Diatom Flora and paleoenvironment of Late Pleistocene and Holocene deposits of Lake Kamo, Sado Island, Central Japan

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Abstract

The boring core KM-11, located at the center of Lake Kamo, Sado Island, provided a good opportunity to examine the Late Pleistocene and Holocene diatom biofacies. Fossil diatom assemblages in the core as well as sedimentary properties were useful for examining historical changes of Holocene sedimentary environment and relative sea level. Based on ecological groups, diatoms of this site are classified into 14 ecological groups. They are marine planktonic, marine epiphytic, brackish planktonic, marine/brackish epipsammic, marine/brackish epipelic, marine/brackish aerophilous, marine/brackish epiphytic, brackish/fresh tychoplanktonic, brackish/fresh epiphytic, brackish/fresh planktonic, brackish/fresh aerophilous, fresh water epiphytic, fresh water planktonic and fresh water epipelic diatom groups. The stratigraphical change of these groups is divided into seven diatom divisions. Each diatom division is closely related to the evolution of sedimentation caused by Holocene sea level and geomorphological changes.

In the Late Pleistocene, fluvial sediments were deposited in the site, then overlain by estuary sediments at the beginning of the Holocene transgression. Following the maximum Holocene transgression in 5,000 yr.BP., two small regressions occurred alternatively with two small transgressions respectively. After 1,800 yr.BP. fresh/brackish lacustrine sediments were deposited and marine/brackish lagoonal sediments have been deposited again since 1902 due to the construction of an artificial water way.

Key words : Holocene, Diatom, Sedimentary environment, Lake Kamo, Sado Island

I. Introduction

Holocene sediments and diatoms of Lake Kamo and its surrounding plain, Sado Island, have been studied by Sato and Kumano (1985, 1986), Matsuki *et al.* (1987) and Kobayashi *et al.* (1993).

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(Manuscript received 27 January, 1997, accepted 6 February, 1997)

These studies are important for understanding the natural environment and history of this lake. Diatom investigations have been carried out to obtain many informations about the paleoenvironmental condition and Holocene sea level change. Sato and Kumano (1985, 1986) analyzed diatoms from two boring cores on the southern bank of Lake Kamo to clarify the paleoenvironmental change during the last 6,000 years. Diatoms were grouped into three ecological categories: marine, brackish and fresh water. Together with ^{14}C dating, these data show that marine transgression occurred in 6,000 yr.BP., a regression in 4,500 yr.BP., a small transgression in 3,000yr.BP. and the final was probably the lowering stage of sea level from 1,800 yr.BP. This corresponds to a fresh/brackish water diatom division at the uppermost part of the core, 2 m in thickness. Matsuki (1987) investigated diatoms of a boring core in Lake Kamo and also stated a marine transgression in 4,670 yr.BP., followed by a minor regression in 4,500 yr.BP. In the Yayoi period, fresh/brackish water occupied, and the present condition of this lake is due to an artificial water way which was made in 1902. However, a detailed study on Holocene sediments and the boundary of Late Pleistocene and Holocene has not yet been carried out. The KM-11 boring core provided a good opportunity to examine the Latest Pleistocene and Holocene sedimentary environments based on diatom research.

The Geological Survey of The Netherlands has focussed its paleoecological diatom research on the reconstruction of the sedimentary environments of the Dutch Holocene coastal deposits. A code list of the most common diatom species in the Holocene coastal deposits of The Netherlands was presented by De Wolf (1982). Recently, a new approach of diatom research was introduced by Vos and De Wolf (1988, 1993). It was based on the factors 'life form' and 'salinity'. The diatoms were classified into ecological groups which were related to specific sedimentary environments in the coastal areas.

In this study, diatom fossils are used to interpret the change of paleoenvironment of the Late Pleistocene and Holocene sediments based on Vos and De Wolf's classification of ecological groups and a brief report (Nguyen and Kobayashi, 1996) was published for the abstract of the 14th International Diatom Symposium in Tokyo.

II. Locality and geological outline

The Lake Kamo boring core (KM-11) is located at the center of Lake Kamo which is about 8 m in water depth. Lake Kamo is situated in Ryotsu City, Sado Island, Niigata Prefecture (Fig.1).

The geological section of boring core KM-11, 54.19 m in length, is divided into six lithological units, named Unit I to Unit VI in ascending order (Fig. 2).

Unit I (-54.19 to -37.10 m) is subdivided into three subunits (Ia - Ic), each consisting of fine sand to sandy silt bed with top peat. There is a sandy gravel bed, 4 m in thickness, at the base of this Unit. Unit II (-37.10 to -31.10 m) is composed of alternated beds of coarse-medium sands and sandy silts, fining upward. A sandy gravel bed is at the base of this unit. Unit III (-31.10 to -27.60 m) is composed of two subunits, each consisting of fine sand to sandy silt bed with humus matters, fining upward. Unit IV (-27.60 to -21.50 m) is composed of dark gray clays and clayey silts commonly bearing shell fragments. Unit V (-21.5 to -8.5 m) is composed of coarse-fine sands and pebbly sands bearing shell

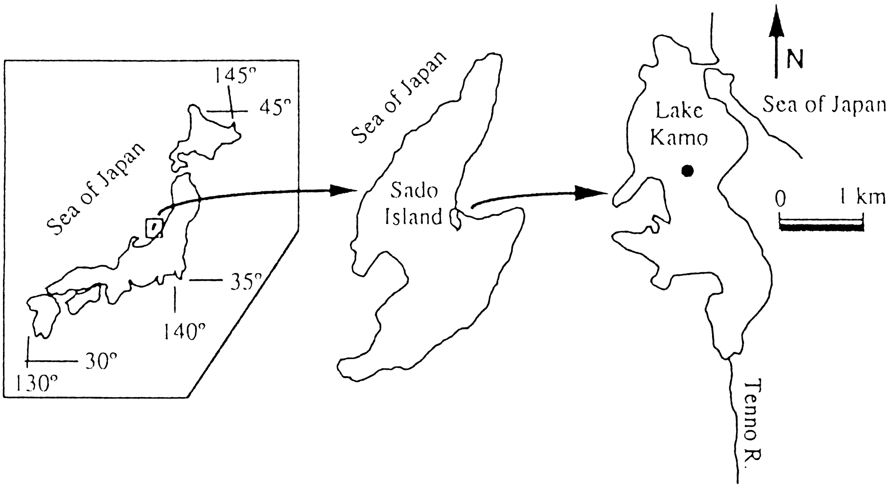


Fig. 1. Location of Lake Kamo; black dot: boring core KM-11.

fragments. Fine sands and sandy silts occupy at the lower part. Unit VI (-8.5 to 0 m) is composed of dark gray clays bearing shell fragments at the lower part, and laminations of very fine sandy silts with humus matters at the top part.

III. Material and method

In this study, 75 sampling points of the boring core KM-11, from -0.1 to -43 m were selected for diatom analysis.

Each sample of approximately 1 to 3 grams in weight is boiled with 15% hydrogen peroxide to remove organic matters, and then dispersed in 250 ml of distilled water. After repeating decantations and settlements to remove clay-sized particles, the solution is brought to near neutral pH. From this solution, a 0.5 ml diatomaceous residue is dried on a coverslide and mounted in Pleurax, commercially named Mountmedia. 200 - 300 frustules of diatoms in each sample are counted and identified by the use of an optical microscope.

Sedimentary environments were reconstructed according to Vos and De Volf (1988, 1993, 1994), who classified diatoms into ecological groups based on the factors 'life form' and 'salinity'. The new categories can be related to tidal exposure and desiccation gradient so that they can be used to reconstruct sedimentary environments (subtidal, intertidal, supratidal and non-tidal). The benthic diatoms are subdivided into epipelic (mobile diatoms, which migrate actively through the mud), and epipsammic taxa (immobile diatoms, which are firmly attached to sand grains). Those benthic diatoms which are adapted to be irregularly flooded have been classified in a special category: benthos aerophilous. Epiphytic group includes taxa which live attached to macrophytes. The plankton group is subdivided into plankton sensu stricto (s.s.) and tychoplankton. Planktonic diatoms s.s. are species which live in

