Pleistocene-Holocene diatom floras of the Shiotsugata Lagoon in the Echigo Plain, central Japan

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Abstract

Diatom floras of the Shorijo 10-2 core in the Shiotsugata Lagoon, northern Echigo Plain, central Japan are analyzed in order to elucidate the Pleistocene-Holocene diatom floral changes. Diatoms of 243 species belonging to 53 genera are identified. The diatom floras in this core are divided into seven divisions, D-1 to D-7. The D-1 to D-6 are in the Holocene and the D-7 is in the Pleistocene. The D-7 is dominant in fresh water species. The D-6 is a mixed flora of marine and fresh water species. The D-5 is characterized by the abundant existence of *Cyclotella caspia* as an indicator of brackish lake with low salinity. The D-4 is characterized by the appearance of several kinds of planktonic species in marine, brackish and fresh water. The D-3 consists mainly of a fresh water lake species *Aulacoseira granulata*. The D-2 and D-1 consist mainly of fresh water species such as *Aulacoseira ambigua* and *Achnanthes* spp..

Key words: Brackish lake, diatom, Echigo Plain, Pleistocene-Holocene, Shiotsugata Lagoon

Introduction

The Holocene diatom floras in the Echigo Plain have been studied by Niigata Diatom Research Group (1976), Kobayashi et al. (1976) and Hasegawa (1976) in the central part, Utashiro and Fujita (1983), Ohira (1992) and Nguyen and Kobayashi (1996) in the northern part. From these works, some characteristics of the diatom floras and the Holocene sedimentary environments in each area have been known.

The Shiotsugata (Shiunjigata) Lagoon is situated in the northern part of the Echigo Plain, and surrounded by the Niigata Sand Dune on the north side, the Tainaigawa River Fan on the

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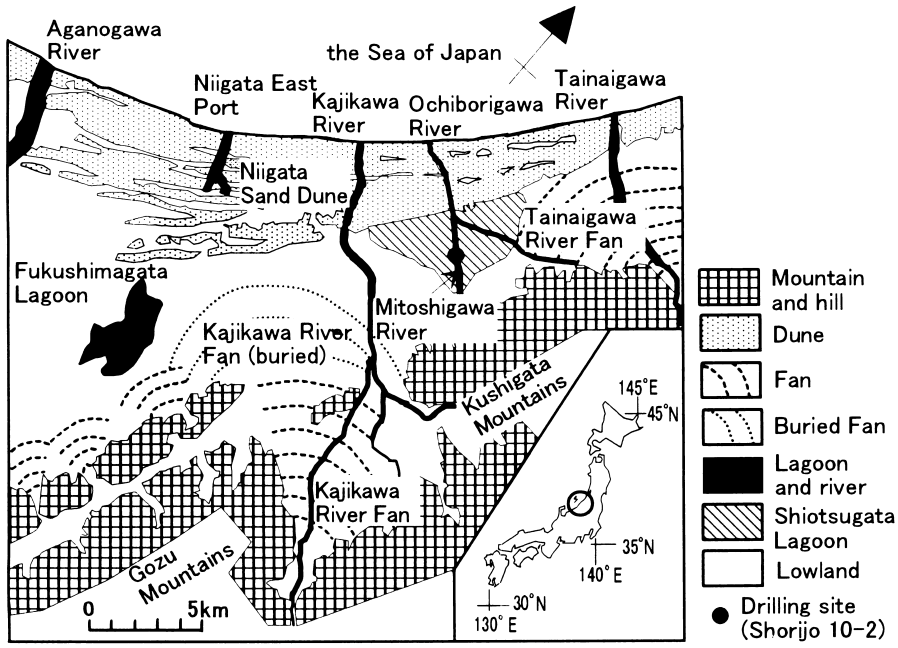

Fig.1. Location map of the Shiotsugata Lagoon

north-eastern side and the Kajikawa River Fan on the southern side (Fig. 1.). The Shiotsugata Lagoon occupied an area of about 2,000 ha before 1723, but it was reclaimed completely in1723-1733, and the Aganogawa and Arakawa Rivers were connected by some creeks and channels through the Shiotsugata Lagoon (Okuma, 1996).

Ohira (1992) analyzed the diatom floras of seven drilling cores located between the Shibata and Murakami Cities in the northern part of the Echigo Plain. One of these cores was drilled in the Shiotsugata Lagoon. But in this study, a detail analysis of diatom flora was not carried out.

The present authors fortunately had a chance to study a core drilled in the Shiotsugata Lagoon. In this short articles, the stratigraphical changes and some characteristics of the Pleistocene-Holocene diatom floras of the Shiotsugata Lagoon are discussed, and the representative diatom species are illustrated with references for determination.

The geologic profile of analyzed core

The drilling site (Shorijo 10-2) is located in the central area of the Shiotsugata Lagoon (38° 0' 47" N, 139° 21' 25" E), viz. Tawarabashi, Kajikawa Village, Niigata Prefecture. (Fig. 1.). The depth of the drilling hole is 54.0 m, and the altitude is 3.62 m over the sea level. The profile of the core is divided into four sedimentary units, I, II, III and IV in descending order (Fig. 2.).

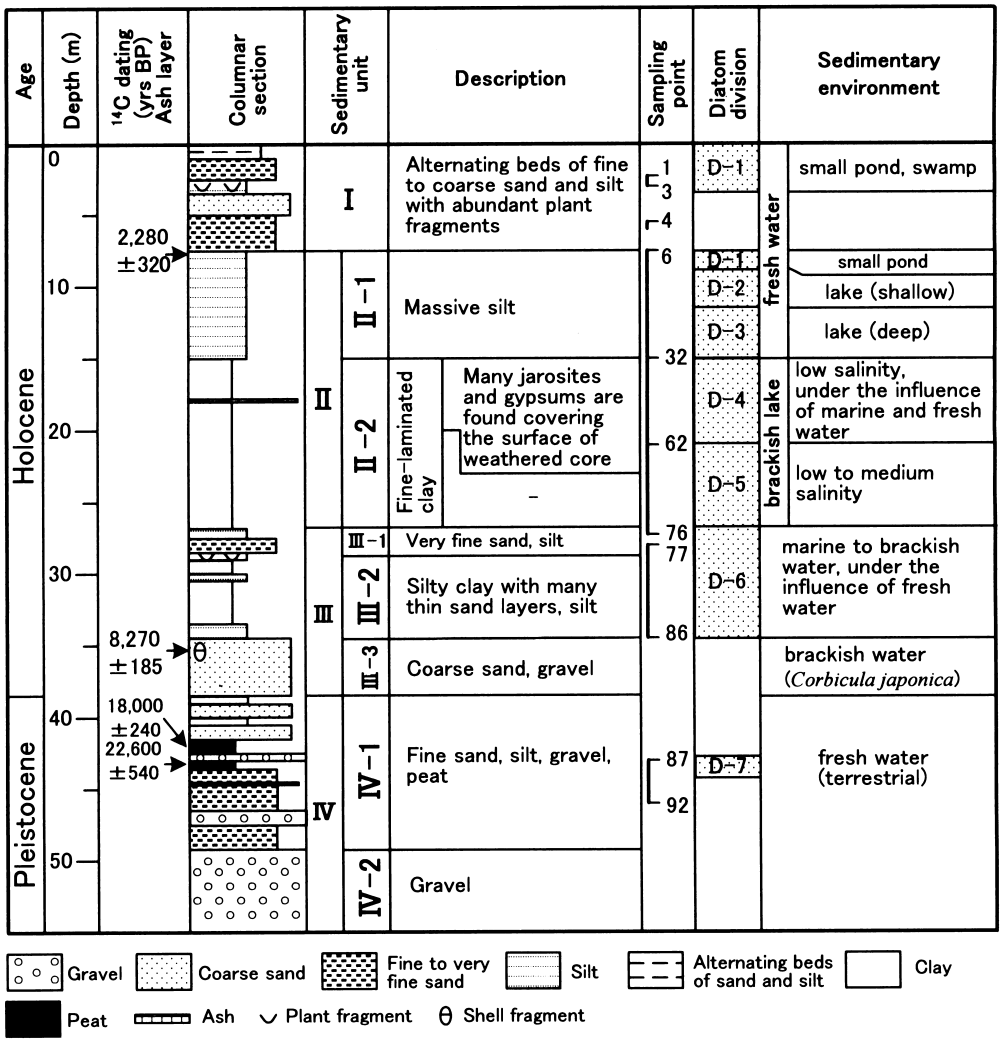

Fig.2. Columnar section, sedimentary unit and diatom division of the Shorijo 10-2 core, Shiotsugata Lagoon with inferred sedimentary environment

The unit I (0.0-7.7 m) is composed of fine to coarse grained sand with silt layers from 2.5-3.3 m below the ground. Abundant plant fragments are contained in the silt layers.

The unit II (7.7-26.8 m) is composed of muddy sediments, and divided into two subunits, II-1 and II-2. The subunit II-1 (7.7-15.0 m) consists of massive silt. The subunit II-2 (15.0-26.8 m) consists of fine-laminated dark gray clay. In the upper part of the subunit II-2 (15.0-21.0 m), many yellowish powders of jarosite ($KFe_3^{3+}(SO_4)_2(OH)_6$) and gypsums were found covering the surface of weathered core drilled before one year. A light gray silty ash layer, 2 mm in thickness, is intercalated at 17.67 m below the ground.

The unit III (26.8-38.7 m) consists of sand and silt, and is divided into three subunits, III-1,

III-2 and III-3. The subunit III-1 (26.8-29.0 m) is composed of very fine grained sand and silt with many plant fragments. The subunit III-2 (29.0-34.6 m) does of silty clay to silt intercalated by many thin layers of very fine grained sand. The subunit III-3 (34.6-38.7 m) does mainly of coarse grained sand and granule-sized gravel with shell fragments of *Corbicula japonica* in the uppermost part.

The unit IV (38.7-54.0 m) is divided into two subunits, IV-1 and IV-2. The subunit IV-1 (38.7-49.2 m) is composed of fine grained sand and gravels which intercalated with three peat layers, and a silty ash layer is intercalated in 43.63 m below the ground. The subunit IV-2 (49.2-54.0 m) is composed of gravels which contained pebbles of sandstone, rhyolite, and granite, with matrices of arkose sand.

^{14}C datings showing in Fig. 2 were obtained in the Mitoshi 63-8 core which is located about 200 m away from the Shorijo 10-2 one (Kamoi et al, 2000). The ^{14}C age of a shell on 35 m in depth was 8,270±185 yrsBP, and ones of peats on 42-44 m in depth were 18,000±240 yrsBP and 22,600±540 yrsBP. On the basis of ^{14}C datings, the boundary between Pleistocene and Holocene is laid in the basal part of the Unit III, 38.7 m below the ground.

Material and method

The upper half of 1 m of the analyzed core was taken by split spoon sampler, and the lower half by core tube. Muddy sediments were cut every 2 cm intervals from the lower half of each 1 m core. Specimens on glass slide for diatom analysis were prepared every about 10 cm intervals of cutting samples.

Each sample of 1g in dry weight was placed into 300 ml beaker and added 20 ml of 30 % hydrogen peroxide to remove organic matter. After three hours, 300 ml of boiling distilled water were added, and soaked overnight. The top clean water was replaced by new distilled water two times, and at three times more distilled water was added to obtain a solution of suitable density. The solution was left for 10 seconds in order to let grains denser than diatoms. And 0.5 ml of the solution were picked on an 18×18 mm cover slip by a pipet, and mounted in Mountmedia.

Slides were observed at each 10 cm interval from 10.7-21.0 m, which many frustules are contained and each 40-60 cm interval in other depths.

200 frustules of diatom in each sample were counted and identified under an optical microscope. Krammer and Lange-Bertalot (1986-1991), Hustedt (1930, 1930-1966) and Hendey (1964) were mainly taken for diatom identification. Ecology of each species is referred to Vos and de Volf (1993) and many reports of recent diatom flora in Japanese brackish lake or estuary (Itimura et al., 1965; Kosuge, 1972; Nigorikawa and Nishikata, 1975; Kato et al., 1977; Gotoh, 1978, 1979; Hasegawa and Nigorikawa, 1993; Nigorikawa and Hasegawa, 1999 etc.).

Division of diatom floras and inferred sedimentary environment

Frustules were contained in 84 slides. And more than 200 frustules were recognized in 76 slides, and 243 species in 53 genera were identified. Specific list from 10.74-20.96 m below the ground is shown in Table 1. The diatom floras in the Shorijo 10-2 core is divided into seven divisions on the basis of specific component, D-1 to D-7 in descending order (Fig. 2.).

1. Division D-1 (0.71-8.56 m, sample nos. 1-7)

This division corresponds to the unit I and the uppermost part of subunit II-1. The number of frustule is 2×10^3-1×10^4/mg. This comprises more than 90 % fresh and brackish/fresh water species. *Achnanthes* spp. (*A. lanceolata, A. linealis* and *A. pusilla*) are dominant (15-35 %), and *Aulacoseira ambigua*, *Cocconeis placentula*, *Cymbella* spp. (*C. minuta* and *C. sinuata*), and *Gomphonema* spp. (*G. angustum* and *G. parvulum*) are accompanied (5-20 %). At the horizon of number 3, *Fragilaria pinnata* and *Navicula carminata* are distinctively occurred (10-20 %). *Navicula carminata* was reported in the Aoki Lake by Hustedt (1966), the Nojiri Lake by Haraguchi (1999) and the Last Glacial deposites in Nojiri Lake (Diatom Research Group for Nojiri-ko Excavation, 1980).

This division indicates to be deposited mainly under fresh water area, such as small ponds and swamps. But during the unit I and the uppermost part of subunit II-1, several expansions of water area sporadically had been occurred , being indicated by the domination of *Aulacoseira ambigua.*

2. Division D-2 (8.56-12.00 m, sample nos. 8-18)

This division corresponds to the upper part of subunit II-1. The number of frustule is generally 6×10^3-5×10^4/mg. *Aulacoseira ambigua*, fresh water planktonic species, is generally dominant (8-63 %). *Fragilaria pinnata, Cocconeis placentula, Achnanthes lanceolata* and *Aulacoseira granulata* are accompanied. These species widely were distributed in a lake and pond of fresh water. And distinctive epiphytic species in a moor or swamp occurs (1-8 %), such as *Eunotia minor* and *Tabellaria flocculosa.* It is noticeable that *Cyclotella caspia*, brackish water planktonic species, and *Thalassiosira lacustris*, brackish/fresh water planktonic species, are contained (about 5 %) in the lower part.

A fresh water lake environment is inferred. But the small influence of brackish water is recognized in the lower part of D-2 division.

3. Division D-3 (12.00-15.00 m, sample nos. 19-32)

This division corresponds to the lower part of subunit II-1. The number of frustule is generally 1-7$\times10^4$/mg. *Aulacoseira granulata* is dominant (20-80 %), and *A. ambigua* is the second dominant species (maximum 38 %). *Achnanthes lanceolata*, *Cocconeis neodiminuta*, *Fragilaria leptostauron* var. *martyi*, *F. virescens*, *Gomphonema grovei* var. *lingulatum*, *Navicula*

carminata, *Synedra ulna* and *Thalassiosira lacustris* are accompanied. *A. granulata* is a distinctive planktonic species in a lake, and live in more spread water area than *A. ambigua*.

A widespread lake environment is inferred.

4. Division D-4 (15.00-20.00 m, sample nos. 33-57)

This division corresponds to the upper part of subunit II-2. Frustules are very abundant. The number of them at almost samples is 10^5/mg. *Cyclotella caspia*, brackish water planktonic species, is dominant (60-90 % over). But at 18.54-18.96 m below the ground, *Aulacoseira granulata* and *A. ambigua*, fresh water planktonic species, are dominant (54-74 %). And at 19.54-19.96 m below the ground, *Skeletonema costatum* and *Thalassiosira excentrica*, marine water planktonic species, are accompanied (5-32 %). *Navicula pygmaea* and *N. pseudony* (marine/brackish water species), *Diploneis pseudovalis* and *Entomoneis paludosa* (brackish water species), *Navicula capitata* var. *hungarica*, *N. crucicula*, *N. gregaria* and *Thalassiosira lacustris* (brackish/fresh water species) are occurred with low frequency. As mentioned above, the characteristic of this division is that several kinds of planktonic species living in different environments, namely marine and fresh waters, appeared repeatedly.

