Weddell Sea. *Tomopteris carpenteri* occurred mostly in the waters of the Drake Passage, and single specimens of *Vanadis antarctica* were found in the Drake Passage and east of the Bransfield Strait. Smaller polychaetes from the genus *Tomopteris* were common and quite abundant in the whole of the study area but since they could have included both juvenile *T. carpenteri* and other species (especially *T. septentrionalis*) and were difficult to differentiate, they were treated together (app.). Other polychaetes — from the genus *Travisiopsis*, from the family *Syllidae*, and larvae of *Spionidae* — were usually observed near land, over the shelf (app). A species present in many samples — *Pelagobia longicirrata* — was not quantitatively treated due to its small dimensions.

Among pteropods, four species were noted: *Limacina helicina, Cleeodora sulcata, Clione limacina,* and *Spongiobranchaea australis*. *L. helicina* was the predominant species; it was observed in the whole of the study area and was most abundant in the waters of the Palmer Archipelago and Drake Passage *C. limacina* was equally common though less abundant. The remaining two species were encountered sporadically and in small quantities. It is worth mentioning that large amounts of eggs, probably of *L. helicina*, were found, especially in the south-western part of the investigated area (app.).

Amphipods were often present but the number of their specimens was small. The most common species were *Hyperiella dilatata*, encountered in the whole area, and *Vibilia antarctica*, which occurred everywhere except for stations in the Weddell Sea. The latter species always co-occurred with

salps. *Themisto gaudichaudii* and *Cyllopus magellanicus* occurred mostly in the Drake Passage and sporadically also in the Bransfield Strait. Single specimens of *Cyllopus lucasii* were present in the whole study area, and *Orchomene plebs* — in shelf waters.

Thysanoessa macrura, Euphausia superba, and *E. frigida* predominated among euphausiids. The distribution of *T. macrura* was uniform in the whole study area. The same may be said about *E. frigida* except that it was not encountered at stations in the Weddell Sea. *E. superba* was much more abundant in the Palmer Archipelago area and off Elephant I. than in the remaining area. *E. triacantha* occurred sporadically, mainly in the western part of the investigated area, and *E. crystallorophias* was found only at two stations in the Bransfield Strait.

Three species of chaetognaths were distinguished: *Eukrohnia hamata, Sagitta gazellae,* and *Sagitta marri. E. hamata* was abundant in the whole of the study area; it was less numerous only at several stations in the western part of the Drake Passage and in the central part of the Bransfield Strait. *S. gazellae* was also present in the whole of the investigated area though in smaller quantities while the scarce occurrence of *S. marri* was irregular.

Besides the above-mentioned groups of animals, ostracods and appendicularians occurred regularly and in relatively large quantities. However, they were not determined in detail (app.). *Lucifer* sp. decapod was encountered quite frequently though in small quantities while *Hydromedusae* and *Ctenophora* were less frequently encountered; small cephalopods were taken twice (app.). At stations close to land, representatives of meroplankton and bottom fauna were found, often in large quantities — larvae of *Cirripedia, Mysidacea, Decapoda,* and *Pisces* (app.). Single specimens of fish larvae were also encountered at stations located far from land.

As can be seen from the above, as regards macrozooplankton composition, the area of the southern part of the Drake Passage and the Bransfield Strait was not too varied in the early summer of 1983/1984. Many species were found in all parts of the study area. However, the differences in macrozooplankton biomass and the uneven distribution of certain species enable to differentiate four areas:

1. Waters of the Drake Passage, characterized by regular occurrence of *Tomopteris carpenteri* and *Themisto guadichaudii* and the relatively small amount of *Eukrohnia hamata,* especially in the western part of this area.
2. Shelf waters west and north of the Palmer Archipelago, characterized by large abundance of many species and therefore a large volume of macrozooplankton (without salps).
3. Waters of the Bransfield Strait with particularly small quntities and volumes of macrozooplankton.

