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# Dinoflagellates from the Norwegian, Greenland and Barents Seas, and the Faroe — Shetland Islands area collected in the cruise of r/v „Oceania", in June-July 1991

ABSTRACT: Phytoplankton samples were collected at 62 stations in the European Arctic Seas and the Faroe — Shetland Islands area. Over 30 species of dinoflagellates were found. 22 species are illustrated by original drawings. The data on synonyms, size or size variability on the distribution and environmental factors (temperature and salinity) are given.

K e y w o r d s : Arctic, Norwegian, Greenland and Barents seas, phytoplankton, Dinoflagellata.

## Introduction

Most of the papers on the phytoplankton of the area under study are devoted to its composition and distribution; some of these works contain the lists of species. Only few publications include information on the morphology of the dinoflagellates along with the illustrations (e.g. Braarud 1935, Paasche 1961). The present paper partly makes up for such deficiency.

## Material and methods

Phytoplankton samples were collected at 62 stations in the Norwegian and Greenland seas as well as in the Spitsbergen area, the Barents Sea, and the Faroe — Shetland Islands area, from June 23 to July 17, 1991 during the „AREX–91" expedition on board of r/v „Oceania" organized by the Institute of Oceanology, Polish Academy of Sciences (Fig. 1). Qualitative hauls were made with a plankton net 17 cm diameter, mesh 70 μm. At all stations, as a rule, the net was hauled starting from the depth of 100 m. Quantitative samples were taken at all stations with a polyethylene pail in the surface layer of ca. 0–20 cm

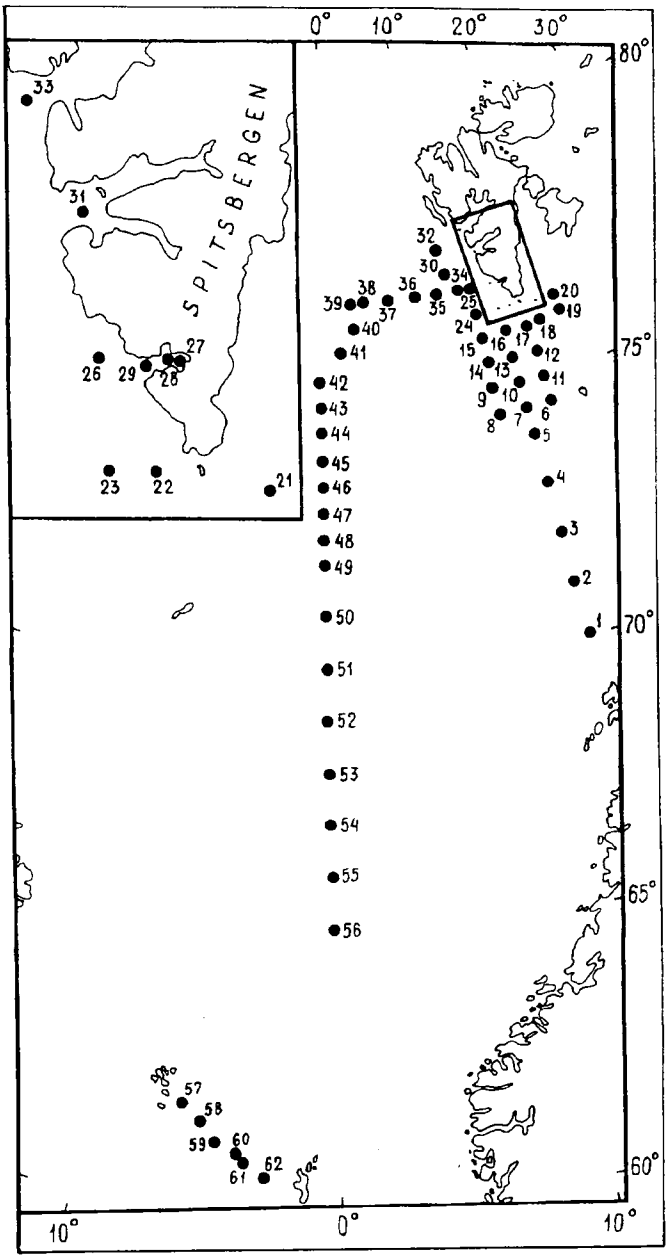


Fig. 1. Distribution of planktological stations of r/v „Oceania" in the Norwegian, Greenland and Barents seas in June–July 1991

and with a plastic water bottle at three depths from the surface down to 60 m at 46 stations. Samples collected by the pail were then concentrated with the aid of the inverse–filtration device and nucleopore filters, the pore size 1μm, the

volume of concentrated water being 1 or 2 l. Bottle samples of the volume 250 ml were not concentrated. In total, 266 samples were collected. Alive algae in net samples were studied under the standard microscope SK – 14, PZO, Warsaw, Poland, using the objectives 10/0,24 and 40/0,65. All samples were fixed by adding 40% formaldehyde to obtain 2 – 4% solution, some subsamples were fixed with the Lugol's solution. Sketches of naked dinoflagellates in fixed samples were made when studying under the inverted microscope ID – 03, Opton. Drawings of all thecate and a few athecate dinoflagellates were made under the compound microscope R – 7, LOMO, Leningrad, USSR, with the use of anoptral contrast microscopy MFA – 2, LOMO, and the camera lucida RA – 1, LOMO. Measurements were done at the total magnitude from 320 to 600. The following references were used for taxonomic identification: Wulff (1919), Kofoid and Swezy (1921), Lebour (1925), Schiller (1933, 1937), Graham and Bronikovsky (1944), Kiselev (1950), Conrad and Kufferath (1954), Sournia (1968), Campbell (1973), Dodge (1975, 1982).