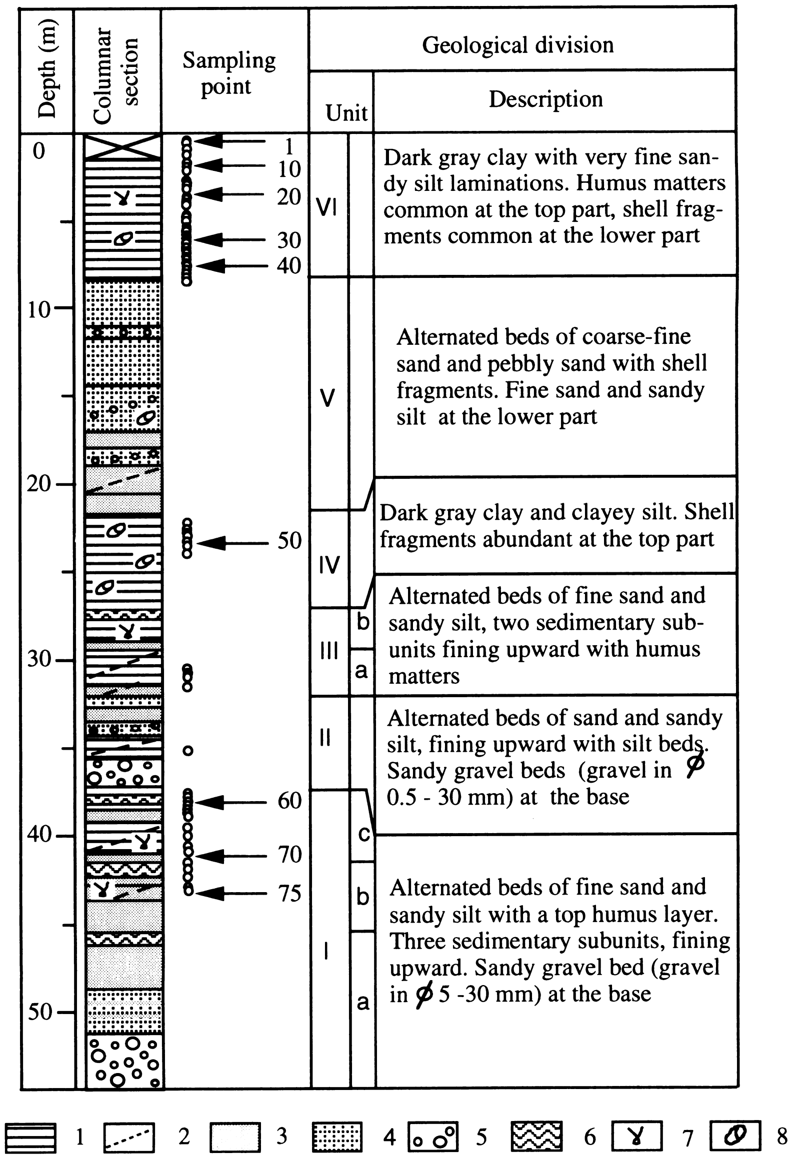


Fig. 2. Geological column and sampling points of boring core KM-11. 1. Clay, 2. Silt, 3 Fine sand, 4. Medium-coarse sand, 5. Gravel, 6. Peat, 7. Plant fragment, 8. Shell fragment

the plankton habitat (metabolize and reproduce in the water column), whereas the tychoplanktonic diatoms are species which occur frequently in the water column, but are also related to another (benthic/epiphytic) habitat.

The results of the diatom analysis have to be synthesized in the form of percentage diagrams for both the individual species and the ecological groups. The paleoenvironmental interpretations are based on the major trends of relative abundances of the ecological groups.

IV. Result of analysis

112 genera and 108 species are discriminated in this study and the list of diatom flora is shown in Table 1. On the basis of Vos and De Wolf's ecological groups, 14 ecological groups are divided. Characteristic species of each ecological group are as follows:

Marine planktonic diatom group is representative of *Actinocyclus ehrenbergii, Paralia sulcata, Thalassionema nitzschioides* and *Thalassiosira eccentrica.*

Marine epiphytic diatom group is representative of *Grammatophora oceanica, Nitzschia pauduriformis* and *Trachyneis aspera.*

Brackish planktonic diatom group is representative of *Coscinodiscus lacustris* , *Cyclotella caspia* and *Cyclotella striata.*

Marine/brackish epipsammic diatom group is representative of *Achnanthes hauckiana Dimeregramma minor* and *Plagiogramma staurophorum.*

Marine/brackish epipelic diatom group is representative of *Amphora proteus, Bacillaria paradoxa, Diploneis smithii, Diploneis suborbicularis, Mastogloia smithii, Nitzschia constrista* and *N. obtusa.*

Marine/brackish aerophilous diatom group is representative of *Diploneis interrupta.*

Marine/brackish epiphytic diatom group is representative of *Achnanthes brevipes, Cocconeis scutellum, Melosira jurgensii, Rhopalodia gibberula* and *Synedra pulchella.*

Brackish/fresh tychoplanktonic diatom group is representative of *Fragilaria construens* and *F.* var. *venter.*

Brackish/fresh epiphytic diatom group is representative of *Amphora lybica, Rhopalodia gibba* and *Cocconeis placentula.*

Brackish/fresh planktonic diatom group is representative of *Diatom elongatum.*

Brackish/fresh aerophilous diatom group is representative of *Hantzschia amphioxys, Navicula pusilla, Pinnularia viridis* and *P. subcapitata.*

Fresh water epiphytic diatom group is representative of *Cymbella cistula, C. tumida, Diploneis ovalis, Epithemia turgida, Gomphonema acuminatum* , *G. constristum* and *Synedra ulna.*

Fresh water planktonic diatom group is representative of *Melosira granulata, M. ambigua* and *Stephanodiscus astrea.*

Fresh water epipelic diatom group is representative of *Caloneis bacillum, Navicula radiosa* and *N. viridula.*

V. Diatom floral change

On the basis of above-mentioned ecological groups, the diatom floral change of the site is divided into seven diatom divisions; namely, A, B, C, D, E, F and G in ascending order relatively with abundant diatom species (Fig. 3) and ecological groups (Fig. 4) as follows:

(1) A diatom division (-43.0 to -37.55 m) corresponds to the upper part of subunit Ib, and the lower part of subunit Ic. It is composed of 30 to 50% fresh water epiphytic, 10 to 30% fresh water

