Diatoms and Siliceous Flagellates (Silicoflagellates, Ebridians, and Endoskeletal Dinoflagellate Actiniscus) from the Subarctic Pacific

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Diatoms and Siliceous Flagellates (Silicoflagellates, Ebridians, and Endoskeletal Dinoflagellate *Actiniscus*) from the Subarctic Pacific

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Abstract

The one hundred seventy two photomicrographs for major diatoms and siliceous flagellates in the pelagic northwestern subarctic Pacific are presented here as supplemental information for our previous publication on diatom and silicoflagellate flux studies at Stations 50N, KNOT, and 40N in the subarctic Pacific. As the siliceous flagellates, silicoflagellates, endoskletal dinoflagellate *Actiniscus pentasterias*, and ebridian *Ebria tripartita* were observed in the samples.

Keywords: diatom, silicoflagellate, *Actiniscus, Ebria*, subarctic Pacific

1. Introduction

In the pelagic subarctic Pacific, the siliceous plankton, especially diatoms, plays a significant role in the carbon cycle as the major component of sinking particles (HONDA *et al*., 2002; TAKAHASHI *et al*., 2002). Among the diatom flux studies in the subarctic Pacific, there are several publications for the relatively long-term monitoring studies (longer than one year) at Stations PAPA and C (TAKAHASHI, 1986; 1997) in the eastern subarctic Pacific, SA and AB in the northern central subarctic and the Bering Sea (KURIHARA and TAKAHASHI, 2002; TAKAHASHI *et al*., 2002), and 50N, KNOT, and 40N in the western subarctic Pacific (ONODERA *et al*., 2005). ONODERA *et al*. (2005) were not able to include the flux data and photomicrographic plates of the observed diatoms due to the limited space and so as ONODERA and TAKAHASHI (2005) for silicoflagellates. As the supplemental information of these publications, photomicrographs of diatoms and siliceous flagellates are presented here. The flux data for the major diatoms presented in ONODERA *et al*. (2005) are also included here as three appendix tables.

2. Materials and Methods

The studied samples were obtained by sediment traps deployed at Stations 50N, KNOT, and 40N during December 1997 through May 2000 in the subarctic Pacific (Fig.1). The deployment depth of sediment trap was approximately 3,000 m at each of the station. The preparing method of

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filter slide for specimen counts was explained in ONODERA *et al*. (2005). The mounting media of filter slide was Cargile® immersion oil Type B or Canada Balsam (Refractive Index = 1.53). For newly preparing another slide, the split sample was treated by 30% H_2O_2, 10% HCl, and Calgon as surfactant. After the deacidification by decantation with distilled water, the sample slurry was dried on a cover slip, and then was mounted on a slide glass with Pleurax or Naphrax (R.I. = 1.73). This new method with the better mounting media improved on previously unrecognized thin-silicified taxa. The cleaned valves and skeletons on cover slips were observed on SEM. The prepared slides were observed on Light Microscope Olympus BX-50. The LM photomicrographs were taken with the mounted digital camera Fujifilm HC-300Z. The SEM photomicrographs were taken using Shimazu SS-550 at the Center of Advanced Instrumental Analysis, Kyushu University.

The species identification was mainly based on the following references: CUPP (1943); HENDEY (1964); SIMONSEN (1974, 1992); POELCHAU (1976); FRYXELL and HASLE (1979); HARGRAVES (1979); SYVERTSEN (1979); SANCETTA (1982); TAKAHASHI (1987, 1991); RINES and HARGRAVES (1988); PITCHER (1990); TAKANO (1990); TAKAHASHI *et al*. (1994); HASLE and SYVERTSEN (1996).

Station 50N is located near the center of the Western Subarctic Gyre (WSG). Diatom and silicoflagellate assemblages at this station are mainly composed of the subarctic pelagic taxa. Station KNOT is located in the mixed water region of the subarctic waters, the Oyashio waters, and the subtropical waters. The coastal water advection from coastal to Station KNOT below upper waters was occasionally significant (ONODERA *et al*., 2005). Therefore, the diversities of diatom and siliceous flagellate assemblages at Station KNOT were relatively high. Station 40N is located near the Subarctic Boundary, and thus it is covered by the subtropical waters as well as the subarctic waters. The characteristics of the water masses at Station 40N reflect the diversified siliceous microplankton assemblages (OKAZAKI *et al*., 2005; ONODERA *et al*., 2005).

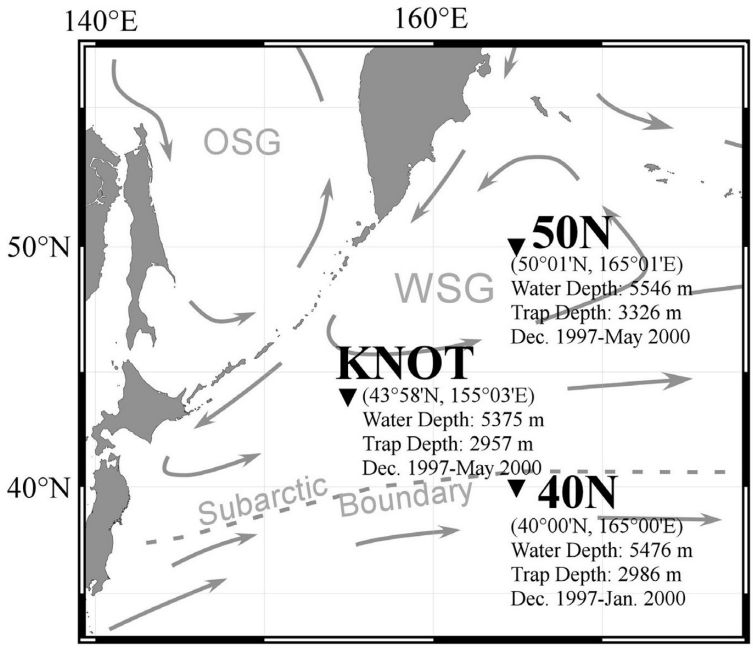

Fig. 1. The locations for sediment trap Stations 50N, KNOT, and 40N (black triangles) in the western subarctic Pacific with the general surface circulation (modified from ONODERA *et al*., 2005); OSG: the Okhotsk Sea Gyre; WSG: the Western Subarctic Gyre. Coordinates, water depth, deployed sediment trap depth, and the sampled duration for each station are presented.

Table 1. The mean abundances of major diatom and siliceous flagellate fluxes at Stations 50N, KNOT, and 40N. The mean abundances for diatoms and siliceous flagellates were separately calculated.

	50N	KNOT	40N
Diatoms			
Centrales			
Thalassiosiraceae			
Bacterosira bathyomphala		T	
Thalassiosira eccentrica	+	P	P
Thalassiosira gravida	+	+	
Thalassiosira hyalina	+	+	
Thalassiosira lineata	P	P	T
Thalassiosira nordenskioeldii	+	P	
Thalassiosira oestrupii	P	P	P
Thalassiosira pacifica		P	
Thalassiosira trifulta Group	P	P	P
Melosiraceae			
Corethron sp.	P	+	P
Palaria sulcata		+	
Stephanopyxis sp.		+	+
Coscinodiscaceae			
Coscinodiscus marginatus	P	+	R
Coscinodiscus occulus-iridis		+	+
Coscinodiscus radiatus	+	+	P
Stellarima stellaris		T	T
Hemidiscaceae			
Actinocyclus curvatulus	P	T	T
Actinocyclus sp.		+	
Azpeitia neocrenulata			T
Azpeitia tabularis	P	+	+
Ropelia tesselata			P
Asterolampraceae			
Asteromphalus heptactis		+	+
Asteromphalus hyalinus	P	+	+
Heliopeltaceae			
Actinoptychus senarius		+	+
Rhizosoleniaceae			
Rhizosolenia bergonii			+
Rhizosolenia hebetata f. *hebetata*	P	T	
Rhizosolenia hebetata f. *semispina*	+	T	+
Proboscia alata			T
Proboscia subarctica	+	T	P
Chaetoceraceae			
Chaetoceros atlanticum	P	T	+
Chaetoceros concavicorne	+	+	
Chaetoceros pervianum	T	+	R
Chaetoceros compressum		T	
Chaetoceros radicans		T	
Subgenus *Hyalochaete* spp.	T	F	P
Pennales			
Diatomaceae			
Thalassionema nitzschioides	T	P	R
Thalassiothrix longissima	T	+	T
Nitzschiaceae			
Fragilariopsis doliolus		P	C
Fragilariopsis oceanica		+	
Fragilariopsis spp.	+	+	
Neodenticula seminae	A	F	R
Nitzschia bicapitata			P
Nitzschia sicula	+	+	+
Diatom Resting Spores			
Chaetoceros furcellatus	P	R	
Total *Chaetoceros* resting spores	P	F	
Siliceous Flagellates			
Silicoflagellates			
Dictyocha mandrai	T	R	R
Dictyocha messanensis	+	P	C
Dictyocha pseudofibula		+	
Distephanus speculum	A	A	C
Distephanus boliviensis	F	R	+
Distephanus septenarius	P	P	
Distephanus octangulatus	P	P	+
Distephanus crux		+	
Distephanus quinquangellus	+	+	+
Distephanus pulchrus		+	T
Siliceous Dinoflagellates			
Actiniscus pentasterias	R	P	P
Ebridians			
Ebria tripartita		+	

Abundances	
<0.1%	(blank)
0.1≤%<0.5	+
0.5≤%<1	T
1≤%<5	P
5≤%<10	R
10≤%<30	F
30≤%<50	C
≥50%	A

3. Diatoms from the pelagic subarctic Pacific

The major diatoms occurred in the studied samples are listed. The system for the diatom taxonomy in this study is essentially based on HASLE and SYVERTSEN (1996). The references for each taxon are selected from some pertinent papers including photomicrographs. The synonyms and reference of original description for each taxon are omitted due to space limitations.

CENTRIC DIATOMS

Bacterosira bathyomphala (CLEVE) SYVERTSEN and HASLE, 1993, p. 298;HASLE and SYVERTSEN, 1996, p. 31, pl. 1. (Plate 1, figs. 1 and 2).

Thalassiosira sp. cf. *binata* FRYXELL in HASLE and FRYXELL, 1977a, p. 244, figs. 24-38; TAKANO, 1990, p. 186-187; **Remarks**: The central annule of this taxon is smaller than that of typical a *T. binata*. (Pl. 1, fig. 3).

Thalassiosira nordenskioeldii CLEVE, 1873:

SYVERTSEN, 1979, p. 49, figs. 6-14; TAKANO, 1990, p. 214-215; HASLE and SYVERTSEN, 1996, p. 36, pl. 5. (Pl. 1, figs. 4-6).

Thalassiosira eccentrica (EHRENBERG) CLEVE, 1904: RIVERA, 1981, p. 64, figs. 129-140; HASLE and SYVERTSEN, 1996, p. 62, pl. 6; **Remarks**: The count data for *T. eccentrica* in ONODERA *et al.* (2005) probably included *Thalassiosira symmetrica*. The latter taxon was newly recognized in Pleurax slide. (Pl. 2, figs. 1-3).

Thalassiosira symmetrica FRYXELL et HASLE, 1972: FRYXELL and HASLE, 1972, p. 312, figs. 37-46; SIMONSEN, 1974, p. 11, pl. 6, figs. 1-2; **Remarks**: This taxon occurred at Stations KNOT and 40N. The count data for this taxon in ONODERA *et al*. (2005) was included as a part of *T. eccentrica*. The revised taxonomy here represents splitting of the previous one taxon into two taxa. (Pl. 1, figs. 11-13).

Thalassiosira gravida CLEVE, 1896: FRYXELL, 1989, figs. 19-21, HASLE and SYVERTSEN, 1996, p. 69, pl. 8. (Pl. 2, figs. 4, 5).

Thalassiosira hyalina (GRUNOW) GRAN, 1880: TAKANO, 1990, pp. 202-203; HASLE and SYVERTSEN, 1996, p. 69, pl. 8. (Pl. 2, fig. 6).

Thalassiosira anguste-lineata (A. SCHMIDT) G. FRYXELL and HASLE: FRYXELL and HASLE, 1977, p. 73, figs. 22-34; TAKANO, 1990, p. 182-183. (Pl. 2, figs. 7-9).

Thalassiosira lineata JOUSÉ, 1868, p.13, pl. 1, figs. 1-2; HASLE and FRYXELL, 1977b, p.22, figs. 15-25. (Pl. 2, figs. 10-12).

Thalassiosira sp. cf. *bioculata* (GRUNOW) OSTENFELD, 1903: HASLE and SYVERTSEN, 1996, p. 69, pl. 8. (Pl. 3, figs. 1-3).

Thalassiosira oestrupii (OSTENFELD) HASLE, 1972: FRYXELL and HASLE, 1980; HASLE and SYVERTSEN, 1996, p. 83, pl. 12. (Pl. 3, figs. 4-7).

Thalassiosira pacifica GRAN and ANGST, 1931: RIVERA, 1981, p. 105, figs. 281-307. (Pl. 1, figs. 7-8).

Thalassiosira punctigera (CASTRACANE) HASLE, 1983: TAKANO, 1990, p. 224-225. (Pl. 1, figs. 9-10).

Thalassiosira trifulta Group; **Remarks**: *Thalassiosira trifulta* G. FRYXELL in FRYXELL and HASLE, *T. poroseriata* (RAMSFJELL) HASLE, and their affinities were lumped and counted as *T. trifulta* group in ONODERA *et al.* (2005). (Pl. 3, figs. 8-11).

Palaria sulcata (EHRENBERG) CLEVE, 1873: HENDEY, 1964, p. 73, pl. 23, fig. 5; HASLE and SYVERTSEN, 1996, p. 91, pl. 14. (Pl. 4, figs. 1-3).

Stephanopyxis turris (ARNOTT in GREVILLE) RALFS in PRITCHARD, 1861: CUPP, 1943, p.40, fig. 3. (Pl. 4, figs. 4-5).

Leptocylindrus mediterraneus (H. PERAGALLO) HASLE, 1892: CUPP, 1943, p.77, fig. 33; HASLE, 1975, p.124, figs. 121-130; HASLE, 1976, figs. 34-35; HASLE and SYVERTSEN, 1996, p.93-96. (Pl. 4, figs. 4-5).

Corethron sp.: **Remarks**: The species of *Corethron* is not identified under LM observation. ONODERA *et al*. (2005) dealt this taxon as *Corethron* sp. SEM microphotograph (Pl. 4, fig. 8) is *Corethron criophilum* CASTRACANE. (Pl. 4, figs. 6-9).

Coscinodiscus marginatus EHRENBERG, 1844: SANCETTA, 1987, p. 231, pl. 1, figs. 1-13. (Pl. 4, figs. 11-12).

Coscinodiscus oculus-iridis EHRENBERG, 1841: SANCETTA, 1982, p. 229, pl. 2, fig. 11; SEMINA, 2003, pp. 74 and 76, pl. 1-2.

Coscinodiscus radiatus EHRENBERG, 1841: HASLE and SIMS, 1986a, pp. 310 and 312, figs. 8-32 and 35-39; SANCETTA, 1987, p. 234, pl. 2, figs. 1-10. (Pl. 5, fig. 3).

Stellarima stellaris (ROPER) HASLE and SIMS, 1986b. (Pl. 5, figs. 4-5).

Actinocyclus octonarius EHRENBERG, 1838: VILLAREAL and FRYXELL, 1983, p. 453, figs. 1-14. (Pl. 6, fig. 1).

Actinocyclus curvatulus JANISCH in A. SCHMIDT, 1878: HUSTEDT, 1930, p. 538, fig. 307. (Pl. 7, figs. 1-4).

Actinocyclus ochotensis JOUSÉ, 1968: KOIZUMI, 1968, pl. 32, figs. 7-10; SANCETTA, 1982, p.224, pl. 1; figs. 4-6. (Pl. 7, figs. 5, 7-9).

Azpeitia neocrenulata (VANLANDINGHAM) G. FRYXELL and T.P. WATKINS in FRYXELL *et al*., 1986, p. 18, figs. 16, 30-2. (Pl. 8, figs. 6-8).

Azpeitia tabularis (GRUNOW) G. FRYXELL and P.A. SIMS in FRYXELL *et al*., 1986, p. 16, figs. 14-15, and 30-1; **Remarks**: The central labiate process is usually hard to discern under LM observation of the sample slide mounted with low refractive index medium such as Canada Balsam or immersion oil. *Azpeitia* sp. in Appendix Table 2 represents the specimens observed on the sample slide prepared with

Canada Balsam or immersion oil, which looks like *A. tabularis* but a central labiate process is not discernible. Thus, there is a good chance that *Azpeitia* sp. is the same as *A. tabularis.* (Pl. 8, figs. 1-5).

Hemidiscus cuneiformis WALLICH, 1860: HENDEY, 1964, p. 94, p. 22, fig. 9; FRYXELL *et al*., 1986, p. 25, fig. 26. (Pl. 8, fig. 9).

Roperia tesselata (ROPER) GRUNOW in VAN HEURCK, 1880-1885: FRYXELL *et al*., 1986, p. 24, figs. 25, 32-3, 32-4. (Pl. 8, figs. 10, 11).

Asteromphalus arachne (BRÉBISSON) RALFS in PRITCHARD, 1861: HERNÁNDEZ-BECERRIL, 1992, p. 279, figs. 1-14. (Pl. 9, fig. 3).

Asteromphalus brookei Bailey, 1856: SANCETTA, 1982, p. 226, pl. 1, fig. 9. (Pl. 9, figs. 1-2).

Asteromphalus heptactis (BRÉBISSON) RALFS in PRITCHARD, 1861: HERNÁNDEZ-BECERRIL, 1991, p. 26, pl. 28-29. (Pl. 9, figs. 6-7).

Asteromphalus hyalinus KARSTEN, 1905: HASLE and SYVERTSEN, 1996, p. 139, pl. 25. (Pl. 9, figs. 4-5).

Actinoptychus senarius (EHRENBERG) EHRENBERG, 1843: HENDEY, 1964, p. 95, pl. 23, figs. 1-2; TAKANO, 1990, p. 258-259. (Pl. 10, figs. 1-2).

Actinoptychus vulgaris SCHUMANN, 1867: SANCETTA, 1982, p. 225, pl.1, fig. 8. (Pl. 10, figs. 3-4).