Cyclotella caspia is an indicator of a lake with low salinity. Kashima (1993, 1994) suggested that the domination of only one species of *Cyclotella caspia* is under a water of 3-10 % in salinity. The composition of epiphytic and benthonic species at this division is similar to that of recent flora in the Hachirogata Lagoon, Akita Prefecture (Itimura et al., 1965 ; Kato et al., 1977) and the Matsukawaura Lagoon, Fukushima Prefecture (Kosuge, 1972 ; Nigorikawa and Hasegawa, 1999). Alternated occurrences of marine, brackish and fresh water planktonic species in one sequence were reported from Holocene diatom flora at the Jinzai Lake, Shimane Prefecture (Sawai, 1997), the Hamana Lake, Shizuoka Prefecture (Honda and Kashima, 1997; Kashima, 1988), and the Kamo Lake, Niigata prefecture (Matsuki et al., 1987; Nguyen and Kobayashi, 1997).

This division indicates to be deposited under brackish lake with low salinity. But it is considered that the salinity of this lake had been affected by the inflow of fresh and marine surface waters.

5. Division D-5 (20.00-26.56 m, sample nos. 58-73)

This division corresponds to the lower part of subunit II-2. The number of frustule is 1-7$\times$ 10^4/mg. *Cyclotella caspia* is dominant (25-75 %). Accompanied species are different in the D-4 division, namely *Melosira nummuloides*, *Skeletonema costatum* and *Thalassionema nitzschioides* (marine water species), *Melosira moniliformis* (marine/brackish water species), *Diploneis pseudovalis* (brackish water species), *Cocconeis placentula*, *Navicula cryptocephara*, *Nitzschia littoralis* and *Rhopalodia gibberula* (brackish/fresh water species), and *Aulacoseira distans* (fresh waer species).

A brackish lake environment is inferred by the dominance of *Cyclotella caspia*. But inferred salinity of the division D-5 was more than that of the division D-4 on the basis of high frequent marine and marine/brackish water species. And judging from the frequency of *Cyclotella caspia* that was gradually higher toward the upper part of this division, lake salinity was lower in the depositional stage of the lower part of subunit II-2.

6. Division D-6 (26.56-34.56 m, sample nos. 74-86)

This division corresponds to the subunits III-1 and III-2. Frustules are few, and number of them is 1×10^2-9×10^3 /mg. Brackish water species decrease in comparison with the D-5 division, marine water planktonic species, as *Actinocyclus ehrenbergii*, *Thalassionema nitzschioides* and *Chaetoceros* spp. (resting spore), are dominant (10-70 %). *Cyclotella caspia*, *Amphora proteus* and *Diploneis pseudovalis* (marine/brackish to brackish water species), *Fragilaria leptostauron* var. *martyi* (brackish/fresh water species), *Aulacoseira granulata* and *Synedra ulna* (fresh water species) are accompanied.

The sediments may be deposited in marine to brackish environment under the influence of fresh water such as a bay mouth or estuary, juging from the mixed composition of marine and fresh water species.

7. Division D-7 (43.64-43.66 m, sample no. 88)

This division corresponds to the subunit IV-1 in upper Pleistocene. Frustules are detected from one sample (no. 88), whose number is 80 /mg. Fresh water species are dominant, namely *Hantzschia amphioxys*, *Diploneis ovalis*, *Pinnularia microstauron*, *Rhopalodia gibberula*, *Diploneis elliptica* and *D. yatukaensis*.

This indicates a fresh water environment. Judging from inclusion of living terrestrial diatoms (Ando, 1990) such as *Hantzschia amphioxys* and *Diploneis elliptica*, it is considered that a terrestrial environment was existed in surrounding area.

Floral and illustration reference

References are given for all identifiable diatom species in the Shorijo 10-2 core. They are arranged alphabetically. Main diatom species are shown on Figs. 3-14. These figure numbers are shown in parentheses of specific references.

Achnanthes biasolettiana Grunow: Krammer and Lange-Bertalot, 1991, p. 321, figs. 1-18 (Fig. 7.55).
Achnanthes brevipes Agardh: Krammer and Lange-Bertalot, 1991, p. 251, figs. 2,3 (Figs. 7.49a,b).
Achnanthes daui Foged: Krammer and Lange-Bertalot, 1991, p. 325, figs. 13-24.
Achnanthes delicatula (Kutzing) Grunow: Krammer and Lange-Bertalot, 1991, p. 326, figs. 1-14 (Fig. 7.51).
Achnanthes delicatula spp. *hauckiana* (Grunow) Lange-Bertalot: Krammer and Lange-Bertalot, 1991, p. 329, figs. 1-8 (Fig. 7.52).
Achnanthes exigua Grunow: Krammer and Lange-Bertalot, 1991, p. 295, figs. 1-19.
Achnanthes lanceolata (Brebisson) Grunow: Krammer and Lange-Bertalot, 1991, p. 331, figs. 1-8 (Figs. 7.53a,b).

Achnanthes lanceolata spp. *rostrata* (Oestrup) Lange-Bartalot: Krammer and Lange-Bertalot , 1991, p. 335, figs. 1-14.
Achnanthes levanderi Hustedt: Krammer and Lange-Bertalot, 1991, p. 279, figs. 8-18.
Achnanthes linearis (W.Smith) Grunow: Krammer and Lange-Bertalot, 1991, p. 322, figs. 19-23 (Fig. 7.54).
Achnanthes obliqua (Gregory) Hustedt: Krammer and Lange-Bertalot, 1991, p. 285, figs. 18-19 (Fig. 7.50).
Achnanthes pusilla (Grunow) De Toni: Krammer and Lange-Bertalot , 1991, p. 322, figs. 9-18.
Actinella brasiliensis Grunow: Krammer and Lange-Bertalot, 1991, p. 551, figs. 2-3 (Fig. 7.48).
Actinocyclus curvatulus Janisch: Hustedt, 1930, p. 539, fig. 307 (Fig. 3.7).
Actinocyclus ehrenbergii Ralfs: Hustedt, 1930, p. 527, fig. 298 (Fig. 4.9).
Actinocyclus ingens Rattray: Kanaya, 1959, p. 97, figs. 6-9.
Actinocyclus normanii (Gregory) Hustedt: Krammer and Lange-Bertalot, 1991, p. 393, figs. 1-5 (Fig. 4.8).
Actinoptycus senarius Ehrenberg: Hendey, 1964, pl. 23, figs. 1-2 (Fig. 4.11).
Actinoptycus splendens (Shadbolt) Ralfs: Hendey, 1964, pl. 22, fig. 1.
Amphora acuta Gregory: Cleve-Euler, 1953, fig. 696 (Fig. 12.122).
Amphora angusta (Gregory) Cleve: Cleve-Euler, 1953, figs. 705a, b (Fig. 12.125).
Amphora coffeaeformis (Agardh) Kutzing: Krammer and Lange-Bertalot , 1986, p. 744, figs. 1-6 (Fig. 12.126).
Amphora delphinea L.W.Bailey: Kato et al., 1977, p. 132, figs. 239-240 (Fig. 12.123).
Amphora fontinalis Hustedt: Gotoh, 1978, p. 45, figs. 58-59 (Fig. 12.120).
Amphora holsatica Hustedt: Hustedt, 1930, p. 344, fig. 633 (Fig. 12.124).
Amphora libyca Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 741, figs. 3-11.
Amphora pediculus (Kutzing) Grunow: Krammer and Lange-Bertalot, 1986, p. 743, figs. 8-13.
Amphora proteus Gregory: Itimura et al., 1965, p. 460, fig. 73 (Fig. 12.121).
Anomoeoneis vitrea (Grunow) Ross: Krammer and Lange-Bertalot, 1986, p. 629, figs. 21-28.
Aulacoseira ambigua (Grunow) Simonsen: Krammer and Lange-Bertalot, 1991, p. 273, figs. 1-16 (Figs. 5.18a,b).
Aulacoseira crassipunctata Krammer: Krammer and Lange-Bertalot, 1991, p. 305, figs. 1-10.
Aulacoseira distans (Ehrenberg) Simonsen: Krammer and Lange-Bertalot, 1991, p. 289, figs. 1-23 (Figs. 4.16a-d).
Aulacoseira granulata (Ehrenberg) Simonsen: Krammer and Lange-Bertalot, 1991, p. 267, figs. 1-12, p. 269, figs. 1-9 (Figs. 5.17a,b).
Asteromphalus robustus Castracane: Hustedt, 1930, p. 497, fig. 278 (Fig. 4.10).
Bacillaria paxillifera (O.Muller) Hendey: Hasle and Syvertson, 1997, p. 292, pl. 66 (Fig. 13.139).
Biddulphia polymorpha (Grunow) Wolle: Hustedt, 1930, p. 851, fig. 505 (Fig. 4.15).
Caloneis bacillum (Grunow) Cleve: Krammer and Lange-Bertalot, 1986, p. 791, figs. 9-20.
Caloneis brevis (Gregory) Cleve: Hendey, 1964, pl. 29, fig. 1 (Fig. 10.105).
Caloneis molaris (Grunow) Krammer: Krammer and Lange-Bertalot, 1986, p. 793, figs. 16-21.
Caloneis permagna (Bailey) Cleve: Krammer and Lange-Bertalot, 1986, p. 781, figs. 1-3.
Caloneis silicula (Ehrenberg) Cleve: Krammer and Lange-Bertalot, 1986, p. 789, figs. 1-7, 9-13 (Fig. 11. 110).
Cocconeis costata Gregory: Hustedt, 1962, p. 333, fig. 785.
Cocconeis disculus (Schumann) Cleve: Krammer and Lange-Bertalot, 1991, p. 361, figs. 1-13.
Cocconeis neodiminuta Krammer: Krammer and Lange-Bertalot, 1991, p. 361, figs. 18-32 (Fig.7.56).
Cocconeis placentula Ehrenberg: Krammer and Lange-Bertalot, 1991, p. 351, figs. 1-5 (Fig. 7.57).
Cocconeis scutellum Ehrenberg: Krammer and Lange-Bertalot, 1991, p. 365, figs. 1-13 (Fig. 7.58).
Coscinodiscus marginatus Ehrenberg: Hustedt, 1930, p. 431, fig. 233 (Fig. 3.4).
Coscinodiscus nodulifer A.Schmidt: Hustedt, 1930, p. 426, fig. 229 (Fig. 3.3).
Coscinodiscus radiatus Ehrenberg: Hustedt, 1930, p. 421, fig. 225 (Fig. 3,6).
Cyclotella caspia Grunow: Krammer and Lange-Bertalot, 1991, p. 323, fig. 1 (Figs. 5.22a, b).
Cyclotella meneghiniana Kutzing: Krammer and Lange-Bertalot, 1991, p. 319, figs. 1-10 (Figs. 5.24a,b).
Cyclotella ocellata Pantocsek: Krammer and Lange-Bertalot, 1991, p. 331, figs. 1-11.
Cyclotella planktonica Brunnthaler: Krammer and Lange-Bertalot, 1991, p. 359, figs. 9-11.
Cyclotella radiosa (Grunow) Lammermann: Krammer and Lange-Bertalot, 1991, p. 355, figs. 5-6, 10-12.
Cyclotella stelligera Cleve and Grunow: Krammer and Lange-Bertalot, 1991, p. 329, figs. 1-4 (Figs. 5.25a,b).

Cyclotella striata (Kutzing) Grunow: Krammer and Lange-Bertalot, 1991, p. 321, figs. 1-8 (Figs. 6. 31a, b).
Cymbella cistula (Ehrenberg) Kirchner: Krammer and Lange-Bertalot, 1986, p. 697, figs. 8-11.
Cymbella cuspidata Kutzing: Krammer and Lange-Bertalot, 1986, p. 735, figs. 1-4 (Fig. 12. 117).
Cymbella minuta Hilse: Krammer and Lange-Bertalot, 1986, p. 681, figs. 1-13 (Fig. 12.118).
Cymbella naviculiformis (Auerswald) Cleve: Krammer and Lange-Bertalot, 1986, p. 733, figs. 6-11.
Cymbella sinuata Gregory: Krammer and Lange-Bertalot, 1986, p. 739, figs. 10-17 (Fig. 12.115).
Cymbella tumida (Brebisson) Van Heurck: Krammer and Lange-Bertalot, 1986, p. 703, figs. 4-6 (Fig. 12.116).
Cymbella turgidula Grunow: Krammer and Lange-Bertalot, 1986, p. 695, figs. 4-7 (Fig. 12.119).
Delphineis surirella (Ehrenberg) Andrews: Hasle and Syvertsen, 1997, p. 245, pl. 51 (Fig. 6.34).
Diatoma mesodon (Ehrenberg) Kutzing: Krammer and Lange-Bertalot, 1991, p. 429, figs. 1-12 (Fig. 6.32).
Diatomella balfouriana Greville: Krammer and Lange-Bertalot, 1986, p. 855, figs. 4-8 (Fig. 6.33).
Diploneis bombus (Ehrenberg) Cleve: Hendey, 1964, pl. 32, fig. 2.
Diploneis elliptica (Kutzing) Cleve: Hustedt, 1962, p. 691, fig. 1077 (Fig. 10.94).
Diploneis interrupta (Kutzing) Cleve: Krammer and Lange-Bertalot, 1986, p. 667, figs. 5-6 (Fig. 10.96).
Diploneis ovalis (Hilse) Cleve: Krammer and Lange-Bertalot, 1986, p. 659, figs. 14-16 (Fig. 10.97).
Diploneis pseudovalis Hustedt: Krammer and Lange-Bertalot, 1986, p. 659, figs. 11-13 (Fig. 10.95).
Diploneis puella (Shumann) Cleve: Krammer and Lange-Bertalot, 1986, p. 661, figs. 15-16.
Diploneis smithii (Brebisson) Cleve: Krammer and Lange-Bertalot, 1986, p. 667, figs. 2-4 (Fig. 10.92).
Diploneis suborbicularis (Gregory) Cleve: Hustedt, 1962, p. 613, fig. 1026 (Fig. 10.98).
Diploneis yatukaensis Horikawa and Okuno: Okuno, 1944, p. 8, fig. 3 (Fig. 10.93).
Entomoneis paludosa (W.Smith) Reimer: Krammer and Lange-Bertalot, 1986, p. 853, figs. 3-4 (Figs. 12.114a,b).
Epithemia adnata (Kutzing) Brebisson: Krammer and Lange-Bertalot, 1988, p. 433, figs.1-3 (Fig. 13.132).
Epithemia sorex Kutzing: Krammer and Lange-Bertalot, 1988, p. 429, figs. 1-13.
Epithemia turgida (Ehrenberg) Kutzing: Krammer and Lange-Bertalot, 1988, p. 435, figs. 4-7.
Eunotia bilunaris (Ehrenberg) Mills: Krammer and Lange-Bertalot, 1991, p. 505, figs. 1-12.
Eunotia flexuosa (Brebisson) Kutzing: Krammer and Lange-Bertalot, 1991, p. 511, figs. 8-18 (Fig. 13.127).
Eunotia formica Ehrenberg: Krammer and Lange-Bertalot, 1991, p. 535, figs. 8-12A.
Eunotia minor (Kutzing) Grunow: Krammer and Lange-Bertalot, 1991, p. 515, figs. 7-15 (Fig. 13.128).
Eunotia pectinalis (Dyllwyn) Rabenhorst: Krammer and Lange-Bertalot, 1991, p. 513, figs. 1-7.
Eunotia praerupta Ehrenberg: Krammer and Lange-Bertalot, 1991, p. 527, figs. 1-17 (Fig. 13.130).
Eunotia serra Ehrenberg: Krammer and Lange-Bertalot, 1991, p. 523, figs. 1-2.
Eunotia veneris (Kutzing) De Toni: Krammer and Lange-Bertalot, 1991, p. 557, figs. 14-19 (Fig. 13.129).
Fragilaria arcus (Ehrenberg) Cleve: Krammer and Lange-Bertalot, 1991, p. 465, figs. 8-13 (Fig. 7.46).
Fragilaria bicapitata A.Mayer: Krammer and Lange-Bertalot, 1991, p. 467, figs. 11-16.
Fragilaria brevistriata Grunow: Krammer and Lange-Bertalot, 1991, p. 491, figs. 9-16.
Fragilaria capucina Desmozieres: Krammer and Lange-Bertalot, 1991, p. 447, figs. 1-8.
Fragilaria capucina var. *rumpens* (Kutzing) Lange-Bertalot: Krammer and Lange-Bertalot, 1991, p. 447, figs. 16-21.
Fragilaria capucina var. *vaucheriae* (Kutzing) Lange-Bertalot: Krammer and Lange-Bertalot, 1991, p. 447, figs. 10-15 (Fig. 7.47).
Fragilaria construens (Ehrenberg) Grunow: Krammer and Lange-Bertalot, 1991, p. 495, figs. 1-5 (Fig. 6.40).
Fragilaria construens f. *binodis* (Ehrenberg) Hustedt: Krammer and Lange-Bertalot, 1991, p. 495, figs. 23-27 (Fig. 6.41).
Fragilaria construens f. *venter* (Ehrenberg) Hustedt: Krammer and Lange-Bertalot, 1991, p. 495, figs. 9-16.
Fragilaria leptostauron (Ehrenberg) Hustedt: Krammer and Lange-Bertalot, 1991, p. 497, figs. 33-41.
Fragilaria leptostauron var. *martyi* (Heribaud) Lange-Bertalot: Krammer and Lange-Bertalot, 1991, p. 497, figs. 29-31 (Figs. 6.45a,b).
Fragilaria parasitica (W.Smith) Grunow: Krammer and Lange-Bertalot, 1991, p. 491, figs. 1-5 (Fig. 6.44).
Fragilaria pinnata Ehrenberg: Krammer and Lange-Bertalot, 1991, p. 497, figs. 1-18 (Figs. 6.43a,b).
Fragilaria virescens Ralfs: Krammer and Lange-Bertalot, 1991, p. 483, figs. 1-10 (Figs. 6.42a,b).
Frustulia rhomboids (Ehrenberg) De Toni: Krammer and Lange-Bertalot, 1986, p. 631, figs. 1-3.