## Results

Twentynine species of dinoflagellates and a species of uncertain taxonomic position are given in the present paper supplied with drawings for 22 species and brief information on synonyms, size or size variation, distribution and environmental factors (temperature and salinity). Drawings of some 15 dinoflagellates (mainly athecate forms) are not included in this paper, since they were studied in fixed samples and appropriate illustrations were not found in the available literature.

### Family PROROCENTRACEAE

—*Prorocentrum cordatum* (Ostenfeld) Dodge (Fig. 2)
Dodge 1975, p. 188, pl. 4C, fig. 2H, I.
Syn.: *Exuwiaella cordata* Ostenfeld 1901, p. 134, fig. 4.
*E. pyriformis* Schiller 1928, p. 50, fig. 3.
*E. peisonis* Schiller 1955, fig. 67a, b.
*E. pacifica* Kusjmina 1960, p. 46, fig. 1.
Size: 13μm long, 12 μm wide.
Observed in St. 3, June 23, surface, temperature 8,7°C, salinity 34,8‰.

— *Prorocentrum minimum* (Pavillard) Schiller (Fig. 3)
Schiller 1933, p. 32, fig. 33a, b.
Syn.: *Exuviaella minima* Pavillard 1916, p. 11, pl. 1, fig. 1 a,b.
*Prorocentrum triangulatum* Martin 1929, p. 557, figs. 1 – 3.
*Exuviaella mariae – lebouriae* Parke et Ballantine 1957, p. 645, figs. 1 – 9.

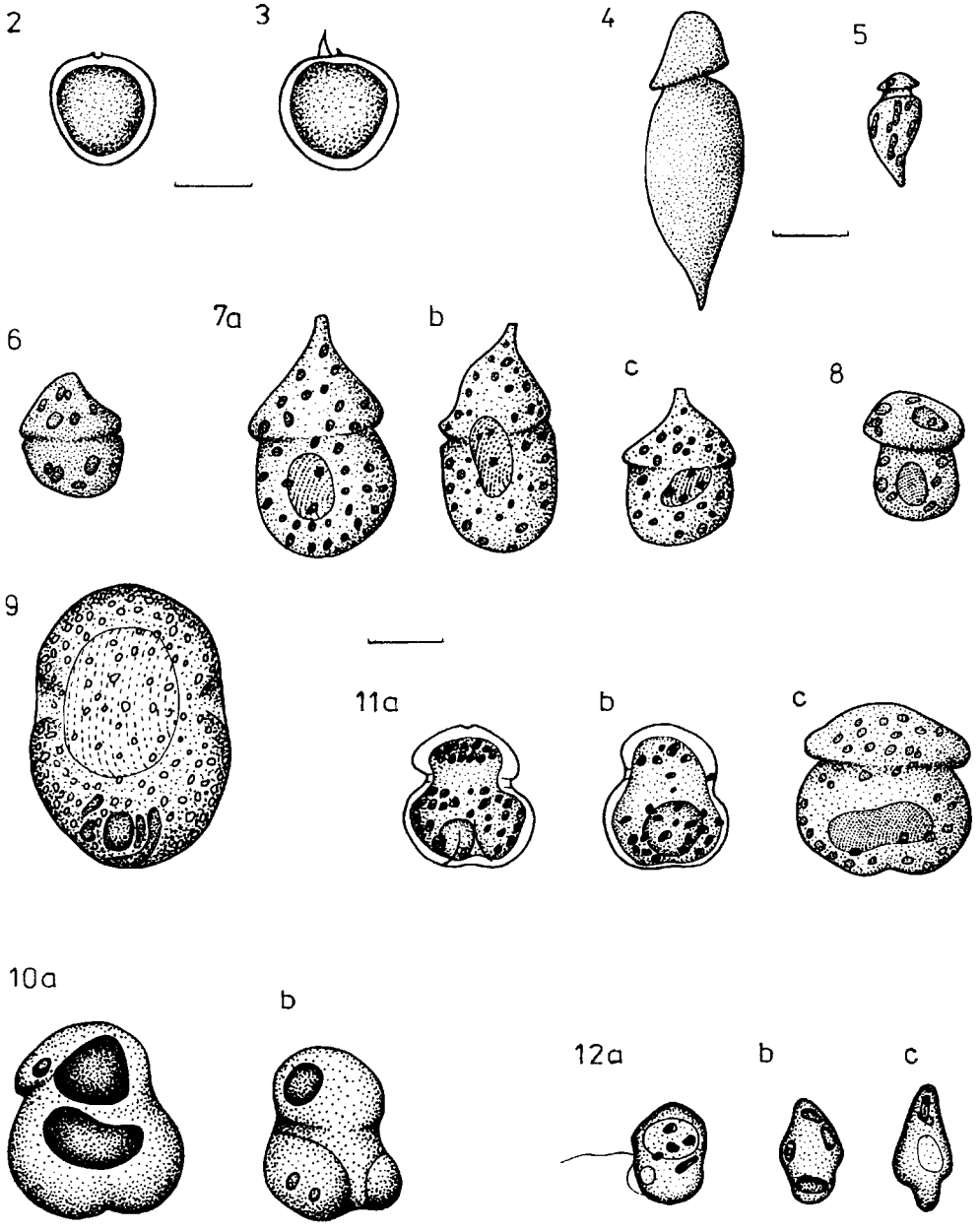


Fig. 2. *Prorocentrum cordatum*
Fig. 3. *Prorocentrum minimum*
Fig. 4. *Amphidinium longum*
Fig. 5. *Amphidinium sphenoides*
Fig. 6. *Gymnodinium arcticum*
Fig. 7a–c. *Gymnodinium conicum*
Fig. 8. *Gymnodinium fungiforme*
Fig. 9. *Gymnodinium heterostriatum*
Fig. 10 a,b. *Gymnodinium simplex*
Fig. 11 a–c. *Gymnodinium wulffi*
Fig. 12a–c. *Katodinium rotundatum*