Table 1. The list of diatom flora
* after Vos and De Wolf, 1996

Ecological group *	Sample number / Species name \ depth (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
		0.1	0.2	0.3	0.4	0.5	0.6	0.75	0.85	1	1.55	1.7	1.8	1.9	2	2.55	2.7	2.8	3	3.5	3.65	3.85	4	4.55	4.7	4.91	5.19	5.31	5.5	5.75	5.83
Marine planktonic	*Actinocyclus ehrenbergii*	7.6	3.2	1.7	0.6	0.3	0.4	1.3	1.4	1.7	1.6	1.4	0.9	1.0	0.2	0.5	1.1	0.2	0.1	0.5	4.0	0.2	0.3	0.4	0.1	0.4	0.2	0.8	0.3	2.0	1.6
	Actinoptychus undutalus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-	-	-	-	-	-	-	0.1	0.2	-	0.1
	Amphiprora angustata	0.9	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.3	0.2	-	-	-	0.4	0.4	0.3	0.5	0.6	0.2	0.1	0.4
	Asteromphalus heptactis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.2	-	-	0.2	0.4	0.2	0.1	0.1	0.2	0.4	0.4	0.4	0.8
	Biddulphia pulchella	-	-	-	-	-	-	-	-	-	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5	0.2	0.2	0.1
	Campylodiscus fastuosus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Coscinodiscus nodulifer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	0.1	0.5	0.4	0.7	0.5	-	-	-	0.5
	Coscinodiscus radiatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.3	0.3	0.4	0.6	0.3	0.2	-	-	0.1
	Paralia sulcata	-	0.2	0.2	0.3	0.2	0.2	0.6	0.2	0.4	0.2	-	0.1	-	-	0.1	1.1	2.5	4.0	0.2	0.2	3.7	6.0	2.8	2.6	3.3	2.0	1.4	0.3	0.1	0.1
Marine epiphytic	*Surirella fatuosa*	2.4	0.6	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Thalassionema nitzschioides	2.4	0.5	0.5	-	-	-	-	-	-	0.2	-	-	-	0.4	1.3	0.1	6.1	5.5	0.3	-	2.3	7.9	8.3	2.8	6.2	5.9	8.4	13.2	5.8	5.7
	Thalassiosira eccentrica	-	-	0.3	0.1	-	0.1	0.3	0.2	0.2	0.1	0.3	0.5	0.2	3.1	4.9	8.5	19.5	18.4	0.7	0.8	13.5	18.1	22.1	16.0	20.8	18.4	29.2	20.1	13.6	30.8
	Grammatophora oceanica	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	0.2	0.7	0.3	-	3.9	2.3	9.0	2.8	5.9	2.3	2.2	2.1	0.6	1.5
	Navicula distans	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.1	0.1	-	-	-	-	0.2	0.3	0.4	0.3	0.5	0.5	0.7	0.4	0.5	0.8
Brackish plantonic	*Nitzschia panduriformis*	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4	0.8	0.1	-	1.2	0.9	0.3	0.5	0.1	0.7	1.0	0.1	0.2	-
	Trachyneis aspera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.1	-	-	-	0.1	0.1	0.1	0.4	0.4	0.2	-	-	-
	Coscinodiscus lacustris	13.1	31.0	32.3	20.5	18.5	19.1	26.2	27.1	18.9	21.0	18.9	16.7	20.4	1.0	1.0	8.7	2.5	1.3	4.8	17.3	1.4	1.4	0.6	0.5	0.8	1.2	1.3	0.2	1.2	0.2
	Cyclotella caspia	4.6	6.7	10.8	12.8	8.4	9.9	10.6	8.4	8.1	9.5	9.3	9.5	10.7	42.4	31.4	21.1	16.6	10.1	26.8	11.0	6.5	10.5	6.3	12.6	7.9	13.4	3.5	4.2	10.6	6.2
	Cyclotella striata	-	0.1	0.1	-	-	-	-	-	-	-	-	-	-	0.2	0.7	-	-	0.1	0.2	-	0.1	0.1	0.2	0.2	-	0.7	1.5	0.7	0.6	0.8
Marine/brackish epipsammic	*Achnanthes hauckiana*	-	-	-	-	-	-	0.1	-	-	-	-	0.1	-	0.3	0.6	0.3	0.3	0.6	-	-	0.7	0.3	0.4	0.2	0.2	0.2	0.1	0.4	0.5	0.1
	Dimeregramma minor	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.8	-	-	2.7	0.2	2.6	0.8	2.1	2.1	2.3	0.4	0.1	0.4
	Opephora martyi	-	-	-	-	-	-	-	-	-	0.1	-	0.1	-	0.3	0.2	0.2	0.1	0.3	0.6	0.2	0.2	0.5	1.3	0.6	0.3	0.2	0.1	-	0.1	-
	Plagiogramma staurophorum	2.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.4	0.1	-	-	-	-	-	-	-	0.4	0.3	-	-	-
	Amphora acuta	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7	0.2	1.7	-	0.2	-	0.5	0.1	0.2	0.1	0.1	0.4	0.7	0.1
	Amphora holsatica	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	-	-	0.8	0.7	0.7	-	1.3	0.2	0.7	0.4	0.3	0.2	0.5	0.9	0.2	0.3
	Amphora proteus	0.9	0.5	1.1	0.4	0.3	0.1	0.3	0.1	1.8	0.4	0.2	1.2	0.9	3.2	9.0	8.3	3.5	4.5	2.0	2.8	2.3	2.0	2.6	1.8	1.5	3.9	2.7	4.1	3.2	5.2
Marine/brackish epipelic	*Bacillaria paradoxa*	1.5	0.6	0.8	0.3	0.4	0.2	0.6	0.3	0.4	1.5	0.3	0.1	0.3	4.2	2.7	1.9	3.3	3.2	3.0	0.1	3.8	1.8	1.4	4.2	1.9	1.9	1.5	2.7	3.2	4.4
	Caloneis brevis	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.3	0.1	-	-	-	-	-	0.3	0.3	-	-	0.2	-	0.2	0.5	0.2
	Caloneis liber	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	0.1	0.4	0.5	0.4	-	0.3	0.3	0.4	0.4	-	0.3	-	-	0.0	0.1
	Cocconeis pseudo-marginata	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-	0.1	0.4	-	-	-	-	-	-	-	-	-	-	-	0.1
	Diploneis bombus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.1	0.8	0.4	-	-	0.8	0.2	0.1	0.4	0.3	0.1	0.3	0.2	-	-
	Diploneis smithii	2.4	3.5	1.3	0.6	0.5	0.4	1.5	0.7	3.5	1.3	1.3	1.5	1.0	0.9	1.7	3.0	2.7	2.5	3.1	3.4	2.8	3.6	3.7	4.0	5.2	2.3	1.1	4.2	6.7	2.2
	Diploneis suborbicularis	-	-	-	-	-	-	-	-	-	-	-	-	-	1.8	3.8	3.0	3.7	3.0	4.4	-	0.5	1.5	0.6	1.0	0.5	1.8	0.1	1.2	4.3	3.2
	Gyrosigma distortum	2.4	-	0.3	0.6	0.1	0.2	0.2	0.2	0.8	0.4	0.3	0.5	-	0.1	0.1	0.1	0.3	0.1	0.2	-	0.5	0.3	-	-	0.1	0.2	-	0.1	0.1	0.1
	Gyrosigma strigilis	2.4	0.2	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mastogloia smithii	0.9	0.5	0.5	0.1	0.1	-	0.2	-	0.5	0.4	0.1	0.2	0.2	1.6	2.1	1.5	1.2	1.6	1.5	-	2.0	0.9	1.8	4.3	2.5	2.6	2.4	6.7	3.3	4.6
	Navicula cancellata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	1.2	0.9	0.3	0.3	-	-	-
	Navicula cf. *peregrima*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.2	0.1	0.1	0.3	0.3	-	-	-	-	-	-	-	-	-	-
	Navicula elegans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Navicula forcipata	-	0.1	0.2	0.1	-	-	0.1	-	-	-	-	-	-	0.7	0.1	0.1	0.1	0.2	0.1	0.1	2.2	1.1	0.5	1.6	0.4	0.8	0.4	2.3	0.6	0.6