Frustulia vulgaris (Thwaites) De Toni: Krammer and Lange-Bertalot, 1986, p. 635, figs. 1-6.
Gomphonema acuminatum Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 763, figs. 1-12 (Fig. 10.101).
Gomphonema angustatum (Kutzing) Rabenhorst: Krammer and Lange-Bertalot, 1986, p. 753, figs. 1-21.
Gomphonema angustum Agardh: Krammer and Lange-Bertalot, 1986, p. 771, figs. 1-16 (Fig. 10.103).
Gomphonema augur Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 757, figs. 1-8 (Fig. 10.102).
Gomphonema augur var. *turris* (Ehrenberg) Lange-Bertalot: Krammer and Lange-Bertalot, 1986, p. 759, figs. 1-6.
Gomphonema clavatum Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 769, figs. 1-12.
Gomphonema clevei Fricke: Krammer and Lange-Bertalot, 1986, p. 771, figs. 20-21.
Gomphonema gracile Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 755, figs. 1-11.
Gomphonema grovei var. *lingulatun* (Hustedt) Lange-Bertalot: Krammer and Lange-Bertalot, 1986, p. 775, figs. 3-11 (Fig. 10.99).
Gomphonema olivaceum (Hornemann) Brebisson: Krammer and Lange-Bertalot, 1986, p. 773, figs. 1-7.
Gomphonema parvulum Kutzing: Krammer and Lange-Bertalot, 1986, p. 751, figs. 1-25 (Figs. 10.100a,b).
Gomphonema subtile Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 767, figs. 10-13.
Gomphonema trucatum Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 761, figs. 11-18.
Grammatophora oceanica (Ehrenberg) Grunow: Hustedt, 1962, p. 46, fig. 573.
Gyrosigma acuminatum (Kutzing) Rabenhorst: Hustedt, 1930, p. 223, fig. 329.
Gyrosigma distortum (W.Smith) Cleve: Hustedt, 1930, p. 225, fig. 334 (Fig. 11.112).
Gyrosigma exoticum Cholnoky: Kato et al., 1977, p. 124, fig. 97 (Fig. 11.113).
Gyrosigma strigile W.Smith: Hustedt, 1930, p. 223, fig. 332.
Hantzschia amphioxys (Ehrenberg) W.Smith: Krammer and Lange-Bertalot, 1988, p. 393, figs. 1-7 (Fig. 14.144).
Hantzschia marina (Donkin) Grunow: Krammer and Lange-Bertalot, 1988, p. 403, figs. 1-3 (Fig. 14.143).
Hantzschia vivax (W.Smith) Peragallo: Krammer and Lange-Bertalot, 1988, p. 399, fig. 5 (Fig. 14.142).
Mastogloia smithii Thwaites: Krammer and Lange-Bertalot, 1986, p. 847, figs. 7-9 (Fig. 11.108).
Melosira lineata (Dillwyn) Agardh: Krammer and Lange-Bertalot, 1991, p. 245, figs. 1-9 (Fig. 5.20).
Melosira moniliformis (O.F.Muller) Agardh: Krammer and Lange-Bertalot, 1991, p. 241, figs. 1-7 (Figs. 5.26a,b).
Melosira nummuloides Agardh: Krammer and Lange-Bertalot, 1991, p. 247, figs. 1-8 (Fig. 5.21).
Melosira undulata (Ehrenberg) Kutzing: Krammer and Lange-Bertalot, 1991, p. 243, figs. 6-7 (Fig. 5.23).
Melosira varians Agardh: Krammer and Lange-Bertalot, 1991, p. 239, figs. 1-8 (Fig. 5.19).
Meridion circulare (Creville) Agardh: Krammer and Lange-Bertalot, 1991, p. 433, figs. 1-7 (Fig. 6.35).
Navicula absoluta Hustedt: Krammer and Lange-Bertalot, 1986, p. 583, figs. 15-21.
Navicula alpha Cleve: Hustedt, 1966, p. 688, fig. 1686 (Fig. 8.62).
Navicula americana Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 575, fig. 1.
Navicula ariiensis Okuno: Ando, 1980, plt. 24, figs. 28-30.
Navicula bacillum Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 575, figs. 2-3 (Fig. 8.75).
Navicula capitata Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 525, figs. 1-4.
Navicula capitata var. *hungarica* (Grunow) Ross: Krammer and Lange-Bertalot, 1986, p. 525, figs. 5-9 (Fig. 9.88).
Navicula carminata Hustedt: Hustedt, 1964, p. 543, fig. 1579 (Fig. 8.74).
Navicula clementis Grunow: Krammer and Lange-Bertalot, 1986, p. 535, figs. 1-9 (Fig. 8.67).
Navicula concentrica Carter: Krammer and Lange-Bertalot, 1986, p. 513, figs. 4-7.
Navicula confervacea (Kutzing) Grunow: Krammer and Lange-Bertalot, 1986, p. 591, figs. 29-31.
Navicula contenta Grunow: Krammer and Lange-Bertalot, 1986, p. 591, figs. 1-5.
Navicula crucicula (W.Smith) Donkin: Krammer and Lange-Bertalot, 1986, p. 549, figs. 1-5 (Fig. 8.64).
Navicula cryptocephara Kutzing: Krammer and Lange-Bertalot, 1986, p. 503, figs. 8-14 (Fig. 9.80).
Navicula decussis Ostrup: Krammer and Lange-Bertalot, 1986, p. 535, figs. 10-18 (Fig. 8.73).
Navicula elginensis (Gregory) Ralfs: Krammer and Lange-Bertalot, 1986, p. 533, figs. 1-9.
Navicula forcipata Greville: Krammer and Lange-Bertalot, 1986, p. 571, figs. 12-13 (Fig. 8.71).
Navicula formenterae Cleve: Kato et al., 1977, p. 129, figs. 172-173 (Fig. 9.79).
Navicula gastrum (Ehrenberg) Kutzing: Krammer and Lange-Bertalot, 1986, p. 539, figs. 4-6 (Fig. 8.65).

Navicula goeppertiana (Bleisch) H.L.Smith: Krammer and Lange-Bertalot, 1986, p. 565, figs. 1-7.
Navicula gregaria Donkin: Krammer and Lange-Bertalot, 1986, p. 517, figs. 10-15 (Fig. 9.81)
Navicula hasta Pantocsek: Krammer and Lange-Bertalot, 1986, p. 493, fig. 1 (Fig. 9.77).
Navicula humerosa Brebisson: Krammer and Lange-Bertalot, 1986, p. 557, fig. 1 (Fig. 7.59).
Navicula jaernefeltii Hustedt: Krammer and Lange-Bertalot, 1986, p. 559, figs. 6-9.
Navicula jentzschii Grunow: Krammer and Lange-Bertalot, 1986, p. 561, figs. 1-2 (Fig. 9.90).
Navicula lacustris Gregory: Krammer and Lange-Bertalot, 1986, p. 557, figs. 2-3.
Navicula laevissima Kutzing: Krammer and Lange-Bertalot, 1986, p. 575, figs. 6-10.
Navicula lanceolata (Agardh) Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 499, figs. 5-7.
Navicula lyroides Hendey: Hendey, 1964, pl. 33, figs. 3-4 (Fig. 8.60).
Navicula marina Ralfs: Hendey, 1964, pl. 31, figs. 1-3 (Fig. 8.61).
Navicula menisculus Schumann: Krammer and Lange-Bertalot, 1986, p. 505, figs. 16-17.
Navicula mutica Kutzing: Krammer and Lange-Bertalot, 1986, p. 563, figs. 1-7.
Navicula peregrina (Ehrenberg) Kutzing: Krammer and Lange-Bertalot, 1986, p. 501, fig. 1 (Fig. 9.76).
Navicula placenta Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 605, figs. 5-6 (Fig. 8.66).
Navicula placentula (Ehrenberg) Kutzing: Krammer and Lange-Bertalot, 1986, p. 541, figs. 1-4 (Fig. 8.68).
Navicula pseudony Hustedt: Hustedt, 1955, p. 59, fig. 11 (Fig. 8.69).
Navicula pseudosilicula f. *olympia* Soveveign: Fujita and Kimura, 1970, pl. 1, figs. 20-21.
Navicula pupula Kutzing: Krammer and Lange-Bertalot, 1986, p. 577, figs. 1-11 (Fig. 9.83).
Navicula pusilla W.Smith: Krammer and Lange-Bertalot, 1986, p. 555, figs. 7-9.
Navicula pusio Cleve: Krammer and Lange-Bertalot, 1986, p. 581, figs. 19-21.
Navicula pygmaea Kutzing: Krammer and Lange-Bertalot, 1986, p. 571, figs. 1-6 (Fig. 8.70).
Navicula radiosa Kutzing: Krammer and Lange-Bertalot, 1986, p. 499, figs. 1-4.
Navicula rotunda Kutzing: Krammer and Lange-Bertalot, 1986, p. 579, figs. 11-13 (Fig. 9.82).
Navicula salinarum Grunow: Krammer and Lange-Bertalot, 1986, p. 511, figs. 5-8 (Fig. 8.72).
Navicula submuralis Hustedt: Hustedt, 1962, p. 248, fig. 1373.
Navicula tenera Hustedt: Krammer and Lange-Bertalot, 1986, p. 573, figs. 19-23.
Navicula tuscula (Ehrenberg) Grunow: Krammer and Lange-Bertalot, 1986, p. 603, figs. 1-8 (Fig. 8.63).
Navicula viridula (Kutzing) Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 515, figs. 1-2 (Fig. 9.78).
Neidium iridis (Ehrenberg) Cleve: Krammer and Lange-Bertalot, 1986, p. 651, figs. 1-4.
Neidium productum (W.Smith) Cleve: Krammer and Lange-Bertalot, 1986, p. 657, figs. 4-6 (Fig. 11.107).
Neodenticula kamutschatica (Zabelina) Akiba and Yanagisawa: Akiba and Yanagisawa, 1986, p. 522, figs. 7-21.
Neodenticula seminae (Simonsen and Kanaya) Akiba and Yanagisawa: Akiba and Yanagisawa, 1986, p. 525, figs. 1-11.
Nitzschia brevissima Grunow: Krammer and Lange-Bertalot, 1988, p. 261, figs. 1-6.
Nitzschia coarctata Grunow: Krammer and Lange-Bertalot, 1988, p. 293, figs. 13-15A.
Nitzschia cocconeiformis Grunow: Ando, 1980, pl. 26, figs. 54-55 (Fig. 14.148).
Nitzschia compressa (Bailey) Boyer: Krammer and Lange-Bertalot, 1988, p. 291, figs. 1-5.
Nitzschia constricta (Kutzing) Ralfs: Krammer and Lange-Bertalot, 1988, p. 287, figs. 1-6 (Fig. 13.133).
Nitzschia filiformis (W.Smith) Van Heurck: Krammer and Lange-Bertalot, 1988, p. 255, figs. 7-12.
Nitzschia granulata Grunow: Krammer and Lange-Bertalot, 1988, p. 287, figs. 9-13 (Fig. 14.145).
Nitzschia hungarica Grunow: Krammer and Lange-Bertalot, 1988, p. 285, figs. 1-3 (Fig. 13.136).
Nitzschia lanceola Grunow: Krammer and Lange-Bertalot, 1988, p. 293, figs. 11-12 (Fig. 13.134).
Nitzschia levidensis var. *salinarum* Grunow: Krammer and Lange-Bertalot, 1988, p. 273, figs. 5-10 (Fig. 14.141).
Nitzschia littoralis Grunow: Krammer and Lange-Bertalot, 1988, p. 279, figs. 1-5 (Fig. 14.140).
Nitzschia lorenziana Grunow: Krammer and Lange-Bertalot, 1988, p. 389, figs. 6-10 (Fig. 13.137).
Nitzschia normannii Grunow: Krammer and Lange-Bertalot, 1988, p. 303, figs. 5-7 (Fig. 13.135).
Nitzschia obtusa W.Smith: Krammer and Lange-Bertalot, 1988, p. 251, fig. 1.
Nitzschia palea (Kutzing) W.Smith: Krammer and Lange-Bertalot, 1988, p. 335, figs. 1-24.
Nitzschia panduriformis Gregory: Krammer and Lange-Bertalot, 1988, p. 295, figs. 6-9 (Fig. 14.147).
Nitzschia scalaris (Ehrenberg) W.Smith: Krammer and Lange-Bertalot, 1988, p. 267, figs. 1-4.
Nitzschia sigma (Kutzing) W.Smith: Krammer and Lange-Bertalot, 1988, p. 263, figs. 1-9 (Fig. 13.138).
Paralia sulcata (Ehrenberg) Cleve: Hendey, 1964, pl. 23, fig. 5.
Peronia fibula (Brebisson) Ross: Krammer and Lange-Bertalot, 1991, p. 561, figs. 15-22 (Fig. 6.38).