4. Waters of the Weddell Sea, characterized by the absence of such forms common elsewhere as *Salpa* sp., *Vibilia antarctica*, and *Euphausia frigida*.

4. Discussion

During the past few decades, various methods of zooplankton collection have been used so the determination of its abundance and composition did not always refer to the same zooplankton fractions. Mackintosh (1934) conducted investigations in the Atlantic sector of the Antarctic, using a net with an inlet diameter of 1 m and a mesh size of about 1.5 mm (15 meshes in an inch) and making oblique hauls in the 0—100 m layer at a distance of 2/3 nM. It may be calculated that the volume of water filtered was in the order of 1000 m^3 per haul. He differentiated a group of 7 most abundant taxons including 3 species of copepods, 2 species of euphausiids, 1 species of pteropods and chaetognaths. The largest quantities of zooplankton observed by him in the summer season occurred in the north-eastern parts of the Scotia Sea and the Weddell Sea, and in the Bellingshausen Sea — over 10 000 specimens per haul while in the area around the Antarctic Peninsula, covering the Palmer Archipelago, South Shetland Is., Bransfield Strait and extending to the South Orkney Is., zooplankton was scarce and not numerous, often below 100 specimens per haul (excepting shoal-forming *Euphausia superba, Salpa fusiformis*, and *Limacina balea*). Foxton (1956) gave one of the first estimates of the Antarctic zooplankton biomass, giving the volume of zooplankton per haul in different layers, seasons, and parts of the Southern Ocean. Assuming that the net used by him (inlet diameter of 0.7 m, mesh size 360 μm) filtered 20 m^3 of water in 50 m of a vertical haul, then mean volume of zooplankton in the summer Antarctic months in the 0—100 m layer was 65.3 mm^3/m^3 in December, 41.5 mm^3/m^3 in January, and 79.8 mm^3/m^3 in February. In the 0—250 m layer, these values were 43.8, 30.7, and 45.0 mm^3/m^3, respectively. Large animals like coelenterates, salps, fish, krill over 20 mm in length, etc. were not taken into account in those measurements. Zooplankton composition was not considered in that paper. According to Voronina and Naumov (1968), who used a vertical net with an inlet diameter of 0.38 m and a mesh size of 180 μm, zooplankton biomass in the 0—100 m layer in the vegetation season in the Indian and Pacific sectors of the Antarctic was, respectively, 72.5 and 74.6 mg/m^3. Copepods constituted the bulk of the biomass (72.8% in the 0—500 m layer), followed by chaetognaths (9.8%) and euphausiids (7.6%). El-Sayed and Taguchi (1981), who were collecting zooplankton in the Weddell Sea in the summer season by means of a vertical net with an inlet diameter of 0.5 m and

