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Distribution of microflagellates and diatoms in the sea-ice zone between Elephant Island and the South Orkney Islands (December 1988 – January 1989)

ABSTRACT: The highest concentrations of algal cells (1.1×10^6 litre^{-1}) and of algal carbon (20 μg litre^{-1}) were associated with a lens of ice melt water in the northeast of the study area. Phytoflagellates were dominant at all stations with greater numbers always in the 0–20 m surface layer and with the peaks of Cryptophyceae in the open waters and also near the ice edge east of 50° W. Picoplankton flagellates and monads (1.5–5.0 μ) were generally next in abundance and most important numerically in the near ice stations in the western part of the study area. Parasinophyceae were usually more abundant than *Nitzschia cylindrus* (Grunow) Hasle, the only common diatom species found mainly in the western near ice edge stations. The presence of *N.cylindrus*, dominant in the pack ice and in phytoplankton near the ice edge, shows that algae released from ice may act as an inoculum for the phytoplankton.

Key words: Antarctic, phytoplankton, sea-ice zone.

Introduction

Spring phytoplankton blooms in the ice-edge zones in polar regions have been always associated with an increased water column stability induced by ice-melt water lenses in the surface layers (Smith and Nelson 1985, 1986; Wilson, Smith and Nelson 1986, Smith 1987, Smith *et al.* 1987). They are found to be also due to the release into the plankton of epontic algae which act as phytoplankton seeding populations (see Smith 1987). Such algal developments may favour a selective growth of just one or two species such as *Nitzschia curta* (Van Heurck) Hasle and *N. closterium* (Ehrenberg) Smith in the Ross Sea (Smith and Nelson 1985), or *Thalassiosira tumida* (Janish) Hasle in the Weddell Sea (El-Sayed 1971). They can also favour a good growth of several species or a few genera such as *Nitzschia, Thalassiosira* and *Phaeocystis* in the Weddell Sea marginal ice zone (Fryxell and Kendrick 1988, Fryxell 1989). On the other hand, in the Arctic, in the Fram Strait and in the Bering Sea, phytoplankton ice edge blooms have been found to be dominated by microflagellates (Schandelmeier and Alexander 1981, Smith *et al.* 1987).

The present study reports an Antarctic spring ice edge phytoplankton increase dominated by flagelates. It has been the purpose of this work to investigate the phytoplankton composition and distribution in the ice edge zone of the northern Weddell Sea between Elephant Island and the South Orkney Islands, and to relate the results to the environmental factors likely to affect the phytoplankton development.

Materials and methods

Sampling was carried out between 26 December 1988 and 18 January 1989 from the r/v „Profesor Siedlecki" in the sea-ice zone between Elephant Island and the South Orkney Islands (Fig. 1). Phytoplankton samples were obtained with a plastic 8-liter bathometer of the Van Dorn type from the following standard depths: 0, 10, 20, 30, 50, 75 and 100 m. Additional samples were taken with a 1-litre plastic bottles just under ice at stations 57, 68, 70 and 75. Aliquots of 150 ml samples were preserved with 1% formalin (final concentration) buffered with hexamine. 50 ml of the preserved samples from all depths were settled for 24 hours in an Utermöhl-type sedimentation chamber. Algal cells

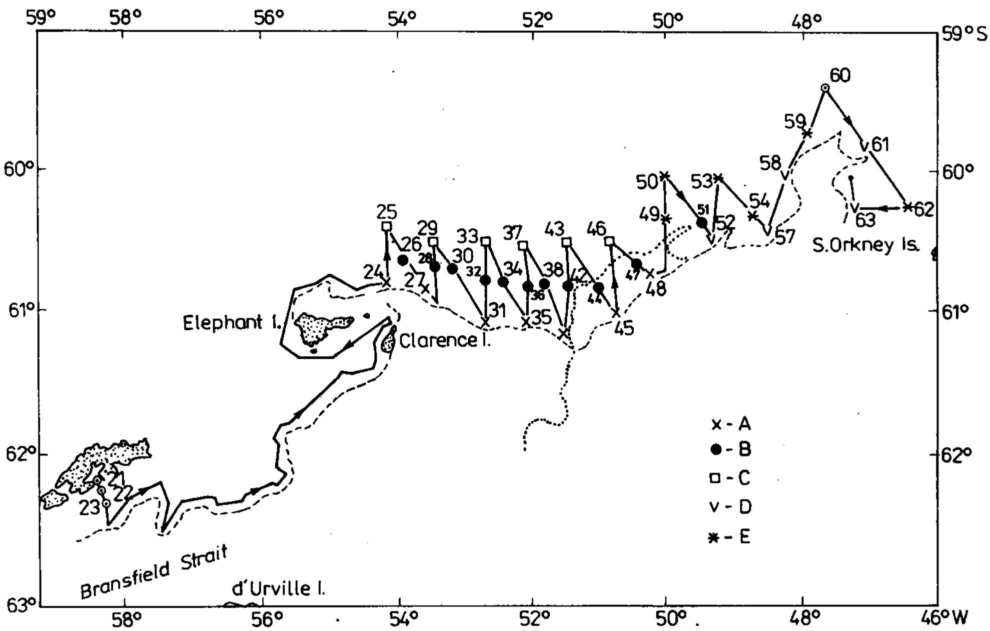


Fig. 1. Location of sampling stations: 1 — station group A (near ice edge stations); 2 — station group B (open water stations); 3 — station group C (open water stations); 4 — station group D (near ice edge stations); 5 — station group E (open water stations)

were examined and counted with a Zeiss inverted microscope at 500x magnification. At least 300 cells were counted along transects across the counting chamber and the numbers were related to the quantities of algae contained in 1 litre of water. Unless otherwise indicated reported cell densities represent the mean water column value calculated from discrete depths at each station.