	Navicula liroides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6	0.2	-	-	0.1	0.1	0.1	0.2	0.1	-
	Navicula marina	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	0.4	0.7	0.8	0.1	0.7	0.7	1.0	-	0.1	0.3	0.2	0.5	0.4	0.2	-
	Navicula sculpta	-	-	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Navicula sp.	-	-	0.1	0.1	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marine/brackish aerophilous	*Nitzschia coarctata*	0.9	0.5	-	-	-	-	-	-	-	0.1	-	0.2	-	0.2	0.1	-	0.4	2.1	0.5	0.1	3.1	4.4	1.2	3.1	1.7	1.8	2.2	3.0	0.9	1.6
	Nitzschia constricta	2.4	0.7	1.0	0.3	0.1	0.1	0.7	0.2	0.6	0.6	0.2	0.6	0.3	0.9	0.4	2.7	2.2	2.1	2.0	0.5	6.5	4.0	3.5	5.0	4.2	1.7	4.0	2.9	2.6	1.6
	Nitzschia granulata	8.6	0.6	0.3	0.1	-	-	-	-	-	-	-	-	-	-	-	-	0.2	0.9	0.3	0.1	0.4	0.6	0.4	0.8	0.5	0.1	0.3	0.9	0.2	0.1
	Nitzschia lanceola	5.5	-	0.2	-	-	-	-	-	-	-	-	-	-	0.3	-	-	0.5	1.2	0.1	-	0.4	0.3	1.2	2.8	3.2	1.4	5.8	0.1	0.3	2.7
	Nitzschia levidensis	-	1.2	3.2	1.3	0.5	0.5	1.4	0.6	1.1	1.3	0.6	0.9	1.0	1.2	1.2	0.9	0.8	0.2	0.6	0.1	0.4	0.2	0.4	0.9	-	-	-	0.2	1.0	0.4
	Nitzschia longissima	0.6	0.2	0.2	-	-	-	0.2	-	-	0.3	-	0.1	0.1	0.1	-	0.1	0.2	0.5	0.2	-	0.3	0.2	0.1	0.1	0.1	0.3	0.2	0.3	0.3	0.1
	Nitzschia lorenziana	2.1	-	-	0.1	0.1	-	0.1	-	-	-	-	0.4	-	-	-	0.1	0.2	0.2	0.6	-	0.3	0.7	-	0.1	0.1	-	0.2	0.1	0.0	0.1
	Nitzschia navicularis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	0.4	0.4	0.5	-	-	-
Brackish/fresh aerophilous	*Nitzschia obtusa*	0.9	0.2	0.1	-	-	-	-	-	0.2	0.1	0.2	0.1	-	0.2	0.7	1.1	1.1	4.5	1.4	0.5	5.9	6.1	5.8	5.0	3.9	3.7	3.5	4.6	1.5	1.1
	Pleurosigma aestuarii	0.9	0.2	0.1	-	-	-	-	-	-	-	-	-	-	0.4	0.7	0.5	0.5	1.1	0.5	-	1.3	0.6	0.4	1.5	0.9	0.5	0.8	1.8	0.4	0.6
	Surirella circumsuta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4	-	-	-	-	-	-	-	-	-	-	-	0.2	0.3	-
	Diploneis interrupta	-	-	-	-	-	-	-	-	0.2	0.1	-	-	-	0.4	0.1	0.1	1.9	1.5	-	-	1.0	0.9	0.3	0.2	0.3	1.0	0.6	1.2	0.5	0.8
	Hantzschia amphioxys	-	0.1	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	-	-
Marine/brackish epiphytic	*Navicula pusilla*	-	0.3	0.2	0.2	0.5	0.6	0.2	0.2	0.2	0.4	0.3	0.4	1.1	0.3	0.1	0.3	-	-	-	0.2	-	0.3	-	0.2	-	-	-	-	0.2	0.1
	Pinnularia microstauron	-	-	-	-	-	0.2	0.2	-	0.2	-	-	-	-	0.1	0.3	0.3	0.3	0.4	0.4	0.5	0.2	-	0.1	-	-	-	-	-	-	-
	Pinnularia subcapitata	-	-	-	-	0.3	0.5	0.2	0.3	0.2	0.2	0.4	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Pinnularia viridis	-	0.1	-	-	1.0	0.8	0.1	0.3	0.5	0.4	0.9	0.2	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Achnanthes brevipes	-	-	0.1	0.1	0.1	0.2	0.2	-	0.6	-	-	0.4	-	0.7	1.0	0.5	1.3	0.9	1.3	0.2	1.6	0.8	0.6	1.4	1.7	1.3	1.5	2.2	1.8	2.3
	Cocconeis scutellum	0.6	-	0.2	0.1	-	-	-	-	0.1	0.2	-	0.4	-	2.1	3.5	0.6	3.2	5.3	1.2	0.6	4.8	3.3	1.9	4.2	4.3	4.0	5.9	3.4	1.8	2.5
Brackish/fresh tychoplanktonic	*Melosira jurgensii*	-	4.6	1.6	0.7	0.4	0.5	0.5	0.3	0.2	0.4	0.1	-	-	2.4	2.7	1.2	0.6	0.1	2.9	-	0.2	0.4	0.4	0.4	0.2	1.3	0.2	0.2	1.4	1.1
	Rhopalodia gibberula	-	0.1	0.1	0.3	0.2	0.2	0.3	0.3	1.4	0.6	0.2	0.4	0.9	3.3	5.4	4.9	4.0	3.6	5.3	3.5	5.0	3.7	3.1	3.8	4.1	3.6	1.3	2.8	3.8	4.9
	Synedra crystalliana	-	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4	0.4	-	-	0.8	0.6	1.3	0.9	0.9	0.3	0.5	-	-	-
	Synedra pulchella	2.4	4.4	3.9	0.7	0.3	0.2	1.6	0.8	1.2	4.1	0.9	1.1	0.3	1.0	1.7	0.8	0.2	0.1	1.8	0.5	0.2	0.3	0.2	0.2	0.3	0.7	0.3	0.7	1.6	0.2
	Synedra tabulata	-	0.2	-	-	-	-	-	-	0.1	1.4	-	0.2	-	0.2	0.1	0.1	0.1	0.7	2.0	0.3	1.5	0.2	0.2	0.1	0.3	0.5	0.4	0.2	1.9	0.8
	Fragilaria construens	-	-	0.6	0.2	0.4	0.2	0.2	-	0.5	0.4	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fragilaria var venter	-	0.3	0.3	0.4	0.4	0.5	0.4	0.6	0.8	0.4	0.5	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brackish/fresh epiphytic	*Amphora lybica*	-	0.3	0.3	0.6	0.8	0.8	0.2	0.6	0.2	0.1	0.5	0.1	-	0.3	0.2	0.2	0.2	0.3	0.3	0.2	0.4	0.3	0.2	0.2	0.3	0.1	0.1	0.1	0.1	-
	Cocconeis placentula	3.1	1.2	2.4	2.6	1.7	1.7	2.1	0.9	1.4	1.9	2.1	3.8	3.5	2.2	2.4	0.8	1.1	1.9	1.2	0.5	0.9	0.3	0.9	0.3	0.3	1.0	0.2	0.2	0.7	0.5
	Rhopalodia gibba	0.6	2.7	2.4	4.6	3.0	3.9	3.0	1.9	2.1	2.2	2.3	2.3	2.8	2.2	1.2	5.2	0.4	0.3	4.6	1.6	-	-	-	0.1	0.2	0.4	0.1	0.2	6.9	0.3
	Roicosphenia curvata	-	0.1	0.6	0.4	1.1	1.1	0.8	0.7	0.9	0.4	0.4	0.6	0.7	1.5	2.6	1.0	0.4	0.4	1.2	0.2	0.2	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.3	0.4
	Diatom elongatum	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brackish/fresh planktonic	*Achnanthes* spp.	-	0.2	0.1	0.1	0.5	0.5	0.2	0.2	0.2	0.2	-	0.3	-	0.3	0.5	0.2	0.4	0.6	-	-	0.2	0.1	-	-	-	0.2	-	0.3	0.3	0.4
	Actinella brasiliensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cymbella sp.	0.6	0.3	0.3	1.5	1.7	1.8	0.8	1.9	1.0	1.3	2.1	1.3	0.2	0.2	0.4	-	-	-	0.2	0.6	-	-	0.3	-	-	-	0.1	-	-	-
	Cymbella cistula	0.3	0.1	0.3	0.2	0.5	0.5	0.4	0.7	0.8	0.6	0.5	0.8	0.1	-	-	-	-	-	-	0.1	0.1	-	-	-	-	-	-	-	-	-
	Cymbella tumida	-	-	0.2	0.2	0.5	0.4	0.3	0.2	0.5	0.2	0.4	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Diatoma hiemale	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fresh water epiphytic	*Diatoma vulgare*	-	-	-	-	-	-	-	-	-	0.1	-	0.1	-	0.1	-	-	-	-	-	-	-	-	-	-	-	0.2	0.1	-	-	-
	Diploneis eliptica	-	3.0	2.6	1.4	0.8	0.6	1.8	1.1	2.0	1.7	0.9	2.2	2.3	3.6	2.7	-	1.8	1.1	1.8	4.0	1.0	1.6	1.0	1.3	1.7	0.8	0.6	1.7	0.7	0.5
	Diploneis ovalis	0.6	0.5	1.3	1.5	1.7	1.7	1.0	1.7	2.0	0.2	0.5	0.3	0.5	0.4	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.1	-	-	-	-	-	0.1	0.1	0.1