a mesh size of 333 μm, gave mean biomass in the northern and central parts of the investigated area at 30.2 mg/m^3, in the southern part — at 99.8 mg/m^3. These authors pointed out that the biomass is much greater in the night catches than in the day-time ones, especially in the northern and central parts of the Weddell Sea. Species composition was not analysed in that paper. Maruyama, Toyoda and Suzuki (1982) used a Bongo net with an inlet diameter of 0.6 m and a mesh size of 1040 μm in the Antarctic sector south of Australia and estimated the biomass in the summer season, in the layer from 0 to 200—320 m, at 12.4—42.5 g/1000 m^3, excepting sapls and medusae. The share of copepods in the biomass was the greatest (mean 61%); chaetognaths (13.6%) and euphausiids (8.6%) came next. *Euphausia superba* occurred only sporadically. Researches carried out under the FIBEX-BIOMASS programme in 1981 by Mujica and Torres (1982), Jażdżewski, Kittel and Łotocki (1982), and Rakusa-Suszczewski (1983)-deal with abundance and composition of zooplankton in the Bransfield Strait and adjacent waters. The first two authors made oblique tows in January and February with a net with an inlet diameter of 1 m and a mesh size of 335 μm in the 0—200 m layer and found out that the volume of zooplankton fluctuated from 7 to 345 ml/1000 m^3 with the predominance of the 50—200 ml/1000 m^3 range. The greatest quantities of zooplankton were found in the south-western part of the Bransfield Strait, off the Antarctic Peninsula, off the Piloto Pardo Is. (Gibbs and Aspland Islands), and off King George I. The smallest quantities were found on the northern shelf of the South Shetland Is. and in the central part of the Bransfield Strait. The authors disregarded mature krill and organisms larger than 5 ml volume in their measurements. Copepods predominated as far as numerical abundance is concerned (13.4—94% of specimens in the samples). They were followed by euphausiids, together with which they constituted almost a 100% of all zooplankton. Jażdżewski, Kittel and Łotocki (1982) and Rakusa-Suszczewski (1983) investigated zooplankton in February and March, using a vertical net with an inlet diameter of 0.7 m and a mesh size of 200 μm. The area covered by them was larger than that mentioned in the previous paper and included also the southern part of the Drake Passage. At stations situated over great depths (over 3000 m in depth) in the Drake Passage, in the 0—100 m layer, the values of the volume of all plankton (zooplankton and phytoplankton) were in the order of several hundred mm^3/m^3 (94—1233 mm^3/m^3); radiolarians, copepods, and tiny *Limacina* sp. were most numerous. Over the shelf of the South Shetland Is. and in the Bransfield Strait, these values were much lower (from several to 564 mm^3/m^3) with copepods being most numerous.

Comparing the results of this paper with those mentioned above, it may be said that although the volume of all zooplankton observed by us

was equal to the highest values noted earlier, it dropped to mean values after the exclusion of salps, and reached the lowest values when krill was disregarded. Since in the papers quoted here salps and krill were usually disregarded in volume measurements of plankton, it appears that the amount of zooplankton without these two forms was relatively small in our materials. This is in agreements with the results of investigations of Mackintosh (1934), who pointed out, as mentioned above, that the area around the Antarctic Peninsula (covering the whole area of the present investigations) is characterized by great paucity of plankton. A similar situation was observed with respect to net phytoplankton (Witek, Pastuszak and Grelowski 1982), whose quantities in the Bransfield Strait and adjacent areas were usually much lower than in the areas farther away. Higher values of the zooplankton volume observed by Mujica and otrres (1982) and Jażdżewski, Kittel and Łotocki (1982), especially outside the Bransfield Strait, in the 1981 summer season, may point out to the changeable range and intensity of this phenomenon, unless the differences result from a different method of research. The changeable boundary between the zones rich and poor in plankton was mentioned by Mackintosh (1934). Attention was also called to it by Jażdżewski, Kittel and Łotocki (1982) (concerning zooplankton) and Kopczyńska and Ligowski (1982) and Witek, Pastuszak and Grelowski (1982) (concerning phytoplankton). Mackintosh (1934) saw the reason for small quantities of zooplankton in the Antarctic Peninsula area in the fact that this whole area is a place of uplifting of "new" deep waters with scarce plankton. Rakusa-Suszczewski (1983) was of the opinion that the decisive factor in the distribution of plankton communities in the area in question was the intensity and range of inflow of waters from the Weddell Sea. Although no satisfactory explanation for the occurrence of small quantities of zooplankton off the Antarctic Peninsula is as yet available, the sources of this phenomenon should be sought among hydrological factors. The exceptionally complex nature of hydrological phenomena of this area was presented, among others, by Clowes (1934), Deacon (1937), Paterson and Sievers (1980), Grelowski, Majewicz and Pastuszak (in press).