Identification of flagellates to species requires combined methods of cultures and electron and light microscopy. Flagellates in the present samples were examined with a Biolar PI (Polish made) phase contrast light microscope equipped with an oil immersion objective of 100x magnitude; they were identified to major groups.

Carbon biomass was estimated from cell volumes and cell abundancis. Cell volumes were calculated by comparing cell shapes to appropriate geometrical figures. The following cell volume to carbon relationships were used for autotrophic microflagellates: $\log_{10}C$ (pg) = $0.94(\log_{10}V) - 0.60$, and for diatoms: $\log_{10}C = 0.76(\log_{10}V) - 0.352$ (Eppley, Reid and Strickland 1970).

Results

Spatial distribution of total plankton and of major phytoplankton groups

At each of the five station groups (Figs. 2–7) the highest concentrations of cells, often exceeding 2.0×10^5 litre^{-1}, were found in the 0–20 m surface layer. Particularly the maximal numbers recorded ($>1.0\times10^6$ litre^{-1}) were associated with a surface lens of ice-melt water in the northeast of the study area (Figs. 3, 5, 7). At depths below 50 m the numbers of phytoplankton were usually less than 3.0×10^4 litre^{-1}. The lowest cell numbers were encountered in the least stable waters of the Weddell Scotia Confluence (stations 24–27, Figs. 2, 6).

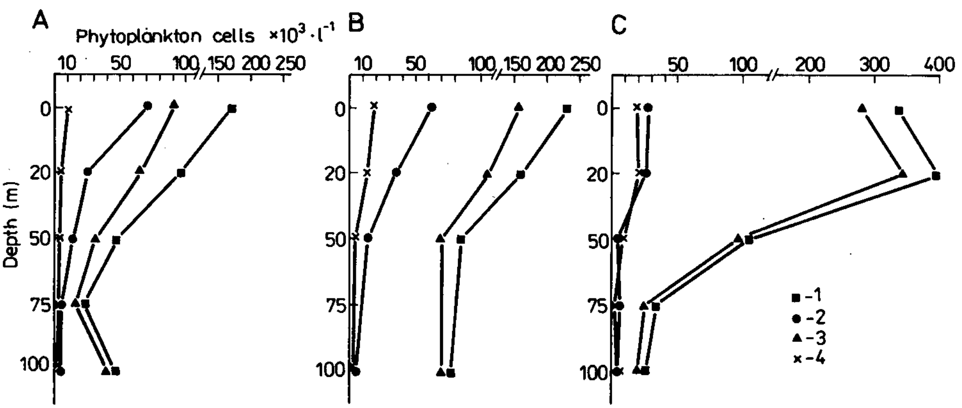


Fig.2. Vertical distribution of mean concentrations of major phytoplankton groups for station groups: A (near ice edge stations 24, 27, 31, 35, 39, 45, 48), B (open water stations 26, 30, 34, 38, 42), C (open water stations 25, 29, 33, 37, 43, 46); 1 — total phytoplankton, 2 — diatoms, 3 — flagellates and monads, 4 — dinoflagellates

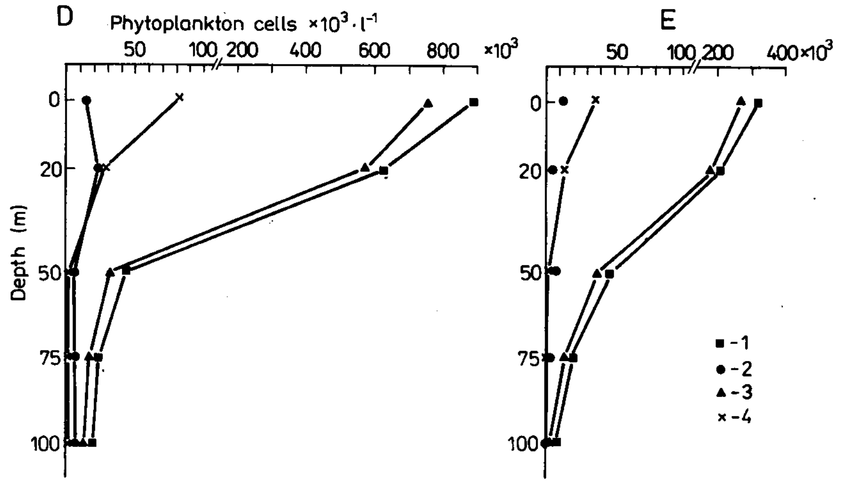


Fig. 3. Vertical distribution of mean concentrations of major phytoplankton groups for stations D (near ice edge stations 52, 57, 58, 61, 63) and stations E (open water stations 49, 50, 53, 54, 59, 62); 1 — total phytoplankton, 2 — diatoms, 3 — flagellates and monads, 4 — dinoflagellates

In station groups A, B, C located west of 50°W meridian (Fig. 2) the cell numbers increased from the ice edge toward the open waters (group C), where they were similar to those recorded in the open water station group E situated in the east part of the study area (Fig. 3). On the other hand, the numbers found in the near ice stations in the east (group D) were twice as high as those in the open waters.