*Prorocentrum cordiformis* Bursa 1959, p. 31, figs. 104–107.
Size: 15 μm long, 12 μm wide.
Recorded from St. 3, June 23, surface, temperature 8.7°C salinity 34.8‰.

## Family DINOPHYSIACEAE

— *Dinophysis norvegica* Claparède et Lachman
Claparède and Lachman 1859, p. 407, pl. 20, fig. 19.
Size: 50–74 μm long, 33–46 μm wide.
Occurred in Stations 3 and 22, June 23 and 29, surface, temperature 2.0 – 8.7°C, salinity 34.35 – 34.80‰.

*Dinophysis ovum* Schütt
Schütt 1895, pl. 1, fig. 6.
Size: 39–42 μm long, 35–37 μm wide
Recorded from Sts. 41 and 49, July 9 and 11, surface, temperature 3.7 – 5.5°C, salinity 34.4 – 34.7‰.

— *Dinophysis rotundata* Claparède et Lachman
Claparède and Lachman 1859, p. 6, pl. 20, fig. 16.
Syn: *Phalacroma rotundatum* Kofoid et Michener 1911, p. 290.
Size: 54–59 μm long, 40–48 μm wide.
Found in Sts. 54 and 57, July 13 and 16, layer 0–20 m, temperature 9.0 – 10.4°C, salinity 35.0 – 35.2‰.

## Family GYMNODINIACEAE

— *Amphidinium extensum* Wulff
Wulff 1919, p. 104, pl. 1, fig. 8.
Identification in doubt.
Size: 21–24 μm long, 9–12 μm wide.
Observed in Sts. 4 and 17, June 24 and 28, layer 50–60 m, temperature 6.5 – 7.0°C, salinity 27.4 – 27.6‰.

— *Amphidinium longum* Lohmann (Fig. 4)
Lohmann 1908, p. 252, pl. 17, fig. 15.
Identification in doubt.
Size: 15 μm long, 7.5 μm wide.
Found in St. 4, June 24, depth 22 m, tempereture 7.0°C, salinity 35.0‰.
Note: Having several chloroplasts, it is similar to *A. stigmatum* Schiller, described from the Gulf of Naples.

— *Amphidinium sphenoides* Wulff (Fig. 5)
Wulff 1919, p. 105, pl. 1, fig. 9 a,b.

Size: 39 μm long, 12 μm wide.
Recorded form St. 15, June 27, depth 40 m, temperature 6,5°C, salinity 27.5‰.

*Gymnodinium arcticum* Kofoid (Fig. 6)
Kofoid 1931, p. 9, pl. 1, fig. 9.
Identification in doubt.
Size: 16 μm long, 13 μm wide.
Observed in St. 3, June 23, surface, temperature 8.7°C, salinity 34.8‰.

*Gymnodinium conicum* Kofoid et Swezy (Fig. 7 a-c)
Kofoid and Swezy 1921, p. 198, fig. 27.
Syn.: *G. viridis* Lebour 1917, p. 189, fig. 4.
Size: 21 – 32 μm long, 15 – 19 μm wide.
Occurred in Sts. 11 and 15, June 26 and 27, layer 8 – 40 m, temperature 5.4 – 6.2°C, salinity 35.05‰.

— *Gymnodinium fungiforme* Anissimova (Fig. 8)
Anissimova 1926, p. 192, figs. 9, 10.
Identification in doubt.
Size: 18 μm long, 13 μm wide.
Found in St. 5, June 24, depth 50 m, temperature 6.5°C, salinity 35.05‰.
Note: Numerous chloroplasts and a nucleus in hypocone distinguish our specimen from the brackish water dinoflagellate *G. fungiforma* described from the north – western Russia.

— *Gymnodinium heterostriatum* Kofoid et Swezy (Fig. 9)
Kofoid and Swezy 1921, p. 221, fig. Y, 7.
Syn: *G. spirale* var. *obtusum* Dogiel 1906, p. 38, pl. 2, figs. 50 – 56.
Identification in doubt.
Size: 37 μm long, 27 wide.
Observed in St. 3, June 23, surface, temperature 8.7°C, salinity 34.8‰.
Note: Our specimen differs from the description in literature mainly by its smaller size and the absence of longitudinal striae.

*Gymnodinium simplex* (Lohmann) Kofoid et Swezy (Fig. 10 a-b) Kofoid and Swezy 1921, p. 256, fig. BB, 8.
Syn.: *Protodinium simplex* Lohmann 1908, p. 264, pl. 17, fig. 17.
Size: 12 – 13 μm long, 10-12 μm wide.
Recorded from Sts. 1, 3 – 5, 9 – 11 and 25, June 23 – 30, layer 0 – 50 m, temperature 4.5 – 9.0°C, salinity 34.8 – 35.1‰.

— *Gymnodinium wulffii* Schiller (Fig. 11 a – c).
Schiller 1933, p. 432, fig. 456 a – e.