The method of plankton collection has a great influence on its composition in the samples. A comparison made by Hardy and Gunther (1935) illustrates this very clearly. Investigating the South Georgia area, they found out that when a vertical net with an inlet diameter of 0.7 m and a mesh size of 360 μm was used, 87% of specimens were copepods with *Protozoa* following (6.5%). When a net with an inlet diameter of 1 m and a mesh size of about 1.5 mm was towed horizontally at the same stations, the share of copepods was only 19.2% and euphausiids predominated, constituting 60% of all collected material. The Bongo sampler used in our investigations, because of the relatively small mesh size, larger amount of water filtered

and its modern technical solutions enables, perhaps, to estimate the share of individual zooplankton groups more precisely than older nets. Still, the predominant role of salps, observed by us, is probably not a common phenomenon in the Antarctic. According to Foxton (1966), they appear in greatest numbers in early summer, then disappear, and the large quantities observed by us do not occur every year. Figures relating to krill should be treated with caution. Great mobility of these crustaceans allows them to avoid plankton nets, especially during the day (the majority of samples with large numbers of krill was taken at night). Besides, since krill occurs in concentrations, the small number of samples and the uneven distribution of stations may lead to falsification of the true relations. Still, despite these reservations, the high percentage of euphausiids other than *E. superba* in relation to copepods is worth noting.

Summing up the results of plankton catches with a Bongo sampler in the Polish stage of the SIBEX project in December, 1983 and January, 1984, it must be said that the area of investigations exhibited low diversity as far as macrozooplankton composition was concerned. The majority of the most important species was found in all parts of the study area. The greatest (relatively speaking) differences in species composition were observed between the northern part of the study area (southern part of the Drake Passage) and its south-eastern part (north-western part of the Weddell Sea). Salps predominated in the biomass in almost the whole area; they occurred in exceptionally large quantities. Large numbers of krill were also encountered in places. The biomass of the remaining macrozooplankton (excluding salps and krill) was small when compared with the quantities known from literature. Relatively large numbers weree found at the periphery of the investigated area — in the Palmer Archipelago and in the Weddell Sea, the smallest — in the Bransfield Strait. When salps and krill were disregarded, other euphausiids predominated in the zooplankton, exceeding the share of copepods.

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5. Резюме

Материал для этой работы собран в течение польских исследований в рамках программы БИОМАСС-СИБЭКС с 10 декабря 1983 по 8 января 1984. Пробы были собраны сетью Бонго на 63 станциях. Ловы проводились до глубины 200 м дважды по скосу. Обработан только материал собранный сетью с ячеей 0,505 мм. Кроме копепод были определены 53 таксона животных, в том 24 вида (аппендикс).

В отношении биомассы во всём исследуемом районе доминировали сальпы, которых было искючительно много. В некоторых местах были обнаружены большие концентрации криля. Биомасса остального макрозоопланктона (без сальп и криля) по сравнению с литературными данными была мала. Сравнительно найбольшие концентрации были на скрае исследуемого района — в районе архипелага Пальмера и в море Уэдделла, найменьшие в проливе Брансфилда. Кроме сальпы и криля найболее часто встречались другие звуаузиды, которых было больше чем копепод (таблица I).

В отношении состава макрозоопланктона район исследований был мало разнообразен. Большинство важнейших видов наблюдалось во всех его частях. Относительно найбольшие различия в видовом составе были обнаружены между северной частью района исследований (южная часть пролива Дрейка), где регулярно встречались *Tomopteris carpenteri*, и *Themisto gaudichaudii* а *Eukrohnia hamata* был исключительно многочисленным, и юго-восточной частью, где не обнаружено так многочисленных в других районах сальп, *Vibilia antarctica* и *Euphausia frigiola*.

6. Streszczenie

Materiał do niniejszej pracy zebrany został podczas polskiego etapu badań w ramach programu BIOMASS-SIBEX, w okresie od 10 grudnia 1983 do 8 stycznia 1984. Próby pobrano siatką Bongo na 63 stacjach. Zaciągi były podwójnie skośne do głębokości około 200 m. Opracowano tylko materiał pochądzący z siatki z gazą z oczka 505 µm, wykazując poza *Copepoda* 53 taksony zwierząt, w tym 24 gatunki (appendix).