	Epithemia sorex	-	-	-	0.4	-	-	0.1	-	0.1	0.1	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Ecological group *	Sample number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	Species name \ depth (m)	0.1	0.2	0.3	0.4	0.5	0.6	0.75	0.85	1	1.55	1.7	1.8	1.9	2	2.55	2.7	2.8	3	3.5	3.65	3.85	4	4.55	4.7	4.91	5.19	5.31	5.5	5.75	5.83
Fresh water epiphytic	*Epithemia turgida*	1.5	1.4	3.0	4.6	6.7	6.8	5.0	2.4	1.9	2.7	2.9	3.4	4.4	0.3	0.4	0.9	-	-	0.3	1.9	-	-	-	-	-	-	-	0.1	0.4	-
	Eunotia pectinalis	-	0.3	0.2	0.2	0.3	0.2	0.2	-	0.4	0.4	0.4	0.6	-	-	0.1	-	0.1	0.1	-	0.8	-	-	-	-	-	-	-	-	-	0.0
	Frustulia vulgaris	-	-	-	-	-	-	0.1	-	-	-	-	0.1	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Gomphonema acuminatum	-	-	-	0.4	1.3	0.5	0.1	1.5	1.9	1.3	0.9	1.4	-	-	0.3	0.2	-	-	-	0.8	-	0.2	-	-	-	0.2	0.1	-	0.5	0.1
	Gomphonema constristum	1.5	1.0	0.3	0.1	0.4	0.4	0.2	0.1	0.2	0.1	0.1	0.1	-	-	-	-	-	-	0.1	0.1	-	0.1	-	-	-	-	-	-	-	-
	Nitzschia palea	-	0.3	0.3	0.1	0.5	0.4	0.3	-	0.4	0.3	-	0.1	0.7	1.6	1.3	0.4	0.4	0.6	0.1	0.1	1.1	0.6	0.2	0.1	0.4	-	0.4	0.3	0.3	-
	Synedra ulna	1.5	2.1	1.7	3.0	2.2	2.4	2.0	1.4	1.9	2.5	1.4	1.9	0.3	0.5	0.3	0.7	0.2	0.1	0.6	0.9	0.2	0.3	-	-	-	1.0	0.3	0.6	4.4	0.4
Fresh wate planktonic	*Synedra vaucheriae*	-	0.2	-	-	-	-	0.1	-	0.1	0.4	-	0.4	-	0.8	0.7	0.2	-	-	-	-	-	-	-	-	-	0.3	-	-	0.1	-
	Tabellaria fenestrata	-	1.1	-	-	0.3	0.2	0.1	-	-	-	-	-	-	-	-	-	-	-	0.1	0.1	0.1	-	-	-	-	-	-	-	-	-
	Melosira ambigua	3.1	0.4	3.1	1.8	3.8	2.6	2.3	3.4	2.9	2.5	3.8	6.1	2.4	-	1.3	0.5	-	-	2.4	1.3	-	-	-	-	-	-	-	-	-	-
	Melosira granulata	4.9	10.3	3.4	24.4	27.4	25.7	17.4	28.1	24.1	20.7	30.1	23.1	28.4	1.1	0.3	4.7	0.1	0.2	4.5	29.3	0.9	0.7	0.4	-	-	3.2	0.6	-	0.1	0.1
	Meridion circulare	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	0.5	-	-	-	-	-	-	-	-	-	-	0.0
	Stephanodiscus astrea	3.1	3.3	5.6	5.5	5.6	6.8	7.7	5.6	5.1	4.1	7.8	7.1	9.1	2.2	1.0	2.0	-	-	0.6	2.6	-	-	-	-	-	-	-	-	-	-
Fresh water epipelic	*Caloneis bacillum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.9	0.4	-	-	0.3	-	0.2	0.2	-	0.3	-	-	0.2	-
	Caloneis silicula	-	0.1	-	-	-	-	-	-	-	0.1	-	0.1	-	-	0.1	-	-	-	0.3	0.1	-	-	-	-	-	-	-	-	-	-
	Gyrosigma acuminatum	-	-	0.3	0.3	0.4	0.5	0.3	0.3	0.2	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Navicula americana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Navicula elginensis	0.6	0.2	0.2	0.3	0.4	0.5	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Navicula placenta	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.2	0.8	0.9	0.6	0.5	0.2	0.2	0.2	0.1	0.2	-	-	-	0.1	0.1	-
	Navicula radiosa	-	0.4	0.4	0.3	0.8	1.0	0.3	0.6	0.3	0.2	0.9	0.2	-	0.1	0.1	1.3	0.4	0.1	0.6	2.3	0.4	0.1	0.1	0.1	0.2	0.2	0.1	-	0.1	0.4
	Navicula viridula	1.5	2.1	2.2	1.0	1.8	1.3	0.8	1.2	0.7	2.3	1.6	0.7	1.6	0.5	0.5	1.7	1.1	0.5	1.4	0.3	0.5	0.3	0.8	0.2	0.3	0.5	0.1	0.7	0.6	0.9
	Neidium iridis	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Nitzschia dissipata	-	-	-	-	-	-	-	-	0.6	0.8	0.5	0.6	-	1.1	1.3	0.7	1.8	1.6	2.5	0.1	2.0	0.9	1.3	1.1	1.1	1.0	0.5	1.1	0.7	0.4
	Stauroneis phoenicenteron	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Surirele elegans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Surirella robusta	-	2.9	0.6	0.5	0.1	0.2	1.0	0.1	0.5	0.8	0.1	0.4	0.2	0.3	0.1	0.4	0.3	0.2	-	0.1	0.2	0.2	0.3	0.1	0.5	-	0.3	-	0.1	0.1
	Unknown	4.0	2.7	2.8	3.1	2.9	2.3	3.1	3.4	3.9	3.0	3.4	3.2	3.6	4.7	3.1	3.4	3.6	3.3	3.0	3.8	3.0	3.2	3.3	3.1	3.4	2.7	3.7	3.8	2.9	3.1
Percentage of ecological groups	Marine plankton	13.5	4.8	3.4	1.0	0.4	0.6	2.2	1.8	2.3	2.9	1.7	1.4	1.2	3.7	6.8	10.8	28.7	28.7	1.9	5.0	20.2	33.1	34.9	22.8	32.4	28.1	41.5	34.7	22.3	40.2
	Marine epiphytes	0.9	-	-	-	-	-	0.1	-	-	-	-	-	-	0.3	0.1	0.1	0.7	1.6	0.3	0.0	5.2	3.6	9.9	3.7	6.9	3.8	4.1	2.5	1.3	2.3
	Brackish plankton	17.7	37.8	43.2	33.4	26.9	29.0	36.9	35.5	26.9	30.6	28.1	26.2	31.1	43.6	33.0	29.9	19.1	11.6	31.8	28.3	7.9	12.0	7.1	13.4	8.7	15.3	6.2	5.0	12.4	7.2
	Marine/brackish epipsammon	3.7	-	-	-	-	-	0.1	-	-	0.1	-	0.2	-	0.7	0.8	0.8	0.7	1.8	0.6	0.2	3.5	0.9	4.3	1.6	2.6	2.9	2.8	0.7	0.8	0.5
	Marine/brackish epipelon	34.3	9.2	10.6	4.0	2.1	1.4	5.4	2.1	8.9	6.2	3.1	5.8	3.8	16.7	23.3	24.3	24.5	31.0	23.7	8.7	36.5	30.5	26.6	39.9	29.0	25.0	27.4	37.2	30.7	29.4
	Marine/brackish aerophilous	-	-	-	-	-	-	-	-	0.2	0.1	-	-	-	0.4	0.1	0.1	1.9	1.5	-	-	1.0	0.9	0.3	0.2	0.3	1.0	0.6	1.2	0.5	0.8
	Brackish/fresh aerophilous	-	0.5	1.0	0.2	1.8	2.1	0.6	0.7	0.9	1.0	1.5	0.6	2.0	0.4	0.3	0.5	0.3	0.4	0.4	0.7	0.2	0.3	0.1	0.2	-	-	-	0.2	0.2	0.1
	Marine/brackisk epiphytes	3.1	10.0	5.9	1.9	0.9	1.2	2.6	1.4	3.5	6.6	1.2	2.5	1.2	9.6	14.3	8.1	9.8	11.1	14.5	5.0	14.1	9.3	7.7	11.0	11.7	11.7	10.0	9.4	12.1	11.8
	Brackish/fresh tychoplankton	-	0.3	1.0	0.6	0.8	0.7	0.6	0.6	1.2	0.8	0.5	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Brackish/fresh epiphytes	3.7	4.3	5.7	8.2	6.6	7.5	6.2	4.1	4.6	4.7	5.4	6.8	7.0	6.3	6.4	7.1	2.2	2.9	7.2	2.5	1.5	0.7	1.3	0.7	0.9	1.7	0.4	0.6	8.1	1.2
	Brackish/fresh plankton	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fresh water epiphytes	6.1	10.6	10.5	13.7	17.2	16.6	12.5	11.2	13.1	12.1	10.2	13.8	8.5	8.0	6.8	2.9	3.0	2.7	3.4	9.6	2.5	3.0	1.5	1.4	2.1	2.6	1.6	3.0	6.8	1.6
	Fresh water plankton	11.0	14.0	12.2	31.6	36.8	35.1	27.4	37.0	32.1	27.3	41.7	36.3	39.8	3.3	2.7	7.2	0.1	0.2	8.0	33.2	0.9	0.7	0.4	-	-	3.2	0.6	-	0.1	0.1
	Fresh water epipelon	2.1	5.7	3.8	2.4	3.5	3.5	2.5	2.2	2.2	4.4	3.1	2.0	1.9	2.2	2.2	4.9	5.4	3.4	5.2	3.1	3.5	1.8	2.8	1.9	2.1	2.0	0.9	1.9	1.8	1.8
	Unknown	4.0	2.7	2.8	3.1	2.9	2.3	3.1	3.4	3.9	3.0	3.4	3.2	3.6	4.7	3.1	3.4	3.6	3.3	3.0	3.8	3.0	3.2	3.3	3.1	3.4	2.7	3.7	3.8	2.9	3.1