Wulff 1919, pl. 1, fig. 10 a–e („Kleine farblose Gymnodinien")
Size: 17–24 µm long, 14–22 µm wide.
Identified more or less reliably at Sts. 1 nad 4, June 26, layer 0–50 m, temperature 7–9°C, salinity 34.9 – 35.1‰.

— *Katodinium rotundatum* (Lohmann) Loeblich III (Fig. 12 a–c) Leoblich III 1965, p. 16.
Syn.: *Amphidinium rotundatum* Lohmann 1908, p. 261, pl. 17, fig. 9.
*Gymnodinium minutum* Lebour 1925, p. 45, pl. 5, fig. 4.
*Massartia rotundata* Schiller 1933, p. 438, fig. 464 a–e.
*Amphidinium pellucidum* Redeke 1935, p. 391, fig. 1.
*A. Redekei* Conrad et Kufferath 1954, p. 109.
*Massartia rotundata* var. *Conradi* Kufferath in Conrad et Kufferath 1954, p. 108, pl. 7, fig. 2.
Size: 9–12 µm long, 6 µm wide.
Found in St. 3, June 23, layer 0–12, temperature 8.6°C, salinity 34.8‰.

## Family PERIDINIACEAE

*Protoperidinium bipes* (Paulsen) Balech
Balech 1974, p. 53.
Syn.: *Glenodinium bipes* Paulsen 1904, p. 21, figs. 3–4.
*Peridinium minusculum* Pavillard 1905, p. 57, pl. 3, figs. 7,9.
*Minuscula bipes* Lebour 1925, p. 138, pl. 29, fig. 3 a,b.
Size: body with spines 29–31 µm, without spines 24–26 µm long, 19–21 µm wide.
Recorded from St. 3, June 23, in net haul 100–0 m, temperature 6.4 – 8.7°C, salinity 34.8 – 35.1‰.

— *Protoperdinium depressum* (Bailey) Balech (Fig. 13 a–d)
Balech 1974, p. 57.
Syn.: *Peridinium depressum* Bailey 1855, p. 12, figs. 33, 34.
Size: 168–210 µm long, 114–116 µm wide, 108–132 µm high (deep).
Occurred in Sts. 3, 12, 19, 23, 28, 29, 31, 56, 58–60 and 62, dominating in terms of abundance at Sts. 28 and 29 in net hauls.

— *Protoperdinium pallidum* (Ostenfeld) Balech
Balech 1973, p. 365, pl. 6, figs. 101–110.
Syn.: *Peridinium pallidum* Ostenfeld 1899, p. 60.
Size: not measured.
Found in Sts. 20, 22 and 26, June 28–30, in net hauls 100–0 m, temperature about 2–5°C, salinity ca. 34.5‰.