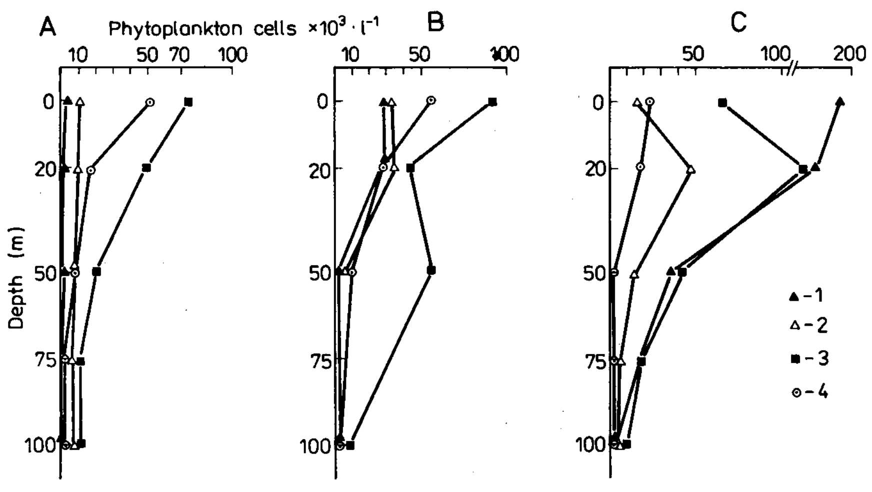


Fig. 4. Vertical distribution of mean numbers of flagellates and of *Nitzschia cylindrus* for station groups: A (near ice edge stations 24, 27, 31, 35, 39, 45, 48), B (open water stations 26, 30, 34, 38, 42), C (open water stations 25, 29, 33, 37, 43, 46); 1 — Cryptophyceae, 2 — Prasinophyceae, 3 — 1.5–5.0 µm flagellates and monads, 4 — *Nitzschia cylindrus*

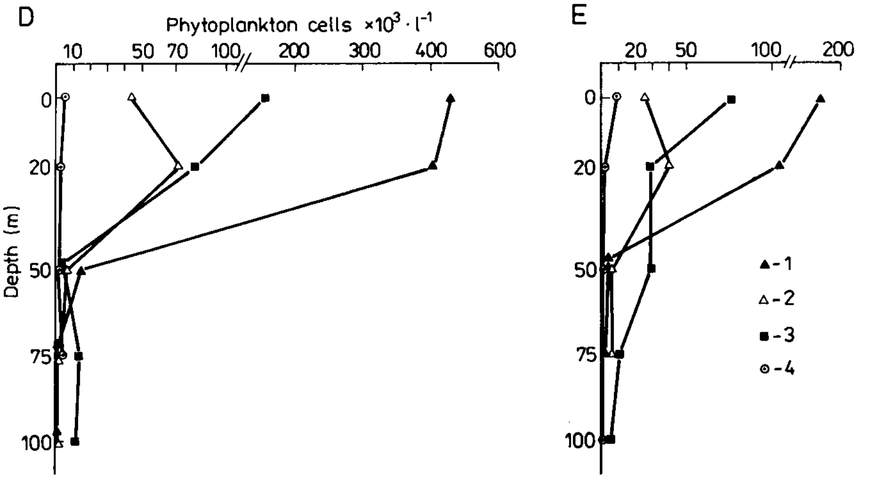


Fig. 5. Vertical distribution of average numbers of flagellates and of *N. cylindrus* for station groups: D (near ice edge stations 52, 57, 58, 61, 63) and E (open water stations 49, 50, 53, 54, 59, 62); 1 — Cryptophyceae, 2 — Prasinophyceae, 3 — 1.5–5.0 μm flagellates and monads, 4 — *Nitzschia cylindrus*

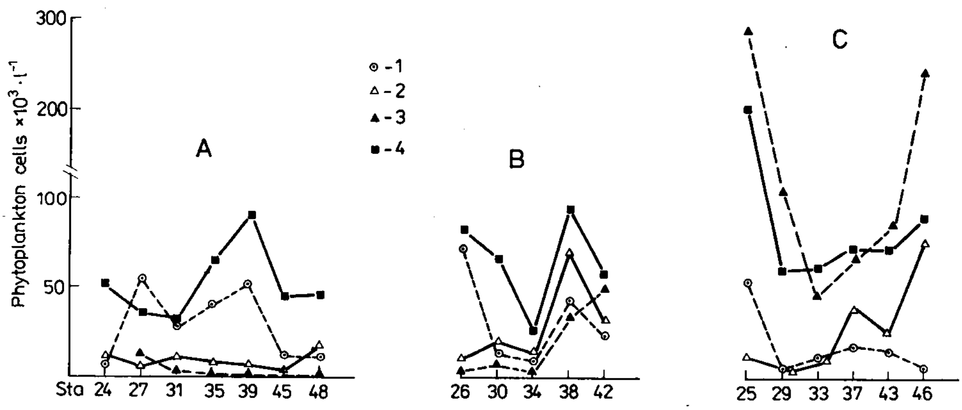


Fig. 6. Station to station distribution of average numbers of dominant taxa for the 0–50 m surface layer (station groups A, B, C): 1 — *Nitzschia cylindrus*, 2 — Prasinophyceae, 3 — Cryptophyceae, 4 — 1.5–5.0 μm flagellates

