The South African SIBEX I Cruise to the Prydz Bay region, 1984: VIII. The plankton encountered during the survey

B.P. Boden
Dept. of Zoology and Entomology
Rhodes University, Grahamstown 6140

This contribution deals with the species structure of the phytoplankton and zooplankton encountered during the SIBEX I survey. The species collected are identified, with comments on their abundance and status. There are indications that some of the populations were tending towards seasonal senescence.

In hierdie bydrae word die spesiestruktuur van die fitoplankton en soöplankton bespreek wat tydens die SIBEX I-opname teengekom is. Die spesies wat versamel is, is geïdentifiseer en aantekeninge oor hul voorkoms en status gemaak. Daar is aanduidings dat sommige bevolkings tot seisoensveroudering geneigd is.

Introduction

The SIBEX grid is situated in the southern, intermediate, oceanic region of the Indian Ocean sector of the Antarctic Zone (Allanson & Parker, this volume).

In biogeographical terms the study area is small for an oceanic survey. In addition the track chart shows that the stations are closely spaced and good resolution may be expected. In his overview of the physical conditions pertaining during this investigation Brundrit (this volume) has demonstrated a distinct change roughly along the 64°S line of latitude.

This communication deals with the phytoplankton and zooplankton encountered in the survey during an attempt to establish any relationship between the distribution of the plankton flora and fauna with any of the numerous physical parameters investigated and presented in this volume.

Methods

Twelve grid stations and one ice-edge station were examined (Fig. 1) and their surface temperatures are indicated. The stations were selected to give as wide a geographical spread as possible within the grid. Station numbers are given in Allanson & Parker (this volume).

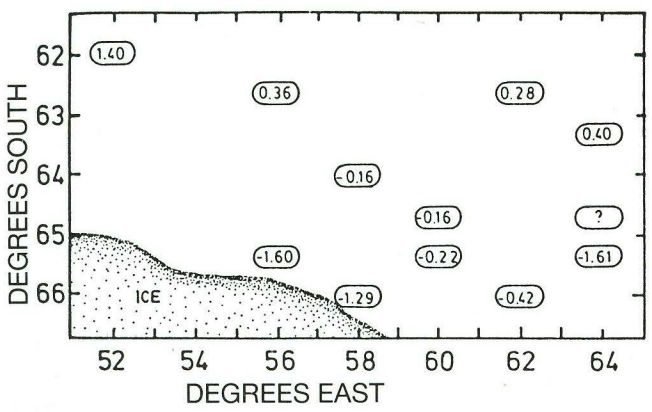

Fig. 1. Phytoplankton stations studied in this survey. Surface temperatures in degree centigrade are indicated.

The phytoplankton was collected with a small net (25 cms. mouth diameter, 25 μ mesh) hauled by hand from 75 m to the surface. This is defined as the surface mixed layer in the survey area by Brundrit (this volume), is within the euphotic zone and is, therefore, the vertical stratum of greatest interest in this aspect of this enquiry. The samples were preserved in 5 per cent buffered formalin in seawater.

Results

Phytoplankton

Table 1 lists the species encountered at the ice-edge. It was a small station and the species are not presented in any particular order.

The diatoms (Bacillariophyceae) are the only constituents of the phytoplankton considered here in any detail (Table 2). The dinoflagellates (Dinophyceae) were negligible and in terms of biomass and number of individuals were overwhelmingly exceeded by the diatoms of all stations except 3, 4 and 6. These stations are on the extreme eastern edge of the survey grid and straddle the physical front shown by Brundrit (this volume). At these stations the dinoflagellates dominated the phytoplankton and were markedly speciose, with the most frequent forms being *Ceratium fusus, Dinophysis caudata* and *Protoperidinium* spp. The tintinnids were also plentiful and the ciliates *Strombidium* and *Lohmaniella* were present. The silicoflagellate *Dictyocha speculum* occurred sparsely to moderately at nearly all stations but was notably absent from these three stations. At times this is known to outnumber any species of diatoms and is considered an important contributor to the planktonic biomass and a primary producer. The nanoplankton was missed by the collection methods employed.