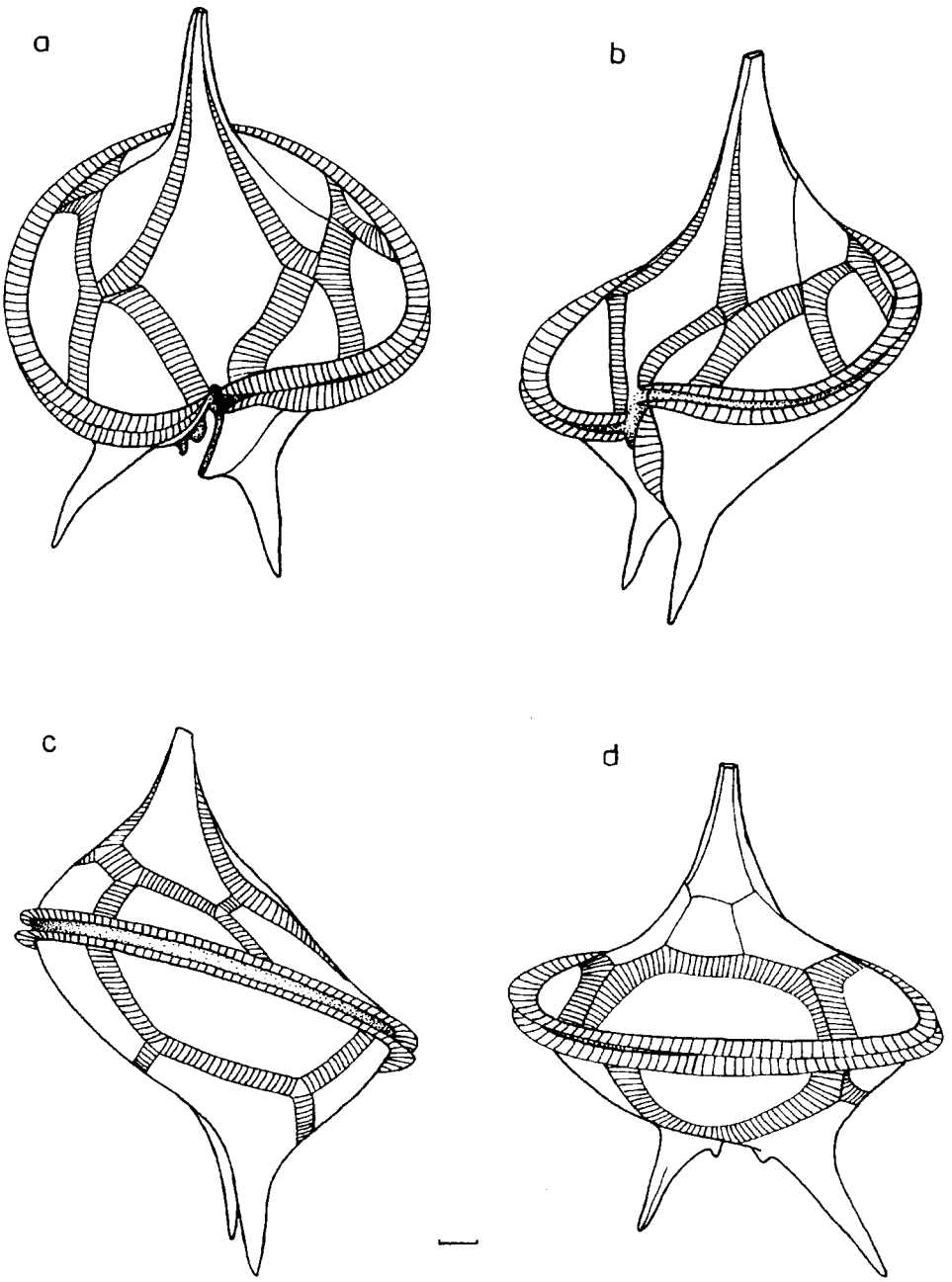


Fig. 13a–d. *Protoperdinium depressum*

— *Protoperdinium pellucidum* Bergh
Bergh 1882, p. 227, pl. 15, figs. 46–48.
Syn.: *Peridinium pellucidum* Schütt 1895, pl. 14, fig. 45.
Size: not measured.
A single theca was reccorded from st. 20, June 28, in net haul 100–0 m.

## Family CERATIACEAE

— *Ceratium arcticum* (Ehrenberg) Cleve (Fig. 14 a–f)
Cleve 1900, p. 207.
Syn.: *Peridinium arcticum* Ehrenberg 1853, p. 528; 1859, p. 239, pl. 35, fig. A.
*Peridinium longipes* Bailey 1855, p. 12.

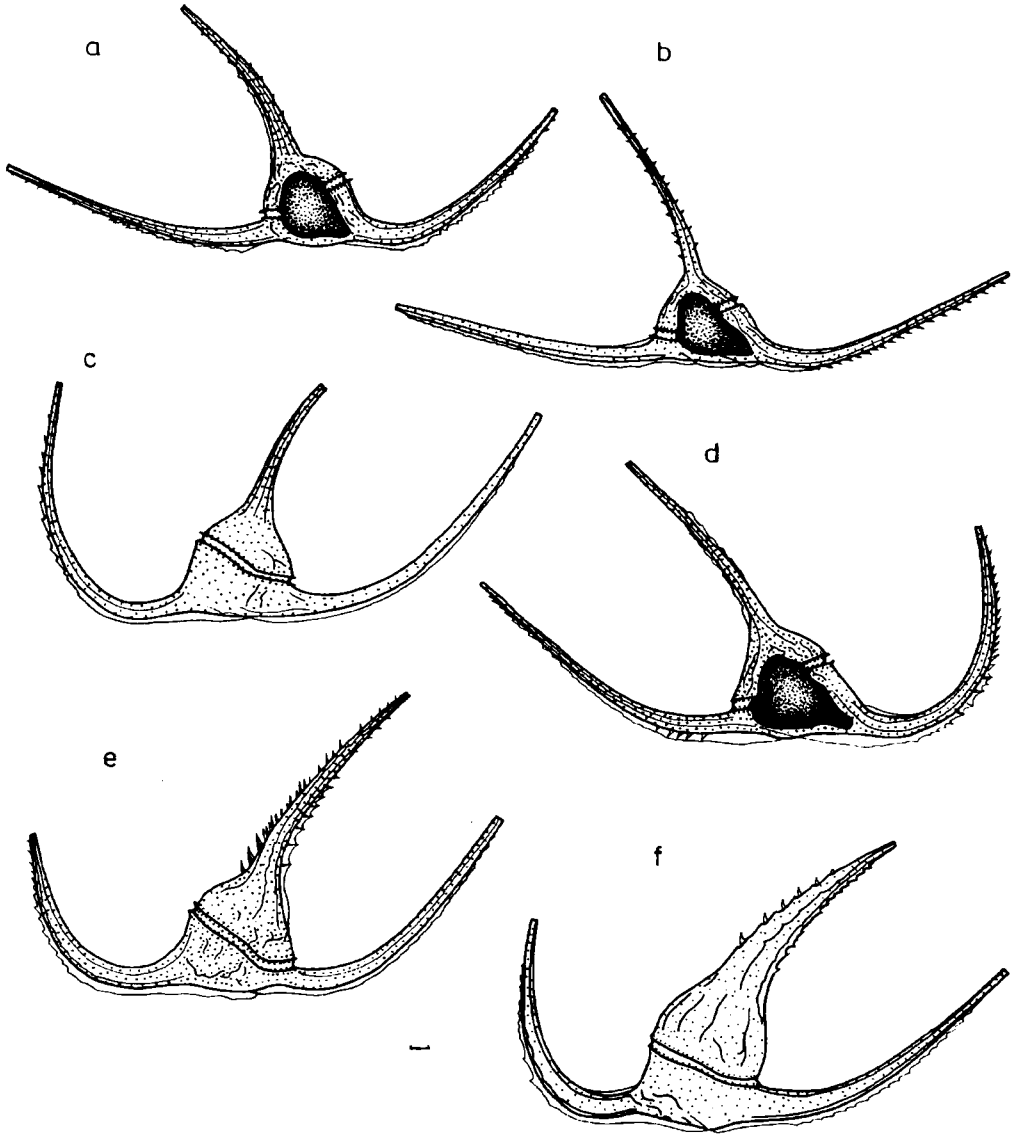


Fig. 14a–f. *Ceratium arcticum: a,b — var, arcticum;* c,d,e — var. *longipes;* f — var. *ventricosum*

var. *arcticum* (Fig. 14 a,b)