At the stations located in the west (Fig. 4 and 6) Cryptophyceae were dominant in the open water (group C), while closer to the ice edge (group B) and at the ice edge (group A) picoplankton (1.5–5.0 μm), *Nitzschia cylindrus* and Prasinophyceae were more abundant than *Cryptomonas* spp. On the contrary, at

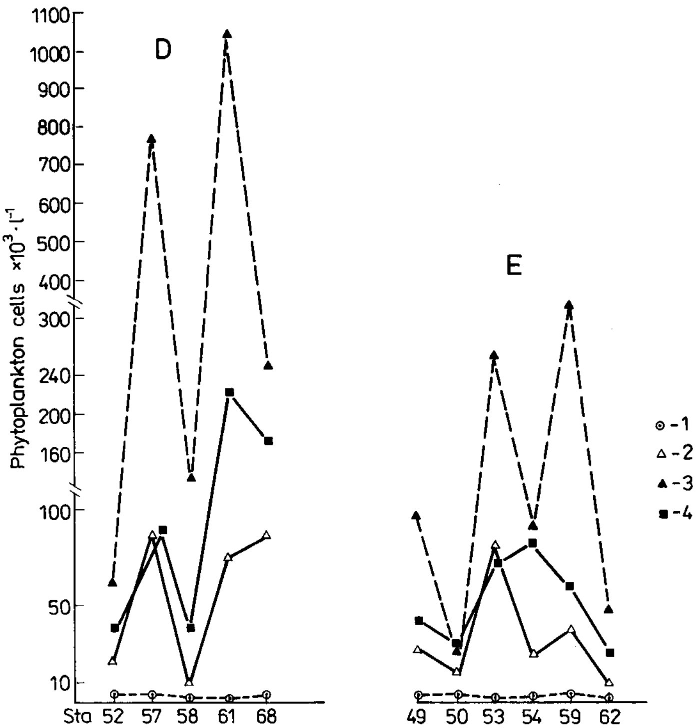


Fig. 7. Station to station distribution of average numbers of dominant taxa for the 0–20 m surface layer; Average numbers of *Nitzschia cylindrus* are for the 0–50 m layer: Station groups D, E: 1 — *Nitzschia cylindrus*, 2 — Prasinophyceae, 3 — Cryptophyceae, 4 — 1.5–5.0 µm flagellates

the eastern stations (Figs. 5 and 7) Cryptophyceae were always dominant, exhibiting peak numbers near the ice edge in a lens of ice melt water.

Phytoplankton composition

At most stations microflagellates made up more than 70% of total algal numbers. Three flagellate groups have been distinguished: *Cryptomonas* spp., ca 10–17 µm (Cryptophyceae), *Pyramimonas* spp., 7–15 µm (Prasinophyceae), and mono- and biflagellates (1.5–5.0 µm) forming the picoplankton. The latter group contained some coccolithophorids and some flagellated cells of the prymnesiophyte *Phaeocytis*. Only very few colonial, mucous enclosed forms of *Phaeocystis* were present. On the other hand, all other flagellates were embedded in gelatinous matrices. Tens or even hundreds cells of Cryptophyceae, Prasinophyceae and picoplankton together with sparse numbers of diatoms were enclosed in mucilaginous matrices.

Diatoms occurred in small quantities and were represented mainly by

Nitzschia cylindrus and *N. curta*, particularly at the near ice stations localized in the western part (west of 50°W meridian) of the study area (stations 24 through 48). Both species, especially *N. cylindrus*, were dominant in the pack ice samples examined concurrently by Ligowski 1991. Their presence in the plankton provides an evidence of „seeding" of the waters by ice-released algae. However, the decrease of *N. cylindrus* numbers from ice stations toward the open waters (where it contributed 0.7–10.0% of total numbers) suggests that this ice-liberated species had not been very viable in the open ocean.

Generally, at the near ice stations diatoms contributed 22–55% in the west, and 0.3–35.0% in the east to the total algal numbers. In the open water stations they contributed usually 0.7 to 10% of the total cell concentrations. Besides *N. cylindrus* which was found to be the only common diatom species, diatoms were represented by other *Nitzschia* species of the sections *Fragilariopsis* and *Pseudonitzschia*, by *Thalassiosira* spp. (mostly 10–15μm cells) and *Chaetoceros* spp. (*Ch. criophilus* Castracane, *C. neogracile* Van Landingham). Other diatom species included: *Corethron criophilum* Castracane, *Leptocylindrus mediterraneus* (Peragallo) Hasle, *Rhizosolenia alata* Brightwell, *Amphiprora* spp. and *Odontella weissflogii* (Janisch) Grunov.