Ecological group *	Sample number / Species name \ depth (m)	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
	depth (m)	5.93	6	6.21	6.4	6.6	6.75	6.95	7.15	7.35	7.5	7.72	7.95	8.17	8.37	8.42	22.2	22.55	22.75	22.95	23.25	23.45	23.9	30.5	30.7
Marine planktonic	*Actinocyclus ehrenbergii*	0.1	2.8	0.9	0.6	0.1	-	-	-	-	-	-	-	-	-	0.8	0.8	0.1	0.1	0.1	0.1	0.7	0.7	-	1.0
	Actinoptychus undutalus	-	-	-	-	-	-	-	-	-	0.1	0.0	0.0	0.0	-	0.1	1.0	0.7	0.4	0.2	0.4	0.2	0.3	-	0.1
	Amphiprora angustata	0.1	-	-	0.1	0.2	0.2	0.5	0.3	0.2	0.1	0.3	0.4	-	0.0	0.4	1.0	0.5	0.6	0.3	0.3	0.6	1.1	-	-
	Asteromphalus heptactis	-	-	-	-	-	-	-	-	-	-	0.2	0.4	0.6	0.5	0.1	0.3	0.1	-	0.3	0.1	-	-	-	-
	Biddulphia pulchella	0.2	-	-	-	-	0.1	0.1	0.1	0.1	0.1	-	0.0	0.1	0.0	-	-	0.2	-	0.2	0.1	-	-	-	-
	Campylodiscus fastuosus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.8	0.3	0.2	0.3	0.3	-	-	-
	Coscinodiscus nodulifer	0.4	-	-	-	0.1	0.3	0.3	0.3	0.4	0.5	0.3	0.7	0.2	0.4	0.7	0.8	0.5	0.6	0.4	0.2	0.3	1.3	1.2	3.3
	Coscinodiscus radiatus	-	-	-	-	0.1	0.4	0.3	0.4	0.4	0.4	0.3	0.2	0.3	0.5	0.7	0.3	0.2	0.1	0.3	-	0.2	1.2	0.7	0.6
	Paralia sulcata	-	-	-	-	-	0.4	-	-	-	-	-	0.1	0.1	-	-	0.3	0.1	-	-	0.3	0.3	0.3	-	0.1
Marine epiphytic	*Surirella fatuosa*	-	-	-	-	-	-	-	-	-	-	0.1	-	-	0.4	0.1	1.0	0.4	0.1	0.5	0.4	0.6	2.4	-	-
	Thalassionema nitzschioides	14.3	1.3	6.7	0.3	2.5	4.8	4.8	2.2	1.3	2.2	5.3	5.0	7.6	4.6	3.4	12.6	13.8	11.8	13.8	14.6	11.9	14.1	0.3	0.7
	Thalassiosira eccentrica	29.9	7.1	28.0	11.8	19.7	48.5	37.0	37.6	36.2	32.7	24.9	28.9	22.8	31.0	17.7	14.0	11.1	10.7	19.8	12.8	13.1	14.4	0.3	0.2
	Grammatophora oceanica	0.8	0.0	-	-	0.4	0.3	0.3	0.2	0.1	0.3	3.7	4.3	8.8	6.7	2.0	0.4	0.5	0.6	0.9	1.4	1.5	5.7	-	-
	Navicula distans	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	0.1	0.3	0.1	-	-
Brackish plantonic	*Nitzschia panduriformis*	0.2	-	0.2	0.0	-	0.3	1.2	0.2	0.3	0.2	0.5	0.7	0.2	0.1	0.1	0.4	3.7	2.9	1.8	3.7	2.2	0.4	0.9	0.1
	Trachyneis aspera	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	0.4	0.8	0.5	0.5	0.4	1.0	-	-	-
	Coscinodiscus lacustris	0.4	2.2	3.0	1.1	1.0	1.4	2.4	1.6	1.7	1.7	0.8	0.1	0.4	0.6	3.2	0.6	-	-	-	-	-	-	1.6	7.7
	Cyclotella caspia	12.8	11.7	8.0	16.2	18.2	9.5	6.7	4.5	9.1	12.2	12.0	11.1	8.5	6.3	10.4	2.9	1.7	2.2	2.1	2.0	2.4	0.8	1.4	1.1
	Cyclotella striata	1.3	0.2	0.2	-	-	-	-	-	-	-	0.2	0.1	0.6	1.2	0.3	0.3	-	-	-	-	-	0.1	-	0.1
Marine/brackish epipsammic	*Achnanthes hauckiana*	0.0	0.1	0.1	0.0	0.2	0.2	-	0.6	0.2	0.6	0.2	0.4	0.5	0.3	-	2.4	7.1	1.7	1.1	0.8	0.2	-	0.5	-
	Dimeregramma minor	-	-	-	-	-	-	-	-	-	-	0.5	1.4	2.3	0.7	0.3	6.0	0.4	0.6	0.1	0.5	0.1	0.1	-	-
	Opephora martyi	-	-	-	-	-	-	-	-	0.0	-	1.1	0.7	0.6	0.3	0.1	-	0.1	-	-	-	0.2	-	-	-
	Plagiogramma staurophorum	-	-	-	-	-	-	-	-	-	-	0.2	0.6	0.4	-	-	-	0.2	0.1	0.1	-	0.2	-	0.5	0.1
	Amphora acuta	0.0	-	-	-	-	0.9	0.5	1.0	0.9	0.5	0.3	0.2	0.2	0.9	0.1	-	-	0.1	-	-	-	0.1	-	-
	Amphora holsatica	0.2	-	-	0.1	2.2	0.4	0.1	0.8	1.2	1.6	0.4	0.4	0.7	0.6	0.1	-	1.5	4.6	3.5	2.0	1.6	-	-	-
	Amphora proteus	4.0	2.2	3.9	3.8	4.4	4.3	4.9	5.6	4.5	4.8	4.8	4.8	5.8	7.8	8.6	4.2	2.4	2.6	1.5	2.0	1.4	1.5	2.7	1.4
Marine/brackish epipelic	*Bacillaria paradoxa*	3.0	4.9	2.7	1.6	1.3	0.3	0.7	1.2	1.7	3.3	1.9	3.6	0.7	1.3	1.8	1.3	1.5	1.5	0.5	0.3	0.3	0.7	0.5	1.1
	Caloneis brevis	0.8	-	-	0.1	-	0.4	0.4	0.2	0.4	0.4	0.6	0.4	0.1	0.2	0.2	-	-	-	-	-	0.1	0.1	0.5	0.2
	Caloneis liber	-	-	-	-	-	-	-	-	-	-	0.1	0.1	0.2	0.2	-	1.3	0.6	0.4	0.4	0.3	1.1	0.9	-	0.8
	Cocconeis pseudo-marginata	-	0.1	-	0.0	0.0	0.7	-	-	-	-	-	-	0.0	-	-	0.4	0.2	0.2	0.7	1.0	0.7	0.3	0.2	-
	Diploneis bombus	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Diploneis smithii	5.4	3.1	5.8	4.8	4.5	3.6	7.6	7.9	7.2	7.6	4.0	5.9	6.4	6.4	6.4	5.6	2.9	2.7	2.4	3.3	5.6	5.7	5.4	7.0
	Diploneis suborbicularis	4.1	1.4	2.7	2.3	2.0	0.8	0.9	1.5	1.1	1.0	0.5	0.4	0.8	0.8	0.2	1.3	1.1	0.3	1.1	0.3	0.9	0.8	4.0	4.8
	Gyrosigma distortum	-	1.2	-	0.1	0.3	0.1	0.1	-	0.1	0.2	0.3	0.4	0.1	0.1	2.2	1.0	1.0	2.6	1.0	2.0	1.8	0.9	0.2	-
	Gyrosigma strigilis	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.1	0.1	-	0.3	0.2	1.1	-	-
	Mastogloia smithii	0.6	7.1	3.2	7.8	3.2	0.7	0.2	1.2	1.4	0.7	4.3	2.3	4.1	2.5	1.3	-	0.4	0.1	0.4	-	-	-	-	-
	Navicula cancellata	-	-	-	-	-	-	-	-	-	-	0.3	0.2	0.9	0.5	0.2	2.3	7.3	8.8	9.3	9.9	11.2	9.6	-	-
	Navicula cf. *peregrima*	-	-	-	-	-	-	-	-	0.1	0.1	-	-	0.0	0.2	-	-	-	-	0.2	0.1	0.4	0.7	2.5	1.4
	Navicula elegans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4	-	-	-	-	0.2	-	-	1.7
	Navicula forcipata	-	-	0.1	0.2	0.3	0.2	0.3	0.4	0.1	0.1	1.0	0.8	0.7	0.8	0.4	2.9	0.9	0.5	0.9	1.0	0.8	1.3	0.3	0.3
	Navicula liroides	-	-	-	-	0.1	0.1	0.1	-	-	-	0.2	0.1	0.2	0.1	-	1.3	0.3	0.5	0.9	0.2	0.3	0.1	-	-
	Navicula marina	-	-	-	0.3	0.1	0.3	0.3	0.3	0.2	0.1	0.3	0.2	0.2	0.1	0.3	3.6	1.6	1.2	0.8	0.8	3.1	4.0	1.8	2.5
	Navicula sculpta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Ecological group *	Sample number / Species name \ depth (m)	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
		5.93	6	6.21	6.4	6.6	6.75	6.95	7.15	7.35	7.5	7.72	7.95	8.17	8.37	8.42	22.2	22.55	22.75	22.95	23.25	23.45	23.9	30.5	30.7
	Navicula sp.	-	-	-	-	-	-	-	0.1	0.3	0.1	0.1	0.0	0.2	0.3	-	-	-	-	0.2	0.2	0.2	0.1	-	-
Marine/brackish aerophilous	*Nitzschia coarctata*	0.4	0.1	0.5	0.7	0.2	0.8	2.5	2.0	2.2	2.7	2.3	2.3	1.8	1.7	0.3	0.3	1.5	2.0	1.5	2.0	2.7	1.2	-	-
	Nitzschia constricta	0.8	3.5	1.2	0.9	0.6	1.1	1.8	2.4	2.1	1.4	2.6	1.8	2.1	2.0	1.0	2.8	2.7	1.8	3.4	3.1	2.7	1.8	0.8	2.7
	Nitzschia granulata	0.3	0.3	0.2	0.1	0.2	0.4	2.1	0.7	1.4	0.8	0.3	0.4	0.4	0.7	0.4	0.6	-	-	-	-	0.2	-	2.9	3.4
	Nitzschia lanceola	-	-	-	-	-	-	0.1	0.1	-	-	0.1	0.3	0.3	0.4	1.0	1.2	2.7	1.1	2.1	2.0	0.8	0.3	0.3	0.3
	Nitzschia levidensis	0.5	0.3	0.4	0.2	0.4	0.2	0.3	0.6	0.2	1.1	0.1	0.1	0.1	0.0	0.8	-	-	-	0.1	-	0.2	-	1.9	2.5
	Nitzschia longissima	0.1	0.7	0.4	0.2	0.3	0.1	-	-	-	0.2	0.6	0.5	0.3	0.3	0.1	0.3	0.4	0.4	0.3	0.7	0.8	0.4	-	-
	Nitzschia lorenziana	-	0.0	-	0.1	0.1	0.1	0.1	-	-	-	-	0.0	-	0.0	0.1	0.1	0.2	0.4	0.4	0.5	0.8	0.4	1.5	1.6
	Nitzschia navicularis	-	-	-	-	-	-	0.5	0.6	0.6	0.4	0.4	0.7	0.9	0.7	0.5	1.8	0.2	0.8	0.3	0.3	0.4	0.4	-	-
Brackish/fresh aerophilous	*Nitzschia obtusa*	0.6	1.3	0.5	0.7	0.8	1.1	0.8	1.4	1.2	1.8	3.0	2.7	2.1	2.3	0.7	1.7	11.4	9.8	10.5	9.5	6.9	6.3	1.2	4.7
	Pleurosigma aestuarii	0.7	-	-	0.2	0.9	0.4	0.3	0.6	1.0	0.4	0.5	0.3	0.6	0.4	0.3	2.8	2.8	10.1	3.2	7.2	6.0	4.5	0.7	0.2
	Surirella circumsuta	0.2	-	-	-	0.1	-	0.2	-	0.1	0.0	0.0	0.1	0.1	-	-	-	-	-	-	-	-	-	1.2	0.5
	Diploneis interrupta	0.9	-	0.7	0.5	0.6	0.5	0.7	0.8	1.5	1.1	1.4	1.3	1.4	0.6	0.2	1.5	0.4	0.2	0.3	0.5	0.6	0.8	-	-
	Hantzschia amphioxys	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	0.1	0.4	0.1
Marine/brackish epiphytic	*Navicula pusilla*	0.3	0.4	-	-	0.6	-	-	-	0.1	0.0	0.1	-	-	-	0.1	-	-	0.1	0.2	-	-	-	1.4	0.3
	Pinnularia microstauron	-	-	-	0.1	-	-	-	0.1	-	-	-	-	-	-	0.1	0.9	1.6	1.1	-	-	-	-	1.3	0.1
	Pinnularia subcapitata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	0.3	0.6	-	-	-	-	-	-
	Pinnularia viridis	-	-	-	-	-	0.1	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Achnanthes brevipes	1.7	0.5	1.5	0.2	0.6	0.5	1.5	0.5	0.2	0.7	0.9	0.9	1.2	1.2	0.4	1.2	0.1	0.6	0.3	-	-	-	7.2	4.3
	Cocconeis scutellum	2.1	1.3	2.6	4.8	4.2	2.7	3.2	5.0	4.4	4.5	3.3	2.5	2.0	2.0	0.9	1.7	3.7	4.8	4.3	5.1	3.6	3.4	1.4	0.2
Brackish/fresh tychoplanktonic	*Melosira jurgensii*	0.6	1.5	1.5	3.2	1.6	0.5	0.6	1.2	1.5	0.9	0.6	0.8	1.0	1.0	1.0	-	-	-	0.2	-	-	-	7.8	4.3
	Rhopalodia gibberula	5.4	7.4	6.1	13.7	8.3	2.3	4.4	5.7	4.6	2.8	4.9	3.2	2.6	3.0	1.7	0.6	0.3	0.1	0.3	0.3	0.6	-	25.9	18.3
	Synedra crystalliana	-	0.1	-	-	-	-	-	-	-	-	-	0.1	0.2	0.1	0.5	0.8	0.4	0.2	0.6	0.9	0.3	0.3	-	-
	Synedra pulchella	0.2	1.4	1.4	1.4	1.2	0.1	-	0.2	0.1	-	0.3	0.0	0.1	0.1	4.4	-	-	-	-	-	-	-	0.4	0.2
	Synedra tabulata	0.4	1.6	0.2	1.2	0.2	0.1	-	-	0.1	0.1	0.2	0.1	0.2	-	2.1	-	-	-	-	-	-	-	-	-
	Fragilaria construens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fragilaria var venter	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brackish/fresh epiphytic	*Amphora lybica*	-	0.1	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0.2	0.1	-	-	-	-	-	-	0.1	0.8
	Cocconeis placentula	0.4	1.5	0.9	9.1	7.0	0.8	1.6	1.4	2.0	2.0	1.0	0.2	0.2	0.1	0.5	-	-	-	0.1	-	-	0.3	1.4	0.6
	Rhopalodia gibba	0.2	9.1	2.4	1.9	0.2	-	0.2	-	0.0	-	-	-	-	-	4.4	0.1	-	-	-	-	0.2	-	1.3	3.4
	Roicosphenia curvata	0.4	3.2	1.7	2.1	0.4	0.9	1.0	1.1	1.2	1.0	0.3	0.1	0.1	0.4	0.2	-	0.1	-	0.1	-	-	-	-	-
	Diatom elongatum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brackish/fresh planktonic	*Achnanthes* spp.	-	1.0	0.7	0.3	0.3	0.2	-	0.1	0.1	-	0.1	0.0	0.0	-	0.1	-	0.1	-	-	-	-	-	-	0.2
	Actinella brasiliensis	-	-	-	-	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cymbella sp.	-	0.1	-	-	0.0	0.2	0.1	-	-	0.0	0.2	0.0	0.0	-	0.5	0.3	0.2	0.1	0.1	0.1	0.2	0.1	0.6	0.8
	Cymbella cistula	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5	0.9
	Cymbella tumida	-	-	-	-	-	-	-	-	0.1	0.1	0.1	0.1	-	-	-	-	-	-	-	-	-	-	0.2	0.3
	Diatoma hiemale	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	1.0	1.0	2.4	-	-
Fresh water epiphytic	*Diatoma vulgare*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Diploneis eliptica	0.7	1.3	2.3	1.1	1.9	1.1	1.8	1.2	1.4	1.3	1.8	1.6	1.7	1.3	1.0	-	0.4	0.4	0.2	0.3	0.3	0.3	0.4	0.3
	Diploneis ovalis	-	-	-	0.1	0.3	0.1	0.1	0.1	0.1	-	0.1	0.1	0.2	-	0.3	-	-	0.1	-	0.3	-	-	0.2	0.1
	Epithemia sorex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.8
	Epithemia turgida	-	9.7	0.6	0.3	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.6	1.9