Rhizosolenia bergonii H. PERAGALLO, 1892: CUPP, 1943, p. 81, fig. 43. (Pl. 10, fig. 5).

Rhizosolenia hebetata BAILEY, 1856: CUPP, 1943, p. 88, fig. 50a-b; **Remarks**: This taxon is counted as *R. hebetata* forma *hebetata* (Pl. 10, fig. 6) and *R. hebetata* forma *semispina* (Pl. 10, figs. 7-8) in ONODERA *et al*., (2005). (Pl. 10, figs. 6-8).

Rhizosolenia styliformis BRIGHTWELL, 1858: HASLE, 1975, figs. 1-3. (Pl. 10, figs. 9-10).

Proboscia alata (BRIGHTWELL) SUNDSTRÖM, 1986: TAKAHASHI *et al*., 1994, p. 413, figs. 2-7; JORDAN and LIGOWSKI, 2004, pp. 97-98, pl. I-III, and IV, figs. 1-4. (Pl. 11, fig. 1).

Proboscia eumorpha TAKAHASHI, JORDAN and PRIDDLE, 1994, p. 415, figs. 8-16. (Pl. 11, fig. 2).

Proboscia subarctica TAKAHASHI, JORDAN and PRIDDLE, 1994, p. 417, figs. 17-37. (Pl. 11, figs. 3-4).

Pseudosolenia calcar-avis (SCHULTZE) SUNDSTRÖM, 1986: CUPP, 1943, p. 89, fig. 51; HASLE and SYVERTSEN, 1996, p. 160, pl. 30. (Pl. 10, fig. 11).

Bacteriastrum delicatulum CLEVE, 1897: DREBES, 1974, p. 60, figs. 45-47; FRYXELL, 1978, p. 63, 1-17. (Pl. 11, fig. 5).

Genus Chaetoceros EHRENBERG; **Remarks**: The gender of generic name "*Chaetoceros*" is sometime erroneously treated as masculine noun. However, Ehrenberg who is the author of this genus defined this word as a neuter noun (HENDEY, 1964). Therefore, the specific names of *Chaetoceros* here are treated as a Latin neuter noun.

Subgenus *Chaetoceros*

Chaetoceros atlanticum CLEVE, 1873: CUPP, 1943, p. 103, fig. 59; TAKANO, 1990, pp. 282-283. (Pl. 11, fig. 7).

Chaetoceros concavicorne MANGIN, 1917: HENDEY, 1964, p. 122, pl. 9, fig. 1; EVENSEN and HASLE, 1975, p. 158, figs. 15-22.

Chaetoceros peruvianum BRIGHTWELL, 1856: CUPP, 1943, p. 113, fig. 68; KOCH and RIVERA, 1984, p. 69, figs. 36-47. (Pl. 11, figs. 8-9).

Subgenus *Hyalochaete*; **Remarks**: Most *Hyalochaete* valves and their resting spores were countered as "*Hyalochaete* spp." and "*Hyalochaete* resting spores", respectively. The morphologically characteristic resting spores, however, were countered at species level.

Chaetoceros compressum LAUDER, 1864: HENDEY, 1964, p. 125, pl. 16, fig. 5; RINES and HARGRAVES, 1988, p. 64, figs. 131-134 and 218. (Pl. 12, figs. 1-3).

Chaetoceros didymus EHRENBERG, 1845: RINES and HARGRAVES, 1988, p. 77, figs. 154-163; TAKANO, 1990, pp. 288-289. (Pl. 12, figs. 4).

Chaetoceros diadema (EHRENBERG) GRAN, 1897: RINES and HARGRAVES, 1988, p. 76, figs. 150-151, 153. (Pl. 12, figs. 9-13).

Chaetoceros furcellatum BAILEY, 1856: HASLE and SYVERTSEN, 1996, p. 213, pl. 45. (Pl. 12, figs. 16-18).

Chaetoceros radicans SCHÜTT, 1895: HENDEY, 1964, p. 134, pl. 14, fig. 4; RINES and HARGRAVES, 1988, p. 90, figs. 192-198. (Pl. 12, figs. 5-7).

PENNATE DIATOMS

Thalassionema nitzschioides (GRUNOW) MERESCHKOWSKY, 1902: HASLE and SYVERTSEN, 1996, p. 257, pl. 56, fig. 4, pl. 57; SEMINA, 2003, pl. 133, figs. 3-4, pl. 134, fig. 4, pl. 136, figs. 1-4, pl. 137, figs. 1-4, pl. 138, figs. 1-4. (Pl. 13, figs. 2-9).

Thalassiothrix longissima CLEVE and GRUNOW, 1880: HASLE and SYVERTSEN, 1996, p. 108, pl. 18, fig. 5, pl.

23-25. (Pl. 13, figs. 10-13).

Fragilariopsis doliolus (WALLICH) MEDLIN and SIMS, 1993: HASLE, 1976, figs. 29-31; SEMINA, 2003, pl. 51. (Pl. 13, figs. 14-16).

Neodenticula seminae (SIMONSEN and KANAYA) AKIBA and YANAGISAWA, 1986, p. 491, pl. 24, figs. 1-11, pl. 26, figs. 1-10; YANAGISAWA and AKIBA, 1990, p. 263, pl. 7, figs. 45-49; SEMINA, 2003, p.40, 59-60, pl. 19-22. (Pl. 13, figs. 17-22).

Nitzschia bicapitata CLEVE, 1901: FRYXELL, 2000, p. 47, figs. 1-11. (Pl. 14, figs. 5-9).

Nitzschia braarudii HASLE, 1960, p. 22, text fig. 11, pl. 7, figs. 58-63; SIMONSEN, 1974, p. 50, pl. 35, fig. 2. (Pl. 14, fig. 10).

Nitzschia interruptestriata SIMONSEN, 1974, p. 52, pl.36, figs. 9-11, pl. 37, 38, figs. 1-7. (Pl. 14, figs. 11-14).

Nitzschia kolaczeckii GRUNOW, 1867: HASLE, 1960, p. 24, pl. 5, figs. 50a-c. (Pl. 14, fig. 15).

Nitzschia sicula (CASTRACANE) HUSTEDT, 1958, p. 180, figs. 128-132; HASLE, 1960, p. 26, fig. 16; HASLE and SYVERTSEN, 1996, p. 327, pl. 74-75. (Pl. 13, figs. 23-24).

Alveus marinus (GRUNOW) KACZMARSKA et G.: KACZMARSKA and FRYXELL, 1996, p. 3, figs. 1-35; SEMINA, 2003, pl. 49-50. **Remarks**: This taxon was observed with rare abundances in many samples at Station 40N. (Pl. 14, figs.3-4).

4. Siliceous flagellates from the pelagic subarctic Pacific

The silicoflagellates, endoskeletal dinoflagellates, and ebridian in the studied samples are listed below. Other siliceous microflagellates are not found in the sediment trap samples. The count and flux data for *Actiniscus* and ebridians are not included here but they will be prepared in the near future.

4. 1. Siliceous Phytoflagellates

Among the marine siliceous phytoflagellates, silicoflagellate skeletons occurred at all of Stations 50N, KNOT, and 40N. The silicoflagellate taxonomy employed here is essentially based on TAKAHASHI (1987; 1991).

SILICOFLAGELLATE

Dictyocha mandrai LING, 1977, p. 209, pl. 1, figs. 13-14; TAKAHASHI, 1991, p.11, pl. 1, figs. 8-11, pl. 2, fig. 1. (Pl. 15, figs. 1-2).

Dictyocha messanensis HAECKEL in PETERS, 1860: TAKAHASHI, 1991, p. 7, 9, pl.1, figs. 1-6; **Remarks**: POELCHAU (1976), TAKAHASHI(1991), and TAKAHASHI and BLACKWELDER (1992) suggested that the two varieties of this taxon showed the different habitats and different skeletal dimensions. ONODERA and TAKAHASHI (2005) did not identify the two varieties and dealt as one taxon *D. messanensis*. (Pl. 15, figs. 3-4).

Dictyocha pseudofibula (SCHULZ) TSUMURA, 1963, p. 55, pl. 11, figs. 1-3, pl. 24, fig. 2. (Pl. 15, fig. 5).

Distephanus boliviensis (FRENGUELLI) BUKRY and FOSTER, 1973, p. 827, pl. 4, figs. 1-3. (Pl. 15, fig. 6).

Distephanus speculum (EHRENBERG) HAECKEL, 1887: POELCHAU, 1976, pl. 2, figs. a-d. (Pl. 15, figs. 7-8).

Distephanus septenarius (EHRENBERG) FRENGUELLI, 1938: DESIKACHARY and PREMA, 1996, pp. 194-195, pl. 59, figs. 3, 5, 7-8, pl. 72, figs. 2, 4-5; **Remarks**: ONODERA and TAKAHASHI (2005) treated this taxon as *Distephanus speculum* (Heptagonal form). (Pl. 15, fig.9; Pl. 16 fig. 1).

Distephanus octangulatus WAILES, 1932: TAKAHASHI, 1987, pl. 1, figs. 6-7, pl. 2, fig. 3. (Pl. 16, figs. 2-3).

Distephanus quinquangellus BUKRY and FOSTER, 1973, p. 828, pl. 5, fig. 4; LING, 1973, p. 753, pl. 2, figs. 16-17. (Pl. 16, figs. 4-5).

Distephanus pulchrus (SCHILLER) LING and TAKAHASHI, 1985, p. 80, pl. 1, figs. 4-9, pl. 2, figs. 1-4, 7; TAKAHASHI, 1991, p. 12, 13, pl. 2, figs. 5-11. (Pl. 16, figs. 6-7).

DINOFLAGELLATE

Actiniscus pentasterias (EHRENBERG) EHRENBERG, 1854: ORR and CONLEY, 1976, p. 92, pl. 1, figs. 1-11, pl. 2, figs. 1-6; TAKAHASHI, 1991, pp. 13-14, pl. 2, figs. 12-15. (Pl. 16, figs. 8-10).

4. 2. Siliceous Zooflagellate

EBRIDIAN

Ebria tripartita (SCHUMANN) LEMMERMANN, 1899: VØRS, 1992, p. 76, figs. 34k-n; **Remarks**: The occurrences were recorded with very rare abundances at Station KNOT (ONODERA, unpublished data). (Pl. 16, figs. 11-13).

5. Acknowledgements

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7. PLATES

LM and SEM photomicrographs of diatoms (Plates 1-14), silicoflagellates (Plates 15-16), and ebridians and *Actiniscus* (Pl. 16) at Stations 50N, KNOT, and 40N during 1998-2000. Whenever deemed appropriate "a" and "b" (and sometimes "c") figures representing different focal planes of the same specimens are illustrated. All scale bars = 10μm.

Plate 1. 1, 2. *Bacterosira bathyomphala* resting spore (Station KNOT, July 1999), **3. *Thalassiosira* sp. cf. *binata*** (KNOT, June 1999), **4-6. *Thalassiosira nordenskioeldii*** (4: 50N, Sept. 1999; 5: KNOT, June 1999; 6: KNOT, July 1999), **7, 8. *Thalassiosira pacifica*** (7: KNOT, July 1999; 8: KNOT, Apr. 1999), **9, 10. *Thalassiosira punctigera*** (KNOT, June 1999), **11-13. *Thalassiosira symmetrica*** (11, 12: KNOT, Jan. 1999; 13: 40N, Apr. 1998).

Plate 2. 1-3. *Thalassiosira eccentrica* (1, 3: KNOT, Apr. 1999; 2: 50N, Apr. 2000), **4, 5. *Thalassiosira gravida*** (KNOT, June 1999), **6. *Thalassiosira hyalina*** (50N, Apr. 1999), **7-9. *Thalassiosira anguste-lineata*** (KNOT, June 1999), **10-12. *Thalassiosira lineata*** (10, 11: KNOT, Apr. 1999; 12: 40N, Apr. 1998).

Plate 3. 1-3. *Thalassiosira* sp. cf. *bioculata* (1, 2: 50N, Jan. 1999; 3. 50N, Apr. 2000), **4-7. *Thalassiosira oestrupii*** (4, 5: 40N, Apr. 1999; 6, 7: 40N, July 1999), **8-11. *Thalassiosira trifulta* group** (8: 50N, May 1999; 9: KNOT, Apr. 1999; 10: 50N, Jan. 1999; 11: 40N, Apr. 1999).

Plate 4. 1-3. *Paralia sulcata* (1, 2: KNOT, Dec. 1997; 3: KNOT, Nov. 1999), **4, 5. *Stephanopyxis turris*** (4: KNOT, June 1998; 5: June 1999), **6-9. *Corethron* sp.** (6, 9: KNOT, May 1999; 7: KNOT, June 1999, 8: 50N, Apr. 2000), **10. *Leptocylindrus mediterraneus*** (KNOT, Apr. 1998), **11, 12. *Coscinodiscus marginatus*** (11: KNOT, Nov. 1999; 12: 40N, July 1999).

Plate 5. 1, 2. ***Coscinodiscus*** **sp. cf.** ***oculus-iridis*** (1: 50N, Apr. 2000; 2: 40N, Apr. 1998), **3.** ***Coscinodiscus radiatus*** (KNOT, June 1999), **4, 5.** ***Stellarima stellaris*** (4: KNOT, Apr. 1999; 5: KNOT, May 1998).

Plate 6. 1, 2?. ***Actinocyclus octonarius*** (1: KNOT, Apr. 1999; 2: KNOT, Apr. 1999), **3.** ***Actinocyclus subtilis*** (3: 40N, Nov. 1999).

Plate 7. 1-4. ***Actinocyclus curvatulus*** (1: KNOT, June 1999; 2: 50N, Mar. 1998; 3, 4: 50N, Jan. 1999), **5-7, 8?, 9.** ***Actinocyclus ochotensis*** (5, 7-9: 50N, Apr. 2000; 6: 50N, Apr. 1998), **10.** ***Actinocyclus*** **sp**. (50N, Apr. 2000), **11.** ***Actinocyclus normanii?*** (40N, Apr. 1998).

Plate 8. 1-5. ***Azpeitia tabularis*** (1, 5: 50N, Apr. 2000; 2, 3: 50N, Apr. 1998; 4: 50N, Jan. 1999), **6-8.** ***Azpeitia neocrenulata*** (6: 40N, Apr. 1998; 7: 40N, Sept. 1999; 8: KNOT, Apr. 1999), **9.** ***Hemidiscus cuneiformis*** (40N, Dec. 1999), **10, 11.** ***Roperia tesselata*** (10: 40N, Dec. 1999; 11: KNOT, Apr. 1999).

Plate 9. 1, 2. ***Asteromphalus brookei*** (1: 50N, Jan. 1999; 2: 40N, Apr. 1998), **3.** ***Asteromphalus arachne*** (40N, Dec. 1999), **4, 5.** ***Asteromphalus hyalinus*** (4: 50N, Jan. 1999; 5: 50N, Apr. 2000), **6, 7.** ***Asteromphalus heptactis*** (6: 40N, Apr. 1998; 7: 40N, July 1999).

Plate 10. 1, 2. ***Actinoptychus senarius*** (1: KNOT, Jan. 1998; 2: KNOT, June 1999), **3, 4.** ***Actinoptychus vulgaris*** (3: KNOT, Sept. 1998; 4: KNOT, Apr. 1999), **5.** ***Rhizosolenia bergonii*** (40N, Apr. 1998), **6-8.** ***Rhizosolenia hebetata*** (6: KNOT, July 1999; 7: 40N, Dec. 1999; 8: 50N, Apr. 2000), **9, 10.** ***Rhizosolenia styliformis*** (40N, Oct. 1998), **11.** ***Pseudosolenia carcaravis***, (40N, Nov. 1999).

Plate 11. 1. ***Proboscia alata*** (40N, Apr. 1998), **2.** ***Proboscia eumorpha*** (KNOT, June 1998), **3, 4.** ***Proboscia subarctica*** (3: KNOT, Apr. 1999; 4: 40N, Apr. 1998), **5.** ***Bacteriastrum delicatulum*** (KNOT, Jan. 1999), **6.** ***Bacteriastrum furcatum?*** (40N, Apr. 1998), **7.** ***Chaetoceros atlanticum*** (KNOT, Dec. 1999), **8, 9.** ***Chaetoceros peruvianum*** (8: KNOT, Nov. 1999; 9: KNOT, Apr. 1998).

Plate 12. 1-3. ***Chaetoceros compressum*** (1, 2: KNOT, June 1999; 3: July 1999), **4.** ***Chaetoceros didymum*** **resting spore** (KNOT, Feb. 1998), **5-7.** ***Chaetoceros radicans*** (KNOT, June 1999), **8.** ***Chaetoceros*** **sp. cf.** ***cinctum*** (KNOT, June 1999), **9-13.** ***Chaetoceros diadema*** **resting spores** (9, 10, 13: KNOT, June 1999; 11, 12: KNOT, Nov. 1999), **14, 15.** ***Hyalochaete*** **spp. and their resting spores** (KNOT, June 1999), **16-18.** ***Chaetoceros furcellatum*** **resting spores** (KNOT, June 1999).

Plate 13. 1. ***Lioloma*** **sp.** (KNOT, Apr. 1999), **2-7, 8?, 9?** ***Thalassionema nitzschioides*** (2, 3, 5: KNOT, Apr. 1999; 4, 6, 7, 9: 40N, Apr. 1998; 8: KNOT, Sept. 1998), **10-13.** ***Thalassiothrix longissima*** (10: 40N, Apr. 1998; 11: 50N, Apr. 2000; 12, 13: KNOT, Jan. 1998), **14-16.** ***Fragilariopsis doliolus*** (14: KNOT, Sept. 1998; 15: 40N, July 1999; 16: KNOT, Apr. 1999), **17-22.** ***Neodenticula seminae*** (17, 19: 50N, Apr. 1998; 18: 50N, Apr. 2000; 20: 50N, Apr. 2000; 21: KNOT, Apr. 1999; 22: 50N, Sept. 1999), **23, 24.** ***Nitzschia sicula*** (40N, Apr. 1998).