Size: body 53–59 μm long, 44–57 μm wide; overall length 196–224 μm; distance between the ends of left and right antapical horns 308–350 μm.

var. *longipes* Bailey (Fig. 14 c,e)

Size: body 59–64 μm long, 59–64 μm wide; overall length 213–232 μm; distance between the ends of left and right antapical horns 202–280 μm.

var. *ventricosum* Ostenfeld (Fig. 14 f)

Size: body 85 μm long, 73 μm wide; overall length 180 μm; distance between the ends of left and right antapical horns 294 μm.

*C. arcticum* var. *arcticum* and var. *longipes* occurred at 46 stations along the route of RV „Oceania" in net hauls, dominating in abundance at Sts. 2, 38–40, 53, 57–60 and 62 (up to 70% of total number of calls in net phytoplankton). A single specimen of *C. arcticum* var. *ventricosum* was recorded only from St. 60.

— *Ceratium compressum* Gran (Fig. 15)

Gran 1902, p. 196, fig. 16.

Syn.: *C. platycorne* Daday var. *compressum* (Gran) Jörgensen 1920, p. 79.

Size: body 51 μm long, 48 μm wide; overall length 147 μm.

A single specimen was recorded from St. 61, July 17, in net haul 100–0 m, temperature about 7.9 – 13.0°C, salinity 35.2‰.

Note: Our specimen resembling *C. compressum* differs from the drawings given by Schiller (1937) and Dodge (1982) by having open antapical horns.

— *Ceratium furca* (Ehrenberg) Claparède et Lachmann (Fig. 16. a,b)

Claparède and Lachmann 1859, p. 399, pl. 19, fig. 5.

Syn.: *Peridinium furca* Ehrenberg 1833, p. 270; 1834, pp. 537, 574, pl. 2, fig. 2.

var. *furca*

Size: body 48–59 μm wide; overall length 258–322 μm.

Observed from Sts. 3 and 59–61 μm, June 23, July 16 and 17, very rare at. Sts. 3, 59 and 60, and subdominant at St. 61 in net hauls 100–0 m, temperature 7.9 – 13.0°C, salinity 35.2‰.

— *Ceratium fusus* (Ehrenberg) Dujardin (Fig. 17)

Dujardin 1841, p. 378.

Syn.: *Peridinium fusus* Ehrenberg 1834, p. 271; 1836, pp. 504, 537, 574, pl. 2. fig. 3

var. *fusus*

Size: body 25–36 μm wide; overall length 460–575 μm.

Found in Sts. 1–3, 5, 10, 30, 52, 54, 56, 58–62 in net hauls 100–0 m, predominating at Sts. 59–61 (up to 30% of total number of cells in net phytoplankton), temperature 7.5 – 13.1°C, salinity 35.2‰.