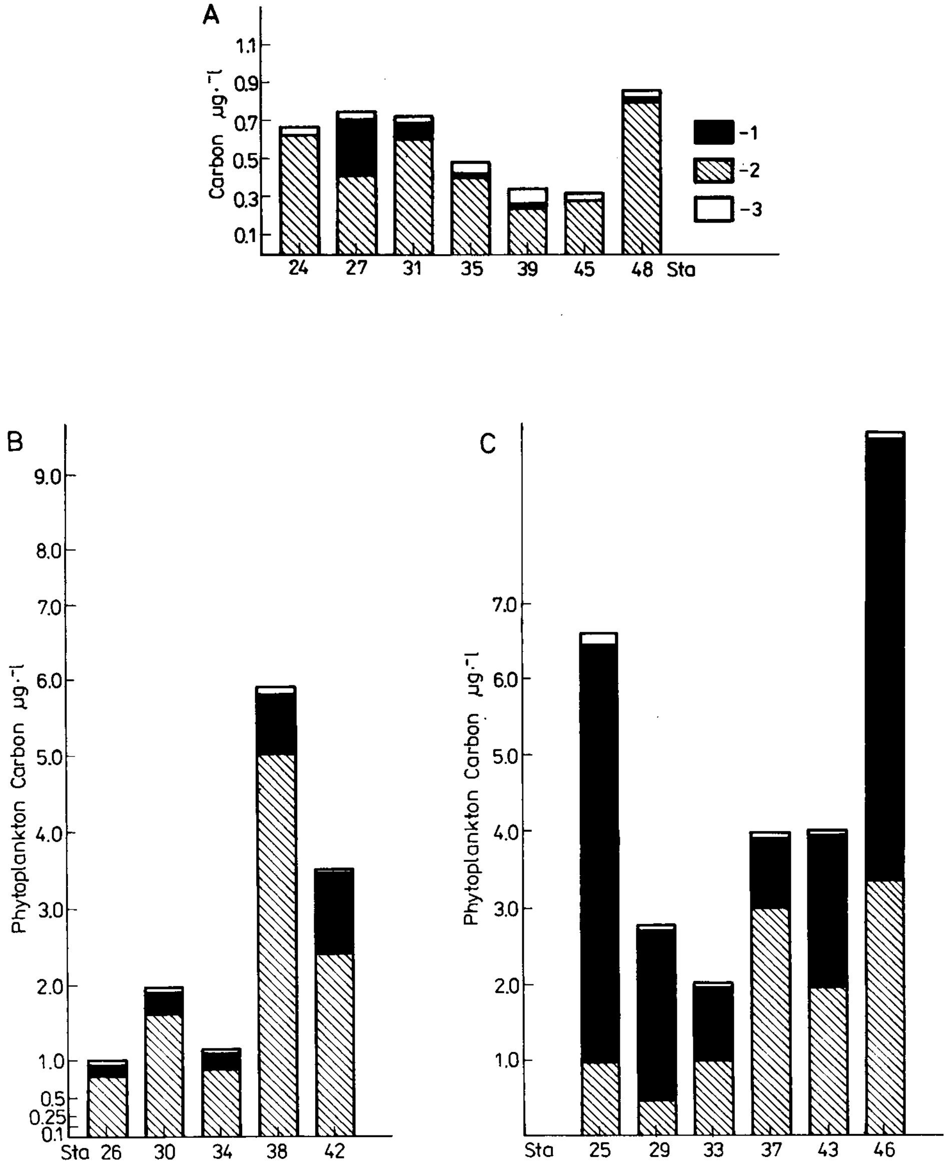
Dinoflagellates were generally present in the least quantities among the algal groups, however, they exceeded diatoms in the surface waters (1m) in the east of the study area (station groups D and E). They were represented mainly by *Prorocentrum* spp. and *Gymnodinium* spp., and to a lesser extent by *Gyrodinium* spp. and *Protoperidinium* spp. It is very likely that many of these forms were heterotrophic capable of feeding on diatoms (Jacobson and Anderson 1986) in areas of their highest abundance.

Distribution of phytoplankton Carbon

In terms of Carbon biomass both Cryptophyceae and Prasinophyceae contributed most to the total phytoplankton Carbon (Fig. 8 a–e). Cryptophyceae provided the largest source of carbon in station groups C, D, E with the maximum values of 1.09–15.6 μg litre^{-1} carbon at the near ice stations (group D) east of 50°W meridian. Prasinophyceae were more abundant than Cryptophyceae in station groups A and B providing 0.2–5.0 μg litre^{-1} carbon, that is 56–94%. Picoflagellates (1.5–5.0 μm size), although they were dominant numerically in station groups A and B, contributed only 0.02–0.073 μg litre^{-1} carbon. The carbon values of *N. cylindrus*, the only common diatom, were negligible (<2% of the total) and could not be shown on the same scale with the flagellates.