Plate 14. 1, 2. ***Nitzschia*** **spp.** (1: 40N, Apr. 1998; 2: 40N, Nov. 1999), **3-4.** ***Alveus marinus*** (3: 40N, Nov. 1999; 4: 40N, Apr. 1998), **5-9.** ***Nitzschia bicapitata*** **Group** (40N, Sept. 1999), **10.** ***Nitzschia*** **sp. cf.** ***braarudii*** (40N, Apr. 1998), **11-14.** ***Nitzschia interruptestriata*** (11: 40N, Nov. 1999; 12, 14: 40N, Apr. 1998; 13: KNOT, Apr. 1999), **15.** ***Nitzschia kolaczeckii*** (40N, Apr. 1998).

Plate 15. 1, 2. ***Dictyocha mandrai*** (1: KNOT, Oct. 1998; 2: 40N, July 1999), **3, 4.** ***Dictyocha messanensis*** (3: KNOT, Oct. 1998; 4: KNOT, Jan. 1999), **5.** ***Dictyocha pseudofibula*** (KNOT, Mar. 1998), **6.** ***Distephanus boliviensis*** (50N, May 1998), **7, 8.** ***Distephanus speculum*** (7: KNOT, Jan. 1999; 8: KNOT, Jan. 1998), **9.** ***Distephanus septenarius*** (KNOT, Jan. 1998).

Plate 16. 1. ***Distephanus septenarius*** (50N, May 1999), **2, 3 (lateral view).** ***Distephanus octangulatus*** (2: 50N, May 1998; 3: 50N, Apr. 2000), **4, 5.** ***Distephanus quinquangellus*** (4: KNOT, Jan. 1999, 5: KNOT, Apr. 1999), **6, 7.** ***Distephanus pulchrus*** (6: KNOT, Oct. 1998; 7: 40N, Nov. 1999), **8-10.** ***Actiniscus pentasterias*** (8: 50N, June 1999; 9, 10: 50N, May 1999), **11-13.** ***Ebria tripartita*** (11: KNOT, Dec. 1999: 12: KNOT, Apr. 1999; 13: KNOT, Jan. 1998).