Pinnularia acrosphaeria Rabenhorst: Krammer and Lange-Bertalot, 1986, p. 807, figs. 1-3.
Pinnularia borealis Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 799, figs. 1-4, 6, 7, 12.
Pinnularia gibba Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 823, figs. 1-3, 8, 9 (Fig. 9.89).
Pinnularia hemiptera (Kutzing) Rabenhorst: Krammer and Lange-Bertalot, 1986, p. 809, figs. 1-3.
Pinnularia interrupta W.Smith: Krammer and Lange-Bertalot, 1986, p. 825, figs. 1-11 (Fig. 9.84).
Pinnularia microstauron (Ehrenberg) Cleve: Krammer and Lange-Bertalot, 1986, p. 827, figs. 1-6.
Pinnularia nobilis (Ehrenberg) Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 841, figs. 2-3.
Pinnularia nodosa (Ehrenberg) W.Smith: Krammer and Lange-Bertalot, 1986, p. 807, figs. 4-10.
Pinnularia ridida Cleve: Cleve-Euler, 1955, fig. 1093 (Fig. 9.87).
Pinnularia schwabei Krasske: Krammer and Lange-Bertalot, 1986, p. 821, figs. 4-8 (Fig. 9.89).
Pinnularia subcapitata Gregory: Krammer and Lange-Bertalot, 1986, p. 831, figs. 1-18 (Fig. 9.85).
Pinnularia viridis (Nitzsch) Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 833, figs. 1-4 (Fig. 9.91).
Plagiogramma staurophorum (Gregory) Heiberg: Hustedt, 1962, p. 109, fig. 635 (Fig. 6.36).
Plagiotropis lepidoptera var. *proboscidea* (Cleve) Reimer: Patrick and Reimer, 1966, p. 13, figs. 3-5 (Fig. 11.111).
Rhoicosphenia abbreviata (Agardh) Lange-Bertalot: Krammer and Lange-Bertalot, 1986, p. 623, figs. 20-28 (Figs. 6.39a,b).
Rhopalodia gibba (Ehrenberg) O.Muller: Krammer and Lange-Bertalot, 1988, p. 439, figs. 1, 2, 4, 6, 7-13.
Rhopalodia gibberula (Ehrenberg) O.Muller: Krammer and Lange-Bertalot, 1988, p. 443, figs. 1-6 (Fig. 13.131).
Rhizosolenia hebetata f. *hiemalis* Gran: Hasegawa, 1977, pl. 22, fig. 2 (Fig. 4.14).
Skeletonema costatum (Greville) Cleve: Hustedt, 1930, p. 312, fig. 149 (Figs. 4.13a,b).
Stauroneis kriegerii Patrick: Krammer and Lange-Bertalot, 1986, p. 621, figs. 23-27.
Stauroneis phoenicenteron (Nitzsch) Ehrenberg: Krammer and Lange-Bertalot, 1986, p. 611, figs. 1-6 (Fig. 11.106).
Stauroneis smithii Grunow: Krammer and Lange-Bertalot, 1986, p. 619, figs. 16-21 (Fig. 11.109).
Surirella biseriata Brebisson: Krammer and Lange-Bertalot, 1988, p. 507, figs. 1-9.
Surirella brebissonii Krammer and Lange-Bertalot: Krammer and Lange-Bertalot, 1988, p. 473, figs. 3-11 (Fig. 14.149).
Surirella fastuosa (Ehrenberg) Kutzing: Hendey, 1964, pl. 15, fig. 4 (Fig. 14.150).
Surirella robusta Ehrenberg: Krammer and Lange-Bertalot, 1988, p. 533, figs. 1-5.
Surirella tenera Gregory: Krammer and Lange-Bertalot, 1988, p. 549, figs. 1-4.
Surirella visurgis Hustedt: Krammer and Lange-Bertalot, 1988, p. 489, figs. 3-5.
Synedra pulchella (Ralfs) Kutzing: Hustedt, 1930, p. 159, fig. 187 (Fig. 6.28).
Synedra ulna (Nitzsch) Ehrenberg: Hustedt, 1930, p. 153, figs. 158-168 (Fig. 6.27).
Tabellaria fenestrata (Lyngbye) Kutzing: Krammer and Lange-Bertalot, 1991, p. 441, figs. 1-4.
Tabellaria flocculosa (Roth) Kutzing: Krammer and Lange-Bertalot, 1991, p. 443, figs. 1-13 (Fig. 6.37).
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Thalassionema nitzschioides (Grunow) H. and M. Peragallo: Hustedt, 1962, p. 245, fig. 725 (Fig. 6.30).
Thalassiosira excentrica (Ehrenberg) Cleve: Hustedt, 1930, p. 389, fig. 201 (Fig. 3.1).
Thalassiosira lacustris (Grunow) Hasle: Hustedt, 1930, p. 433, fig. 235 (Figs. 3.5a,b).
Thalassiosira lineata Jouse: Hustedt, 1930, p. 393, fig. 204 (Fig. 3.2).
Triceratium condecorum Brightwell: Hasegawa, 1977, pl. 20, figs. 9-11.
Triceratium pentacris f. *guadrata* Hustedt: Hustedt, 1930, p. 814, fig. 475.
Tubularia fasciculata (Kutzing) Williams and Round: Krammer and Lange-Bertalot, 1991, p. 501, figs. 1-18 (Fig. 6.29).

Conclusion

Diatoms of 243 species in 53 genera are identified in the Pleistocene to Holocene strata in the Shorijo 10-2 core of the Shiotsugata Lagoon, northern Echigo Plain, central Japan. The diatom floras in this core are divided into seven divisions, D-1 to D-7 in descending order on the basis of specific component. The D-1 to D-6 are in the Holocene and D-7 is in the Pleistocene.

The Holocene diatom floras in this area are characterized by the dominance of some plank-

tonic species as *Skeletonema costatum* (marine water), *Cyclotella caspia* (brackish water), *Aulacoseira granulata* and *A. ambigua* (fresh water), in muddy sediments from 7.7-26.8 m below the ground. These floras are similar to recent one of lake and lagoon which connect with a sea through small outlets.

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Table 1-1. The list of diatom flora in the Shorijo 10-2 core, Shiotsugata Lagoon (1)

No.	Species \ Depth(m)	Habitat	Ecology	10.74–10.76	10.84–10.86	10.94–10.96	10.98–11.00	11.64–11.66	11.74–11.76	11.84–11.86	11.94–11.96	12.54–12.56	12.64–12.66	12.74–12.76	12.84–12.86	12.98–13.00	13.64–13.66	13.74–13.76	13.84–13.86	13.98–14.00	14.54–14.56	14.64–14.66
	Sample number			11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1	*Achnanthes brevipes* Agardh	M/B	E	1																1		
2	*Achnanthes delicatula* (Kutz.) Gru.	M/B	E	7	4	2	3			1		1		1					1		1	
3	*Achnanthes delicatula* spp. *hauckiana* (Gru.) Lange-Bertalot	M/B	E	7	7	9									9	2	2		4			
4	*Achnanthes lanceolata* (Breb.) Gru.	F	E	12	6	7	16	3	6	15	10	3	3	3	2	3		1	7	12	4	7
5	*Achnanthes lanceolata* spp. *rostrata* (Oestrup) Lange-Bartalot	F	E	1	4	3		2	4	1								1	4		1	
6	*Achnanthes linearis* (W.Smith) Gru.	F	E	10	5	9	8	5	4	4				1				1	1	2		
7	*Achnanthes obliqua* (Greg.) Hust.	F	E				1															
8	*Achnanthes pusilla* (Gru.) De Toni	F	E						1													
9	*Achnanthes* spp.						2															
10	*Actinocyclus curvatulus* Janisch	M	P																			
11	*Actinocyclus normanii* (Greg.) Hust.	B	P								1											
12	*Actinoptycus senarius* Ehr.	M	P																			
13	*Amphora angusta* (Greg.) Cl.	M	B																			
14	*Amphora delphinea* L.W.Bailey	B/F	B																			1
15	*Amphora fontinalis* Hust.	B/F	B																			
16	*Amphora holsatica* Hust.	M/B	B																			
17	*Amphora libyca* Ehr.	F	B							1			1					2			2	
18	*Amphora pediculus* (Kutz.) Gru.	F	B							1												
19	*Amphora proteus* Greg.	M/B	B	2		1						1							2	1		
20	*Anomoeoneis vitrea* (Gru.) Ross	F	B	1																		
21	*Anomoeoneis* sp.																					
22	*Aulacoseira ambigua* (Gru.) Simonsen	F	P	32	18	11	33	79	66	40	52	1	3	11	1	2	1	55	49	23	34	15
23	*Aulacoseira distans* (Ehr.) Simonsen	F	P																			
24	*Aulacoseira granulata* (Ehr.) Simonsen	F	P	18	2		1				1	102	125	130	164	140	152	89	38	54	129	140
25	*Asteromphalus robustus* Castrocane	M	P																			
26	*Bacillaria paxilifera* (O.F.Muller) Fendey	B/F	B					1														
27	*Caloneis bacillum* (Gru.) Cl.	F	B										1									
28	*Caloneis molaris* (Gru.) Krammer	F	B																			
29	*Caloneis permagna* (Bailey) Cl.	B	B															1				
30	*Caloneis silicula* (Ehr.) Cl.	F	B		2	1	1							1					1			
31	*Caloneis* spp.																					
32	*Chaetoceros* spp. (resting spore)	M	P																			
33	*Cocconeis neodiminuta* Krammer	F	E	2	7	1	2	2	10	4	8	20	10	5		9	11	2	7	8	4	3
34	*Cocconeis placentula* Ehr.	B/F	E	7	11	24	28	4	7	14	9	1		1	1	1			2	2		
35	*Coscinodiscus marginatus* Ehr.	M	P														1					
36	*Coscinodiscus nodulifer* A.Schmidt	M	P																		1	
37	*Cyclotella caspia* Gru.	B	P					4	7	5	3	12				3		8	1			
38	*Cyclotella meneghiniana* Kutz.	B/F	P	2		3	1		3									2			1	1
39	*Cyclotella ocellata* Pantocsek	F	P														1			1		
40	*Cyclotella stelligera* Cl. & Gru.	F	P	3		4					1							1				1
41	*Cyclotella striata* (Kutz.) Gru.	B	P													1			2			
42	*Cymbella cistula* (Ehr.) Kirchner	F	E															2				
43	*Cymbella minuta* Hilse	F	E	6	6	7	11		1	3	2	2		1	1	1		1	4	1		1
44	*Cymbella naviculiformis* (Auerswald) Cl.	F	E	2	1	1				1												
45	*Cymbella sinuata* Greg.	F	E	3	4	3	5		2	1				1	3	1			4	2	1	
46	*Cymbella tumida* (Breb.) Van Heurck	F	E	1	2	1	1															
47	*Cymbella turgidula* Gru.	F	E																			1
48	*Delphineis surirella* (Ehr.) Andrews	M	E	1																		
49	*Diatoma mesodon* (Ehr.) Kutz.	F	E			2				1			1	1								

Habitat M: Marine, M/B: Marine to brackish, B: Brachish, B/F: Brackish to fresh, F: Fresh Ecology P: Plankton, E: Epiphyte, B: Benthos

Table 1-2. The list of diatom flora in the Shorijo 10-2 core, Shiotsugata Lagoon (2)

No.	Species \ Depth(m)	Habitat	Ecology	10.74–10.76	10.84–10.86	10.94–10.96	10.98–11.00	11.64–11.66	11.74–11.76	11.84–11.86	11.94–11.96	12.54–12.56	12.64–12.66	12.74–12.76	12.84–12.86	12.98–13.00	13.64–13.66	13.74–13.76	13.84–13.86	13.98–14.00	14.54–14.56	14.64–14.66
50	*Diatomella balfouriana* Greville	F	E					1														
51	*Diploneis ovalis* (Hilse) Cl.	F	B		3	1																
52	*Diploneis pseudovalis* Hust.	B	B	1		1	1		1	1							1	2	1	13		
53	*Diploneis puella* (Shumann) Cl.	B/F	B																			
54	*Diploneis smithii* (Breb.) Cl.	M/B	B																1			
55	*Diploneis suborbicularis* (Greg.) Cl.	M/B	B																			
56	*Entomoneis paludosa* (W.Smith) Reimer	B	E																			
57	*Epithemia adnata* (Kutz.) Brebisson	F	E	1	1	1			1	1	2	2		3								1
58	*Epithemia sorex* Kutz.	F	E							2												
59	*Epithemia turgida* (Ehr.) Kutz.	F	E																	2		
60	*Eunotia bilunaris* (Ehr.) Mills	F	E		1	3													1			
61	*Eunotia flexuosa* (Breb.) Kutz.	F	E		1	1					1											
62	*Eunotia minor* (Kutz.) Gru.	F	E	3	16	10	5	2	1	2	6										1	
63	*Eunotia pectinalis* (Dyllwyn) Rabenhorst	F	E	1	1	4	1															
64	*Eunotia praerupta* Ehr.	F	E	1		1		1											1			
65	*Eunotia veneris* (Kutz.) De Toni	F	E			1		1		4											1	
66	*Fragilaria arcus* (Ehr.) Cl.	F	E		3	2	2															
67	*Fragilaria bicapitata* A.Mayer	F	E	1	4																1	
68	*Fragilaria brevistriata* Gru.	B/F	E	1	4	10		1	1	4	6	4	5	3	1	2	1	3		1		
69	*Fragilaria capucina* Desmazieres	F	E	2		1	3															
70	*Fragilaria capucina* var. *rumpens* (Kutz.) Lange-Bertalot	F	E						1									1	1		1	
71	*Fragilaria capucina* var. *vaucheriae* (Kutz.) Lange-Bertalot	F	E	1	2		2															
72	*Fragilaria construens* (Ehr.) Gru.	F	E	2	1	1	4	4	3	4	4	1				1	1			1		
73	*Fragilaria construens* f. *binodis* (Ehr.) Hust.	F	E			1					1											
74	*Fragilaria construens* f. *venter* (Ehr.) Hust.	F	E	5				21	16	17	8		1	3	2	1		1		1	1	
75	*Fragilaria leptostauron* (Ehr.) Hust.	F	E													1						
76	*Fragilaria leptostauron* var. *martyi* (Heribaud) Lange-Bertalot	B/F	E		1	2	3	2	2	1	3	5	2	3	1	1	2	3	4	22	1	2
77	*Fragilaria parasitica* (W.Smith) Gru.	F	E	1			2	1		2	1								1			
78	*Fragilaria pinnata* Ehr.	B/F	E	14	4	8	1	30	24	20	24	2	3		1	2	1			2		1
79	*Fragilaria virescens* Ralfs	F	E	4	7	1	3	12	14	7	14	4	8	4	2	4	3	3	2	3	2	
80	*Frustulia rhomboides* (Ehr.) De Toni	F	E	1	4	1	2	1														
81	*Gomphonema acuminatum* Ehr.	F	E		3	1					1							2			1	1
82	*Gomphonema angustatum* (Kutz.) Rabenh.	F	E																1			
83	*Gomphonema angustum* Agardh	F	E	4	4	4	5		2	4	2											
84	*Gomphonema augur* Ehr.	F	E		1																	
85	*Gomphonema clavatum* Ehr.	F	E					1														
86	*Gomphonema clevei* Fricke	F	E			1																
87	*Gomphonema gracile* Ehr.	F	E										1									
88	*Gomphonema grovei* var. *lingulatum* (Hust.) Lange-Bertalot	F	E	2			4	1	1	2	1	4	3	2		2	10	4	1		1	4
89	*Gomphonema parvulum* Kutz.	F	E	3	3	11	4			1	1	1							2		2	2
90	*Gomphonema subtile* Ehr.	F	E																			
91	*Gomphonema truncatum* Ehr.	F	E																			1
92	*Gyrosigma acuminatum* (Kutz.) Rabenh.	B/F	B					1		1										1		
93	*Gyrosigma distortum* (W.Smith) Cl.	M/B	B																			
94	*Gyrosigma exoticum* Cholnoky	B	B																			

Habitat M: Marine, M/B: Marine to brackish, B: Brachish, B/F: Brackish to fresh, F: Fresh Ecology P: Plankton, E: Epiphyte, B: Benthos

Table 1-3. The list of diatom flora in the Shorijo 10-2 core, Shiotsugata Lagoon (3)

No.	Species \ Depth(m)	Habitat	Ecology	11 10.74–10.76	12 10.84–10.86	13 10.94–10.96	14 10.98–11.00	15 11.64–11.66	16 11.74–11.76	17 11.84–11.86	18 11.94–11.96	19 12.54–12.56	20 12.64–12.66	21 12.74–12.76	22 12.84–12.86	23 12.98–13.00	24 13.64–13.66	25 13.74–13.76	26 13.84–13.86	27 13.98–14.00	28 14.54–14.56	29 14.64–14.66
95	*Gyrosigma strigile* W. Smith	M/B	B																			
96	*Hantzschia amphioxys* (Ehr.) W.Smith	F	B																			
97	*Hantzschia marina* (Donkin) Gru.	M/B	B																			
98	*Hantzschia vivax* (W.Smith) Peragallo	M/B	B																			
99	*Melosira lineata* (Dillwyn) Agardh	B/F	E/P		2																	
100	*Melosila moniliformis* (O.F.Muller) Agardh	M/B	E/P																			
101	*Melosira nummuloides* Agardh	M	E/P																			
102	*Melosira varians* Agardh	F	P			1	3	1								1						
103	*Meridion circulare* (Creville) Agardh	F	E		1	4				1				1								
104	*Navicula absoluta* Hust.	F	B				2															
105	*Navicula americana* Ehr.	F	B																			1
106	*Navicula ariiensis* Okuno	F	B																			
107	*Navicula bacillum* Ehr.	F	B	2	1													1	1			
108	*Navicula capitata* var. *hungarica* (Gru.) Ross	B/F	B																			
109	*Navicula carminata* Hust.	F	B				17	1		5	9	7	6	7	1	4			6	10		2
110	*Navicula clementis* Gru.	F	B																			
111	*Navicula concentrica* Carter	B/F	B																			
112	*Navicula confervacea* (Kutz.) Gru.	F	B	2	4	3																
113	*Navicula contenta* Gru.	B/F	B			1																
114	*Navicula crucicula* (W.Smith) Donkin	B/F	B			1																
115	*Navicula cryptocephala* Kutz.	B/F	B		1	1															1	1
116	*Navicula decussis* Ostrup	F	B	2			1	1														
117	*Navicula elginensis* (Greg.) Ralfs	F	B															1	1			
118	*Navicula forcipata* Greville	M/B	B																			
119	*Navicula gastrum* (Ehr.) Kutz.	F	B		1												1					
120	*Navicula goeppertiana* (Bleisch) H.L.Smith	F	B	1	1																	
121	*Navicula gregaria* Donkin	B/F	B																			
122	*Navicula lanceolata* (Agardh) Ehr.	F	B		4	4	1	4	1		1								1	3		
123	*Navicula marina* Ralfs	M	B												1							
124	*Navicula menisculus* Schumann	F	B																			
125	*Navicula mutica* Kutz.	B/F	B			3	1		1													
126	*Navicula peregrina* (Ehr.) Kutz.	M/B	B			3					1											
127	*Navicula placenta* Ehr.	F	B							1			1									
128	*Navicula pseudony* Hust.	M	B																			
129	*Navicula pupula* Kutz.	F	B		1	1	4		2					1						1		
130	*Navicula pusio* Cl.	F	B						1													
131	*Navicula pygmaea* Kutz.	M/B	B				1										4	1				
132	*Navicula radiosa* Kutz.	F	B	1	2		3			2									1			
133	*Navicula rotunda* Hust.	F	B						1													
134	*Navicula salinarum* Gru.	M/B	B																			
135	*Navicula submuralis* Hust.	F	B	5				3	5	6	2	2										
136	*Navicula tenera* Hust.	F/B	B																			
137	*Navicula tuscula* (Ehr.) Gru.	F	B						1		2											
138	*Navicula viridula* (Kutz.) Ehr.	F	B		1																	1
139	*Navicula* spp.			2	3	3				2			1	1		1			1			
140	*Neidium iridis* (Ehr.) Cl.	F	B		3	1									1							
141	*Neidium productum* (W.Smith) Cl.	F	B																			
142	*Neidium* sp.																					
143	*Neodenticula seminae* (Simonsen & Kanaya) Akiba & Yanagisawa	M	P										1						1	1		