Pod względem biomasy niemal na całym obszarze dominowały salpy występujące w wyjątkowo wielkich ilościach. Mejscami napotykano też duże ilości kryla. Biomasa pozostałego makrozooplanktonu (bez salp i kryla) w porównaniu do danych znanych z literatury była mała. Stosunkowo duże ilości występowały na peryferiach obszaru badań — w rejonie Archipelagu Palmera i w Morzu Weddella, najmniejsze natomiast w Cieśninie Bransfielda. Pomijając salpy i kryla w zooplanktonie największy udział miały eufauzje, przeważając nad widłonogami (tabela I).

Pod względem składu makrozooplanktonu obszar badań był słabo zróżnicowany. Większość najważniejszych gatunków występowała we wszystkich jego częściach. Stosunkowo największe różnice w składzie gatunkowym stwierdzone były między północną częścią rejonu badań (południowa część Cieśniny Drake'a), w której regularnie występowały *Tompteris carpenteri* i *Themisto gaudichaudii* a *Eukrohnia hamata* był wyjątkowo mało liczny — a częścią południowo-wschodnią (północno-zachodnia część Morza Weddella), gdzie brak było pospolitych na pozostałym obszarze salp, *Vibilia antarctica* i *Euphausia frigida*.

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APPENDIX

Abudance of the identified taxons (ind/1000 m^3) at particular stations

Station No.	3	8	10	12
Souding (m)	370	2000	3430	1100
Max. haul depth (m)	180	180	210	200
Filtrated water volume (m^3)	794	867	929	1081
Zooplankton wet volume (ml/1000 m^3)	4.8	96.8	66.8	29.1
1. *Hydromedusae*		4		
2. *Ctenophora*				
3. *Diphyes antarctica*	4	10	18	3
4. other *Calycophorae*	5	16	156	65
5. *Physonectae*				
6. *Siphonophorae* (indet.)				
7. *Rhynchonereella bongraini*	13	54	88	61
8. *Vanadis antarctica*		1		
9. *Tomopteris carpenteri* (adult)		1		
10. *Tomopteris* sp.. (small)	5		52	22
11. *Travisiopsis* sp.	1			
12. *Syllidae*				
13. *Spionidae* larvae				
14. *Polynoidae*				
15. *Polychaeta varia* (small, incl. *Pelagobia longicirrata*)		+	+	+
16. *Limacina helicina*	8	2	10	3
17. *Cleodora sulcata*	5	2		
18. *Clione limacina*	3		2	
19. *Spongiobranchaea australis*		1	2	
20. *Pteropoda* (ova)				
21. *Cephalopoda*		1		
22. *Ostracoda*		21	245	
23. *Copepoda*	1172	5523	10044	1085
24. *Cumacea*				
25. *Cirripedia* larvae	55			
26. *Vibilia antarctica*				1
27. *Cyllopus magellanicus*				
28. *Cyllopus lucasii*		1	2	
29. *Cyllopus* sp.				
30. *Hyperiella dilatata*	1	1	1	
31. *Hyperoche medusarum*	1			
32. *Themisto gaudichaudii*				
33. *Primno* sp.		1	1	
34. *Scina* sp.			1	
35. *Eusirus tridentatus*				
36. *Orchomene plebs*				
37. *Amphipoda* (not identif., adult)			1	
38. *Amphipoda* juvenes			174	4
39. *Euphausia superba*	3	6	5	4
40. *Euphausia frigida*				
41. *Euphausia crystallorophias*				
42. *Euphausia triacantha*				
43. *Thysanoessa macrura*	5	513		2
44. *Euphausiacea* (not identif., adult)				
45. *Euphausiacea* larvae		21		7
46. *Mysidacea*				
47. *Lucifer* sp.		5		17
48. *Decapoda* larvae	3			4
49. *Eukrohnia hamata*	25	333	441	203
50. *Sagitta gazellae*	4	20	15	20
51. *Sagitta marri*		6	17	
52. *Chaetognatha* (indet.)				
53. *Salpa sp.**)				16.2
54. *Appendiculariae*		104	29	6
55. *Pisces* larvae et juvenes	3	7		