The relative estimated abundance of the most commonly encountered species of diatom is shown in Table 2.

Table 1

Diatoms encountered in a short haul at the edge of the pack-ice

Species at ice-pack edge

Thalassiothrix longissima et
Thalassiothrix longissima
var. *antarctica*
Rhizosolenia hebetata
f. hiemalis
Rhizosolenia alata et
Rhizosolenia alata
f. curvirostris
Fragilariopsis antarctica et
Fragilariopsis antarctica
f. bouvet
Corethron criophilus
Coscinodiscus lineatus
Coscinodiscus sp.
Chaetoceros atlanticus
f. indet.
Chaetoceros convolutus
Chaetoceros radiculus
Asteromphalus hookeri
Asteromphalus parvulus
Biddulphia aurita
Cylindrotheca closterium
Dactyliosolen antarcticus

Table 2

Relative estimated abundance of the most commonly encountered species of diatoms. Four plusses indicate an exceptionally heavy bloom, three – very abundant (bloom, dominance), two – moderate or frequent, one – sparse. A space means absent.

Species	Station											
	1	3	4	6	10	15	17	18	26	29	30	34
Thalassiothrix longissima et		+++	+++	+++	+++	+++	+++	++	+++	+	+	+++
Thalassiothrix longissima var. *antarctica*			++		+++	+++	+++	++	+++			+++
Synedra pelagica	+	+	++	++	+		+	+				
Rhizosolenia hebetata f. semispina	++				+	+++	++	+++	+++	+	+	++
Rhizosolenia hebetata f. hiemalis	+				+	++	+	+	+			
Rhizosolenia alata et	+		+	+	+	+++	+	+++	++			++
Rhizosolenia alata f. inermis						++			++			+
Rhizosolenia alata f. gracillima	+					+++		++	++			++
Rhizosolenia alata f. curvirostris	+				+	++	+	+	++	+		
Asteromphalus heptactis	+++					+		+	++		++	+
Asteromphalus parvulus							+	++		+	+	
Corethron criophilum	+				++	++	++	++	+			+
Coscinodiscus excentricus	+	+++	+++	+		++				++	++	+
Coscinodiscus lentiginosus	+	++	++			++		+	+			
Coscinodiscus lineatus						+				++	++	
Coscinodiscus marginatus		+	++	+						+		
Coscinodiscus radiatus	+									+	+	
Coscinodiscus spp.	++	+++	++	++	+	++	++	++	++	++	++	++
Chaetoceros affine f. indet.	+											
Chaetoceros atlanticus			++								+	
Chaetoceros convolutus			+	+			+					
Chaetoceros criophilus	+				+	+			+			
Chaetoceros laciniosus	+											
Chaetoceros radiculus					+						++	
Fragilariopsis antarctica	++++	++	++	++	++	+++	+++		+++	+++	+++	++
Fragilariopsis antarctica f. bouvet	++++	+		+		+++	++		++	+	++	++
Fragilariopsis sublinearis		+								++	++	++
Leptocylindrus danicus	+											
Dactyliosolen antarcticum	++							+	+	+		
Plagiogramma vanheurcki	+								+			
Biddulphia aurita	+		++									
Nitzschia seriata											++	
Cylindrotheca clostoridium	+			+							++	
Pseudoeunotia doliolum		++	++									
Planktoniella sol		+										
Pleurosigma directum										+	+	
Triceratium favus											+	

Systematic notes and ecological comment

1. *Thalassiothrix longissima* Cleve et Grunow, and *Thalassiothrix longissima* var. *antarctica* Cleve et Möller = *T. antarctica* (Karsten & Hendy).

Hendy (1937) refers this variety to *T. antarctica* Karsten. However, Karsten (1905) designates it *T. antarctica* Schimper, apparently referring to Schimper's ms notebook. Prof Ruth Patrick, Smithsonian Institute, states (pers. comm.) that a type-slide (no 125) has been lodged there by Cleve & Möller referring to *T. longissima* var. *antarctica.* There appears to be no legal published authority. It is reduced to a variety here with the authority accorded to Cleve & Möller on grounds of the type slide.