Habitat M: Marine, M/B: Marine to brackish, B: Brachish, B/F: Brackish to fresh, F: Fresh Ecology P: Plankton, E: Epiphyte, B: Benthos

Table 1-4. The list of diatom flora in the Shorijo 10-2 core, Shiotsugata Lagoon (4)

No.	Species \ Depth(m)	Habitat	Ecology	11 10.74–10.76	12 10.84–10.86	13 10.94–10.96	14 10.98–11.00	15 11.64–11.66	16 11.74–11.76	17 11.84–11.86	18 11.94–11.96	19 12.54–12.56	20 12.64–12.66	21 12.74–12.76	22 12.84–12.86	23 12.98–13.00	24 13.64–13.66	25 13.74–13.76	26 13.84–13.86	27 13.98–14.00	28 14.54–14.56	29 14.64–14.66
144	*Nitzschia brevissima* Gru.	B/F	B		1																	
145	*Nitzschia coarctata* Gru.	M	B																			
146	*Nitzschia hungarica* Gru.	M/B	B																			
147	*Nitzschia levidensis* var. *salinarum* Gru.	M/B	B		1	1													2	1		
148	*Nitzschia littoralis* Gru.	B/F	B		1	1																
149	*Nitzschia lorenziana* Gru.	M/B	B			2																
150	*Nitzschia normannii* Gru.	M/B	B																			
151	*Nitzschia obtusa* W.Smith	B	B				1															
152	*Nitzschia palea* (Kutz.) W.Smith	F	E			1			1													
153	*Nitzschia sigma* (Kutz.) W.Smith	M/B	B																			
154	*Nitzschia* sp.A					2																
155	*Nitzschia* spp.																					
156	*Paralia sulcata* (Ehr.) Cl.	M	P									3	2									
157	*Pinnularia borealis* Ehr.	F	B																			
158	*Pinnularia gibba* Ehr.	F	B	1		2	1		1													
159	*Pinnularia hemiptera* (Kutz.) Rabenhorst	F	B							1												
160	*Pinnularia interrupta* W.Smith	F	B																	1		
161	*Pinnularia microstauron* (Ehr.) Cl.	F	B		3																	
162	*Pinnularia nobilis* (Ehr.) Ehr.	F	B				1															
163	*Pinnularia ridida* Cl.	B/F	B																			
164	*Pinnularia schwabei* Krasske	F	B																			
165	*Pinnularia viridis* (Nitz.) Ehr.	F	B	1	1	2					1											
166	*Plagiotropis lepidoptera* var. *proboscidae* (Cleve) Reimer	F	E																			
167	*Rhoicosphenia abbreviata* (Agardh) Lange-Bertalot	B/F	E		1			1	2													
168	*Rhopalodia gibba* (Ehr.) O.Muller	F	E																			
169	*Rhopalodia gibberula* (Ehr.) O.Muller	B/F	E							1												
170	*Skeletonema costatum* (Greville) Cl.	M	P																			
171	*Stauroneis kriegerii* Patrick	F	B		1																	
172	*Stauroneis phoenicenteron* (Nitz.) Ehr.	F	B								1											
173	*Stauroneis smithii* Gru.	F	B		1																	
174	*Surirella robusta* Ehr.	F	B			1																
175	*Surirella visurgis* Hust.	F	B		1																	
176	*Synedra pulchella* (Ralfs) Kutz.	M/B	E																			
177	*Synedra ulna* (Nitz.) Ehr.	F	E	4	5	3	1	4	2	3	3	2		2	2	1	1	3	27	12	6	3
178	*Tabellaria fenestrata* (Lyngbye) Kutz.	F	E	3	10	2	1															
179	*Tabellaria flocculosa* (Roth) Kutz.	F	E												1				1			
180	*Thalassionema nitzschioides* (Gru.) H. & M. Peragallo	M	P	3	1		1	2		5	5	10	7	1	2	13	5	3	3	6		1
181	*Thalassiosira excentrica* (Ehr.) Cl.	M	P																			
182	*Thalassiosira lacustris* (Gru.) Hasle	B/F	P	7	2	2	4	4	4	8	13	10	15	13	4	2	2	6	12	12	3	8
183	*Thalassiosira lineata* Jouse	M	P																			
184	*Thalassiosira* spp.	M	P		1		1															
185	*Tubularia fasciculata* (Kutz.) Wiliams & Round	M/B	E																			
186	unknown															1						1
	Total			200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200

Habitat M: Marine, M/B: Marine to brackish, B: Brachish, B/F: Brackish to fresh, F: Fresh Ecology P: Plankton, E: Epiphyte, B: Benthos

Table 1-5. The list of diatom flora in the Shorijo 10-2 core, Shiotsugata Lagoon (5)

	30	31	32	33	35	36	37	38	39	40	41	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
No.	14.74–14.76	14.84–14.86	14.94–14.96	15.54–15.56	15.74–15.76	15.84–15.86	15.94–15.96	16.54–16.56	16.64–16.66	16.74–16.76	16.84–16.86	17.54–17.56	17.64–17.66	17.74–17.76	17.84–17.86	17.94–17.96	18.54–18.56	18.64–18.66	18.74–18.76	18.84–18.86	18.94–18.96	19.54–19.56	19.64–19.66	19.74–19.76	19.84–19.86	19.94–19.96	20.54–20.56	20.64–20.66	20.74–20.76	20.84–20.86	20.94–20.96
1	1									1		1													1						2
2	2												1					1			1	1			1	1					
3											1			1						1				1		1				1	1
4	7	5	3				1																						1		1
5			1								1																		1		1
6	2	2			3					1	3	1	2	2	1				2							1	1	1			
7																															
8									2				1																		
9											3					1															
10																									2						
11																		1							2						1
12					1																										
13													1																		
14																															
15																												1			1
16					1								1							2			1						1		
17	1																														
18																															
19						1	2	1				2							1			1			2	1		1	1		
20																															
21													10																		
22	12	52	17	4	7	11		5									9	3	58	4	35			1						1	19
23				1									1											1							
24	133	104	156	11		1		12									99	141	60		78									28	122
25													1																		
26						1		3				4					2		1							1					
27																															
28			1																												
29																															
30																															
31													1																		
32						1					2	3			2						2		1	1				1			
33	7	2	2		1	2		3			5	2		1	1			2							1	1					1
34	1	1								1																		1			
35																															
36																															
37		2	1	158	161	152	171	151	182	179	129	136	105	168	181	191	61	27	41	152	61	122	153	163	156	141	193	167	177	156	37
38							1			1										3	1				1					1	
39																															
40	1	2	2																												
41									1		1	2		1	1								2	3	3				3		
42																															
43		1			1						1						1			1											
44																															
45	3					1																	1								
46			1			1		1																							
47															1																
48																															
49					1						1								1												

Table 1-6. The list of diatom flora in the Shorijo 10-2 core, Shiotsugata Lagoon (6)

	30	31	32	33	35	36	37	38	39	40	41	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
No.	14.74–14.76	14.84–14.86	14.94–14.96	15.54–15.56	15.74–15.76	15.84–15.86	15.94–15.96	16.54–16.56	16.64–16.66	16.74–16.76	16.84–16.86	17.54–17.56	17.64–17.66	17.74–17.76	17.84–17.86	17.94–17.96	18.54–18.56	18.64–18.66	18.74–18.76	18.84–18.86	18.94–18.96	19.54–19.56	19.64–19.66	19.74–19.76	19.84–19.86	19.94–19.96	20.54–20.56	20.64–20.66	20.74–20.76	20.84–20.86	20.94–20.96
50																															
51																															
52	2	1	1	5		1	1		1		1			1			6	2	3	3	2	1		2				2		1	4
53																	1			1											1
54											1																				1
55										1																					
56					1				1						1			1	1									1	1		
57	1	2																													
58																															
59																															
60																															
61																															
62	1	1																													
63																															
64																															
65																															
66														1														1			
67																															
68						2																								1	
69																															
70	1																														
71											2	1										1		1		1	2	2			
72	1																														
73																															
74																															
75																															
76	3	2	1					1		1						1					1					1					
77																															
78	1									1																					
79	1	1																												1	
80																															
81						1																									
82																															
83		2						1					1								1										
84																															
85		1																		1											
86																															
87																															
88	3	2																													
89		1								1					1																
90	1																														
91																															
92																															
93																		1													
94																										1					

Table 1-7. The list of diatom flora in the Shorijo 10-2 core, Shiotsugata Lagoon (7)

	30	31	32	33	35	36	37	38	39	40	41	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
No.	14.74–14.76	14.84–14.86	14.94–14.96	15.54–15.56	15.74–15.76	15.84–15.86	15.94–15.96	16.54–16.56	16.64–16.66	16.74–16.76	16.84–16.86	17.54–17.56	17.64–17.66	17.74–17.76	17.84–17.86	17.94–17.96	18.54–18.56	18.64–18.66	18.74–18.76	18.84–18.86	18.94–18.96	19.54–19.56	19.64–19.66	19.74–19.76	19.84–19.86	19.94–19.96	20.54–20.56	20.64–20.66	20.74–20.76	20.84–20.86	20.94–20.96
95									1																						
96										1																					
97																				1											
98																													1		
99																															
100										1																1					
101				1								1	1											1							
102						2					1								1												
103																	1														
104																										1					
105																															
106		1																													
107			2																												
108								1	1		1			1	1			1	1		1			2		2		1			
109	1			1				2				7																			
110			1									1														1					
111								1																							
112																															
113																															
114					1	1	1											2	1			1			1				1		
115				3	1	2		2			3		2				2		5	4	1		1	1	1	2		2	1	1	1
116							1				1																				
117	1		1								1																				
118								4																							
119																															1
120																															
121				3	5	3	5		2		10	5	4	4	2	1	2		1	1		1	1			1	1	2	1		
122					1																										
123																				1											2
124									1	1	1		1						1		1										
125																															1
126																															
127											2																				
128						2							1		1			1		4	3		2	2	3		3	1	3	1	
129		1																1													
130	1																														
131		1	1	2	2	3	2	2	1		4			12	1	3			1	2		1			1	1		2	1	1	
132																										1					
133																															
134																	1			1						1		1			
135																															
136							1	1			1	2	41	4			1	1	3	4					4	1		1	1		
137																															
138	1																														
139			1	2	4	2			1	1	3	7	8								1	1				2			1	1	
140																															
141		1																													
142					1																										
143																															

Table 1-8. The list of diatom flora in the Shorijo 10-2 core, Shiotsugata Lagoon (8)

	30	31	32	33	35	36	37	38	39	40	41	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
No.	14.74–14.76	14.84–14.86	14.94–14.96	15.54–15.56	15.74–15.76	15.84–15.86	15.94–15.96	16.54–16.56	16.64–16.66	16.74–16.76	16.84–16.86	17.54–17.56	17.64–17.66	17.74–17.76	17.84–17.86	17.94–17.96	18.54–18.56	18.64–18.66	18.74–18.76	18.84–18.86	18.94–18.96	19.54–19.56	19.64–19.66	19.74–19.76	19.84–19.86	19.94–19.96	20.54–20.56	20.64–20.66	20.74–20.76	20.84–20.86	20.94–20.96
144																															
145																									2						
146								1							1						1				1				1		
147						2			1			1						1	1			1		3		1					
148											1	1	1		1	1	1												1		
149										1							1	2	3												
150																									1						
151																															
152					2				1		1		2				2				1	1						1	1		
153					1																					1					
154					1	1	2		1	3	2	8	2					1		10		1	5	2	4	10		9	1	4	1
155					1														1												
156																															
157					1																										
158																															
159																															
160																															
161																															
162																															
163																						1									
164				2			1											1													
165																															
166									1																						
167																															
168	1																														
169																															
170				4		4	8	4	2	4	15	4	9	2	4		1	5	5	2	7	65	33	2	5	22		2	2	1	
171																															
172				1																											
173																															
174																															
175																															
176						1		2																					1		
177	2	5	3	1	2					1	1						1	2	1		1										1
178																															
179			2																												
180	2	1	2								1							1								2					
181							1					8		2								1		14	8						
182	6	6	1	1		2	2	2					3			2	6	2	7	2	1										1
183												2																			
184																															
185												1					2														
186																															
	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200

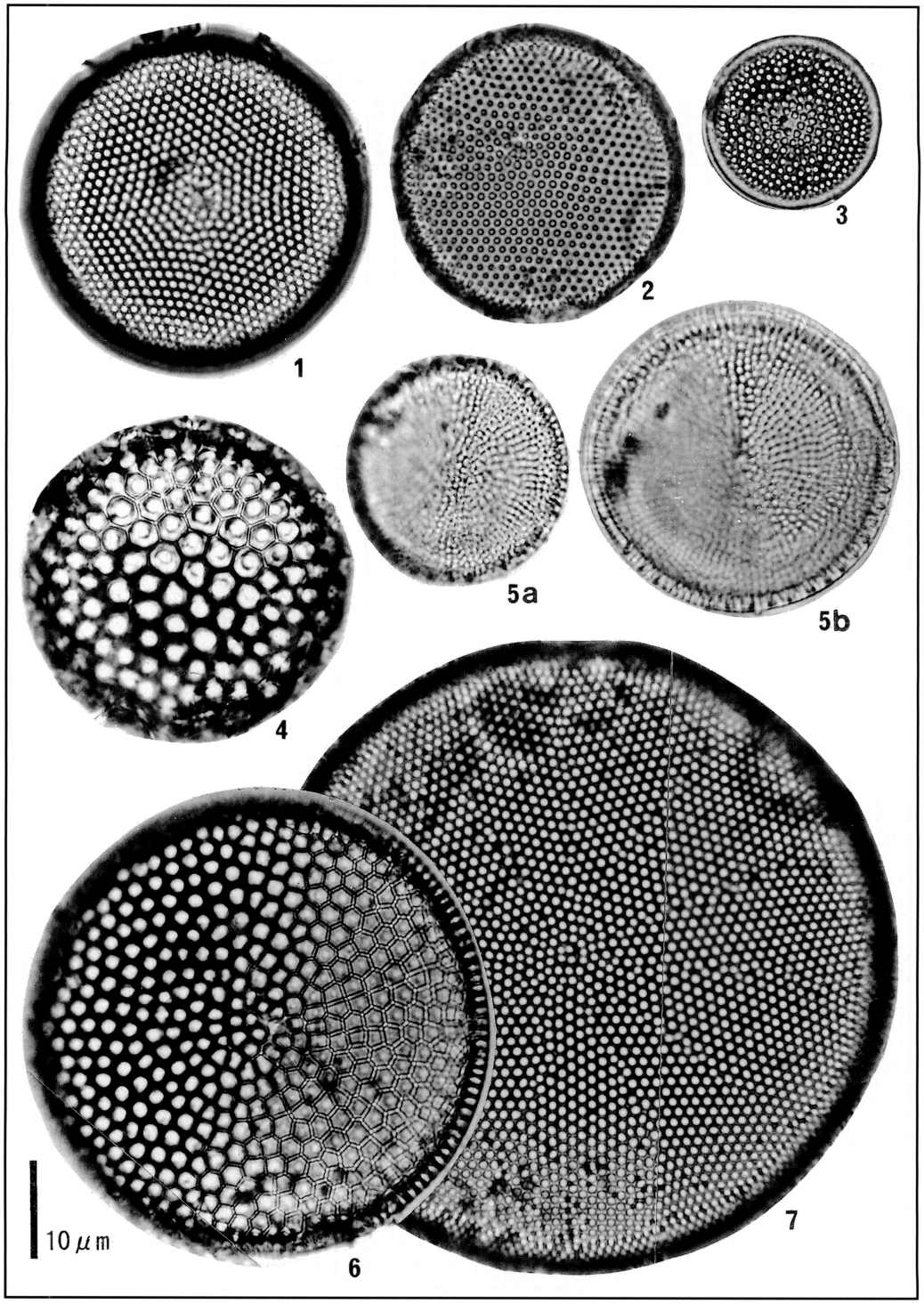

Fig. 3. Diatom fossils in the Shorijo 10-2 core, Shiotsugata Lagoon (1) 1: *Thalassiosira excentrica*, 2: *Thalassiosira lineata*, 3: *Coscinodiscus nodulifer*, 4: *Coscinodiscus marginatus*, 5a, b: *Thalassiosira lacustris*, 6: *Coscinodiscus radiatus*, 7: *Actinocyclus curvatulus*