Fresh water epiphytic	*Eunotia pectinalis*	-	0.1	-	0.1	0.1	-	-	0.1	-	-	0.1	-	-	-	0.1	0.3	-	-	-	-	-	-	-	0.5
	Frustulia vulgaris	-	0.2	0.2	-	0.1	-	-	-	-	-	-	-	-	-	0.1	-	0.1	-	-	-	-	-	-	-
	Gomphonema acuminatum	0.0	0.3	0.4	0.1	0.1	0.1	0.1	0.2	-	0.1	-	-	-	0.0	0.7	0.6	-	-	0.2	0.1	-	0.1	0.4	0.3
	Gomphonema constristum	-	0.1	0.2	0.3	-	-	-	-	0.1	0.1	-	-	-	-	0.5	1.0	-	-	0.3	0.1	-	-	-	-
	Nitzschia palea	-	0.5	0.1	-	0.1	-	-	0.1	0.3	0.1	0.1	0.2	0.2	0.2	0.3	0.4	1.0	0.9	0.3	0.6	0.6	-	0.3	-
	Synedra ulna	0.2	2.2	3.0	0.4	0.8	0.4	0.1	0.6	0.2	0.3	0.2	0.1	0.4	0.2	2.0	0.1	-	-	0.1	0.1	-	-	1.3	1.0
	Synedra vaucheriae	-	0.0	0.1	0.2	-	-	-	-	-	-	-	-	-	-	0.6	-	-	-	-	-	-	-	-	-
	Tabellaria fenestrata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-
Fresh wate planktonic	*Melosira ambigua*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Melosira granulata	-	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	-	0.1	-	-	0.0	-	0.1	-	-	-	-	-	0.1	-	-
	Meridion circulare	-	-	-	-	-	-	-	0.0	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-
	Stephanodiscus astrea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Caloneis bacillum	0.2	-	-	0.3	0.3	0.1	0.2	0.3	0.2	0.2	0.2	0.7	0.3	0.6	-	-	-	0.1	-	-	-	-	-	0.1
	Caloneis silicula	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Gyrosigma acuminatum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5	0.6
Fresh water epipelic	*Navicula americana*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1
	Navicula elginensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Navicula placenta	0.1	-	-	0.1	-	0.1	0.1	0.1	0.3	0.1	0.4	0.2	0.2	-	0.2	-	-	-	-	-	0.1	-	0.4	1.9
	Navicula radiosa	0.1	0.1	0.1	0.1	0.3	0.1	0.4	0.1	0.1	0.1	0.1	0.1	0.2	-	0.8	1.3	-	-	-	-	-	0.5	0.7	1.3
	Navicula viridula	0.5	0.9	0.4	0.5	0.7	0.5	0.3	0.3	0.3	0.7	0.3	0.5	0.3	0.6	2.7	0.1	0.1	0.1	0.1	-	0.2	-	4.9	1.9
	Neidium iridis	-	-	-	-	-	-	-	-	-	0.0	0.1	-	-	-	-	-	-	0.1	-	-	-	-	-	-
	Nitzschia dissipata	0.3	1.2	0.5	0.3	1.2	0.5	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.1	1.9	0.6	1.1	0.6	0.8	0.7	0.6	0.9	-	-
	Stauroneis phoenicenteron	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.4	0.2
	Surirele elegans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Surirella robusta	-	-	-	0.1	-	-	0.1	0.1	0.1	0.1	-	-	0.1	0.1	0.1	-	0.2	0.2	0.1	0.1	0.1	0.1	-	-
	Unknown	2.9	2.4	3.9	3.1	3.5	4.7	4.8	4.0	2.7	3.0	3.4	2.5	3.0	3.2	3.7	5.4	3.2	4.1	3.1	2.8	3.9	4.0	4.2	2.1
Percentage of ecological groups	Marine plankton	44.9	11.2	35.6	12.9	22.8	54.6	43.0	40.8	38.5	36.1	31.4	35.8	31.7	37.5	24.0	31.9	28.3	24.6	35.8	29.4	28.3	35.7	2.5	5.9
	Marine epiphytes	1.3	0.0	0.2	0.0	0.4	0.6	1.5	0.4	0.4	0.5	4.2	5.0	9.1	6.8	2.2	1.2	5.1	4.1	3.3	5.6	4.9	6.2	0.9	0.1
	Brackish plankton	14.5	14.0	11.2	17.2	19.2	10.9	9.1	6.0	10.9	13.9	13.0	11.3	9.5	8.1	13.9	3.8	1.7	2.2	2.1	2.0	2.4	0.9	3.0	8.9
	Marine/brackish epipsammon	0.0	0.1	0.1	0.0	0.2	0.2	-	0.6	0.3	0.6	2.0	3.1	3.7	1.3	0.4	8.5	7.8	2.3	1.3	1.2	0.8	0.1	1.0	0.1
	Marine/brackish epipelon	22.0	26.3	21.6	24.3	22.0	17.1	25.1	28.5	28.0	29.3	28.9	29.0	30.1	31.3	27.0	37.4	43.6	52.3	45.3	48.8	51.3	43.2	28.6	37.3
	Marine/brackish aerophilous	0.9	-	0.7	0.5	0.6	0.5	0.7	0.8	1.5	1.1	1.4	1.3	1.4	0.6	0.2	1.5	0.4	0.2	0.3	0.5	0.6	0.8	-	-
	Brackish/fresh aerophilous	0.3	0.4	-	0.1	0.6	0.1	-	0.2	0.1	0.0	0.1	-	-	-	0.3	0.9	1.9	1.7	0.3	-	-	0.1	3.0	0.5
	Marine/brackisk epiphytes	10.3	13.8	13.3	24.5	16.1	6.2	9.7	12.6	10.9	9.0	10.1	7.7	7.2	7.4	11.0	4.2	4.4	5.7	5.6	6.3	4.5	3.7	42.6	27.4
	Brackish/fresh tychoplankton	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Brackish/fresh epiphytes	0.9	13.9	5.0	13.1	7.6	1.7	2.8	2.5	3.3	3.0	1.3	0.3	0.4	0.5	5.3	0.3	0.1	-	0.1	-	0.2	0.3	2.7	4.7
	Brackish/fresh plankton	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fresh water epiphytes	0.9	15.5	7.5	2.8	4.3	2.0	2.2	2.3	2.3	2.0	2.7	2.1	2.5	1.8	6.3	2.7	1.9	1.5	2.1	2.5	2.2	3.2	4.5	6.9
	Fresh water plankton	-	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	-	0.1	-	-	0.0	-	0.1	-	-	-	-	-	0.1	0.3	-
	Fresh water epipelon	1.1	2.2	1.0	1.3	2.5	1.4	1.0	1.0	1.1	1.5	1.4	1.9	1.3	1.5	5.7	2.1	1.5	1.2	0.9	0.8	0.9	1.7	6.8	6.1
	Unknown	2.9	2.4	3.9	3.1	3.5	4.7	4.8	4.0	2.7	3.0	3.4	2.5	3.0	3.2	3.7	5.4	3.2	4.1	3.1	2.8	3.9	4.0	4.2	2.1