It was separated from the parent species because of the torsion of the cell around the centre (through 90° in the species and 180° in the variety), more delicate striations in the variety, and the lack of terminal apiculi and spines. The variety is typically S-shaped while the species is a simple bow-shape.

The type is characteristically cold-water and the variety reportedly temperate. The forms co-existed in our material but there were intergrades, suggesting that specific rank is not warranted. Both forms are solitary but entangle in ball-like masses.

T. longissima and its variety *antarctica* occurred at all stations except station 1. The great abundance of this form was shown more clearly by the Bongo net hauls. At times the net was clogged and the sample was a sago-like soup of diatom boluses that completely masked the zooplankton. It is very probable that the net had not filtered sufficiently well to capture representative zooplankton. A diatom species is considered to be in bloom when concentrations reach 10^5 cells.ℓ. While it was not possible to get an accurate count, our estimates of this species are well above 10^9 cells.m^3.

The variety *antarctica* of *T. longissima* decreased in abundance from the north until it was absent from station 15 at the pack-ice edge. The type was in bloom throughout. This conforms to the general N-S gradient in temperature for the type is a cold water form while the variety is generally considered as temperate. Both were absent from station 1(46) and the temperature at this station is relatively high (1.40 °C).

2. *Synedra pelagica* Hendy = *S. spathulata* (Schimper) ex Karsten (1905) non O'Meara (1875).

This species was also entangled in the *Thalassiothrix* boluses but was not very abundant. It is essentially a cold-water form.

3. *Chaetoceros convolutus* Castracane

This is the second most abundant diatom at stations 17 and 18. It is an oceanic form with a preference for low temperatures but usually high salinity. *C. atlanticus* was found at the ic-edge. It is a neritic form common in the south. *C. radiculus* is an oceanic, usually cold-water form. Only the solitary form was found but it does exist in chains.

4. *Fragilariopsis antarctica* (Castracane) Hustedt, in Schmidt, and *Fragilariopsis antarctica* f. *bouvet* Karsten.

Both type and form were in bloom to heavy bloom (exceptionally heavy at station 1) at all stations except 4, 10 and 18 from which the form was absent. The form is slightly smaller than the type and the cells are more regularly rectangular in girdle view. It is less variable in size and shape. The type is probably oceanic and the form neritic but in our material they are found in roughly the same numbers. They are cited as amongst the most common Antarctic diatoms, but according to Hendy (1937) they are usually most plentiful in the spring.

5. *Corethron criophilus* Castracane

The genus is monotypic but Hendy (1937) divides it into five "phases". The *inermis, hystrix* and *criophilum* phases or forms are common in the sub-Antarctic and all were present in our material.

6. *Rhizosolenia hebetata* (Bailey) Gran emend.

This is a dimorphic species. The form *semispina* (Hensen) Gran is a warm-water and summer form and its distribution is considered to be a classical example of antitropicality by a sub-polar form. It has been noted in Californian waters and even in the Gulf of California (Boden pers.obs.). The form *hiemalis* Gran is usually a cold-water and winter form. Boden (1949) considered the presence of *semispina* and the absence of *hiemalis* in the Antarctic in March to be an indication that the diatom population was a later summer one. By this token the presence of both forms in the present material may indicate either a seasonally transitional community or a water mass of mixed origins. The former is believed to be the case, for the chloroplasts were pale, brownish and somewhat amorphous, suggesting that senescent forms were being examined.

At stations 1 and 10 in the northern sector variants of both *semispina* and *hiemalis* were found that had two apical spines. Sometimes there were two at one end and one at the other. They are possibly separate forms but it seems more probable that they are auxospores or resting spores. It has been suggested that *hiemalis* is a winter, resting stage of *semispina* and if resting spores are being found at this time it may be another indication of a senescent summer population transforming into a fall or winter one. The type and f. *semispina* showed a preference for the central stations but f. *hiemalis*, occuring in small numbers, was indifferently distributed. Both the type and this form appear in rafts.