*) wet volume (ml/1000 m^3)

	17	23	29	39	41	52	55	58	60	62
	250	270	271	1160	1350	536	3080	3150	3500	3500
	185	180	210	193	205	190	223	210	210	170
	1068	981	1079	1016	1015	1098	883	960	1086	1227
	12.8	21.9	7.4	16.9	38.7	1483.1	1001.0	486.5	140.7	444.0
1.			7	2			5		5	5
2.										
3.	5	2	3	8	13	6		5		
4.	66	67	88	22	50		57	16	34	5
5.					56					15
6.										
7.	20	14	19	58	46			3		5
8.								1	1	
9.								1	1	2
10.	13	36	33	9	14	36	42	25	63	126
11.										
12.			1							
13.										
14.										
15.		+	+	+	+	+	+		+	+
16.	2	2	1	7		6	16	31	108	107
17.										
18.	1	1	7	3	2	1	1	2	8	5
19.			5					1	2	
20.		+	+			+			+	+
21.										
22.	7	49	13	39	12		23	5	55	25
23.	530	1498	660	510	1524	455	340	483	2377	9146
24.										
25.										
26.	1			1	4	43	33	22	37	13
27.						2	2	3	3	2
28.										
29.										
30.	1			1	2	1	5	3	2	2
31.								1	3	
32.	2							8		20
33.					1	1			1	1
34.										
35.										
36.		6	6							
37.										
38.	20		45	6		129	45	9	182	17
39.	1	22	5	4	2	29	9	7	1	4
40.	76			8		1	1	43		17
41.										
42.										1
43.	127	16	15	1	3	206	441	135		21
44.										2
45.	35	31		16	12			1	768	587
46.		58	1							
47.	10		5		2	1				
48.	2	109	18		3	34				
49.	674	306	203	295	67	9	104	1	691	285
50.	4	5	10	10	16	7	16	11	37	10
51.		3				3			5	2
52.								1		
53.				10.3	19.7	1463.6	974.0	468.8	116.9	409.1
54.	116	80	33	25	10				41	70
55.	1	3	4			9	3	2		

	64	67	70	73	75	77	79	81	83	86
	800	315	455	2000	3640	3500	3570	3750	420	2250
	235	193		180	180	180	145	170	163	160
	918	909	1138	770	820	839	944	683	752	748
	223.1	140.8	166.7	162.6	277.5	386.5	264.2	425.3	62.0	94.8
1.					1	1	5	1		
2.										
3.	3		4			2			3	3
4.	34	256	156	1	52	21	1		94	21
5.									11	
6.							1			
7.	2		2	6	2	1	1		1	1
8.					1					
9.					2		7		4	
10.	3	6	25	9	18	21	85	20	106	32
11.										
12.										
13.									4	
14.										
15.	+	+		+	+		+		+	
16.	13	7	3	88	23	231	99	50	66	49
17.				1						
18.			2	5	2	7	8	1		19
19.		2				8	2	1		1
20.	+			+	+	+	+	+	+	+
21.					1					
22.	12	19	1		1	1		47	5	
23.	208	978	70	106	338	98	198	940	5212	2436
24.										
25.										
26.	12	8	9	1	20	19	15	6	7	7
27.					5	6	1			
28.	1								1	
29.										
30.	2		5	6		4	7	1	7	3
31.										
32.							21	1		3
33.				1					4	
34.										
35.										
36.										
37.								1		
38.	50	25	4	8	15	2	47	29	27	5
39.	1	1		5			1			
40.	14			1295	7			26	76	
41.										
42.										
43.	10	59	763	1794		12	190	4	15	5
44.	2									
45.		6	2			57	138	20	27	
46.										
47.									5	4
48.				1						
49.	114	468	68	6	6	5	5	7	290	3
50.	7	19	8	22	27	20	74	10	41	7
51.	1	2							3	
52.	1				1					
53.	217.9	129.8	131.8	58.4	268.3	375.1	233.4	417.3	33.9	81.6
54.				4		11	22		7	3
55.		1	8	1		1		4	8	