Discussion

As expected, the greatest cell concentrations and phytoplankton C-values were associated with a lens of ice melt water, while sparse populations occurred in the least stable waters of the Weddell-Scotia Confluence area as found (Tokarczyk *et al.*, 1991) in the location of stations 24 to 27. Phytoplankton blooms embedded in the ice-melt water lenses at ice edges have been reported previously from the Ross Sea (Smith and Nelson 1985, 1986, Wilson, Smith and Nelson 1986) and the Weddell Sea (Nelson *et al.* 1987, Fryxell and Kendrick 1988). The role of water column stability in phytoplankton development has often been discussed (Sverdrup 1953). It has been also shown by a study in Admiralty Bay, King George Island (Kopczyńska 1981), where sparse algal numbers are associated with storm conditions and deep mixing, while high



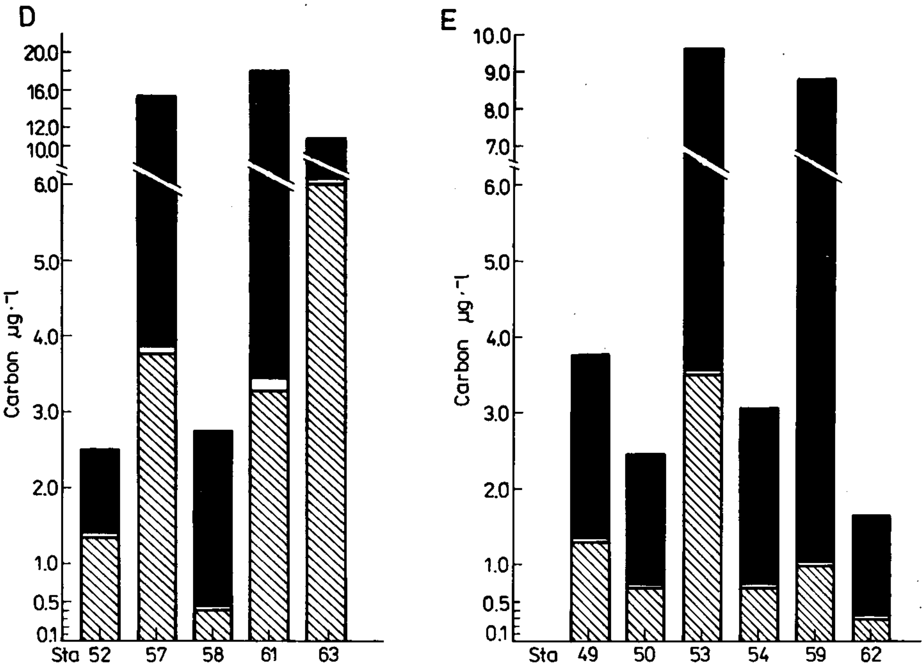


Fig. 8. (A, B, C, D, E) Distribution of phytoplankton Carbon (C μg^{-liter}) by source in the 0–50 m surface water layer; A, D — near ice edge stations, B, C, E, — open water stations. For station groups D and E data are for the 0–20 m layer. 1 — Cryptophyceae, 2 — Prasinophyceae, 3 — flagellates and monads

densities always follow periods of calm days and thus of increased water column stability.

In the present study, the phytoplankton communities, both at the northern Weddell Sea ice edge and in open waters in the north, were dominated by microflagellates. The same had been observed in October–November 1986 in the Scotia Front west of Elephant Island (Kopczyńska 1988) and in a year-round study in Admiralty Bay (Kopczyńska, unpubl. data). Microflagellates, <20 µm, were numerically dominant in winter and spring in the Arctic marginal ice zone of the Fram Strait (Smith *et al.* 1987) and in the southeast Bering Sea (Schandelmeier and Alexander 1981). Kopczyńska (1992) made many observations on the distribution of microflagellates in the Antarctic Peninsula region and found that they consistently dominate, both numerically and in terms of C-biomass, over diatoms in the areas of deep vertical mixing and extensive krill concentrations. In the present study, flagellates were found everywhere in ice melt lenses and in open water, as well as in the samples taken by divers just below floating ice (st. 68). Their ubiquitous distribution brings to mind the „regenerating community" (Peinert, von Bodungen and Smetacek (1989) which is present year-round including winter and consist of nanoplankton organisms whose production is mainly based on ammonia released by heterothrops. It is likely than, that in our sampling region the flagellate populations, evidently present year-round and under the ice (see also Takahashi *et al.* 1978), demonstrated the first stage of summer phytoplankton progression in the ice melt water lenses in the east (Figs. 3, 5, 7, 8). On the other hand, the dominance of microflagellates, observed in this study, may also be partly due to a grazing pressure exerted by the zooplankton. There are several indications supporting this supposition. First of all, water samples taken from just under ice at stations 70 and 75 were devoid of almost any algae, while diatoms were present deeper (1 m) in the water column. This suggests krill feeding under ice (Smetacek, pers.comm.). Secondly, both whole water and net phytoplankton samples from some western stations contained very few algae and instead of them some krill, salpa, Tintinidae and also krill feces. Thirdly, net tow collections (Ligowski and Kopczyńska, 1991) obtained concurrently, contained in many cases empty *Corethron criophilum* frustules several times in excess of the live cells. These empty diatom frustules may have resulted from feeding by dinoflagellates (Jacobson and Anderson 1986). Finally, interesting results were obtained by German investigators (Adler *et al.* 1989), who performed grazing experiments with krill. After *Euphausia superba* Dana had grazed down natural populations of makrozooplankton and diatoms from the ice edge area of the Weddell Sea, a nanoplankton community of flagellates developed.