7. *Rhizosolenia alata* Brightwell and f. *curvirostris* Gran, f. *gracillima* (Cleve) Grunow, f. *inermis* (Castracane) Hustedt

These all appeared at stations throughout the grid. The type and f. *gracillima* were in bloom at two stations and dominated the plankton community together with *R. hebetata f. semispina*. Hart (1934) showed that *R. alata* does not usually appear in the Antarctic until late summer.

8. *Asteromphalus heptactis* (Brébisson) Ralfs ex Pritchard was present randomly throughout the grid. A variable species, it is not usually found in great numbers but approached bloom stage at station 1.

9. *A. parvulus Karsten* occurred in small numbers in the south. A small, oceanic form, it favours cold water of low salinity. *A. hookeri* Ehrenburg was found only at the edge of the ice-pack. These two species may be regarded as truly Antarctic.

10. *Coscinodiscus* Ehrenburg

Most of the species seen were small, mainly oceanic. They are very difficult to identify in water mounts and there were probably more species than are indicated in Table 2. *Coscinodiscus* sp. is a consortium of unidentified forms.

11. *C. lentiginosus* Janisch in Schmidt is a readily identified Antarctic form that occurred at most stations.

12. *Cylindrotheca clostridium* occurred sparsely at stations 1, 6 and frequently at station 30 – the warmest and coldest surface temperatures in the grid and from oceanic to pseudolittoral (ice-edge) locations. It is generally regarded as a ubiquitous species in temperate, coastal consitions.

13. *Nitzschia seriata* was also common at station 30 only. This is very near the ice. The species is usually regarded as littoral to neritic.

14. *Biddulphia aurita* appeared only at stations 1 and 4 – as widely separated as possible in both N-S and W-E directions, but both oceanic stations. Cupp (1937) lists it as a neritic and littoral species abundant in boreal waters. Only the variety *obtusa* has been reported previously from Southern Oceans (Hendy 1937). This is the southernmost record of the type and the variety was not encountered.

15. *Leptocylindrus danicus* was found only at station 1. It is regarded as a temperate, littoral form often found in oceanic situations so its presence here is not remarkable.

16. *Pseudoeunotia doliolum* and *Planktoniella sol* are warm to tropical water forms. They occur only in the easternmost leg of the grid.

The Antarctic Zone is typified by a uniformity of environmental conditions. The lack of dramatic indicators is, therefore, not surprising. The collection described here does not allow any subdivision of the Zone on the basis of plankton distribution, but the whole area lends itself to a general colonisation by cosmopolitan forms and is easily invaded by temperate forms. For instance, although there are no notable exotic forms, a number of species generally regarded as temperate were encountered. Whether they are transients or visitors is debatable. It seems more probable they are relics of a summer population.

Vague indications of a loose conformity of species and their varieties and forms to the general N-S gradient in temperature appear to be the result of seasonal effect rather than a linkage to foreign water masses. The two genera that deserve special attention with this in mind are *Thalassiothrix*

and *Rhizosolenia*, particularly with regard to their physiological condition and possible developmental stages.

One gains the overall impression of a fall, or early-winter population being present during this survey. The flora is still rich in numbers and species which may be suggestive of a second seasonal bloom. Such a burgeoning occurs in other parts of the Antarctic, notably the Scotia and Bellingshausen Seas, after the vernal bloom has died down.

A determined effort, born of experience, was made to remain objective in estimating the relative abundance of species. However, it must be remembered that the data are presented in a quasi-quantitative format and lack the authority of numbers per unit volume.

Zooplankton

The zooplankton at 13 stations in the SIBEX I study area was surveyed in a rather preliminary fashion. These were selected stations and their distribution is shown in Figure 2.