Plate 1

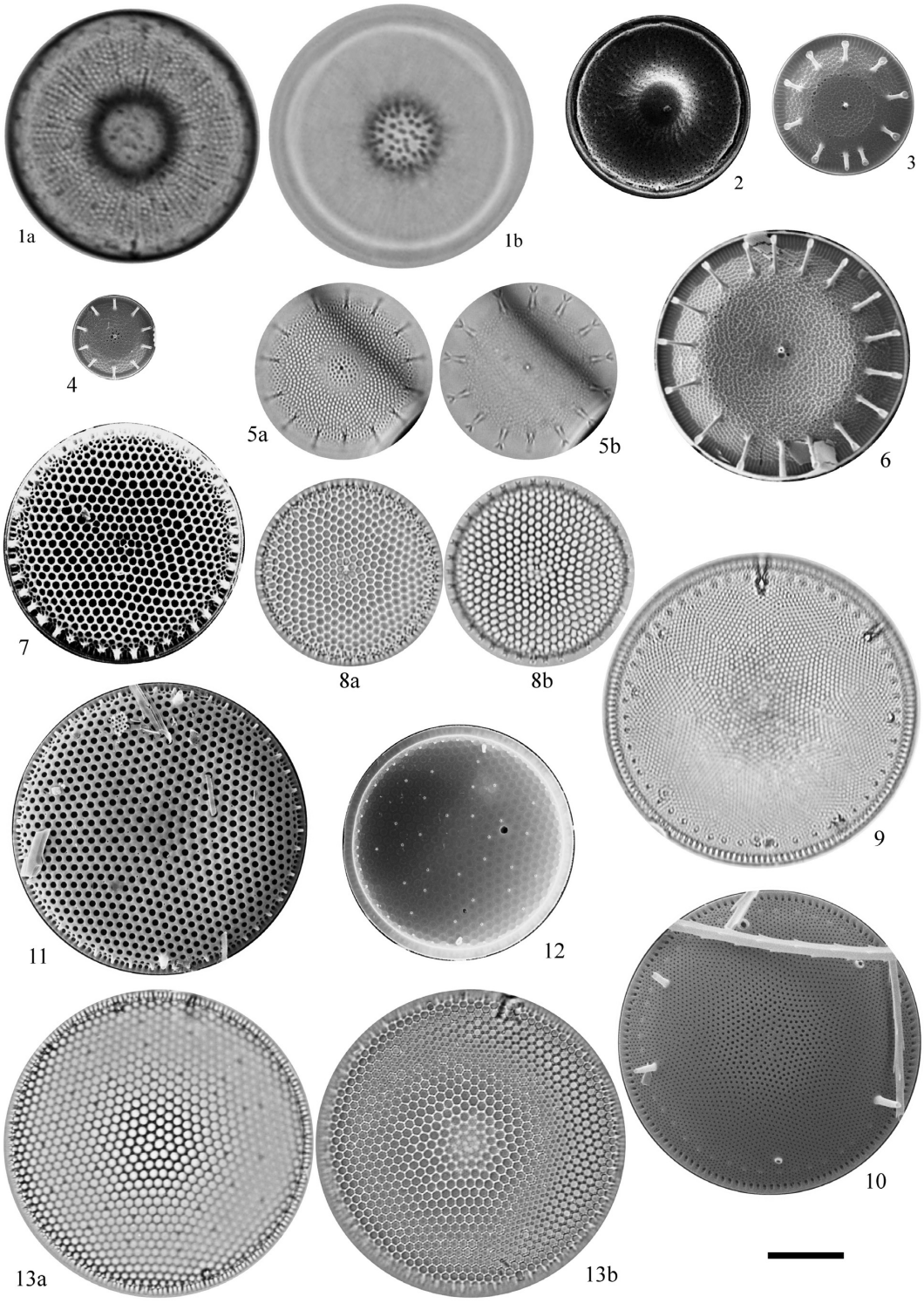


Plate 2

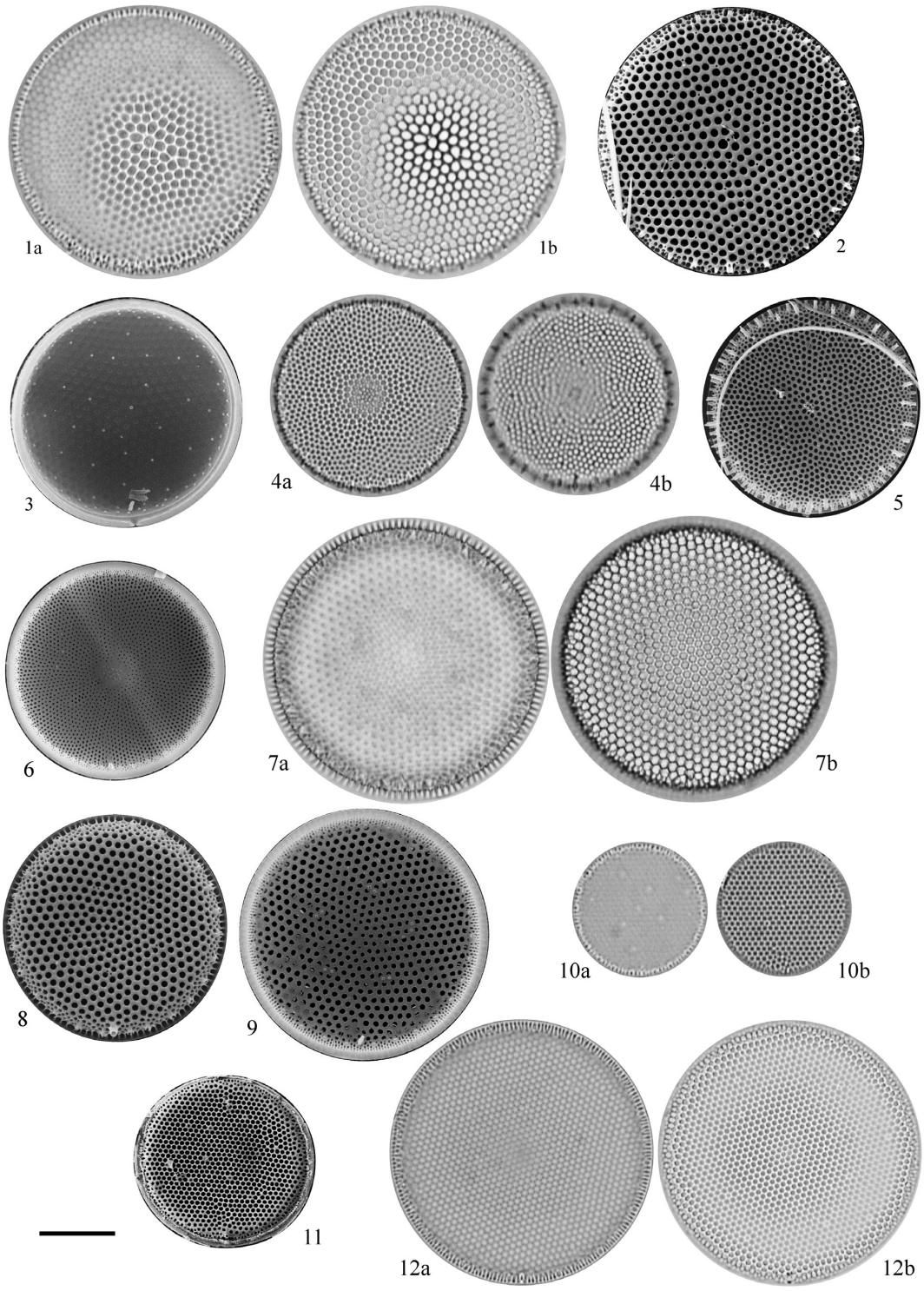


Plate 3

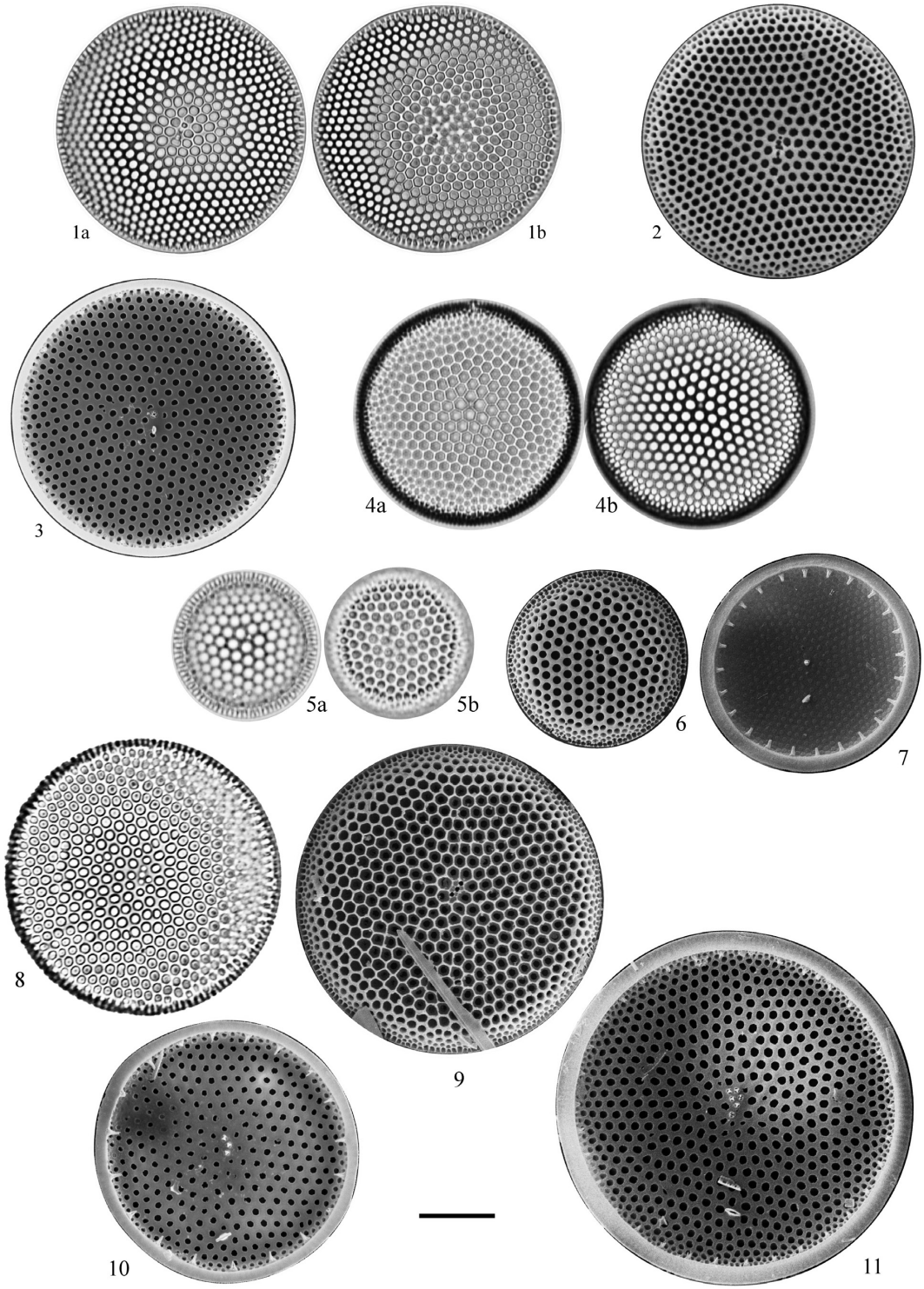


Plate 4

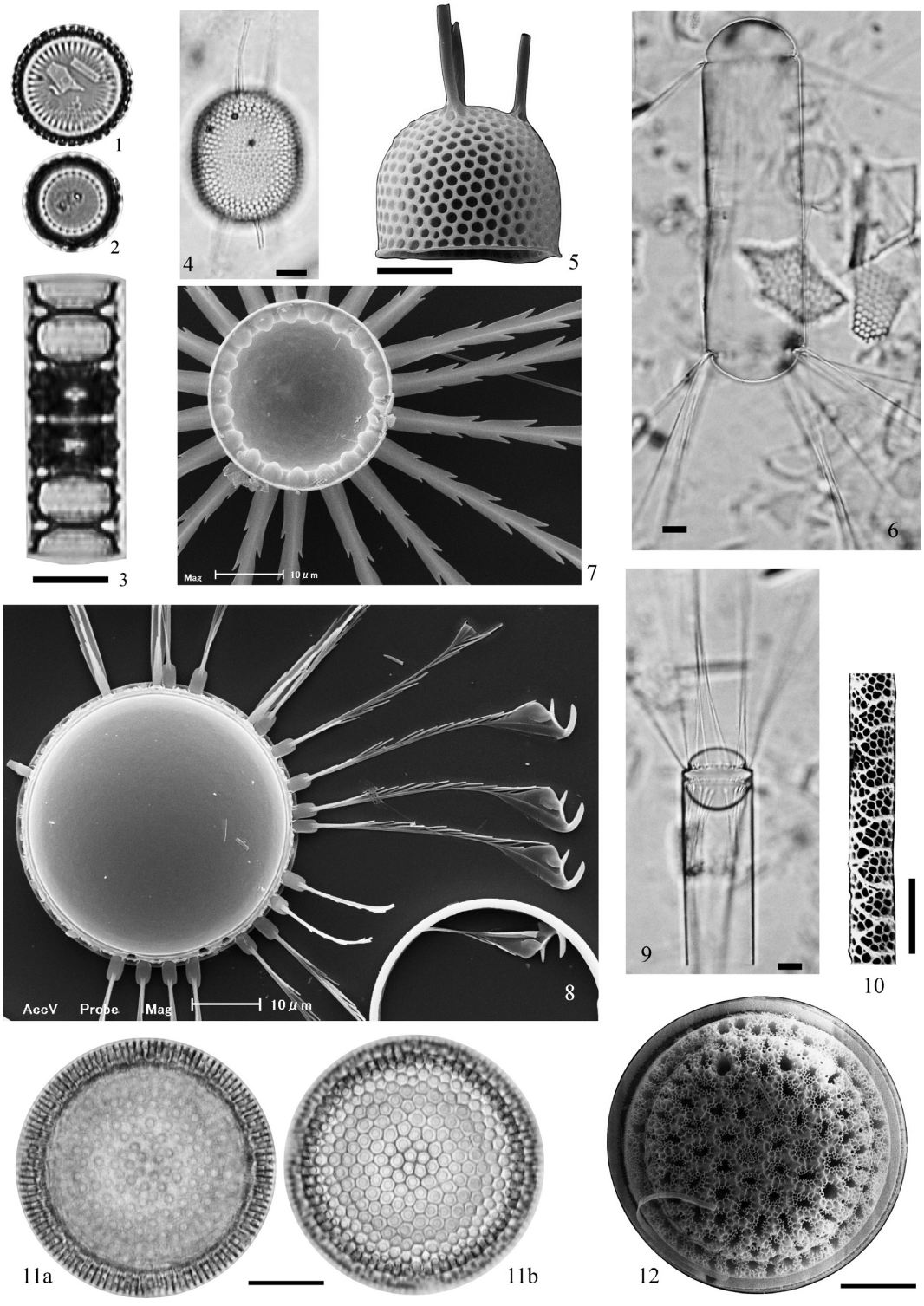


Plate 5

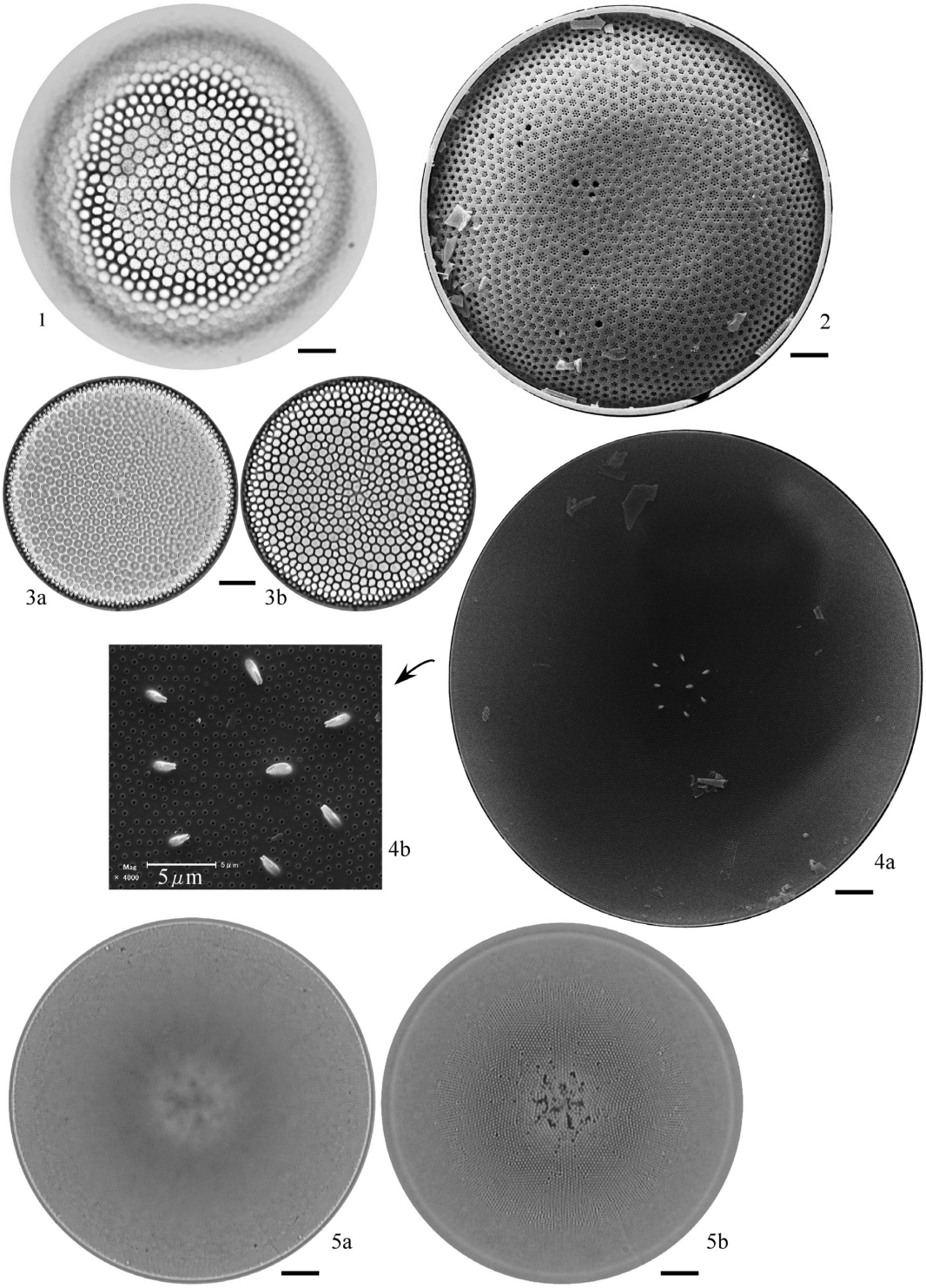
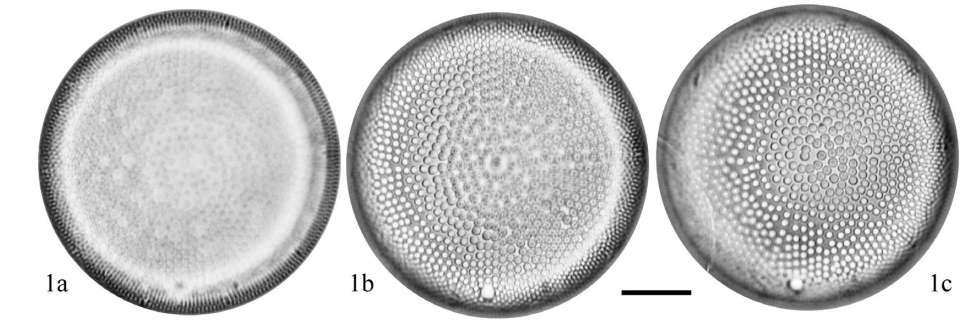
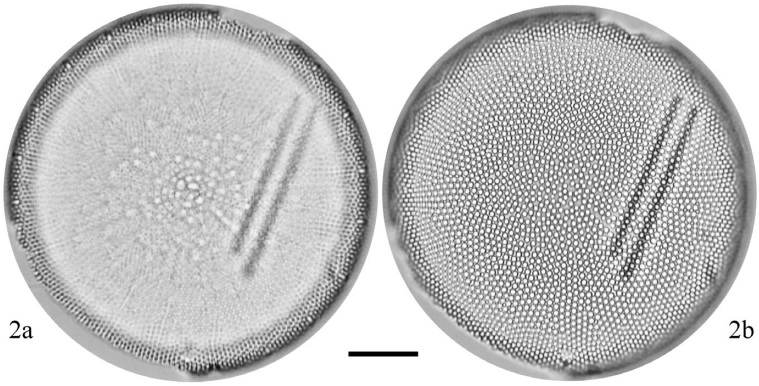
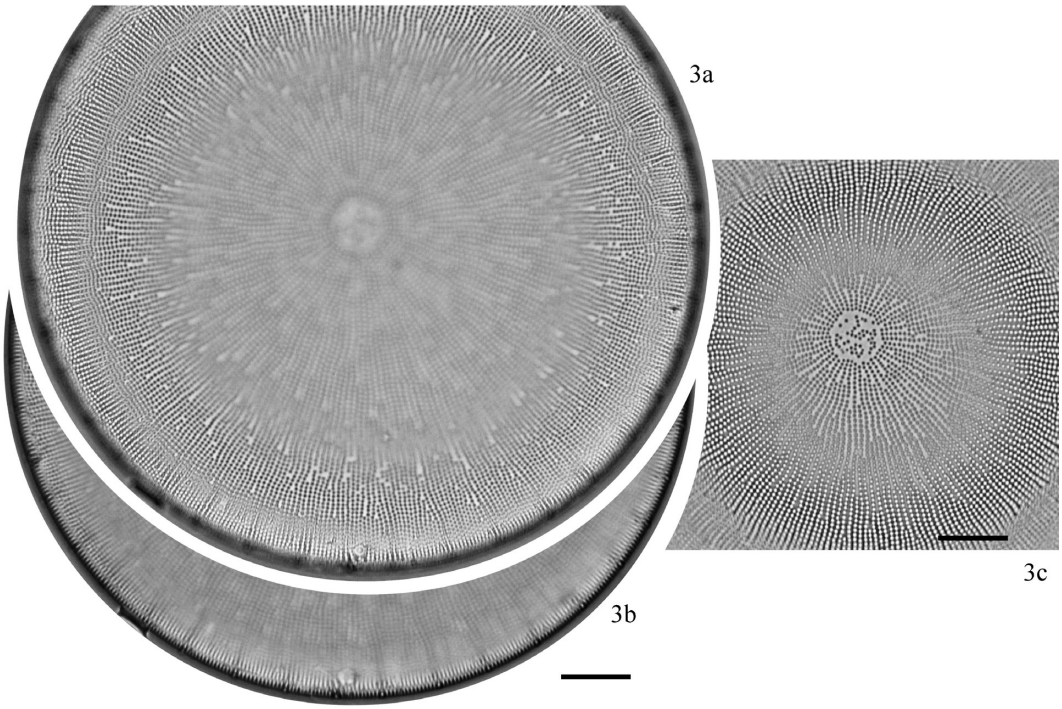


Plate 6







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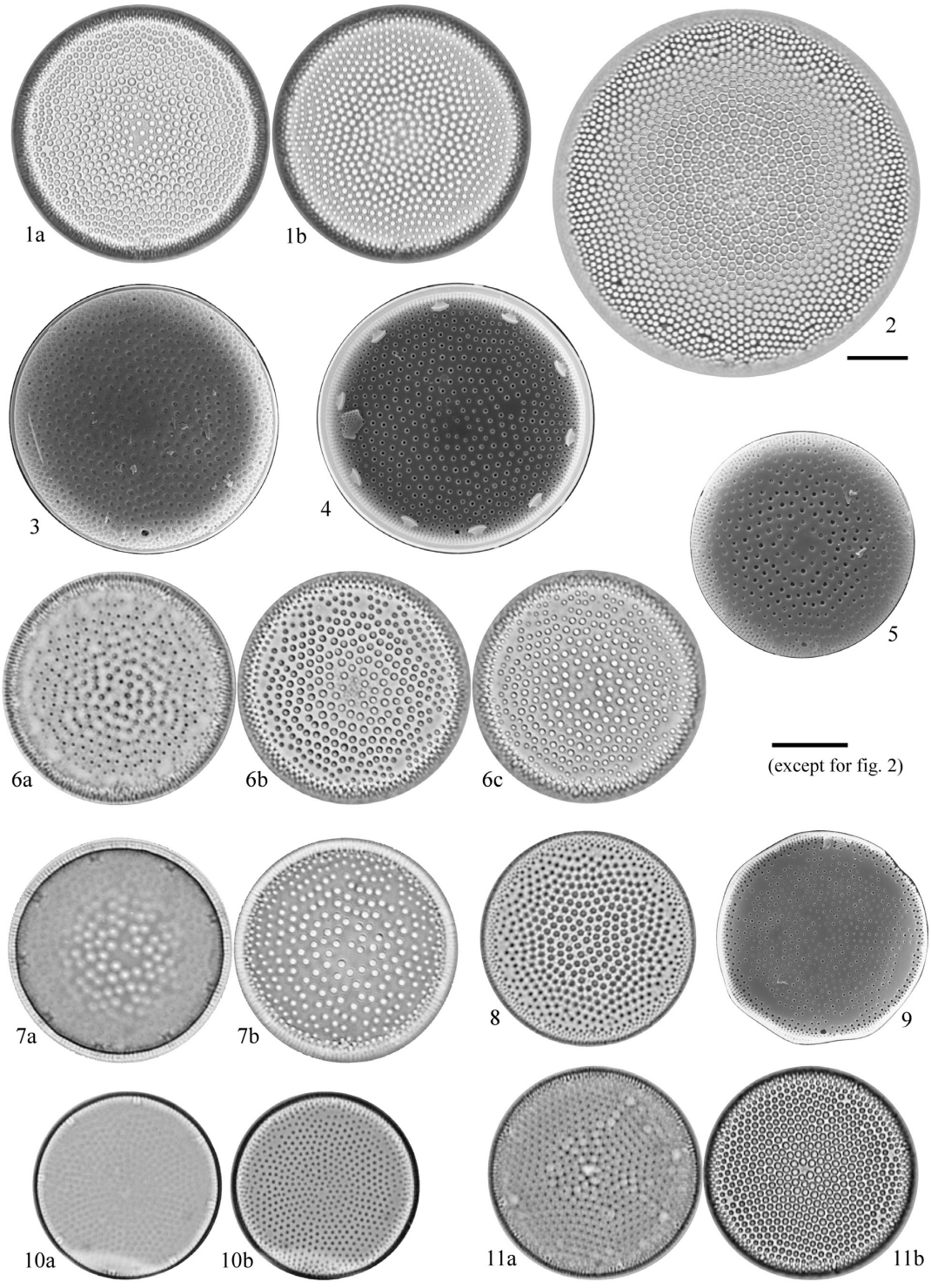