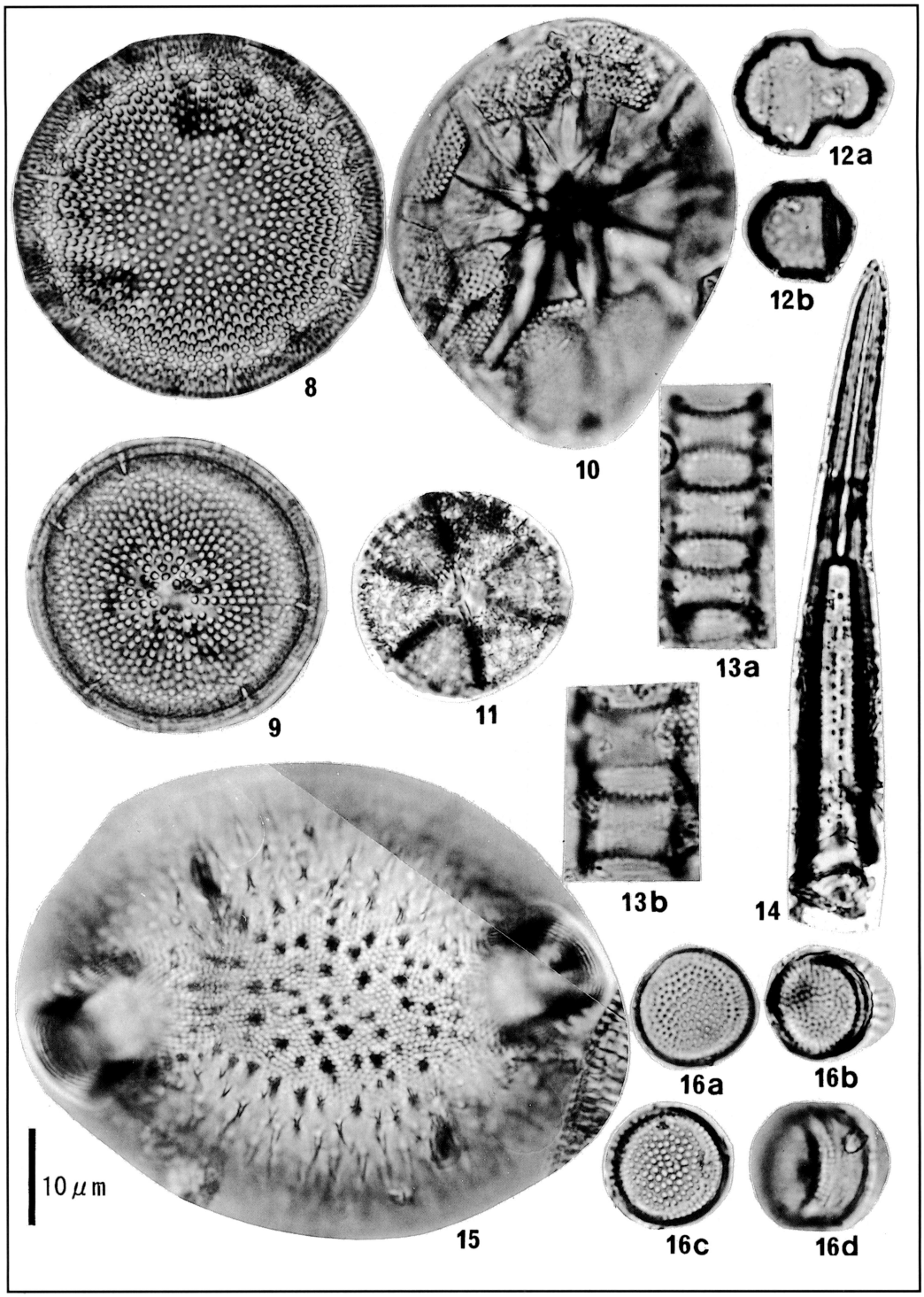

Fig. 4. Diatom fossils in the Shorijo 10-2 core, Shiotsugata Lagoon (2) 8: *Actinocyclus normanii*, 9 : *Actinocyclus ehrenbergii*, 10: *Asteromphalus robustus*, 11: *Actinoptycus senarius*, 12a, b: *Chaetoceros* spp. (resting spore), 13a,b: *Skeletonema costatum*, 14: *Rhizosolenia hebetata* f. *hiemalis*, 15: *Biddulphia polymorpha*, 16a - d: *Aulacoseira distans*

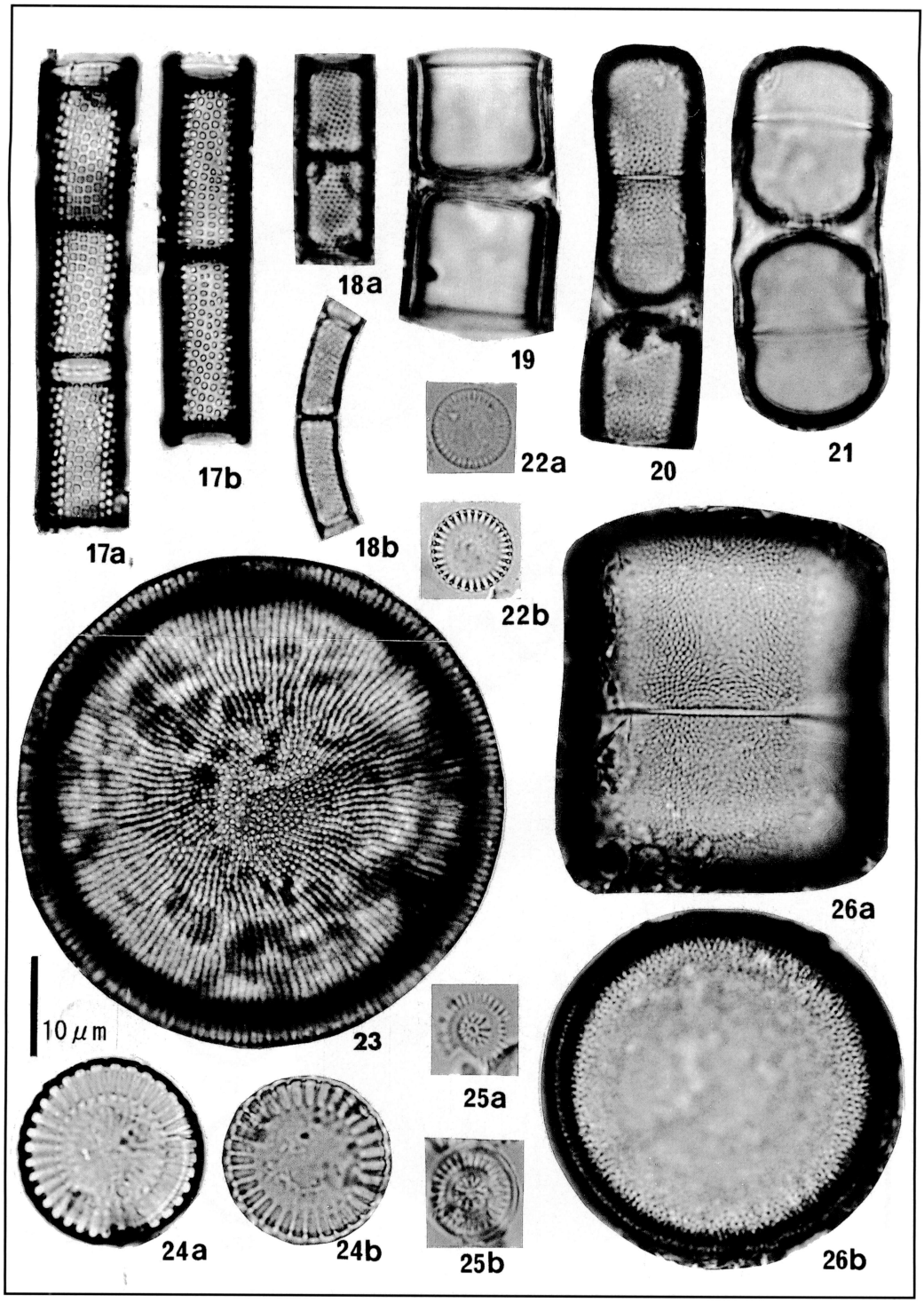

Fig. 5. Diatom fossils in the Shorijo 10-2 core, Shiotsugata Lagoon (3) 17a, b: *Aulacoseira granulata*, 18a, b: *Aulacoseira ambigua*, 19: *Melosira varians*, 20: *Melosira lineata*, 21: *Melosira nummuloides*, 22a, b: *Cyclotella caspia*, 23: *Melosira undulata*, 24a, b: *Cyclotella meneghiniana*, 25a, b: *Cyclotella stelligera*, 26a, b: *Melosira moniliformis*

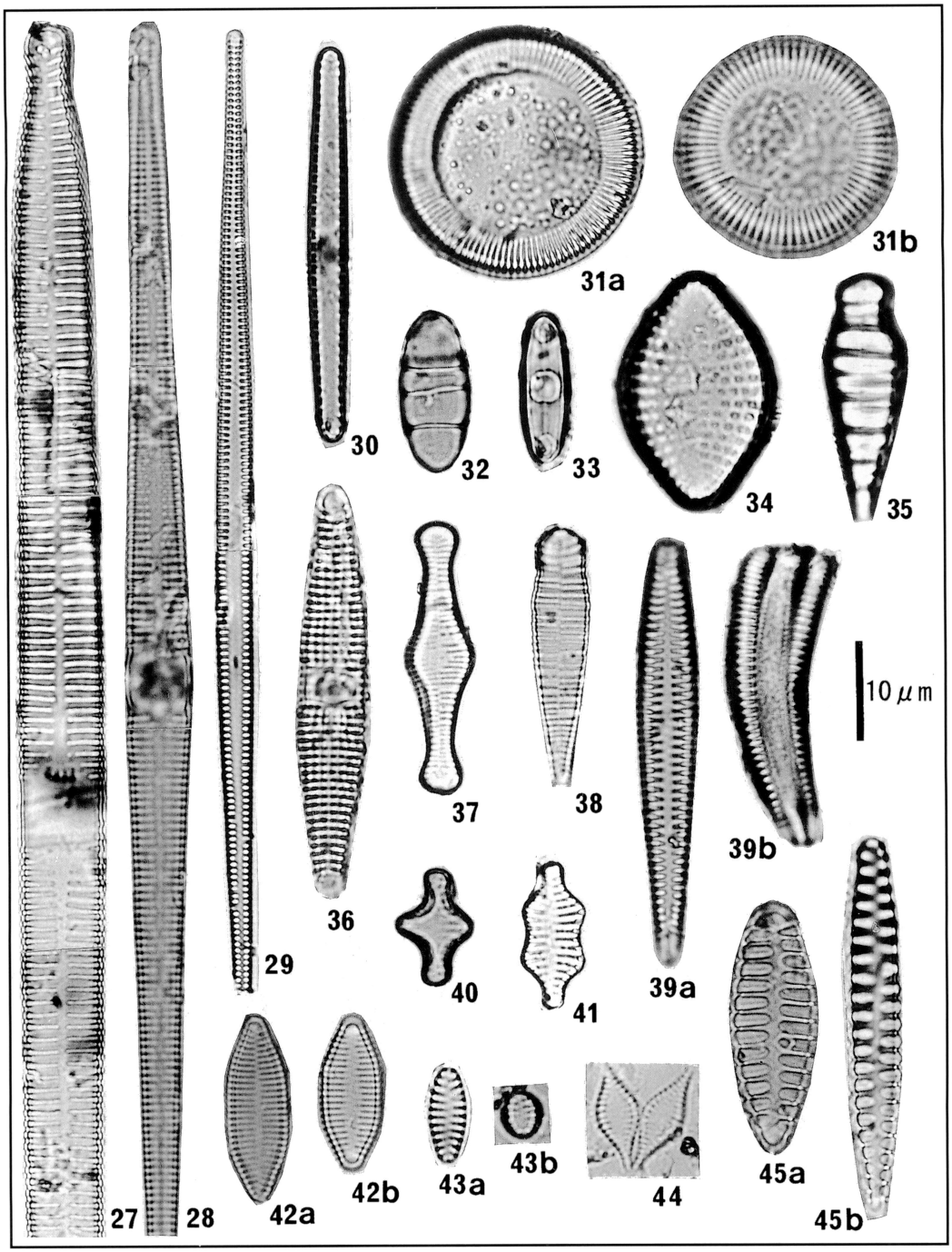

Fig. 6. Diatom fossils in the Shorijo 10-2 core, Shiotsugata Lagoon (4) 27: *Synedra ulna*, 28: *Synedra pulchella*, 29: *Tubularia fasciculata*, 30: *Thalassionema nitzschioides*, 31a, b: *Cyclotella striata*, 32: *Diatoma mesodon*, 33: *Diatomella balfouriana*, 34: *Delphineis surirella*, 35: *Meridion circulare*, 36: *Plagiogramma staurophorum*, 37: *Tabellaria flocculosa*, 38: *Peronia fibula*, 39a, b: *Rhoicosphenia abbreviata*, 40: *Fragilaria construens*, 41: *Fragilaria construens* f. *binodis*, 42a, b: *Fragilaria virescens*, 43a, b: *Fragilaria pinnata*, 44: *Fragilaria parasitica*, 45a, b: *Fragilaria leptostauron* var. *martyi*