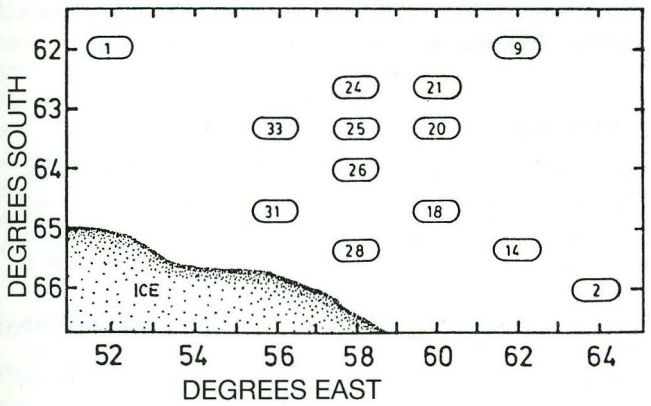

Fig. 2. Zooplankton stations studied in this survey.

Counts were made of the representatives of most groups and are presented for the four major groups; the copepods, chaetognaths, ostracods, and gastropod larvae. The stations were arranged in a N-S direction (Table 3) and in a W-E direction (Table 4).

Table 3

Numbers per 1000 m³ of the four main zooplankton groups arranged in N-S direction.

Station No.	Copepoda	Chaetognatha	Ostracoda	Gastropoda
1	23542	1406	585	234
9	22666	2400	400	533
24	6663	3280	0	205
21	5361	1608	146	0
33	13457	2263	251	503
25	4012	1974	0	123
20	2071	858	62	62
26	6823	2369	94	95
31	27701	13416	513	1697
18	5328	1864	53	159
28	3289	264	302	529
14	4806	1827	338	135
2	566	135	16	533

Copepods

The copepods were by far the most abundant forms. The copepod species that appeared to be the most common were identified but were by no means the only species present. The author is not competent to identify all the copepods, particularly the juveniles and copepodids which made up the bulk of the material. Very few chaetognaths were identified but credence can be given to the 'lumped' numbers. The ostracods and gastropod larvae were also lumped. A neritic component of the plankton may be detected in the persistent presence of the gastropod larvae. This has not yet been identified. It may be neritic but not meroplanktonic. Contrary to widely held opinion the terms are not necessarily synonymous. It may be a holoplanktonic, even oceanic form. The seasonal presence of the pack-ice around the Antarctic Continent confused the concept of 'neritic' by modifying conventional coastal influences and processes.

Table 4

Numbers per 1000 m³ of the four main zooplankton groups arranged in W-E direction.

Station No.	Copepoda	Chaetognatha	Ostracoda	Gastropoda
1	23542	1406	585	234
33	13457	2263	251	533
31	27701	13416	513	1697
24	6663	3280	0	205
25	4012	1974	0	123
26	6823	2369	94	95
28	3289	264	302	529
21	5361	1608	146	0
20	2071	858	62	62
18	5328	1864	53	159
9	22666	2400	400	533
14	4806	1827	338	135
2	566	135	16	533

The calanoid copepods were the main representative of this overwhelmingly dominant group. A few harpacticoids were noted on occasion but not in significant numbers. The calanoids found are listed below in descending order of abundance:

Metridia gerlachei Giesbrecht – this is one of the most abundant species of copepod in Antarctic waters. It is mesopelagic in the Antarctic Intermediate Water south of the Antarctic Convergence but there are bathypelagic distribution records farther north in the Indian Ocean.

Calanoides acutus Giesbrecht – this species is uniformly circumpolar in Antarctic waters. The Antarctic Convergence is the distinct northern limit of its distribution. The developmental stages show a very different pattern of diurnal vertical migration from that of the adults. We could gain no information on stratification by our collection methods.

Calanus simillimus Giesbrecht – this is a very conspicuous component of the Southern Ocean epiplankton. It is cited as an Antarctic form that is not strictly confined to the Antarctic Zone.