All algae were embedded in gelatinous matrices. Mucilage surrounding cells may enhance buoyancy (Smayda 1970, Margalef 1978), or may provide defenses against predators (see Fryxell and Kendrick 1988). Mucous aggregates of algae may also scavenge other particles which accelerate sinking, a process often accompanied by formation of resting stayes,which lead to the establishment of a refuge population at depth (Smetacek 1985). Thus, the gelatinous matrices of algae, encountered in the present study, may have very well served all these three purposes.

The only diatoms which occurred more numerously than others were *Nitzschia cylindrus* and *N. curta*. Both species were abundant in the ice-melt samples examined concurrently with this study (Ligowski, 1991). They appeared to have provided seeding populations of especially *N. cylindrus* in the plankton near the ice edge in the western part of the research area, but were rare and less viable at stations remote from the ice edge. Somewhat greater concentration of *N. cylindrus* in the open water station 25 may have been seeded by the Drake Passage water found (Tokarczyk *et al.*, 1991) at the Weddell-Scotia Confluence. Quite similar general distribution of *N. cylindrus* was observed by Fryxell (1989) at the Weddell Sea ice edge. Another species, *N. curta*, occurred in the present study in only small numbers at the ice edge station, in contrary to its distribution at the ice edge stations in contrary to its distribution at the ice edge of the Ross Sea, where it is reported (Smith and Nelson 1985) to form extensive, nearly unialgal blooms. Both species representatives of the section *Fragilariopsis*, have been found in the Indian Ocean sector of the Antarctic to occur very abundantly at the southernmost stations south of the Antarctic Divergence (Kozlova 1966, Kopczyńska, Weber and El-Sayed 1985, 1986).

I would like to thank all my colleagues, who helped me to collect the phytoplankton samples.

References

Adler V., Cuzin-Roudy J., Fransz G., Graneli E., Larsen J., Rabbani M. and Thomsen H. 1989. Macro- and Micrograzing effects on phytoplankton communities. — The Expedition Antarctis VII/3 (EPOS leg 2) of RV „Polarstern„ in 1988/89, 65/68: 123–126.

El-Sayed S.Z. 1971. Observations on phytoplankton bloom in the Weddell Sea. — *In*: G.A. Llano and I.E. Wallen (eds.), Biology of the Antarctic Seas, vol. IV. Am. Geophys. Union. Antarc. Res. Ser., 17: 301–312.

Eppley R.W., Reid F.M.H. and Strickland J.D.H. 1970. The ecology of the plankton off La Jolla, California, in the period April through September 1967. — *In*: J.D.H. Strickland (ed.), III. Estimates of phytoplankton crop size, growth rate and primary production. Bull. Scripts Inst. Oceanogr., 17: 33–42.

Fryxell G.A. 1989. Marine phytoplankton at the Weddell Sea ice edge: seasonal changes at the specific level. — Polar Biol., 10: 1–18.

Fryxell G.A. and Kendrick G.A. 1988. Austral spring microalgae across the Weddell Sea ice edge: spatial relationships found along a northward transect during AMERIEZ 83. — Deep-Sea Res., 35 (1): 1–20.

Jacobson D.M. and Anderson J.M. 1986. Thecate heterotrophic dinoflagellates feeding behaviour and mechanism. — J. Phycol., 22: 249–258.

Kopczyńska E.E. 1981. Periodicity and composition of summer phytoplankton in Ezcurra Inlet. Admiralty Bay, King George Island, South Shetland Islands. — Pol. Polar Res., 2: 55–70.

Kopczyńska E.E. 1988. Spatial structure of phytoplankton in the Scotia Front west of Elephant Island (BIOMASS III, October–November 1986). — Pol. Polar Res., 9: 231–242.

Kopczyńska E.E. 1992. Dominance of microfagellates over diatoms in the Antarctic areas of deep vertical mixing and krill concentrations. — J. Plankton Res., 14, 8: 25 pp.

Kopczyńska E.E., Weber L.H. and El-Sayed S.Z. 1985. Phytoplankton date from the February–April 1980 cruise of the MVSA Agulhas: quantitative species counts and net tow data from the Indian sector of the Antarctic Ocean. — Texas A & M Research Foundation Project RF–4539, Tech. Rep.; 73 pp.

Kopczyńska E.E., Weber L.H. and El-Sayed S.Z. 1986. Phytoplankton species composition and abundance in the Indian sector of the Antarctic Ocean. — Polar Biol., 6: 161–169.

Kozlova O.G. 1966. Diatoms in the Indian and Pacific sectors of the Antarctic. — Nauka, Moskva (Eng. transl., Jerusalem, Israel Progr. Sci. Transl.); 191.

Ligowski R. 1991. Sea ice microalgae at the northern boundary of the pack ice between Elephant Island and South Orkney Islands (December 1988 — January 1989). — Pol. Polar Res., 12: 547–564.

Ligowski R. and Kopczyńska E. 1991. Distribution of net phytoplankton in the sea-ice zone between Elephant Island and the South Orkney Islands (December 1988 — January 1989). — Pol. Polar Res., 12: 529–546.