Plate 8

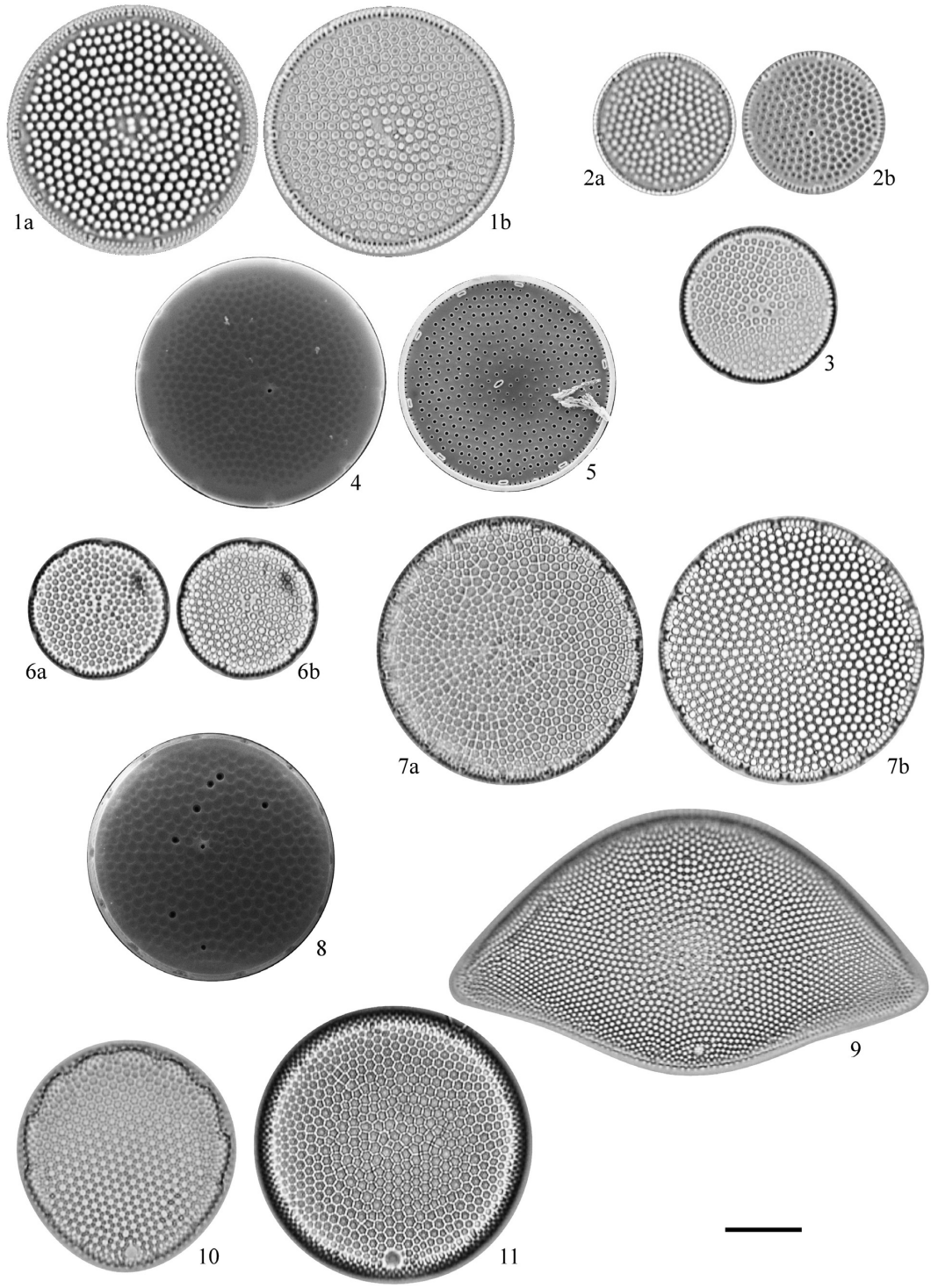


Plate 9

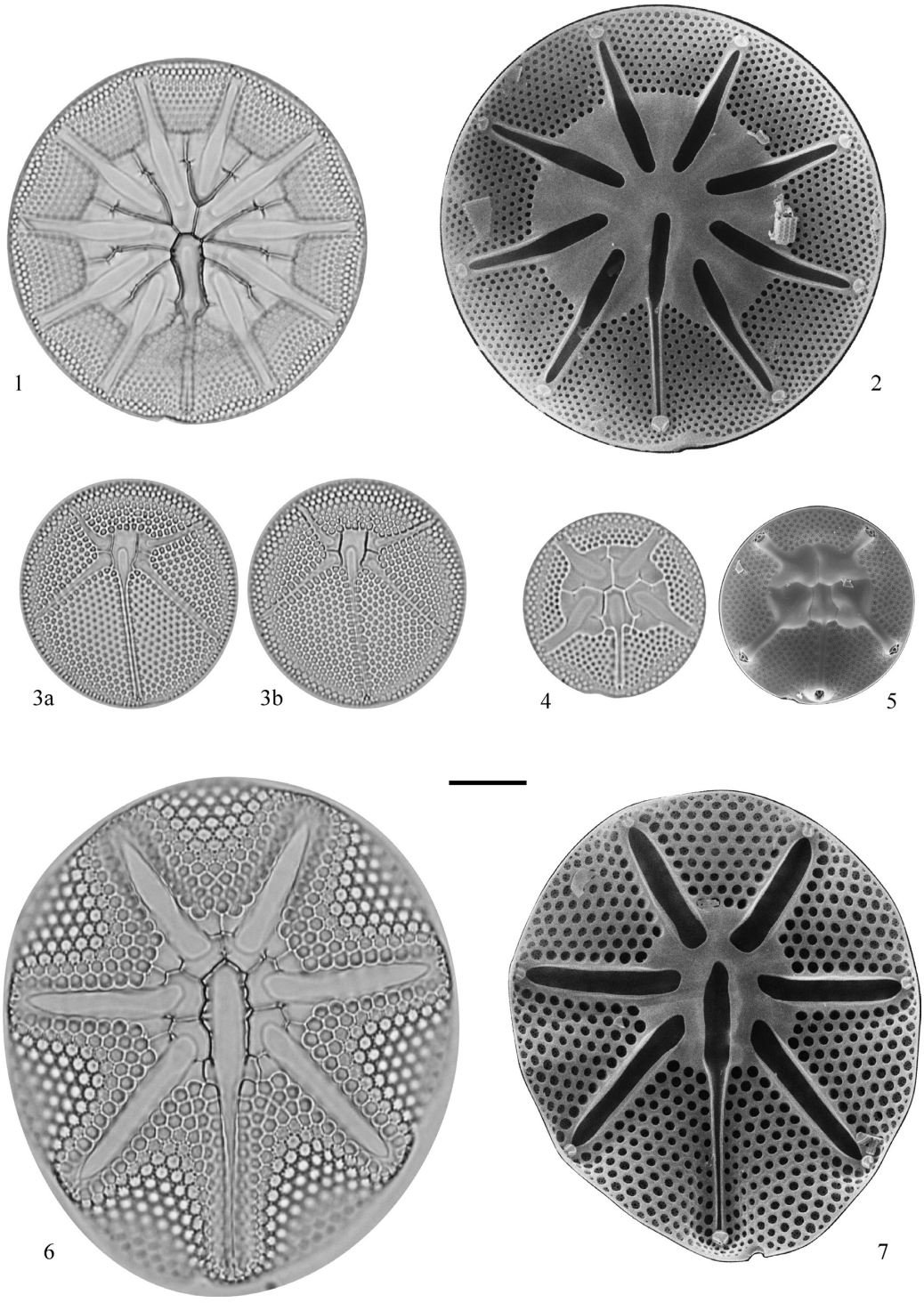


Plate 10

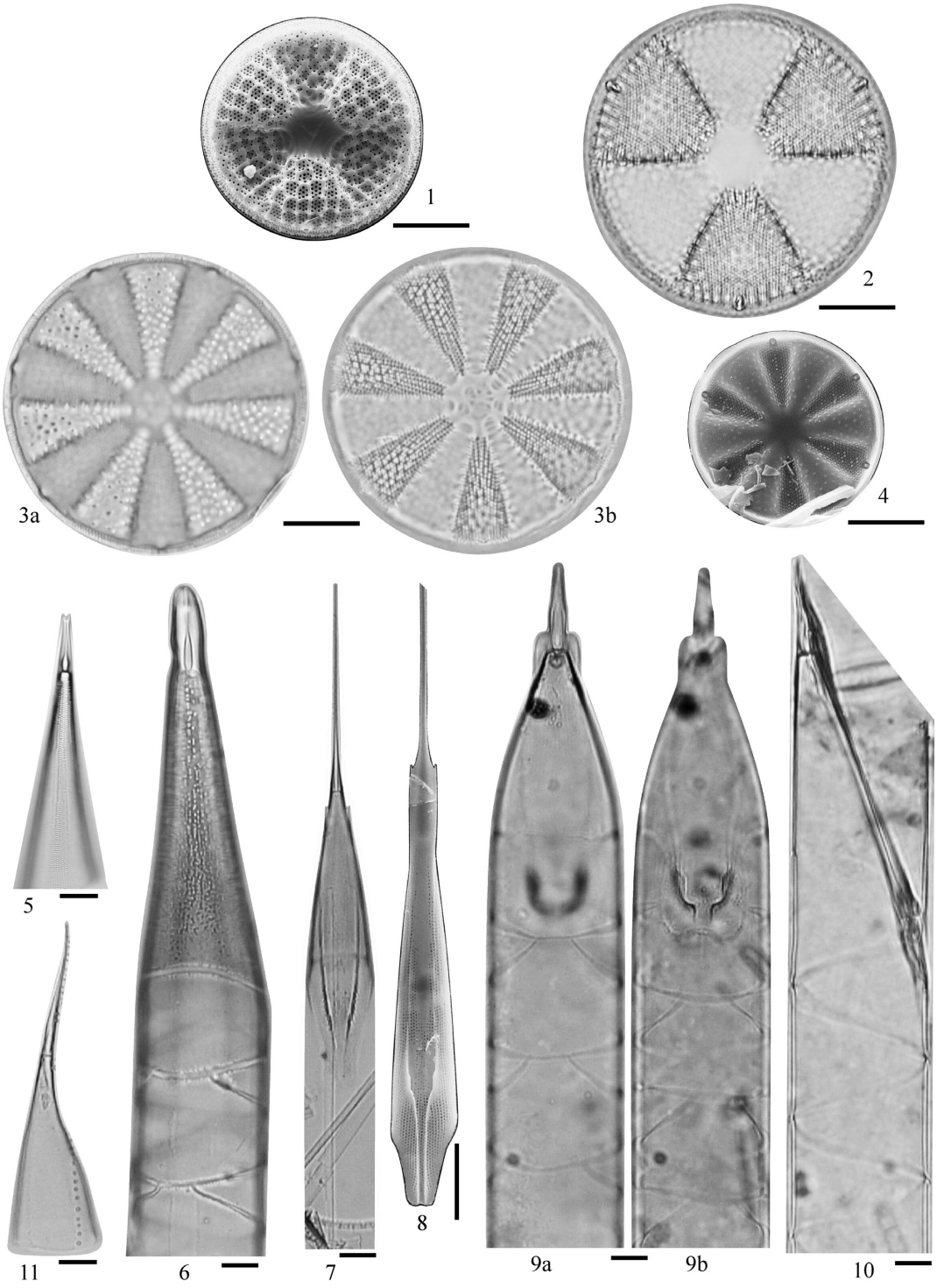


Plate 11

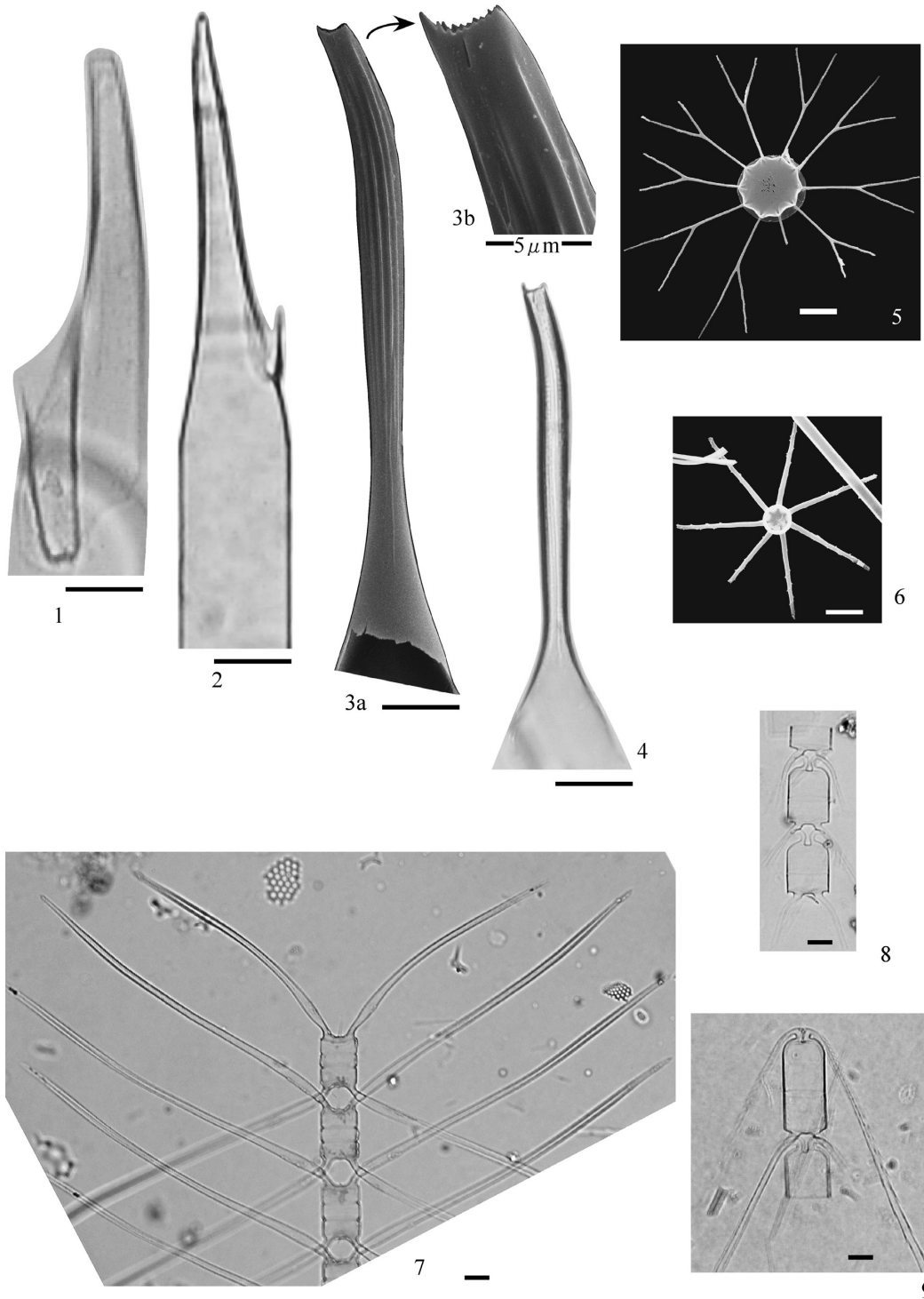


Plate 12

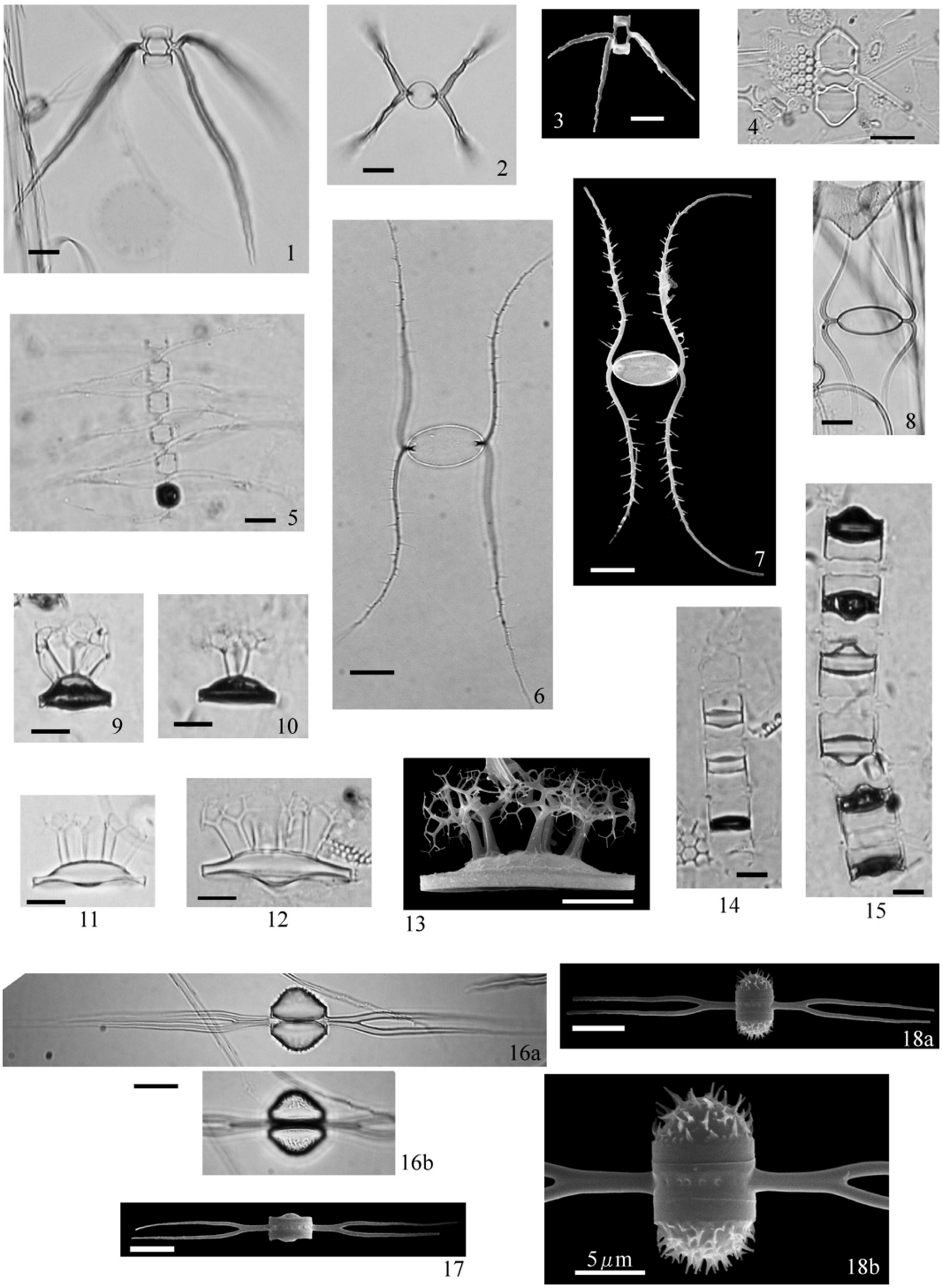


Plate 13

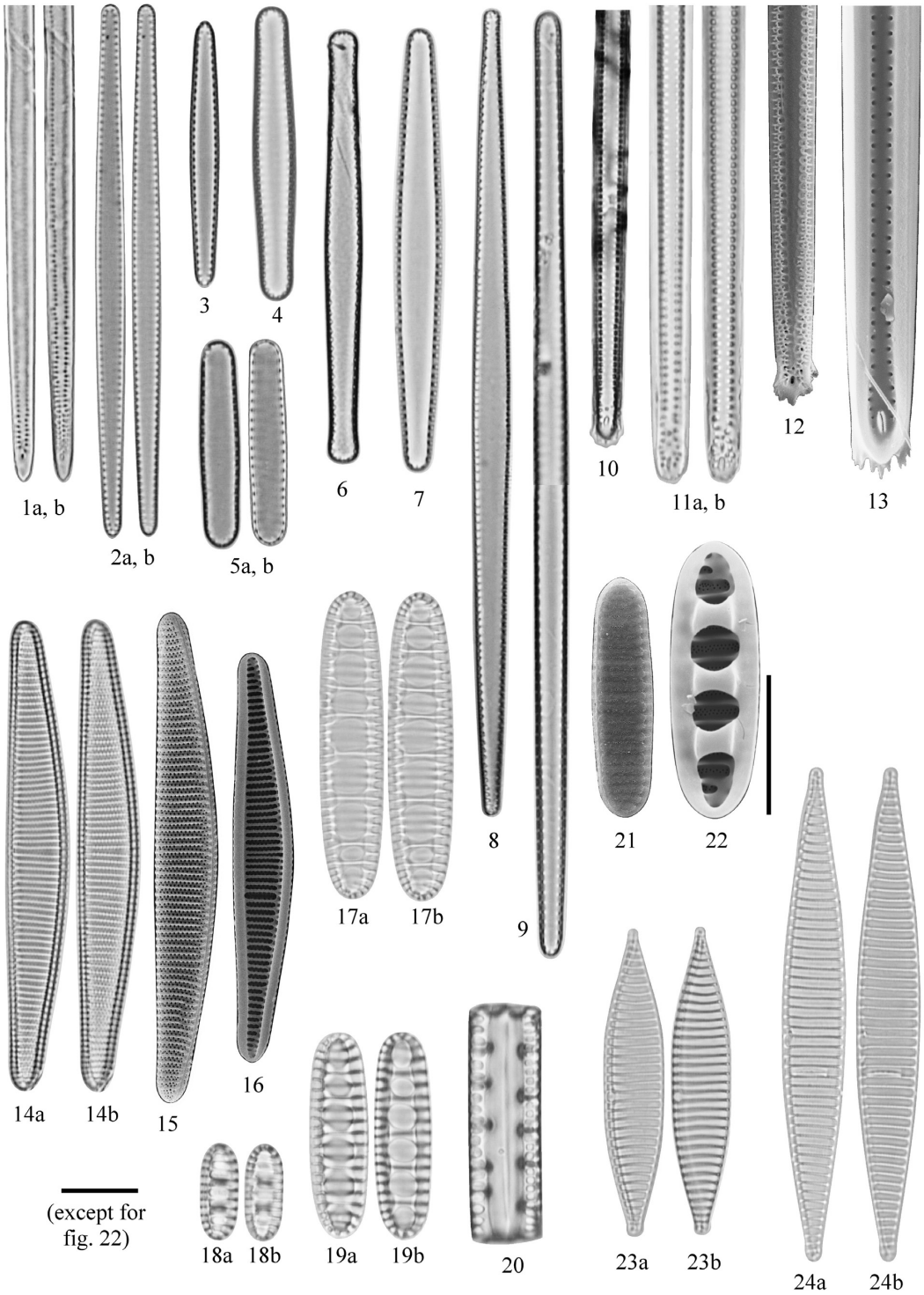

1a, b
2a, b
3
4
5a, b
6
7
8
9
10
11a, b
12
13
14a
14b
15
16
17a
17b
18a
18b
19a
19b
20
21
22
23a
23b
24a
24b
(except for fig. 22)