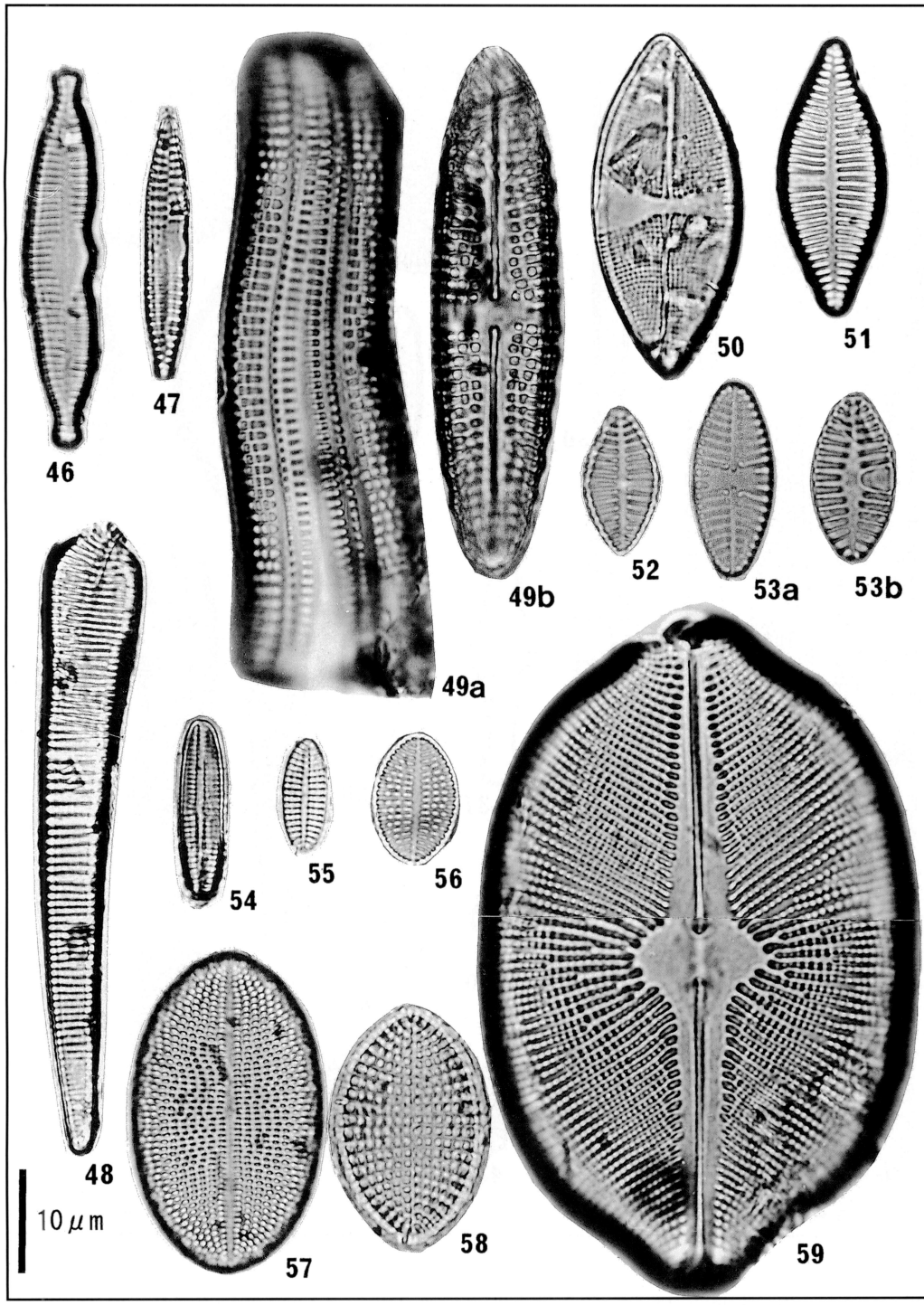

Fig.7. Diatom fossils in the Shorijo 10-2 core, Shiotsugata Lagoon (5) 46: *Fragilaria arcus*, 47: *Fragilaria capucina* var. *vaucheriae*, 48: *Actinella brasiliensis*, 49a, b: *Achnanthes brevipes*, 50: *Achnanthes obliqua*, 51: *Achnanthes delicatula*, 52: *Achnanthes delicatula* spp. *hauckiana*, 53a, b: *Achnanthes lanceolata*, 54: *Achnanthes linearis*, 55: *Achnanthes biasolettiana*, 56: *Cocconeis neodiminuta*, 57: *Cocconeis placentula*, 58: *Cocconeis scutellum*, 59: *Navicula humerosa*

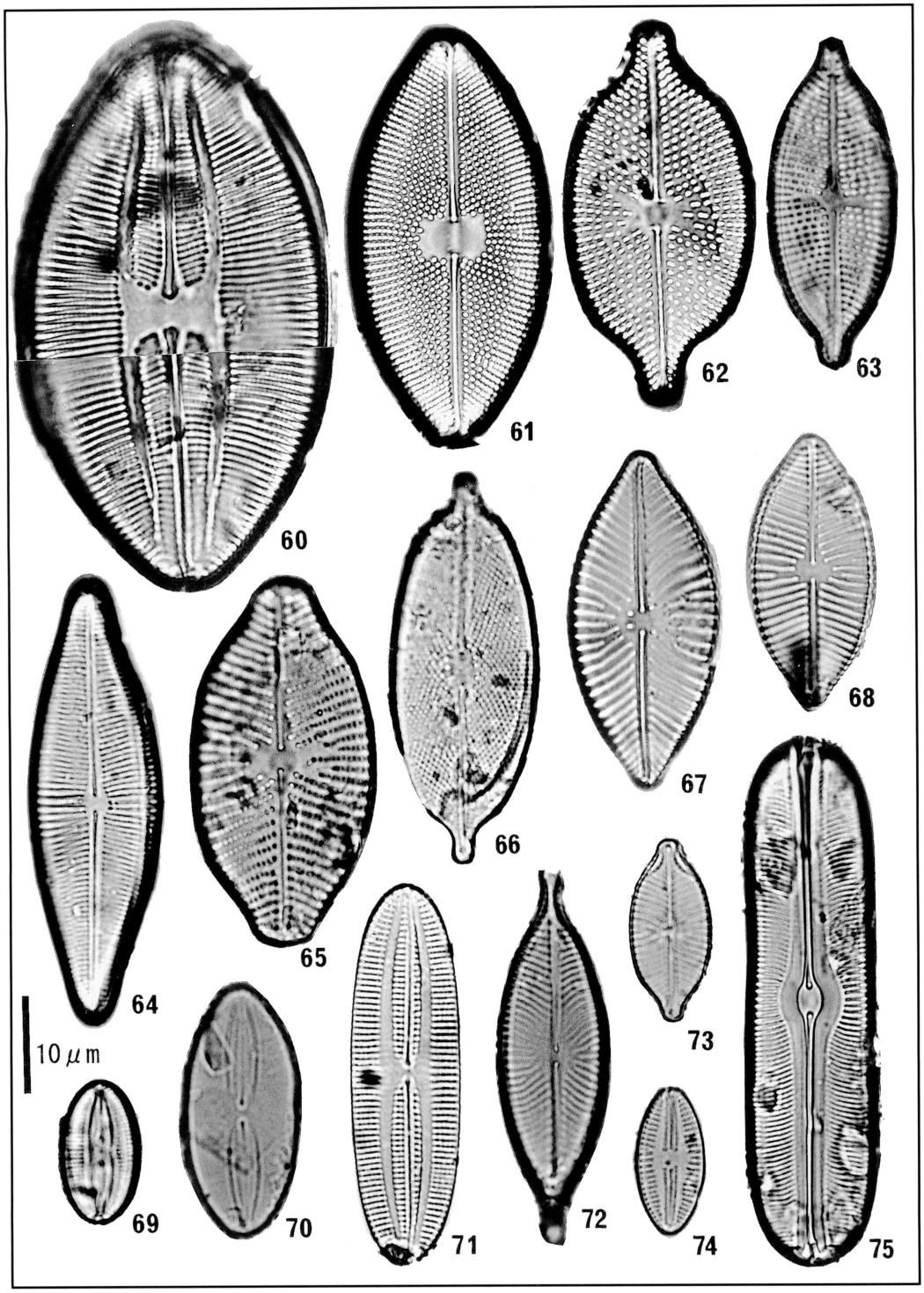

Fig.8. Diatom fossils in the Shorijo 10-2 core, Shiotsugata Lagoon (6) 60: *Navicula lyroides*, 61: *Navicula marina*, 62: *Navicula alpha*, 63: *Navicula tuscula*, 64: *Navicula crucicula*, 65: *Navicula gastrum*, 66: *Navicula placenta*, 67: *Navicula clementis*, 68: *Navicula placentula*, 69: *Navicula pseudony*, 70: *Navicula pygmaea*, 71: *Navicula forcipata*, 72: *Navicula salinarum*, 73: *Navicula decussis*, 74: *Navicula carminata*, 75: *Navicula bacillum*

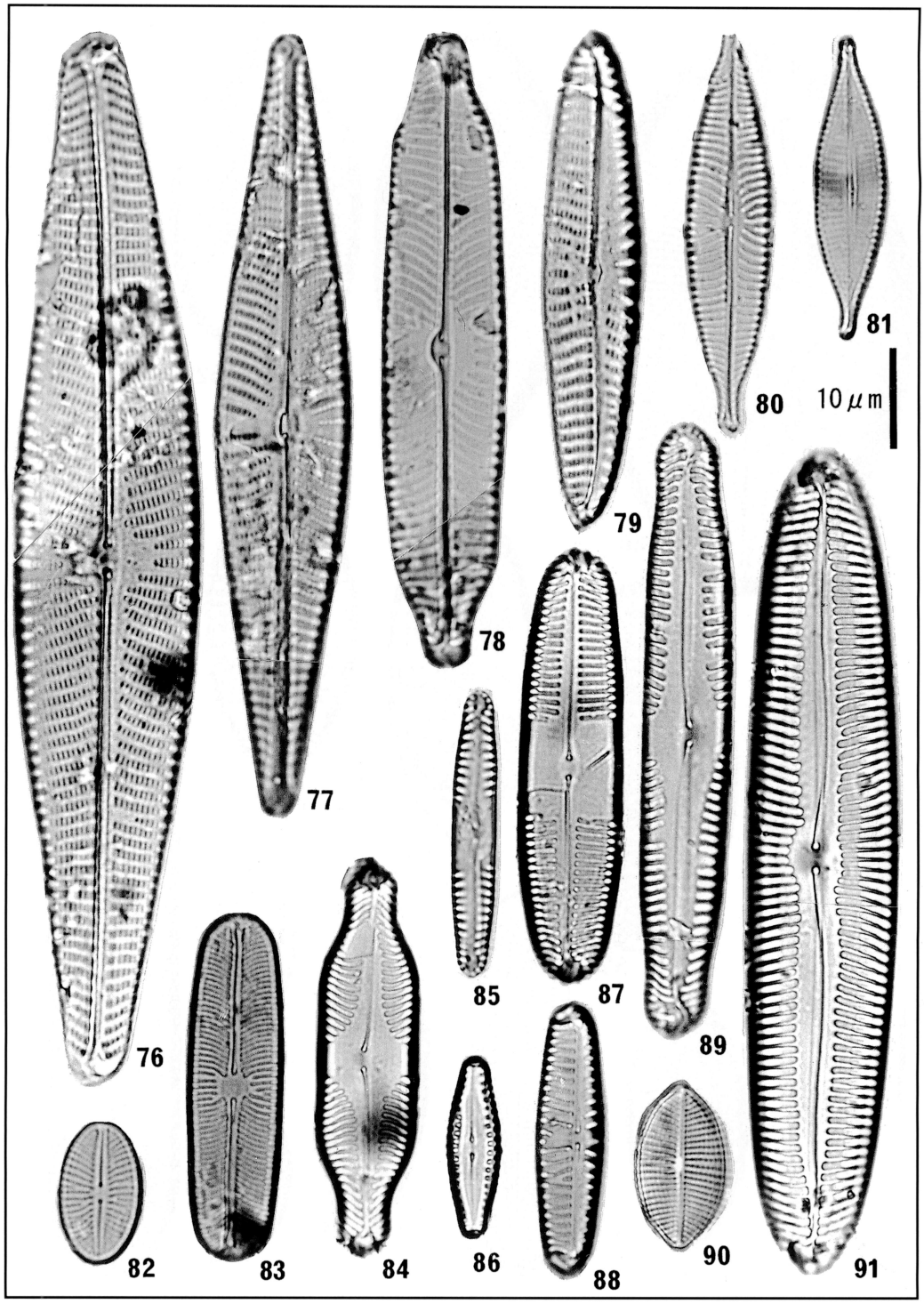

Fig.9. Diatom fossils in the Shorijo 10-2 core, Shiotsugata Lagoon (7) 76: *Navicula peregrina*, 77: *Navicula hasta*, 78: *Navicula viridula*, 79: *Navicula formenterae*, 80: *Navicula cryptocephara*, 81: *Navicula gregaria*, 82: *Navicula rotunda*, 83: *Navicula pupula*, 84: *Pinnularia interrupta*, 85: *Pinnularia subcapitata*, 86: *Pinnularia schwabei*, 87: *Pinnularia ridida*, 88: *Navicula capitata* var. *hungarica*, 89: *Pinnularia gibba*, 90: *Navicula jentzschii*, 91: *Pinnularia viridis*

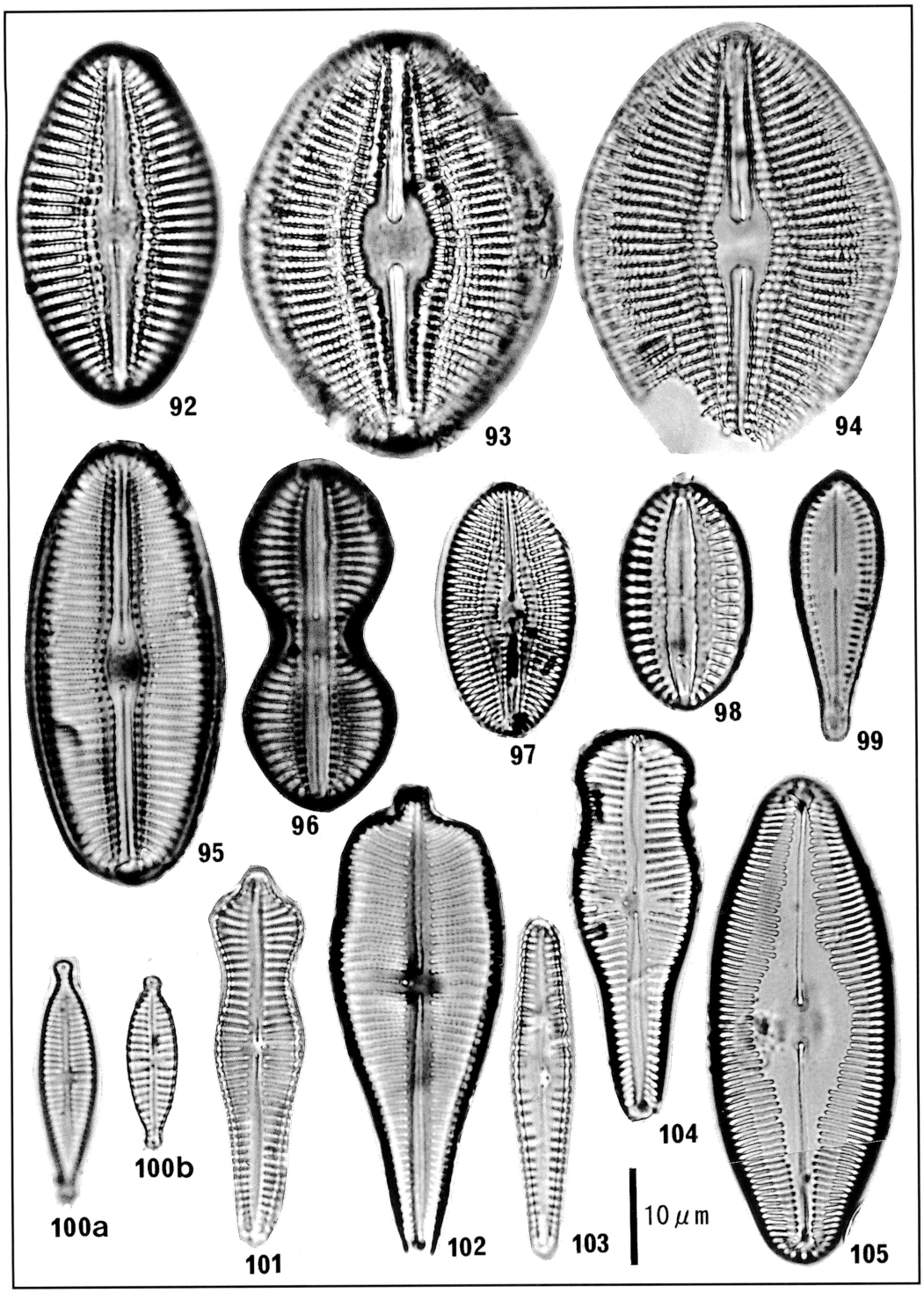

Fig. 10. Diatom fossils in the Shorijo 10-2 core, Shiotsugata Lagoon (8) 92: *Diploneis smithii*, 93: *Diploneis yatukaensis*, 94: *Diploneis elliptica*, 95: *Diploneis pseudovalis*, 96: *Diploneis interrupta*, 97: *Diploneis ovalis*, 98: *Diploneis suborbicularis*, 99: *Gomphonema grovei* var. *lingulatum*, 100a, b: *Gomphonema parvulum*, 101: *Gomphonema acuminatum*, 102: *Gomphonema augur*, 103: *Gomphonema angustum*, 104: *Gomphonema truncatum*, 105: *Caloneis brevis*