Calanus propinquus Brady – this is another copepod characteristic of the Southern Ocean epiplankton but not confined by the Antarctic Convergence. However, reservations are entertained on the identification in the distribution records north of the Convergence. It is suspected that the tropical and subtropical identifications may have been of large *Calanus finmarchicus* or *C. helgolandicus*.

Rhincalanus gigas Brady (=*R. grandis* Giesbrecht) – this is a very characteristic member of the Antarctic plankton usually being found between 250 – 50 m. It is apparently mesopelagic in the winter and becomes epiplanktonic in summer which would account for its presence in our collections. As is the case with *C. acutus* the vertical range of the developmental stages differs from that of the adult. As it approaches sexual maturity the form sinks to the warmer intermediate water layers. In both species this would account for the predominance of the early stages in our material.

Haloptilus oxycephalus Giesbrecht – this is a cosmopolitan species and has been recorded in the deep waters of subtropical and tropical regions. It is found regularly in the Antarctic epiplankton but is not a characteristic Antarctic form.

Haloptilus ocellatus Wolfenden – this is a very characteristic Antarctic form invariably occurring south of 60°S in the Indian Ocean sector of the Antarctic where it inhabits the upper layers. It is usually absent from the surface during the day.

Pleuromamma robusta (Dahl) f. *antarctica* Steuer – positive identification of this species awaits confirmation by authority. It is well within the recognised distribution range and occurs in moderate numbers.

Euchaeta antarctica Giesbrecht (=*Par(a)euchaeta antarctica* Brady) – this species is a typically Antarctic, deep-water form with a pronounced diurnal, vertical migration pattern. It has not been observed north of the Antarctic Convergence and is completely absent from the surface during the day.

Zooplankton other than copepods

1. *Amphipods*

The only amphipods that were definitely identified were *Themisto gaudichaudii* and *Primno macropa*. The first was taken in neuston net hauls in vast numbers, sometimes to the exclusion of all other forms. There was no discernible pattern to its distribution within the grid. It is a cosmopolitan, epiplanktonic form and at times must be of great importance to the biomass.

Primno macropa appeared in moderate numbers. According to Bowman (pers. comm.) of the Smithsonian Institute it is circumpolar in sub-Antarctic and Antarctic waters. It has been considered a bipolar form but, on the basis of material supplied by us, he has split it from the northern form which he has named *P. abyssalis*.

Several other unidentified species appeared sporadically in very small numbers. Kaczmaruk (S.A. Museum) is analysing the copepods of this collection in detail and will publish separately.

2. *Ostracods*

Several species of Halocyprid ostracods were found. They appeared to belong mostly to the genus *Conchoecia*. Since they occur in relatively large numbers and seem to be of some importance in the community they will be placed at the disposal of an authority for further analysis.

3. *Chaetognaths*

This group is obviously of great importance in the ecological picture. They are voracious omnivores and appear in quite large numbers. Two species were identified *Eukrohnia hamata* and *Sagitta gazellae*, and found to be well within their normal distribution range. A further attempt will be made to identify the other species present or they will be sent to the National Fisheries Service in California.

4. *Euphausiids*

These had been removed from the samples and analysed separately. They will be the subject of a report by the Sea Fisheries Research Institute.

4. *Polychaetes*

These occurred as unidentified larval forms in moderate numbers. One large adult (unidentified) appeared once.

Conclusions

There does not appear to be an obvious relationship between phytoplankton and the physical phenomenon revealed by Brundrit's data (this volume). There are indications, however, of a difference in community structure in a W-E direction. As mentioned in the Introduction, at the easternmost stations examined (stations 3, 4 and 6) the diatoms have surrendered dominance completely to the dinoflagellates, which are of no consequence in the other stations in the survey. In addition several species of diatoms are peculiar to, or are concentrated at, these stations. However, no correlation between this phenomenon and any physical parameter is readily apparent.

In the long view the zooplankton distribution, too, held no surprises. This together with the largely uneventful distribution of the phytoplankton leads one to conclude that the environmental conditions in the study area were remarkably stable. There are hints that the populations are seasonally transitional but there is little evidence of geographical constraint.

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