	88	91	93	96	99	102	104	107	111	113
	3150	1460	525	300	740	380	290	175	525	225
	215		222	195	197	180	245	150	180	120
	810	1010	829	866	911	1023	787	709	864	622
	771.6	133.9	57.7	387.0	2943.4	50.5	70.1	70.9	51.4	3.9
1.			1	2		6	5			
2.										
3.							5		6	
4.	17	154	323	60	209	27	67	10	164	27
5.	5	4	13							
6.										
7.			12			12	5	10	1	
8.										
9.	1		2							
10.	72	13	21	7		88	32	142	14	5
11.						2				
12.						2				
13.									3	
14.										
15.		+	+	+	+	+		+	+	
16.	63	70	100	83	77	55	89	169	37	10
17.										
18.	6	3	1	1	11	12		18	1	
19.	2									
20.	+	+	+		+	+	+	+	+	+
21.										
22.	170	45	1544	69	757	23	38	18	59	
23.	2445	3079	18842	16185	11712	3461	2338	3787	2103	302
24.										
25.										
26.	30	4	4				6		7	
27.										
28.							1		1	
29.				1					2	
30.	5	7	47	14	3	8	8	1	8	1
31.										
32.	6									
33.	1					1	1			
34.										
35.										
36.			1	1					2	
37.										
38.	22	20	109	55		35	15	10	17	
39.		15	5	831	5906	4	3	10	1	
40.	20	10	19			6	13	10	2	
41.										
42.			2		11	8				
43.	401	2	53	447	3063	463	10	451	411	77
44.										
45.	30					18	23	245		3
46.										
47.		1								
48.										
49.	62	143	577	426	209	587	633	595	265	23
50.	31	14	30	15	11	41	30	48	12	3
51.	9	2	11				10	10	1	
52.					10	4	4		1	1
53.	740.7	103.0	16.9	0.6	32.9	10.8	41.9	28.2	31.3	
54.	2		7			2	10	113	5	5
55.	4	1				18	3	28	1	

	116	119	121	123	127	129	131	134	137	140
	180	750	1000	175	690	1000	725	180	110	455
	205	175	195	117	200	220	210	175	110	167
	891	873	861	656	926	909	920	671	329	1167
	30.6	43.9	86.4	19.2	88.8	104.4	115.1	67.9	575.2	78.6
1.	1								1	
2.										
3.					2	4	1	1		
4.	33	23	168	2	10	13	39	18		
5.	9		1							
6.					1					
7.			7	6	1	1		1	15	3
8.										
9.			1							
10.	3	10	57	14	82	1		1		1
11.			1							
12.		1			1				3	1
13.								3		
14.									2	
15.	+	+	+		+	+	+	+	+	
16.	2	11	37	15	25	3	2	4		
17.			1							
18.		1	2	3	1	1				1
19.								1		
20.		+	+	+	+					
21.										
22.	79	33	98	2	5	2	32	101	30	
23.	1373	286	5863	1183	2299	17	304	912	103	42
24.										
25.			9	8			2		12	58
26.	2		9	5	11	7	5	1	12	3
27.						1	1			
28.			1							
29.		2								
30.	4	10	13	12	3	1	5	1	9	2
31.										
32.		2								
33.		1								1
34.										
35.										
36.	1	3								
37.										
38.	12	31	28	11	27		3	6	36	3
39.	1		9	3	3	2				
40.			3	2	9					
41.							3	9		
42.			3		2					
43.	174	31	20	427	325	563	347		3	44
44.					7			3		
45.	7	3	23	6	27	1		9		6
46.	2								3	
47.			2	2						
48.		1		3		1	1	1	30	7
49.	297	5	480	21	266		193	122		2
50.	8	5	19	6	30	1	7	3	6	
51.			7					4		
52.		3	3		8		5	5	3	
53.	18.0	40.1	58.1	6.9	59.4	85.8	104.3	64.1	571.4	77.1
54.	3		1	2	1			1		
55.	2		8	2	1	3		3	15	9