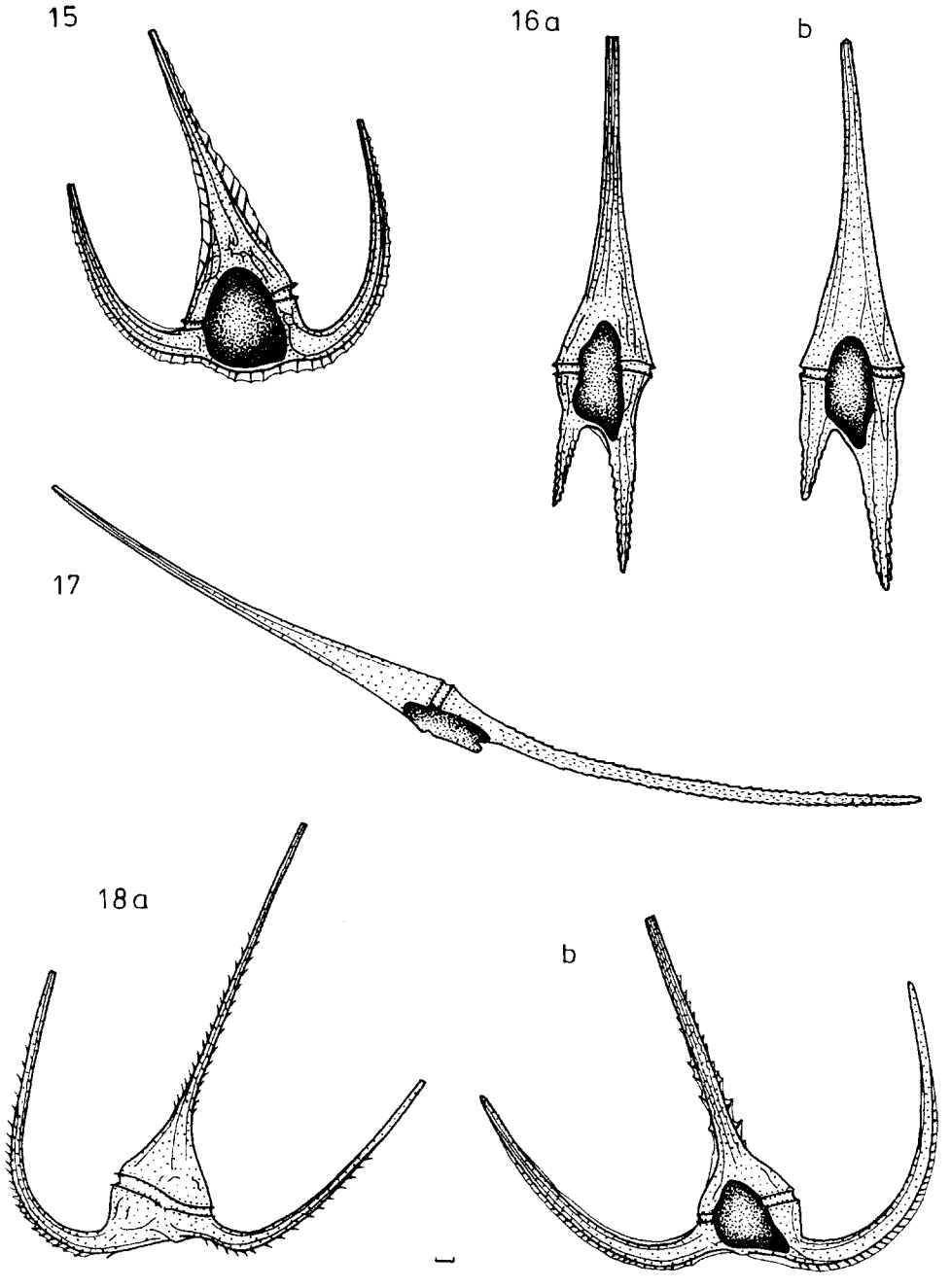


Fig. 15. *Ceratium compressum*
Fig. 16 a,b. *Ceratium furca var. furca*
Fig. 17. *Ceratium fusus* var. *fusus*
Fig. 18 a,b. *Ceratium horridum* var. *horridum*

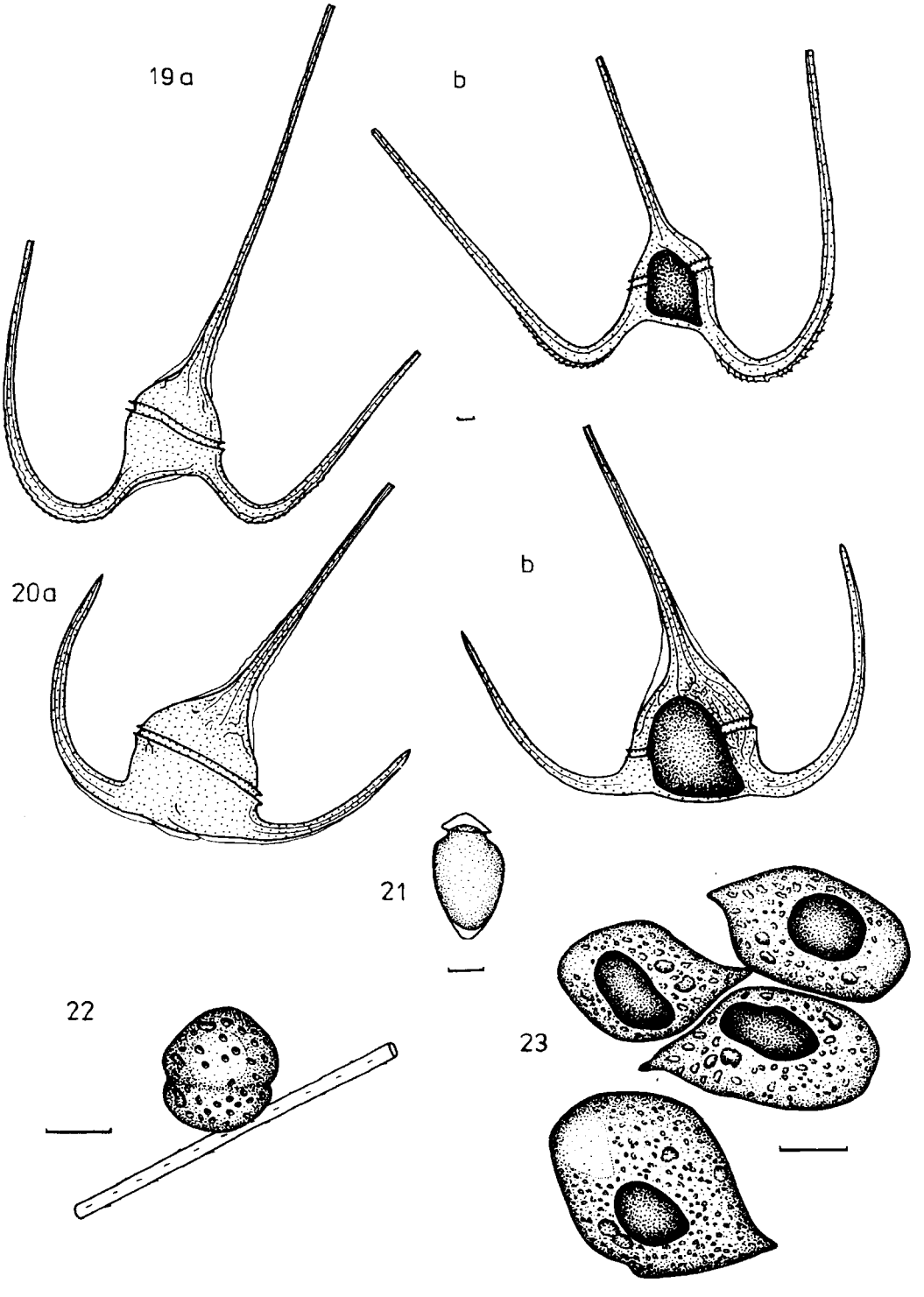


Fig. 19 a,b. *Ceratium macroceros* var. *macroceros*
Fig. 20 a,b. *Ceratium tripos* var. *atlanticum*
Fig. 21. *Oxytoxum laticeps*
Fig. 22. *Paulsenella chaetoceratis* attached to the seta of *Chaetoceros decipiens*
Fig. 23. Dinophyta gen.sp. (?)