Plate 14

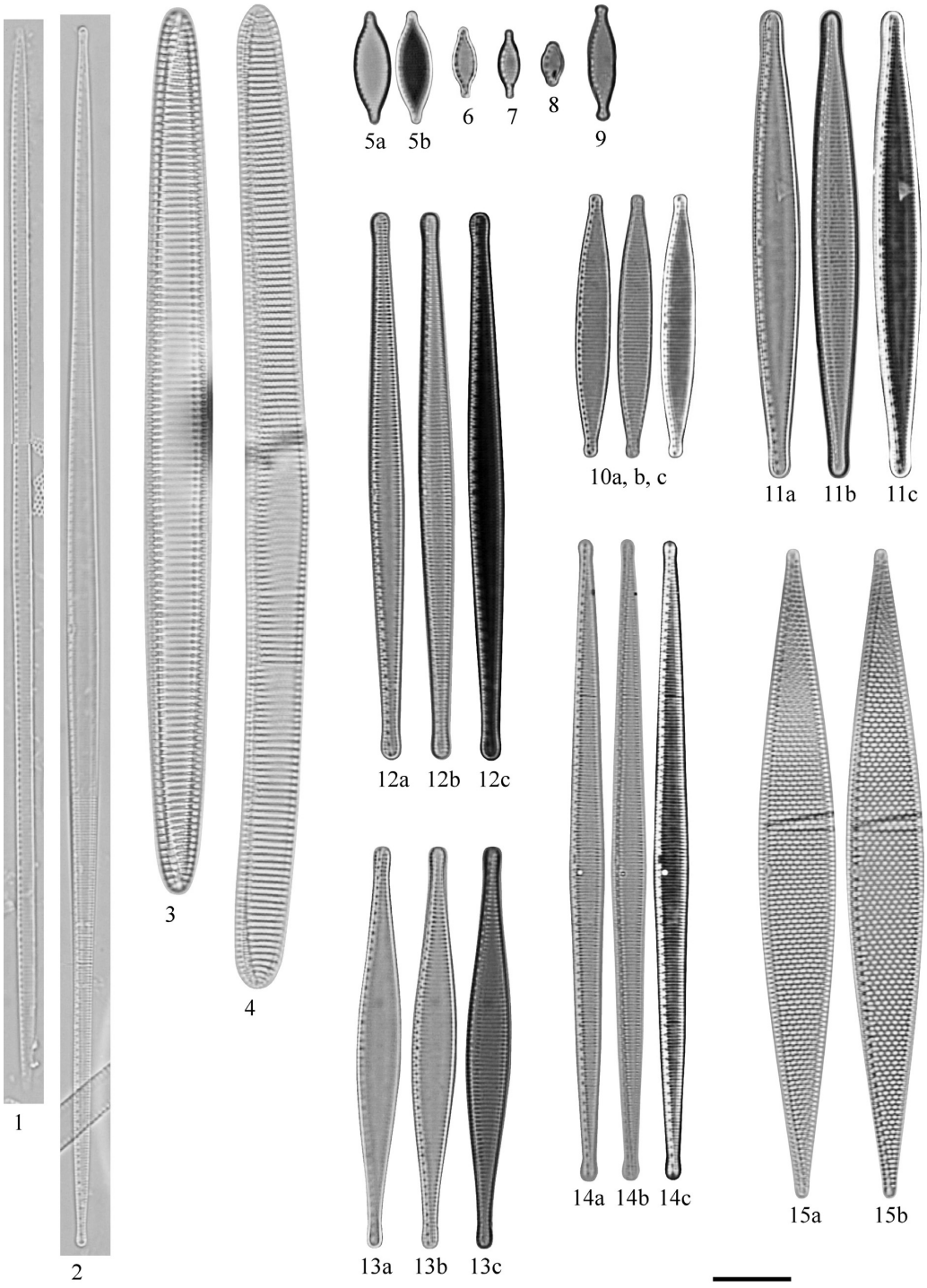
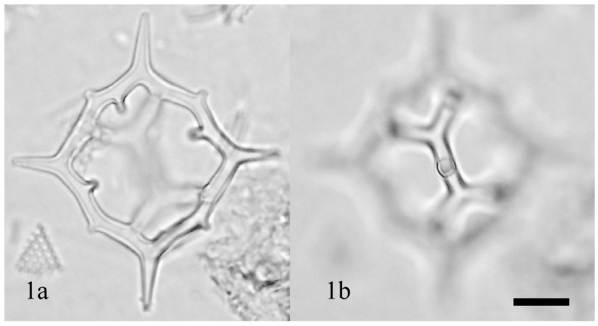
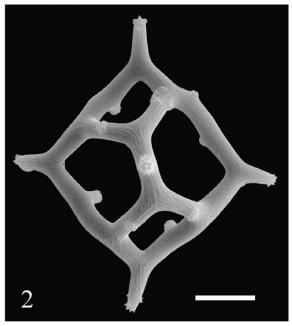
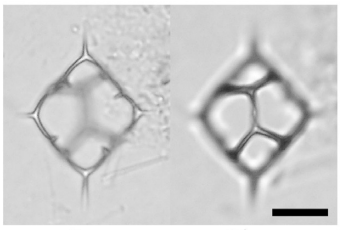
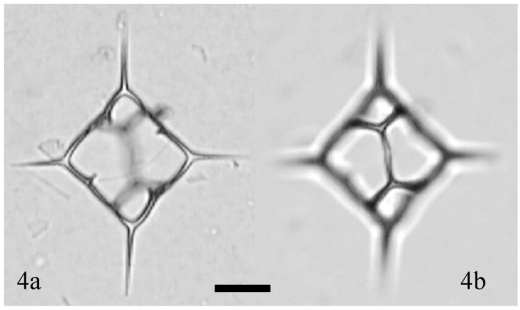

1
2
3
4
5a
5b
6
7
8
9
10a, b, c
11a
11b
11c
12a
12b
12c
13a
13b
13c
14a
14b
14c
15a
15b

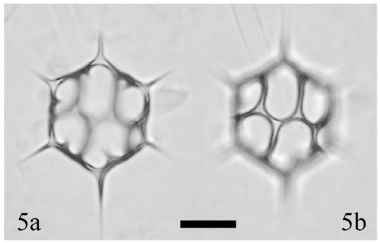
Plate 15

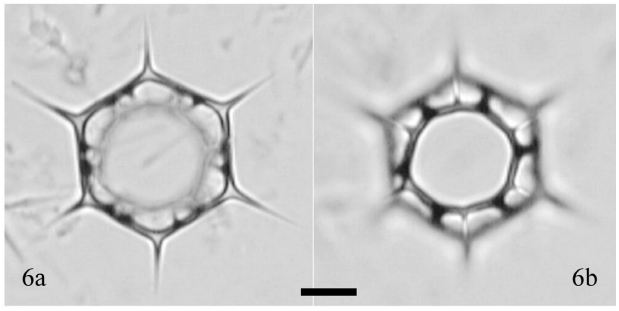


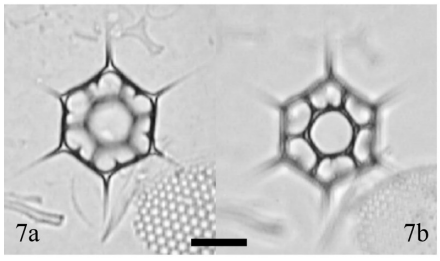


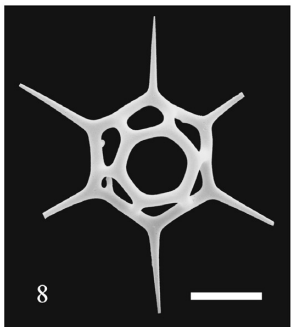












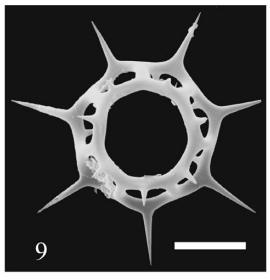
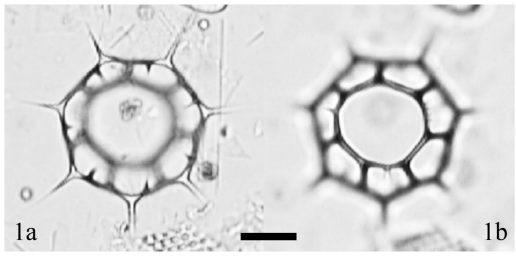
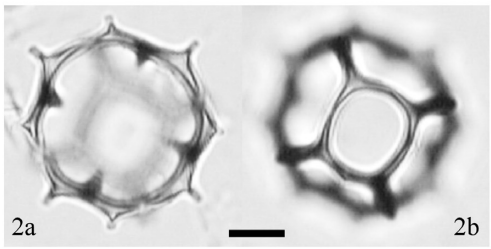
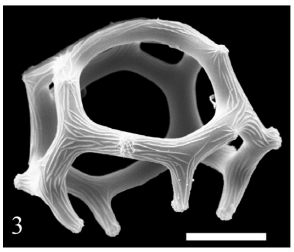
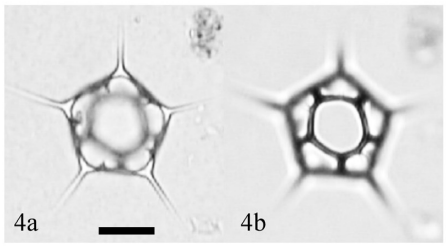


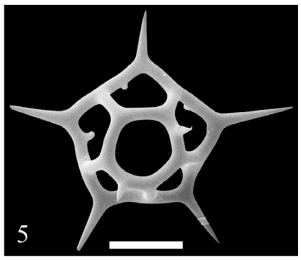
Plate 16

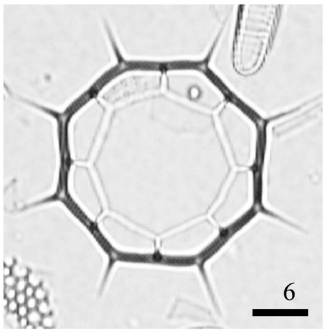


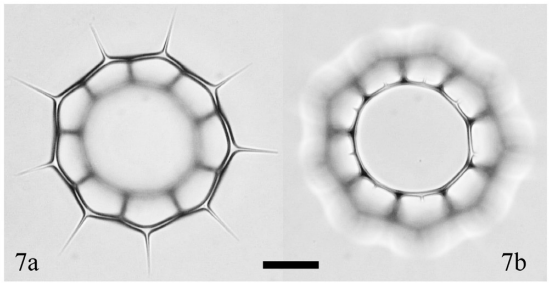


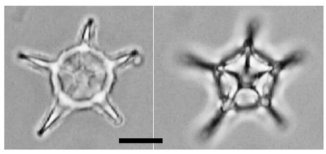


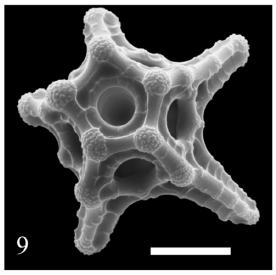


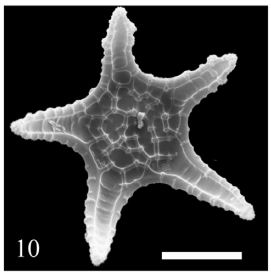


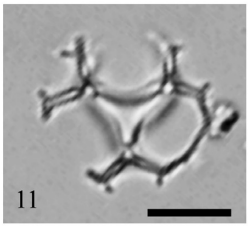


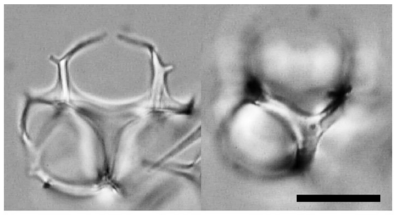












Appendix Table 1. The diatom fluxes ($\times 10^3$ valves m^{-2} d^{-1}) at Station 50N 3000 m during Dec. 1997 through May 2000. The symbol "+" represent less than 1000 valves m^{-2} d^{-1}. N.A. represents no samples due to turn-around of the sediment traps or malfunction of the trap.

Station 50N Initial Date	1 Dec. 1997	18 Dec. 1997	4 Jan. 1998	22 Jan. 1998	8 Feb. 1998	25 Feb. 1998	15 Mar. 1998	1 Apr. 1998	19 Apr. 1998	6 May 1998	23 May 1998	20 Jul. 1998	4 Aug. 1998	19 Aug. 1998	3 Sep. 1998	18 Sep. 1998	3 Oct. 1998	18 Oct. 1998	2 Nov. 1998	17 Nov. 1998	2 Dec. 1998	17 Dec. 1998	1 Jan. 1999	16 Jan. 1999	31 Jan. 1999	15 Feb. 1999	2 Mar. 1999
No. Valves Counted	1036	1467	1185	1113	1140	1585	1835	1234	1444	1422	N.A.	1169	3868	1186	934	875	910	1283	1006	1231	886	1110	1327	974	993	1041	959
Ac. curvatulus	439	102	115	166	205	235	310	307	809	160		311	242	367	296	266	370	226	311	237	325	189	160	104	155	151	142
Ac. ochotensis	9	0	5	0	20	8	15	0	51	6		0	99	0	0	7	0	7	15	0	0	0	9	0	0	0	0
Actinoptychus senarius	1	0	0	0	0	0	0	0	5	0		0	10	0	0	4	0	3	0	0	0	0	6	6	2	30	2
Asteromphalus brookei	20	33	18	22	23	17	33	19	77	21		7	15	21	21	7	30	5	32	30	52	15	16	4	15	7	1
As. heptactis	0	15	5	13	8	8	20	10	10	0		0	5	0	12	0	0	0	0	0	15	0	0	0	0	0	3
As. hyalinus	0	3	5	3	3	5	10	20	72	26		44	20	95	284	22	89	22	192	213	89	38	38	15	11	18	15
As. robustus	0	0	14	6	6	21	38	86	118	2		74	35	41	36	18	0	36	39	107	59	36	22	24	9	9	0
Azpeitia tabularis	38	302	189	233	184	210	346	399	635	221		488	291	331	391	237	385	229	340	320	281	136	115	81	96	92	86
Az. sp.	0	72	20	15	13	20	20	31	184	67		59	15	12	12	37	30	22	30	24	59	15	15	4	4	0	3
Bacterosira bathyomphala	1	0	0	0	0	+	0	0	0	0		7	20	3	9	4	7	2	13	18	0	0	1	6	0	1	0
Chaetoceros atlanticum	74	56	36	18	11	18	46	213	143	59		181	44	52	26	6	19	3	246	269	181	36	21	8	10	16	4
Ch. concavicorne	34	16	83	7	4	4	27	67	394	199		285	123	26	31	58	13	5	19	31	84	5	4	5	0	3	0
Ch. pervianum	87	130	114	38	15	11	40	112	179	64		39	0	31	52	45	65	13	13	16	65	16	16	6	11	6	1
Corethron sp.	43	52	60	29	12	17	36	118	296	157		790	316	254	150	84	45	23	52	83	45	39	14	5	8	0	3
Coscinodiscus marginatus	181	195	121	155	93	108	90	106	125	11		194	232	228	264	194	343	198	369	539	544	241	202	128	147	218	80
Cos. oculus-iridis	0	0	0	1	0	+	0	3	15	0		0	10	3	6	0	4	2	13	6	0	0	1	0	0	0	0
Cos. radiatus	0	1	0	0	0	0	0	3	10	2		37	35	53	36	78	67	16	32	24	52	59	47	37	46	34	30
Ditylum sp.	0	0	0	1	3	0	0	0	0	0		0	0	0	0	4	4	5	19	0	0	21	18	35	20	31	0
Hyalochaete spp.	98	14	0	0	28	0	0	0	0	56		32	81	130	65	65	97	32	32	32	65	0	32	0	49	16	11
Proboscia alata	10	5	1	0	1	3	8	26	41	32	N.A.	30	10	0	6	0	0	0	0	0	0	6	1	2	2	0	2
Pr. eumorpha	26	22	13	4	8	15	20	70	82	21		22	0	0	9	15	0	0	6	18	15	6	1	4	0	9	0
Pr. subarctica	1	104	104	47	67	131	184	317	338	98		104	49	83	74	48	26	29	155	349	207	77	50	50	44	43	0
Rhizosolenia hebetata f. *hebetata*	0	51	55	67	99	106	161	198	276	46		141	108	6	71	78	89	49	65	71	96	65	43	41	46	64	35
Rh. hebetata f. *semispina*	3	0	0	0	0	0	4	42	51	22		126	74	44	65	26	33	16	32	41	30	21	19	17	6	6	9
Stellarima stellaris	0	0	0	0	0	0	3	16	5	0		0	44	3	0	0	0	13	45	30	7	6	1	6	2	3	2
Thalassiosira eccentrica	13	13	15	10	18	33	3	10	72	6		15	20	71	12	7	30	11	0	12	15	9	21	18	37	21	15
Th. gravida	0	8	5	0	0	0	0	0	10	0		30	15	0	47	52	0	22	30	0	59	0	12	11	15	3	12
Th. hyalina	0	10	10	5	15	10	10	72	31	10		30	5	71	95	44	44	15	74	36	15	30	53	26	11	21	21
Th. lineata	13	18	3	18	23	107	315	727	952	173		266	20	272	154	104	89	92	459	639	370	151	112	52	37	62	77
Th. nordenskioeldii	0	0	0	0	0	0	0	0	0	0		59	64	24	36	30	0	4	0	24	0	3	0	0	0	0	0
Th. oestrupii	141	251	182	202	171	174	261	399	461	67		311	197	331	284	281	488	329	636	805	533	284	414	266	311	175	266
Th. trifulta group	94	56	72	87	72	110	159	246	410	170		473	301	343	367	222	473	248	473	462	340	225	323	296	222	127	186
TOTAL CENTRICS	1352	1575	1263	1167	1113	1393	2193	3663	6022	1706		4309	2561	2945	2988	2131	2893	1721	3818	4478	3661	1786	1830	1274	1339	1177	1014
Neodenticula seminae	7422	9593	7310	7240	7044	7072	8179	16329	18962	21847		25579	17307	24025	14959	16319	18683	4808	19622	19945	16125	7318	6913	7010	6621	6055	4317
Nitzschia sicula	9	23	15	18	20	13	46	31	0	10		30	0	12	0	0	0	0	0	12	0	3	0	4	0	3	0
Thalassionema nitzschioides	0	3	3	4	3	6	24	102	82	19		133	25	56	41	59	59	53	58	124	22	36	50	76	92	58	31
Thalassiothrix longisima	78	46	60	33	41	47	49	80	77	8		7	20	41	21	26	15	11	45	47	74	33	38	15	76	21	14
TOTAL PENNATES	7510	9672	7390	7306	7129	7148	8313	16553	19300	21897		25749	17366	24135	15036	16419	18757	4885	19894	20407	16302	7403	7049	7139	6799	6148	4377
TOTAL VEGETATIVE VALVES	8862	11247	8652	8472	8242	8542	10506	20216	25322	23603		30058	19927	27080	18024	18549	21649	6606	23711	24885	19963	9190	8879	8414	8138	7325	5392
Ch. furcellatum	5	5	1	19	0	3	1	10	5	0		37	10	59	30	15	15	10	6	12	7	15	6	6	6	10	2
Ch. spp.	8	1	10	12	10	3	4	0	0	2		22	35	6	74	30	37	29	26	41	37	12	15	20	24	27	13
TOTAL RESTING SPORES	13	6	12	31	10	6	5	10	5	2		59	44	65	107	44	52	39	32	53	44	27	21	26	30	37	16
TOTAL DIATOM FLUXES	8875	11253	8664	8503	8252	8548	10511	20225	25327	23604	N.A.	30117	19979	27153	18150	18614	21701	6645	23743	24938	20008	9216	8900	8440	8168	7362	5455

Appendix Table 1. (cont.)