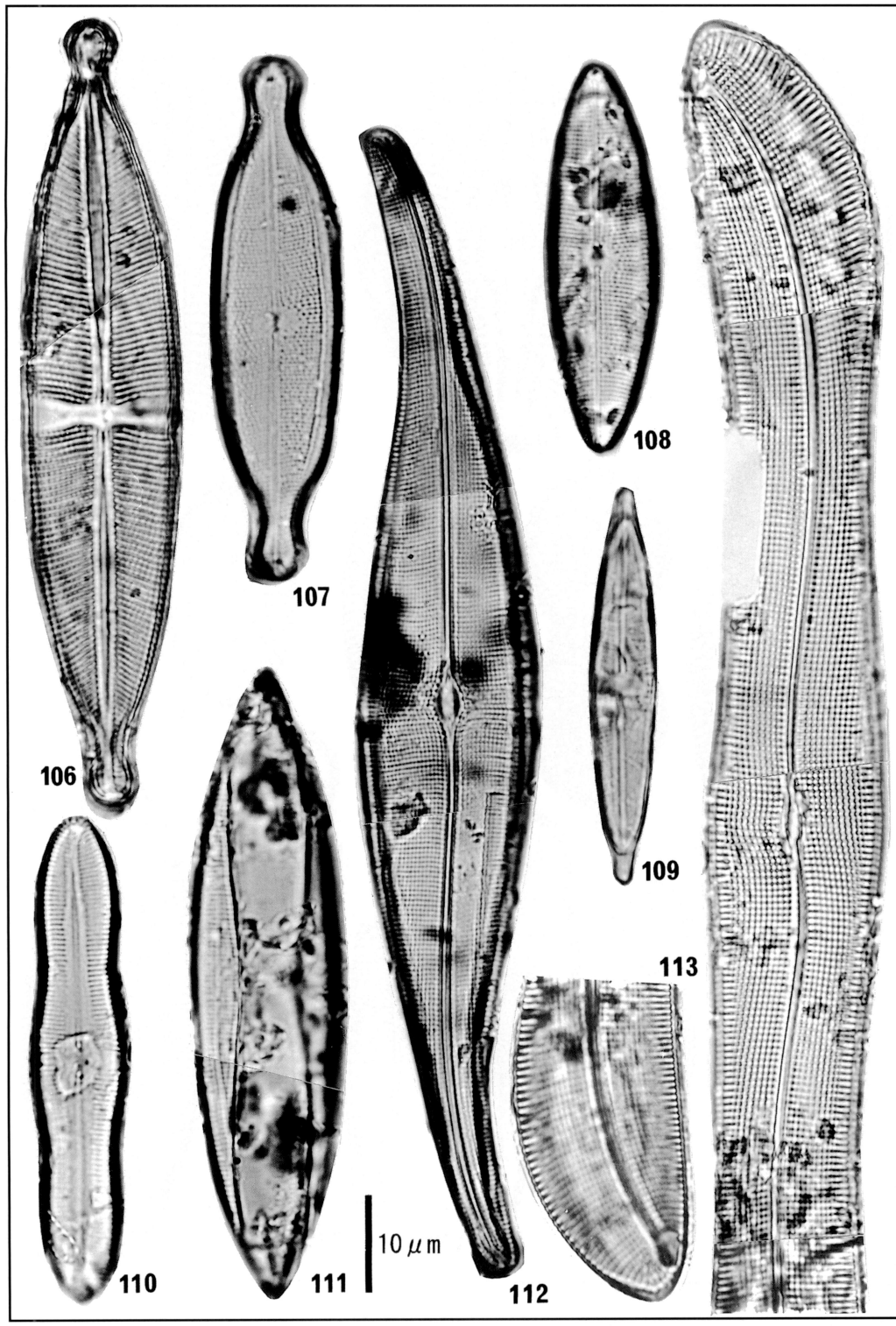

Fig.11. Diatom fossils in the Shorijo 10-2 core, Shiotsugata Lagoon (9)106: *Stauroneis phoenicenteron*, 107: *Neidium productum*, 108: *Mastogloia smithii*, 109: *Stauroneis smithii*, 110: *Caloneis silicula*, 111: *Plagiotropis lepidoptera* var. *proboscidea*, 112: *Gyrosigma distortum*, 113: *Gyrosigma exoticum*

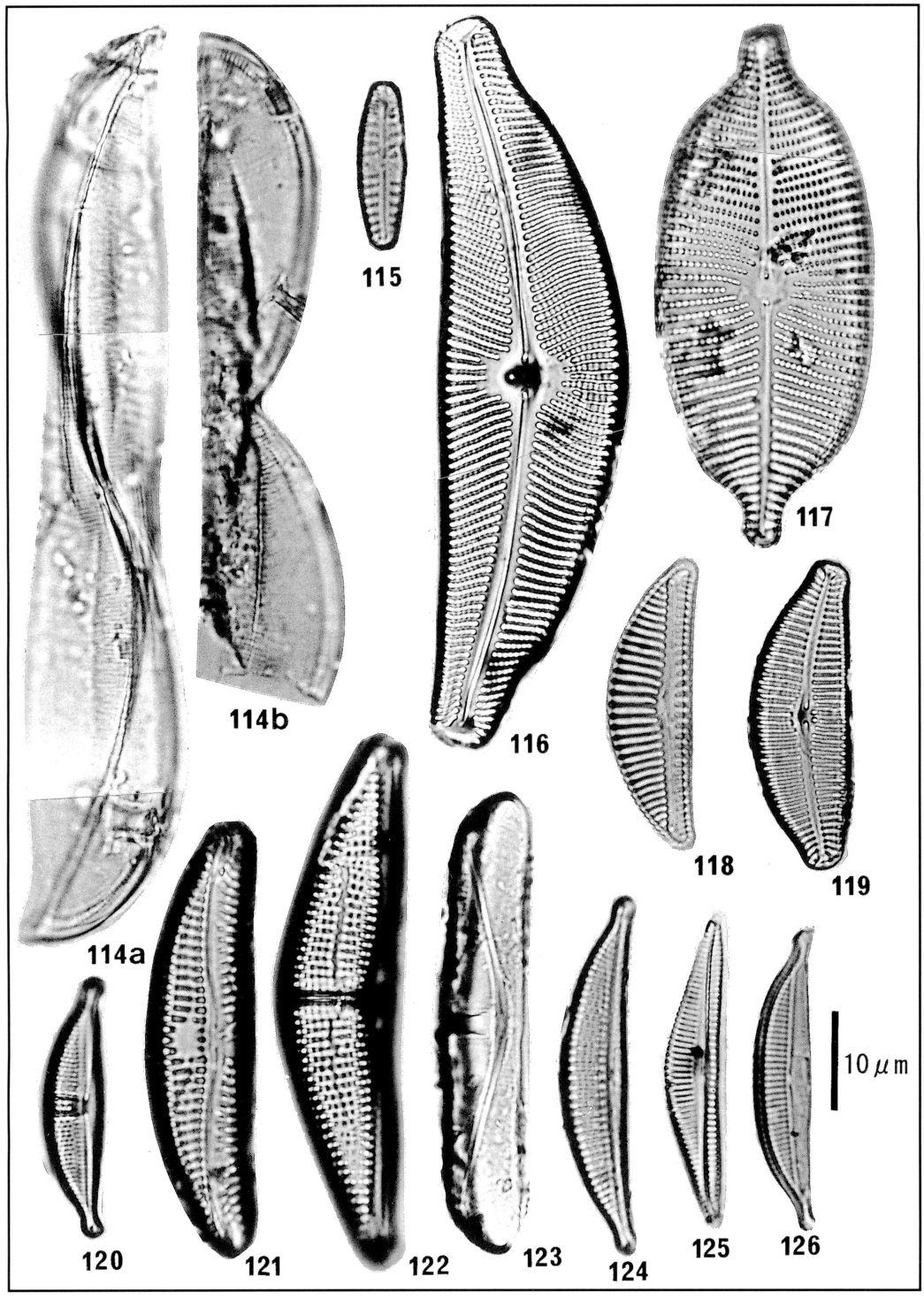

Fig. 12. Diatom fossils in the Shorijo 10-2 core, Shiotsugata Lagoon (10) 114a, b: *Entomoneis paludosa*, 115: *Cymbella sinuata*, 116: *Cymbella tumida*, 117: *Cymbella cuspidata*, 118: *Cymbella minuta*, 119: *Cymbella turgidula*, 120: *Amphora fontinalis*, 121: *Amphora proteus*, 122: *Amphora acuta*, 123: *Amphora delphinea*, 124: *Amphora holsatica*, 125: *Amphora angusta*, 126: *Amphora coffeaeformis*

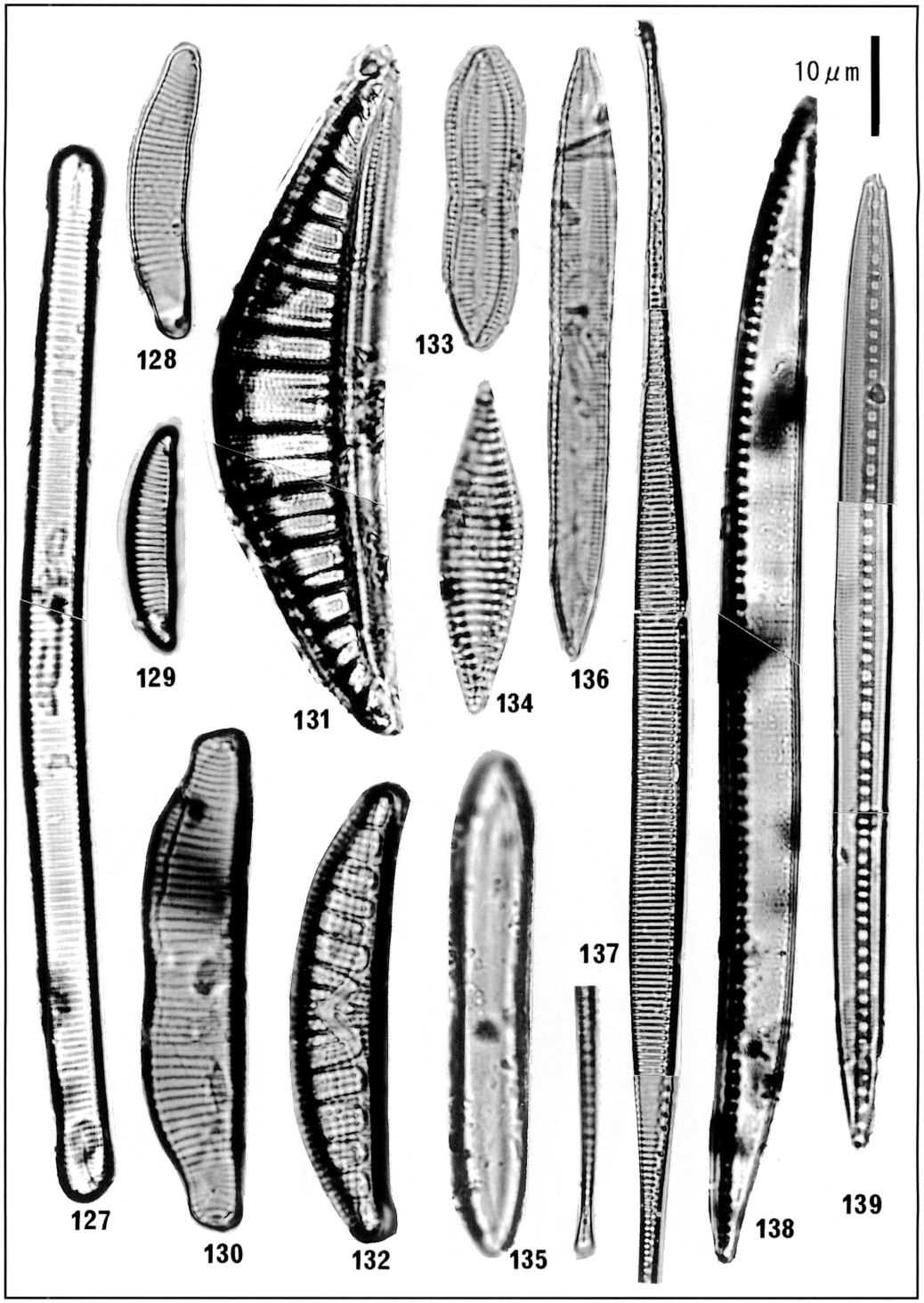

Fig. 13. Diatom fossils in the Shorijo 10-2 core, Shiotsugata Lagoon (11) 127: *Eunotia flexuosa*, 128: *Eunotia minor*, 129: *Eunotia veneris*, 130: *Eunotia praerupta*, 131: *Rhopalodia gibberula*, 132: *Epithemia adnata*, 133: *Nitzschia constricta*, 134: *Nitzschia lanceola*, 135: *Nitzschia normannii*, 136: *Nitzschia hungarica*, 137: *Nitzschia lorenziana*, 138: *Nitzschia sigma*, 139: *Bacillaria paxillifera*

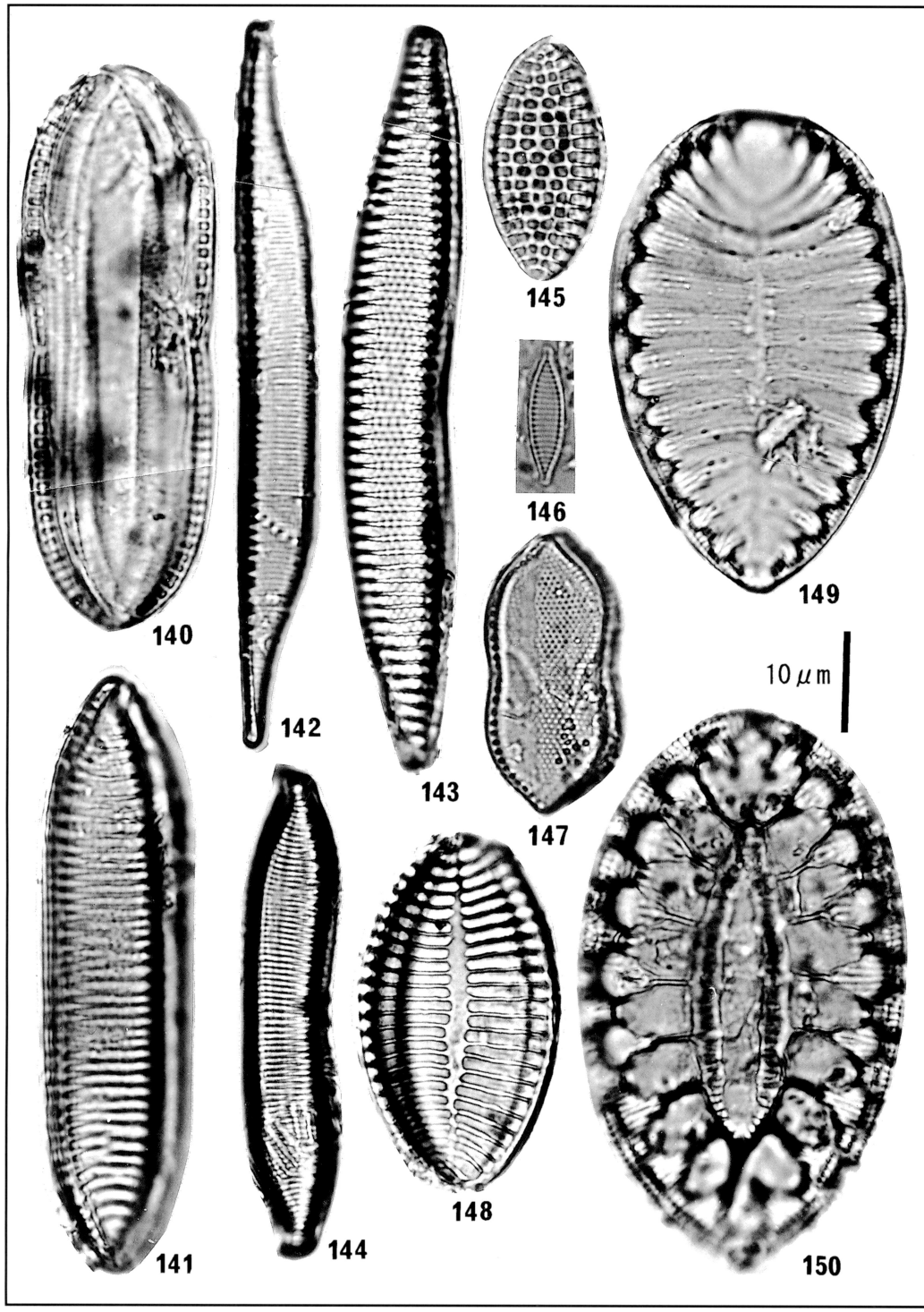

Fig.14. Diatom fossils in the Shorijo 10-2 core, Shiotsugata Lagoon (12) 140: *Nitzschia littoralis*, 141: *Nitzschia levidensis* var. *salinarum*, 142: *Hantzschia vivax*, 143: *Hantzschia marina*, 144: *Hantzschia amphioxys*,145:*Nitzschia granulata*, 146. *Nitzschia* sp. A,147: *Nitzschia panduriformis*, 148: *Nitzschia cocconeiformis*, 149: *Surirella brebissonii*, 150: *Surrirella fastuosa*