— *Ceratium horridum* (Cleve) Gran (Fig. 18 a,b)
Gran 1902, p. 54, 193, („*C. /macroceros* subsp./ *horridum* Cl." and „*C. horridum* Cl., s. *dilat.*").
Syn.: *C. tripos* var. *horridum* Cleve 1897, p. 302, fig. 4.
*C. intermedium* (Jörg.) Jörgensen 1905, p. 111; 1911, p. 83, figs. 174–176.
*C. batavum* Paulsen 1908, p. 84, fig. 114.
var. *horridum*
Size: body 56–78 μm long, 48–59 μm wide; overall length 185–280 μm.
Occurred in Sts. 59–61, July 16 and 17, in net hauls 100–0 m, very rare in Sts. 59 and 60, and rather often in St. 61, temperature 7.5 – 13.1°C, salinity 35.2‰.

— *Ceratium macroceros* (Ehrenberg) Vanhöffen (Fig. 19 a, b)
Vanhöffen 1897, pp. 310, 382, pl. 5, fig. 10
Syn.: *Peridinium macroceros* Ehrenberg 1840, p. 201.
*Ceratium tripos* var. *macroceros* Claparède et Lachman 1859, p. 397, pl. 19, fig. 1.
var. *macroceros*
Size: body 64–70 μm long, 56 μm wide; overall length 314–361 μm.
Recorded from Sts. 59 and 61, July 16 and 17, in net hauls 100–0 m, very rare.

— *Ceratium tripos* (O.F. Müll.) Nitzsch (Fig. 20 a, b)
Nitzsch 1817, p. 4.
Syn.: *Cercaria tripos* O.F. Müller 1781, p. 206; 1786, p. 136, pl. 19, fig. 22.
*Peridinium tripos* Ehrenberg 1836, p. 573, pl. 2, fig. 1 a–e, g, h, non f.
var. *atlanticum* (Ostenfeld) Paulsen
Size: body 84–92 μm long, 70–81 μm wide; overall length 179–294 μm.
Observed in Sts. 59–62, July 16 and 17, in net hauls 100–0 m, predominating at St. 61 (50% of total number of cells in net phytoplankton), temperature 7.5 – 13.4°C, salinity 35.2 – 35.4‰.

## Family OXYTOXACEAE

— *Oxytoxum laticeps* Schiller (Fig. 21)
Schiller 1937, p. 461, fig. 523.
Identification in doubt.
Size: 35 μm long, 20 μm wide.
A single specimen was found in St. 49, July 11, layer 34 m, temperature 5.5°C, salinity 34.7‰.
Note: Unlike the illustrations and descriptions given by Schiller (1937) and Dodge (1982), our specimen is larger and without papilla at the anterior end and small spine at the posterior end.

## Family GONYAULACACEAE

— *Peridiniella catenata* (Levander) Balech
Balech 1977, pp. 125, 133, pl. 2, fig. 48, pl. 3.
Syn.: *Peridinium catenatum* Levander 1894, p. 1, pl. 2, fig. 22.
*Amylax catenata* (Lev.) Meunier 1910, p. 52, pl. 1 bis, figs. 46, 47, pl. 3, figs. 28–34.
*Gonyaulax catenata* (Lev.) Kofoid 1911, p. 291, pl. 18, figs. 1–7.
Size: body with spines 34 μm long, 34 μm wide.
Recorded from St. 5, June 26, surface, temperature 7°C, salinity 34.98‰.

## Family PHYTODINIACEAE

— *Paulsenella chaetoceratis* (Paulsen) Chatton (Fig. 22)
Chatton 1920, p. 320, fig. 139.
Syn.: *Apodinium chaetoceratis* Paulsen 1911, p. 316, fig. 17.
Size: 15 μm diameter.
Recorded from St. 6, June 25, in net haul 100–0 m, temperature 3.5 – 4.0°C, salinity 34.9‰; found attached to the seta of *Chaetoceros decipiens* Cl.

## Species of uncertain position

— *Dinophyta* gen. sp. (Fig. 23)
Reference to dinoflagellates is doubtful. Cells 31–39 μm long, 19–26 μm wide, pyriform, not compressed, with one rounded and another pointed ends, some specimens having depression in the medium (cingulum?). Chloroplasts numerous, in the form of ovate or irregular granules scattered throughout the cell. Nucleus rather large, central.

Found in Sts. 7, 22, 26, 31, 33, 41, 44, 47, 49–51. Maximal concentration (2000 cells in litre) was observed in St. 41, July 9, surface, temperature 3.2°C, salinity 34.4‰.

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## Streszczenie

Praca przedstawia 30 gatunków bruzdnic planktonowych, zebranych z 62 stacji (rys. 1) w rejonie Arktyki Europejskiej i Wysp Owczych. Morfologię 22 gatunków zilustrowano (rys. 2–23) na tle danych o wynikach ekologicznych, temperatury, zasolenia i rejonu występowania.