	142	145	150	152	154	156	159	162	165	168
	1480	650	175	1810	1450	320	120	385	245	245
	180	210	75	185	195	192	75	165	180	145
	974	898	438	1035	1239	1175	466	1009	992	1199
	84.7	82.6	26.5	162.3	243.7	100.8	104.7	43.4	31.1	19.6
1.		2		4				2	2	
2.										
3.	1			5	5			8	1	2
4.	12	134	2	46	25			13	2	
5.		18								
6.										
7.	7	7	2			24	21	2		7
8.										
9.					1					
10.	10	51		11	26	2			1	1
11.					2			2		
12.		7			1	14	2	1		5
13.									24	7
14.										
15.	+	+	+	+	+	+	+	+	+	+
16.	14	16	7	10	4		2	4	1	5
17.								1		
18.		7	23	1	1			2	1	
19.							2	1		1
20.	+	+	+	+		+		+	+	
21.										
22.	27			8	155	7	17	26	36	8
23.	39	7624	1477	674	6343	1519	503	1297	1162	755
24.							4			
25.					82	5270	3809	3885	645	2407
26.	3		2	1	13		2			
27.		1	5		1					
28.										
29.										
30.	7	2	2	3	6					
31.										
32.										
33.	2			3		1				
34.										
35.										
36.		1		1	2				2	
37.					1			1		
38.	2	100	18	23	19		4	6	2	3
39.	2		16	3	4	124		16	42	42
40.	1	9		2	19	2	6	2		
41.										
42.										
43.	210	58		531	44	63	9	69	12	13
44.										
45.	1	147	50	12	329	68	49	57	101	292
46.							4			
47.		7	1		1					
48.				2	1	26	32	15	5	36
49.		470	23	193	291	70	71	69	51	78
50.	11	36	2	8	13	3	4	4		1
51.				2	2				1	
52.		2				4		1		
53.	73.9	50.1	18.3	135.3	201.8	74.9	94.4	25.8	9.6	0.5
54.	1	7	1	3	19	3	2	4		
55.		7	14	4	7	19	24	11	24	58

	170 355 195 1143 5.2	173 610 160 983 238.1	176 540 160 1104 2901.2	184 2000 180 1024 434.9	200 680 200 947 1159.6	208 800 155 1083 650.9	210 220 148 512 1324.9	213 1900 197 987 488.2	217 310 193 910 245.8
1.							2	2	7
2.		2							
3.		2	3					3	
4.			5				31	8	18
5.									
6.									2
7.	4		8	1	2				2
8.			2						
9.				1		2			
10.		4	8	5		13			2
11.	1								
12.	1								
13.									
14.									
15.	+	+	+	+		+		+	+
16.	1	10	2	12	11	21	4	4	5
17.	1								2
18.	3	1		1	2	3	4	1	
19.									
20.	+		+				+		
21.									
22.			6			1	20	1	3
23.	2998	311	11578	671	232	478	153	43	192
24.									
25.	119								8
26.		20	30	12	13	17	16	8	3
27.						2			
28.		1				1			
29.									
30.	1			4			2	2	1
31.		1							
32.				4	1	255	4		
33.									
34.									
35.									
36.									1
37.									
38.	10		6	2	2	2		2	1
39.		20	68	9	596	300	4	4	
40.				22	63	538	4		
41.									
42.									
43.	3	70	75	96	209	540	27	40	558
44.							10		
45.	87		207	6	13	5	4	12	13
46.									
47.			6		2				
48.	4								4
49.	54	2	240		6	6	27	21	32
50.	1	5	16		6	3	8	2	2
51.									
52.							2		
53.		223.8	2815.2	424.8	1056.0	517.1	1320.3	481.3	219.8
54.	5	3	22						
55.	19		3	4	4	1			2