Station 50N 3000 m Initial Date	17 Mar. 1999	1 Apr. 1999	16 Apr. 1999	1 May 1999	16 May 1999	19 May 1999	5 Jun. 1999	22 Jun. 1999	10 Jul. 1999	27 Jul. 1999	13 Aug. 1999	31 Aug. 1999	17 Sep. 1999	5 Oct. 1999	22 Oct. 1999	8 Nov. 1999	26 Nov. 1999	13 Dec. 1999	30 Dec. 1999	17 Jan. 2000	3 Feb. 2000	21 Feb. 2000	10 Mar. 2000	27 Mar. 2000	14 Apr. 2000	1 May 2000
No. Valves Counted	930	1115	913	1660	N.A.	1060	1157	916	1233	3105	2095	1995	1504	1283	949	2127	2311	1525	1148	1466	1606	1390	1386	1429	1409	1462
Ac. curvatulus	157	148	740	1621		723	348	262	376	307	326	339	809	729	627	367	354	303	240	247	267	183	373	960	2272	1920
Ac. ochotensis	0	6	133	130		32	0	0	10	166	10	13	72	26	38	9	13	9	16	9	16	0	11	0	64	0
Actinoptychus senarius	1	7	7	0		6	1	0	1	0	0	0	0	6	19	0	3	3	0	0	3	3	0	6	0	0
Asteromphalus brookei	12	9	59	41		11	0	4	7	51	0	16	92	45	45	46	33	18	51	15	6	20	13	58	141	154
As. heptactis	0	0	0	0		0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
As. hyalinus	18	38	1184	2568		941	200	80	54	0	22	13	133	51	102	34	34	30	21	4	11	21	21	112	1344	1024
As. robustus	25	22	59	62		11	0	10	7	13	0	6	31	26	13	15	10	10	16	8	10	13	3	13	77	77
Azpeitia tabularis	89	124	414	509		147	120	96	87	154	58	32	205	205	90	179	128	94	75	102	91	55	117	288	960	896
Az. sp.	3	9	30	0		0	3	0	0	0	0	0	0	0	0	0	0	13	27	0	16	4	5	64	96	32
Bacterosira bathyomphala	0	0	0	0		0	1	0	0	26	26	26	31	0	0	5	20	5	0	3	16	10	3	0	0	0
Chaetoceros atlanticum	10	6	194	176		190	9	3	4	102	17	11	67	140	11	108	87	76	22	54	22	7	96	2448	5343	2086
Ch. concavicorne	0	0	117	155		22	13	14	2	512	118	57	22	45	22	11	18	7	39	34	14	13	22	304	320	294
Ch. perviamum	3	25	414	1440		381	74	50	69	0	154	62	85	50	73	13	31	31	11	25	6	0	6	208	704	320
Corethron sp.	4	10	635	1979		403	76	28	22	64	20	14	9	17	45	7	7	11	3	0	14	0	32	1184	992	1318
Coscinodiscus marginatus	146	172	233	145		112	119	77	148	90	25	59	112	230	286	215	197	217	210	177	269	179	205	304	768	448
Cos. oculus-iridis	0	0	0	0		0	0	0	0	13	0	0	0	0	0	0	0	0	3	0	0	0	3	0	13	13
Cos. radiatus	30	15	37	26		6	3	0	2	0	0	0	20	19	6	8	5	15	10	26	6	10	3	13	0	64
Ditylum sp.	19	19	15	10		6	2	0	2	0	0	3	0	13	6	0	3	3	3	3	3	5	0	0	0	0
Hyalochaete spp.	97	0	194	65		0	14	0	56	560	84	168	504	224	392	168	224	0	84	224	140	98	168	0	0	336
Proboscia alata	0	0	0	0	N.A.	0	0	0	0	13	0	0	0	0	0	5	8	3	6	0	0	0	0	0	0	0
Pr. eumorpha	0	0	22	10		11	0	0	1	0	0	0	0	6	6	3	0	8	3	0	0	0	0	13	38	0
Pr. subarctica	37	49	67	57		34	0	0	40	51	29	38	41	77	38	44	56	41	0	51	38	23	77	48	128	90
Rhizosolenia hebetata f. *hebetata*	44	81	355	212		106	0	48	53	333	208	234	532	531	320	322	246	202	198	195	285	118	330	432	1075	1165
Rh. hebetata f. *semispina*	4	7	192	202		101	32	17	17	141	80	26	41	64	58	10	28	18	3	5	19	3	13	29	77	179
Stellarima stellaris	3	3	0	26		56	4	6	6	0	6	0	10	0	6	0	0	0	0	3	0	0	0	0	13	26
Thalassiosira eccentrica	18	15	163	118		32	0	6	26	38	3	54	123	128	77	47	38	47	64	21	48	38	48	192	352	224
Th. gravida	12	12	0	0		6	0	0	3	51	93	195	287	26	38	384	537	192	59	124	368	166	101	64	256	160
Th. hyalina	24	21	118	189		70	15	22	20	0	10	38	92	51	38	13	17	21	5	17	27	34	21	32	288	32
Th. lineata	41	98	769	970		256	84	54	64	51	86	83	235	218	230	68	68	60	75	128	107	43	112	256	864	1120
Th. nordenskioeldii	0	0	0	0		0	0	0	0	179	480	582	348	77	115	239	311	55	32	60	53	60	21	80	32	0
Th. oestrupii	281	308	562	734		243	207	160	184	410	125	186	645	781	448	307	243	401	453	299	256	299	533	1120	2527	3039
Th. trifulta group	178	275	518	876		205	259	211	177	1062	358	483	1536	1293	691	499	333	503	400	303	235	183	256	736	1376	1504
TOTAL CENTRICS	1265	1492	7326	12354		4142	1589	1160	1448	4719	2478	2820	6153	5166	3936	3209	3151	2428	2181	2170	2384	1610	2633	9003	20444	16659
Neodenticula seminae	5391	6395	20204	29918		12716	6036	5784	7548	30306	8921	11708	30418	29185	24144	14537	11007	9467	9495	13080	9187	5182	5448	18038	40557	35067
Nitzschia sicula	0	0	30	0		0	0	0	5	0	3	0	41	128	243	94	119	98	75	55	64	0	32	48	128	192
Thalassionema nitzschioides	34	28	67	36		50	34	18	22	38	58	32	51	58	90	18	5	10	19	51	93	84	54	365	2432	2432
Thalassiothrix longisima	24	18	148	145		45	20	18	17	576	115	384	1403	793	403	292	195	243	173	123	125	38	93	179	512	371
TOTAL PENNATES	5456	6450	20522	30116		12817	6102	5822	7597	30920	9103	12159	31994	30203	24892	15028	11450	9875	9867	13439	9633	5479	5699	18646	44300	38350
TOTAL VEGETATIVE VALVES	6721	7941	27848	42470		16958	7691	6981	9045	35639	11581	14979	38147	35368	28829	18237	14601	12303	12048	15609	12017	7089	8332	27649	64744	55009
Ch. furcellatum	0	1	15	5		0	2	3	3	2982	1744	1564	2027	633	250	1408	2368	845	665	737	1964	1211	1113	656	896	1216
Ch. spp.	30	13	30	16		45	11	10	20	512	262	58	102	64	58	51	46	64	61	59	67	51	19	32	102	141
TOTAL RESTING SPORES	30	15	44	21		45	13	13	24	3494	2022	1660	2129	697	307	1459	2414	909	726	796	2032	1262	1133	688	998	1357
TOTAL DIATOM FLUXES	6798	7992	27928	42491	N.A.	17048	7749	6997	9073	39133	13603	16663	40301	36066	29136	19696	17015	13212	12774	16405	14048	8351	9465	28336	65742	56365

Appendix Table 2. The diatom fluxes ($\times 10^3$ valves m^{-2} d^{-1}) at Station KNOT 3000 m during Dec. 1997 through May 2000. The symbol "+" represent less than 1000 valves m^{-2} d^{-1}. N.A. represents no samples due to turn-around of the sediment traps or malfunction of the trap.

Station KNOT Initial Date	1 Dec. 1997	18 Dec. 1997	4 Jan. 1998	22 Jan. 1998	8 Feb. 1998	25 Feb. 1998	15 Mar. 1998	1 Apr. 1998	19 Apr. 1998	6 May 1998	23 May 1998	10 Jun. 1998	27 Jun. 1998	9 Jul. 1998	20 Jul. 1998	4 Aug. 1998	19 Aug. 1998	3 Sep. 1998	18 Sep. 1998	3 Oct. 1998	18 Oct. 1998	2 Nov. 1998	17 Nov. 1998	2 Dec. 1998	17 Dec. 1998	1 Jan. 1999	16 Jan. 1999	31 Jan. 1999
No. Valves Counted	1246	2470	2719	1033	1262	1812	2289	2371	2167	1626	2004	2660	N.A.		1689	1619	2158	1738	1168	2156	1698	2138	1513	2051	1045	1477	2183	2230
Actinocyclus curvatulus	171	405	785	665	277	405	789	546	512	533	448	717			296	148	493	237	395	179	197	129	136	133	247	237	197	179
Ac. ochotensis	0	64	34	0	0	0	0	68	0	43	43	85			25	0	0	0	0	0	0	0	0	25	0	0	0	12
Actinoptychus senarius	0	0	0	0	0	+	19	15	13	90	122	113			104	67	18	6	0	18	15	4	11	24	7	41	22	30
As. heptactis	34	171	51	17	21	64	64	34	21	21	21	17			123	0	0	59	49	6	74	6	18	20	173	59	25	37
As. robustus	36	26	13	41	32	8	160	195	179	77	122	92			30	44	12	18	30	4	30	15	11	3	0	18	26	37
Azpeitia tabularis	154	320	392	341	448	469	448	222	107	277	0	307			99	25	99	79	123	49	123	49	68	69	49	59	37	62
Bacterosira bathyomphala	5	6	3	10	13	0	0	5	6	0	0	5			141	30	817	947	414	166	244	111	111	107	96	47	33	18
Chaetoceros atlanticus	76	364	202	128	168	302	347	282	544	307	339	246			118	89	237	136	200	33	185	6	7	40	207	349	215	277
Ch. concavicornis	31	34	67	0	56	207	218	188	64	77	102	15			244	318	172	284	340	18	81	9	24	9	30	89	67	59
Ch. pervianus	0	50	13	10	17	17	62	18	32	45	6	10			111	518	183	219	244	74	96	27	11	18	7	24	7	4
Corethron sp.	13	67	67	107	45	78	146	323	160	224	288	184			200	178	107	59	15	4	7	6	4	7	15	12	15	33
Coscinodiscus marginatus	18	39	18	10	22	0	28	27	51	13	70	97			133	81	95	101	59	41	74	43	54	53	163	71	33	48
Cos. oculus-iridis	10	13	1	61	38	3	45	138	154	269	250	266			311	104	41	36	59	67	96	28	37	36	192	65	0	89
Cos. radiatus	0	19	4	10	0	3	13	72	64	83	83	102			118	67	24	0	44	30	37	30	15	74	133	77	67	118
Hyalochaete spp.	1917	16192	19662	9106	5378	7366	11331	10270	9243	6778	5066	4656			3626	3432	8613	6346	6022	2477	22665	4889	2105	5019	11851	16448	5796	5569
Palaria sulcata	159	0	3	10	0	0	0	97	0	64	109	184			451	15	24	148	7	96	222	83	59	68	44	118	81	152
Proboscia subarctica	10	45	29	67	154	24	224	312	250	474	774	686			192	126	65	89	148	70	74	70	81	65	222	337	196	229
Rhizosolenia hebetata f. *hebetata*	46	51	32	87	96	38	589	573	672	384	339	353	N. A.		222	170	166	142	155	111	118	43	96	59	74	53	59	92
Rh. hebetata f. *semispina*	61	154	13	77	64	4	26	77	122	0	6	56			148	251	254	225	303	141	274	81	100	92	118	107	67	78
Stellarima stellaris	15	0	3	36	26	3	90	235	141	237	224	369			259	111	101	47	81	111	96	37	67	47	67	107	48	70
Stephanopyxis sp.	5	13	0	10	13	8	64	246	346	352	435	399			155	74	47	6	15	67	74	17	55	27	15	41	0	18
Thalassiosira eccentrica	171	213	375	239	213	747	640	700	725	896	1365	1331			616	345	99	178	296	284	912	247	271	266	222	138	549	376
Th. gravida	239	149	239	102	43	107	43	34	21	0	21	17			99	321	434	335	148	154	395	99	80	44	0	79	0	25
Th. hyalina	0	0	0	0	0	0	0	0	0	0	0	51			49	25	335	296	25	18	74	62	37	15	99	59	25	25
Th. lineata	273	1002	1211	956	1216	1749	1984	2133	1408	747	1024	734			518	49	138	118	173	99	99	31	25	163	616	1026	752	573
Th. nordenskioeldii	239	320	154	34	64	64	43	0	64	21	0	1041			1923	5277	8857	6647	3304	1338	1800	431	475	261	444	296	99	68
Th. oestrupii	1007	1493	2798	1655	1685	1429	981	887	832	747	1194	870			937	814	434	217	740	333	1948	370	425	360	1257	1539	758	530
Th. pacifica	0	64	34	34	235	128	171	239	533	192	128	392			173	271	237	138	123	37	173	12	31	5	0	39	12	6
Th. trifulta group	683	619	580	580	725	896	917	1109	768	960	853	768			493	370	355	335	197	123	641	136	160	178	247	651	493	758
TOTAL CENTRICS	5860	23783	28368	14890	11609	15095	20660	19994	18069	14634	14590	15260			12806	14439	22945	18107	14867	6989	32735	7554	5137	7842	18150	23579	10405	10277
Fragilariopsis doliolus	51	173	9	46	6	10	32	113	173	275	633	461			422	52	53	30	200	314	192	388	451	645	629	610	514	562
F. oceanica	137	0	0	0	0	0	0	0	0	0	85	119			271	468	59	0	0	0	0	6	99	0	0	0	0	0
Fragilariopsis spp.	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neodenticula seminae	8661	8113	7114	8011	8739	11848	18109	33069	45735	29030	29440	22868			11721	11462	14765	9131	4533	4161	5634	2720	2574	1522	2137	3367	2364	2169
Nitzschia sicula	119	192	222	102	85	43	107	68	0	0	0	0			25	25	0	20	49	18	49	6	0	39	74	99	6	62
Thalassionema nitzschioides	41	154	58	322	352	55	691	1275	800	525	1676	1070			540	200	213	160	399	259	377	207	274	228	651	864	422	555
Thalassiothrix longisima	67	141	104	133	96	0	83	113	90	38	45	363			81	59	59	59	30	22	89	26	26	62	89	89	67	89
TOTAL PENNATES	9239	8800	7712	8700	9349	12020	19242	34828	46881	29953	31951	24953			13220	12355	15359	9525	5416	4836	6485	3534	3506	2575	3804	5235	3472	3517
TOTAL VEGETATIVE VALVES	15099	32583	36080	23590	20958	27115	39902	54823	64950	44587	46541	40213			26026	26794	38304	27632	20283	11825	39220	11088	8643	10417	21954	28815	13877	13794
Ch. furcellatum Resting Spores	1259	1101	264	701	307	42	467	445	326	288	154	1341			1265	1154	2225	953	695	322	703	202	259	175	259	290	163	181
Chaetoceros spp. Resting Spores	1525	820	12221	8363	3331	6051	2893	488	2469	2274	3481	5741			16498	23414	8887	18004	9411	7227	15584	5516	3148	6120	7520	11545	0	0
TOTAL RESTING SPORES	2907	4621	12608	9453	3766	6106	3706	1271	3083	2575	3794	8004			18392	24790	11456	19069	10217	7697	16938	5769	3499	6395	7904	12054	300	270
TOTAL DIATOM FLUXES	18006	37204	48688	33044	24724	33221	43608	56093	68033	47162	50335	48217	N.A.		44418	51584	49759	46701	30500	19523	56157	16857	12142	16812	29859	40869	14177	14064

Appendix Table 2. (cont.)