Margalef R. 1978. Life-forms of phytoplankton as survival alternatives in an unstable environment. — Oceanologica Acta, vol. 1, No 4:

Nelson D.M., Smith W.O., Gordon L.I. and Huber B.A. 1987. Spring distributions of density, nutrients and phytoplankton biomass in the ice edge zone of the Weddell-Scotia Sea. — J. Geophys. Res., 92: 7181–7190.

Peinert R., von Boungen B. and Smetacek V.S. 1989. Food web structure and loss rate. — *In*: W.H. Berger, V.S. Smetacek and G. Wefer (eds.), Productivity of the ocean: present and past. Dahlem Konf., John Wiley, Chichester; 35–48.
Schandelmeier L. and Alexander V. 1981. An analysis of the influence of ice on spring phytoplankton population structure in the southeast Bering Sea. — Limnol. Oceanogr., 26: 935–943.
Smayda T.J. 1970. The suspension and sinking of phytoplankton in the sea. — *In*: H. Barnes (ed.), Oceanography and marine biology. Ann. Rev., London, 8: 353–414.
Smetacek V.S. 1985. Role of sinking in diatom life-history cycles: ecological, evolutionary and geological significance. — Marine Biol., 84: 239–251.
Smith W.O. 1987. Phytoplankton dynamics in marginal ice zones. — Oceanogr. Mar. Biol. Ann. Rev., 25: 11–38.
Smith W.O. and Nelson D.M. 1985. Phytoplankton bloom produced by a receeding ice edge in the Ross Sea: Spatial coherence with the density fields. — Science, 227: 163–166.
Smith W.O. and Nelson D.M. 1986. Importance of ice-edge phytoplankton production in the Southern Ocean. — BioScience, 36: 251–257.
Smith W.O., Bauman M.E.M., Wilson D.L. and Aletsee L. 1987. Phytoplankton biomass and productivity in the marginal ice zone of the Fram Strait during summer 1984. — J. Geophys. Res., 92: 6777–6786.
Takahashi M., Barwell-Clarke J., Whitney F. and Koeller P. 1978. Winter condition of marine plankton populations in Saanich Inlet; Phytoplankton and its surrounding environment. — J. Exp. Mar. Biol. Ecol., 31: 283–301.
Sverdrup H.U. 1953. On conditions for the vernal blooming of phytoplankton. — J. Cons. Int. Explor. Mer. 18: 287–295.
Tokarczyk R., Lipski M., Perez F.F. and Reboredo R.P. 1991. Hydrology and hydrochemistry of the surface water layer near the sea-ice edge in the Scotia Sea (December 1988 — January 1989). — Pol. Polar Res. 12: 495–505.
Wilson D.L., Smith W.O, and Nelson D.M. 1986. Phytoplankton bloom dynamics of the western Ross Sea ice edge. I. Primary productiivity and species specific production. — Deep-Sea res., 33: 1375–1387.

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Streszczenie

W okresie od 26 grudnia 1988 do 13 stycznia 1989 prowadzono prace badawcze na statku „Profesor Siedlecki" w Antarktyce, w strefie morza i brzegu lodu wzdłuż granicy paku lodowego pomiędzy Wyspą Wlephant a Południowymi Orkadami (rys. 1). Obok różnorodnych prób biologicznych i pomiarów fizyko-chemicznych uzyskano na 33 stacjach próby fitoplanktonu butlowego (butlą typu Van Dorn) z następujących standardowych głębokości: 0, 10, 20, 30, 50, 75 i 100 m. Utrwalone 2% buforowaną formaliną próby przeglądano i liczono pod mikroskopem odwróconym Zeissa (metoda Utermohla).

Największe koncentracje komórek fitoplanktonu (max. 1.1×10^6 l^{-1}) i największe ilości biomasy węgla (C = 20 µg l^{-1}) znaleziono w soczewkach wody z topniejącego paku lodowego w powierzchniowej warstwie oceanu (0–20 m) we wschodniej części badanego rejonu (stacje od 53 do 63; rys. 2–8). Najmniejsze ilości komórek zaobserwowano w najmniej stabilnych wodach Konfluencji Mórz Weddella i Scotia (stacje 24–27; rys. 2, 6).

Na większości stacji flagellata stanowiły ponad 70% liczebności fitoplanktonu. Wyodrębniono trzy grupy flagellata: Cryptophyceae (10–17 µm). *Pyramimonas* spp. (7–15 µm, Prasinophyceae)

oraz mono- i biflagellata (1.5–5.0 µm), tworzące picoplankton. *Cryptomonas* spp. osiągnęły maximum ilości w wodach otwartych oceanu, ale także w pobliżu granicy lodów na wschód od 50°W. Grupa pico-planktonu była następna pod względem ilości, szczególnie na stacjach położonych blisko lodów w zachodniej części obszaru badań. Grupa Prasinophyceae (*Pyramimmonas* spp.) była liczniejsza niż okrzemki, które wystąpiły w małych koncentracjach i reprezentowane były głównie przez *Nitzschia cylindrus* (Grunow) Hasle i *Nitzschia curta* (Van Heurck) Hasle. Okrzemki znaleziono głównie na stacjach w pobliżu granicy lodów w zachodniej części obszaru badań. *Nitzschia cylindrus* była dominantem w próbach roztopionego lodu i jej obecność w fitoplanktonie może stanowić dowód na „zasiewanie" wody glonami rosnącymi na lodzie.