Station KNOT Initial Date	15 Feb. 1999	2 Mar. 1999	17 Mar. 1999	1 Apr. 1999	16 Apr. 1999	1 May 1999	14 May 1999	31 May 1999	17 Jun. 1999	5 Jul. 1999	22 Jul. 1999	8 Aug. 1999	26 Aug. 1999	12 Sep. 1999	30 Sep. 1999	17 Oct. 1999	3 Nov. 1999	21 Nov. 1999	8 Dec. 1999	25 Dec. 1999	12 Jan. 2000	29 Jan. 2000	16 Feb. 2000	5 Mar. 2000	22 Mar. 2000	9 Apr. 2000	26 Apr. 2000
No. Valves Counted	2455	1616	1230	1157	1067	1141	1963	1724	4867	3565	3182	1953	1982	1146	3092	2591	1428	1132	2786	2114	1549	973	2215	1079	1952	1292	1297
Actinocyclus curvatulus	108	395	95	173	79	119	358	819	665	192	192	102	256	64	96	273	171	149	73	77	43	171	144	341	410	16	1664
Ac. ochotensis	25	25	6	99	59	59	17	137	51	64	64	0	64	64	0	0	34	21	9	0	13	0	0	51	137	144	256
Actinoptychus senarius	15	7	104	207	107	213	471	491	597	277	96	648	358	102	35	41	82	38	47	38	51	64	43	34	290	154	768
As. heptactis	30	0	0	0	0	30	17	68	102	128	32	51	64	0	0	68	0	0	0	0	0	21	0	17	0	0	64
As. robustus	30	67	15	89	24	125	31	205	17	64	32	34	0	26	10	20	0	13	26	9	5	13	16	17	85	51	64
Azpeitia tabularis	54	148	15	99	20	178	137	341	0	128	32	119	43	21	27	51	51	21	26	21	4	64	11	34	102	16	256
Bacterosira bathyomphala	18	37	0	0	47	18	20	41	0	171	678	529	1075	819	544	1792	614	627	482	256	69	154	96	188	188	188	64
Chaetoceros atlanticus	558	777	806	592	722	694	517	512	921	314	275	133	128	32	13	20	15	13	14	17	19	64	117	415	712	394	960
Ch. concavicornis	22	96	141	81	30	36	118	410	266	38	32	31	141	6	8	0	0	0	0	5	9	13	34	41	133	61	704
Ch. perviamus	11	22	22	74	6	53	67	0	143	77	26	41	13	0	2	0	0	0	1	4	6	6	3	10	26	15	0
Corethron sp.	7	37	81	67	47	53	97	328	276	352	77	51	26	26	3	0	0	0	3	3	5	6	38	56	113	179	960
Coscinodiscus marginatus	30	52	37	22	18	62	56	287	102	45	109	123	224	109	80	113	51	83	61	65	58	51	61	61	77	61	64
Cos. oculus-iridis	137	163	0	355	130	374	287	287	358	21	173	154	128	51	29	154	102	51	81	34	26	51	48	51	154	0	320
Cos. radiatus	100	192	237	296	59	196	246	450	222	149	32	68	90	0	6	31	10	26	60	17	8	19	53	51	188	17	384
Hyalochaete spp.	6314	9814	5620	5224	2612	7613	7326	70582	53217	23752	11092	10027	7674	2868	2101	4930	3137	3753	3193	1947	966	3977	3641	3529	8739	4201	3641
Palaria sulcata	15	52	0	15	47	213	143	205	119	235	6	0	269	166	13	41	154	179	30	47	41	51	101	0	188	273	704
Proboscia subarctica	292	362	370	533	213	231	266	123	324	213	58	239	166	38	35	92	82	64	55	34	36	19	37	51	102	68	64
Rhizosolenia hebetata f. *hebetata*	96	222	385	370	237	356	450	614	785	384	288	85	282	77	112	225	113	77	171	68	69	96	213	665	1945	802	2048
Rh. hebetata f. *semispina*	74	104	74	89	47	160	287	4955	3088	832	269	307	307	141	438	809	532	486	307	192	92	154	85	239	239	171	128
Stellarima stellaris	122	407	843	1124	793	1316	1208	901	1143	363	186	683	230	90	26	72	143	64	94	43	46	45	43	154	171	137	256
Stephanopyxis sp.	22	30	15	0	12	71	123	369	410	43	32	68	13	0	3	10	20	13	9	4	3	13	11	17	119	51	768
Thalassiosira eccentrica	335	271	59	542	217	682	410	1502	973	288	64	256	213	128	27	154	137	149	94	94	43	43	69	154	171	240	1024
Th. gravida	20	0	3	25	0	0	0	0	0	384	576	188	619	469	752	0	0	491	282	213	115	171	0	222	102	16	576
Th. hyalina	20	0	12	345	118	148	51	273	102	128	736	205	320	341	149	444	222	128	60	21	13	0	0	34	34	80	0
Th. lineata	538	2268	192	1233	454	741	1177	1433	768	160	96	222	192	64	11	17	68	43	21	13	13	64	5	119	222	128	64
Th. nordenskioeldii	25	25	9	123	0	89	34	341	2457	7103	5599	2730	4180	2112	901	2252	1092	725	137	145	34	64	101	68	34	64	0
Th. oestrupii	735	1553	207	616	572	593	1075	2389	1126	1024	640	990	874	384	176	239	307	469	491	444	508	1024	507	1348	683	656	1536
Th. pacifica	30	49	0	74	0	59	273	1160	1177	224	192	171	917	85	16	68	68	64	9	30	13	43	16	188	154	224	320
Th. trifulta group	705	912	148	740	710	771	1246	1979	2150	1952	1120	1007	0	597	517	802	512	1024	657	567	401	491	469	1502	1740	1360	3071
TOTAL CENTRICS	10984	18982	9979	14196	8273	16905	18193	94355	74082	40951	23627	20712	20352	9469	6389	13171	8338	9188	6807	4680	2853	7337	6323	10784	18540	10918	23221
Fragilariopsis doliolus	473	710	1346	1494	1326	1387	1044	573	2286	405	237	648	141	166	22	154	113	128	132	166	154	96	85	51	85	102	0
F. oceanica	0	0	0	0	0	0	205	0	2150	1280	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fragilariopsis spp.	0	0	0	0	0	0	0	0	0	0	7263	0	0	0	80	0	0	0	0	0	0	0	0	0	0	0	0
Neodenticula seminae	3529	11160	7836	9814	11160	15703	17596	14229	12212	6050	3921	4425	5266	3047	1554	2801	1568	4033	2059	924	812	2437	4229	8403	20839	14901	11036
Nitzschia sicula	0	74	12	25	0	0	0	0	0	160	64	0	64	0	0	0	0	0	13	13	9	107	43	137	51	64	0
Thalassionema nitzschioides	732	2545	2929	3062	2414	2615	3235	3358	1553	896	410	1126	525	179	96	420	491	678	388	256	102	717	501	2321	4488	2730	512
Thalassiothrix longisima	67	185	118	59	59	160	225	696	410	128	109	154	128	64	64	51	113	218	77	38	28	51	107	205	273	222	128
TOTAL PENNATES	4844	14794	12342	14553	15018	19895	22414	18897	18679	9015	12137	6473	6289	3811	1971	3890	2729	5266	2805	1496	1175	3627	5125	11269	25923	18084	11803
TOTAL VEGETATIVE VALVES	15827	33776	22321	28750	23291	36800	40608	113252	92761	49966	35764	27185	26642	13280	8361	17061	11067	14454	9612	6176	4028	10964	11448	22054	44463	29002	35025
Ch. furcellatum Resting Spores	226	222	266	74	83	71	174	14661	18002	15293	7493	6876	6616	4633	3644	12818	5928	4390	3477	2547	1170	2169	1802	1348	2201	1246	1152
Chaetoceros spp. Resting Spores	3934	6171	2901	2583	3111	6722	3540	32650	0	0	16589	9847	6367	2911	3580	3358	0	0	899	804	555	851	2528	1985	6908	5687	17
TOTAL RESTING SPORES	4233	6489	3271	2716	3218	6811	3939	48703	20015	17021	24344	16911	13099	7595	7284	16401	6030	4569	4504	3385	1776	3058	4373	3401	9280	6933	1297
TOTAL DIATOM FLUXES	20061	40265	25592	31466	26509	43611	44547	161955	112776	66986	60108	44097	39741	20876	15645	33462	17097	19023	14116	9561	5804	14022	15821	25455	53743	35935	36322

Appendix Table 3. The diatom fluxes ($\times 10^3$ valves m^{-2} d^{-1}) at Station 40N 3000 m during Dec. 1997 through Feb. 2000. The symbol "+" represent less than 1000 valves m^{-2} d^{-1}. N.A. represents no samples due to turn-around of the sediment traps or malfunction of the trap.

Station 40N Initial Date	1 Dec. 1997	18 Dec. 1997	4 Jan. 1998	22 Jan. 1998	8 Feb. 1998	25 Feb. 1998	15 Mar. 1998	1 Apr. 1998	19 Apr. 1998	6 May 1998	23 May 1998	10 Jun. 1998	27 Jun. 1998	14 Jul. 1998	4 Aug. 1998	19 Aug. 1998	3 Sep. 1998	18 Sep. 1998	3 Oct. 1998	18 Oct. 1998	2 Nov. 1998	17 Nov. 1998	2 Dec. 1998	17 Dec. 1998	16 May 1999	22 May 1999
No. Valves Counted	1565	1435	1169	1039	2041	1558	1741	1791	1712	1715	1352	1519	998	N.A.	1066	1473	1162	1908	1862	1942	1810	1440	1267	N.A.		2223
Actinocyclus curvatulus	64	220	81	21	96	102	137	154	205	205	77	256	154		178	207	138	67	296	192	118	20	148			256
Ac. octonarius	9	3	0	4	0	10	0	51	0	0	0	0	17		30	0	0	0	0	0	7	20	30			26
Actinoptychus senarius	26	5	0	4	26	61	0	0	0	51	0	17	51		30	0	20	15	0	0	15	39	59			77
Asteromphalus arachne	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0			0
As. heptactis	21	3	0	9	13	61	119	77	205	68	51	51	0		118	118	39	44	59	0	30	59	89			256
As. hyalinus	4	3	9	0	0	0	34	0	0	0	0	0	0		0	89	0	15	0	0	0	0	0			51
Azpeitia neocrenulata	0	0	64	115	378	235	0	26	0	324	435	375	222		266	266	197	67	178	222	133	473	740			384
Az. tabularis	277	77	34	13	32	51	102	282	102	102	128	119	102		237	89	99	126	118	44	126	79	89			26
Bacteriastrum delicatulum	4	0	0	0	0	0	0	26	0	0	0	0	0		0	0	0	0	0	0	0	0	0			0
B. furcatum	0	3	9	0	0	20	85	102	0	0	26	17	0		30	0	0	0	30	0	0	355	621			26
Chaetoceros atlanticus	4	3	3	5	13	10	20	41	31	61	41	20	31		36	12	0	9	0	0	6	12	12			31
Ch. pervianus	4	0	491	402	1655	2836	3522	3112	2949	2519	1894	952	1003		1101	1397	793	476	876	337	364	1089	2817			4054
Corethron sp.	0	5	192	131	474	461	645	1126	921	461	471	450	328		355	864	367	210	414	272	163	237	379			502
Coscinodiscus marginatus	124	18	102	67	452	788	737	1024	1116	594	450	614	604		876	1905	1148	1089	1953	923	858	781	1089			1116
Cos. oculus-iridis	9	5	4	4	0	10	0	0	0	0	77	205	119		0	0	59	0	0	0	15	20	0			128
Cos. radiatus	94	33	38	30	64	72	273	486	461	307	333	427	341		444	296	276	0	148	148	67	158	89			1049
Hyalochaete spp.	0	5	0	0	0	31	34	154	230	0	0	102	17		30	59	39	15	30	0	15	118	118			77
Proboscia alata	0	0	0	0	0	20	17	0	0	0	0	17	0		1154	2426	809	52	0	15	0	59	118			0
Pr. eumorpha	0	0	0	0	0	0	0	0	0	0	34	26	34	34	N.A.	59	207	99	7	0	0	0	30	N.A.		0
Pr. subarctica	55	49	77	132	486	880	1706	1689	1510	836	537	1229	580		740	769	256	229	118	104	111	39	89			1075
Pseudosolenia calcar-avis	0	0	0	0	6	0	0	26	0	0	0	0	34		0	59	0	15	0	0	7	0	0			0
Rhizosolenia bergonii	4	0	4	4	19	20	51	26	51	0	26	85	17		59	178	118	22	0	74	37	0	59			26
Rh. hebetata f. *hebetata*	0	0	0	0	0	10	34	0	51	34	0	34	51		0	30	20	0	0	0	0	0	0			0
Rh. hebetata f. *semispina*	98	41	17	0	38	113	119	77	154	51	77	102	68		473	740	197	126	0	44	30	39	59			0
Rh. styliformis	9	0	0	5	4	10	10	10	10	0	10	10	0		12	24	24	6	12	9	24	24	24			20
Ropelia tesselata	132	59	94	81	102	358	410	665	358	341	358	580	273		118	178	59	89	1154	947	185	651	592			819
Stellarima stellaris	21	36	38	17	77	276	427	563	435	256	333	358	290		266	207	118	96	30	104	59	20	59			256
Stephanopyxis sp.	0	0	4	13	6	0	0	102	128	17	0	85	34		118	30	59	0	0	0	15	0	0			0
Thalassiosira eccentrica	166	136	213	115	397	287	563	486	512	853	461	427	375		325	621	138	170	444	178	178	276	296			614
Th. lineata	38	18	94	30	64	174	239	256	230	205	307	444	290		148	385	217	104	385	207	111	355	266			179
Th. oestrupii	491	312	448	290	665	1423	1416	1740	2099	1399	1561	1928	1263		1539	1775	1124	547	828	414	355	592	888			2559
Th. trifulta	137	72	132	34	96	184	137	282	102	222	307	973	171		237	444	237	170	325	148	126	158	148			307
TOTAL CENTRICS	1826	1118	2284	1595	5535	9204	11903	14123	13099	9822	8569	13514	7661		10125	15918	8450	4481	17487	7400	4591	8368	12261			15280
Alveus marinus	0	3	4	0	9	20	20	31	20	10	10	41	0		0	0	0	0	12	15	15	59	30			102
Fragilariopsis doliolus	819	691	840	934	1668	1792	2662	2703	2304	1085	1392	1208	880		1255	1657	1124	604	3598	3055	3129	14064	14350			55541
Neodenticula seminae	2969	1313	1152	601	1088	1904	3092	3624	4535	7126	5354	3604	2314		4474	5160	4628	1542	2474	1871	2027	1775	1509			6092
Nitzschia bicapitata	55	26	34	17	38	205	225	174	235	113	72	31	164		142	249	201	53	414	296	200	276	118			256
Ni. kolaczeckii	17	5	26	4	13	31	20	72	51	20	31	20	20		36	59	12	6	24	22	22	39	178			51
Ni. sicula	21	8	9	9	9	51	41	143	154	102	41	133	82		95	24	59	6	178	81	30	39	118			51
Thalassionema nitzschioides	751	361	38	806	1199	2590	2293	2416	1710	1618	1607	1413	1177		959	1030	1290	509	5574	2049	1080	1894	1953			3634
Thalassiothrix longissima	115	90	17	21	68	113	133	133	61	61	82	20	51		83	71	59	27	450	15	15	79	59			51
TOTAL PENNATES	4850	2554	2167	2427	4146	6747	8692	9480	9235	10207	8682	6624	4822		7125	8545	7728	2775	13090	7582	6672	18601	18729			66035
TOTAL VEGETATIVE VALVES	6676	3673	4451	4023	9681	15951	20595	23604	22334	20029	17251	20138	12491		17270	24464	16179	7257	30576	14982	11263	26969	30991			81362
TOTAL RESTING SPORES	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	39530	0	0	0	0	0	0			0
TOTAL DIATOM FLUXES	6676	3673	4451	4023	9681	15951	20595	23604	22334	20029	17251	20138	12491	N.A.	17270	24464	16218	7257	30576	14982	11263	26969	30991	N.A.		81362

Appendix Table 3. (cont.)

Station 40N Initial Date	8 Jun. 1999	25 Jun. 1999	13 Jul. 1999	30 Jul. 1999	16 Aug. 1999	3 Sep. 1999	20 Sep. 1999	8 Oct. 1999	25 Oct. 1999	11 Nov. 1999	29 Nov. 1999	16 Dec. 1999	2 Jan. 2000	20 Jan. 2000
No. Valves Counted	1457	1546	1805	1818	2062	1496	1257	1576	1754	1708	1305	1610	1568	1309
Actinocyclus curvatulus	102	188	128	154	333	154	358	179	77	70	51	19	58	89
Ac. octonarius	17	0	51	205	0	26	0	0	0	0	34	0	0	11
Actinoptychus senarius	34	17	0	51	333	51	51	26	32	6	34	13	19	33
Asteromphalus arachne	0	0	26	0	0	0	0	26	0	0	34	19	0	0
As. heptactis	102	34	128	410	128	77	154	77	19	6	17	13	13	33
As. hyalinus	17	0	26	51	51	51	0	38	0	0	0	0	6	0
Azpeitia neocrenulata	239	256	205	205	230	282	179	102	64	70	119	141	128	189
Az. tabularis	171	68	102	0	26	77	77	64	45	32	17	32	38	44
Bacteriastrum delicatulum	34	17	154	51	51	77	51	0	6	0	102	6	13	0
B. furcatum	0	17	26	0	0	0	26	26	0	0	17	13	26	56
Chaetoceros atlanticus	20	10	20	10	0	10	0	3	3	0	0	0	0	0
Ch. pervianus	1935	1597	2344	2385	1515	1157	758	235	233	184	307	230	238	814
Corethron sp.	307	215	584	512	287	317	154	41	87	87	276	54	74	107
Coscinodiscus marginatus	870	993	1607	2938	4597	2170	2027	653	729	842	2928	632	537	738
Cos. oculus-iridis	17	85	154	0	77	26	26	51	0	0	17	13	0	0
Cos. radiatus	307	444	665	307	742	435	410	230	122	141	137	45	147	100
Hyalochaete spp.	119	17	2739	9061	1126	358	461	218	173	58	614	134	51	167
Proboscia alata	0	0	51	154	0	26	0	0	0	6	137	6	6	0
Pr. eumorpha	0	0	154	51	26	0	0	0	0	0	0	0	6	11
Pr. subarctica	324	580	768	717	410	307	307	141	96	134	222	32	64	145
Pseudosolenia calcar-avis	0	0	0	0	26	26	0	26	19	0	239	6	13	44
Rhizosolenia bergonii	34	34	26	0	26	0	26	77	32	26	461	45	58	100
Rh. hebetata f. *hebetata*	0	0	0	0	0	26	26	13	0	0	0	6	0	11
Rh. hebetata f. *semispina*	0	0	0	51	0	0	51	26	0	6	34	19	13	44
Rh. styliformis	0	0	10	20	113	123	82	18	18	20	235	5	0	13
Ropelia tesselata	665	563	742	512	435	537	307	410	90	230	324	147	224	311
Stellarima stellaris	324	307	486	614	384	154	230	141	77	45	102	38	32	22
Stephanopyxis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thalassiosira eccentrica	256	171	358	358	512	589	102	218	109	134	256	77	90	122
Th. lineata	205	154	410	563	486	307	77	128	115	90	171	51	32	89
Th. oestrupii	1314	1485	1612	1792	1587	1177	1254	755	224	352	512	198	173	523
Th. trifulta	324	119	384	410	384	128	358	179	45	32	85	77	102	100
TOTAL CENTRICS	8712	8446	16887	27182	17855	11216	10217	4871	2982	3091	8518	2577	2679	4649
Alveus marinus	0	26	51	102	0	0	26	13	6	6	10	0	4	15
Fragilariopsis doliolus	15075	18275	31942	27028	17763	13591	9956	3385	3858	4095	2590	2325	2082	2720
Neodenticula seminae	2764	3353	5631	7576	2559	3686	3558	1389	1453	877	758	576	559	519
Nitzschia bicapitata	154	102	461	1075	512	589	282	6	147	122	635	90	64	67
Ni. kolaczeckii	51	77	102	51	0	0	26	6	13	13	51	9	4	22
Ni. sicula	128	154	154	51	154	26	51	19	13	13	92	17	9	30
Thalassionema nitzschioides	2687	1971	6296	6040	3660	2508	3071	768	1056	883	2027	973	1207	1416
Thalassiothrix longissima	26	26	102	102	102	717	384	83	26	32	154	158	60	59
TOTAL PENNATES	21090	24085	44893	42334	25109	21346	17353	5733	6623	6130	6747	4223	4048	4921
TOTAL VEGETATIVE VALVES	29850	32567	61816	69516	42963	32606	27615	10608	9608	9221	15265	6824	6750	9571
TOTAL RESTING SPORES	0	0	0	0	0	0	49412	26160	13080	0	0	0	0	0
TOTAL DIATOM FLUXES	29850	32567	61816	69516	42963	32606	27666	10633	9621	9221	15265	6824	6750	9571