Ecological group *	Sample number / Species name \ depth (m)	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
		30.85	30.95	31.55	35.5	37.55	37.7	37.8	38	38.2	38.5	38.7	39.56	40	40.55	40.69	40.74	41.54	41.85	42.35	42.45	42.95
Marine planktonic	*Actinocyclus ehrenbergii*	-	-	0.7	0.3	0.1	-	0.8	0.2	0.1	0.1	0.3	0.4	0.1	-	-	-	-	-	0.2	-	-
	Actinoptychus undutalus	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	0.1	-	-	-
	Amphiprora angustata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Asteromphalus heptactis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Biddulphia pulchella	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Campylodiscus fastuosus	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6	-	-	0.2	0.4	-	-	-
	Coscinodiscus nodulifer	1.0	3.6	4.6	0.4	1.2	-	4.2	0.1	0.3	0.4	0.8	0.8	0.8	-	-	-	-	-	0.4	-	-
	Coscinodiscus radiatus	0.4	0.3	1.0	0.4	0.1	-	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Paralia sulcata	-	0.1	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marine epiphytic	*Surirella fatuosa*	-	0.2	0.9	-	-	-	-	-	-	-	0.1	0.4	0.7	1.9	0.7	0.3	0.5	0.3	0.4	-	-
	Thalassionema nitzschioides	-	1.2	2.0	1.2	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	0.4	-	-
	Thalassiosira eccentrica	-	0.3	-	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Grammatophora oceanica	0.1	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-
	Navicula distans	2.4	1.6	1.0	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brackish plantonic	*Nitzschia panduriformis*	0.1	-	-	2.9	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-
	Trachyneis aspera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Coscinodiscus lacustris	10.0	1.8	1.6	4.1	0.4	-	-	-	-	-	-	-	-	0.1	-	-	0.1	-	-	-	-
	Cyclotella caspia	0.4	0.1	-	-	0.2	-	0.3	0.3	0.2	0.5	-	0.8	0.1	0.1	-	-	-	-	-	-	-
	Cyclotella striata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marine/brackish epipsammic	*Achnanthes hauckiana*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Dimeregramma minor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Opephora martyi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Plagiogramma staurophorum	0.3	-	-	-	0.1	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Amphora acuta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Amphora holsatica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Amphora proteus	2.0	0.5	0.7	2.7	0.5	-	0.3	1.4	0.9	0.9	0.2	0.8	-	-	-	-	0.1	0.1	0.1	-	-
Marine/brackish epipelic	*Bacillaria paradoxa*	0.2	0.2	0.3	-	0.2	-	-	0.7	0.4	0.1	-	0.3	0.3	1.8	1.1	1.7	1.6	0.1	1.8	0.7	1.2
	Caloneis brevis	1.0	-	-	-	-	-	0.4	0.1	0.1	0.1	0.2	0.1	-	-	-	-	0.2	-	-	-	-
	Caloneis liber	-	1.1	0.5	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cocconeis pseudo-marginata	-	0.1	-	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Diploneis bombus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Diploneis smithii	4.9	6.1	4.6	6.2	0.4	-	-	0.1	0.3	0.6	-	-	-	-	-	-	-	-	0.1	-	-
	Diploneis suborbicularis	8.3	6.2	2.5	1.2	0.1	-	0.1	0.6	0.4	0.7	0.2	0.7	0.5	-	-	-	0.1	0.1	0.1	-	-
	Gyrosigma distortum	-	-	0.3	0.3	2.3	2.5	5.1	3.3	1.3	1.5	0.4	2.2	1.4	1.3	-	0.7	0.8	0.3	0.4	-	0.8
	Gyrosigma strigilis	-	3.0	0.4	0.4	-	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mastogloia smithii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Navicula cancellata	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Navicula cf. *peregrima*	3.7	1.3	0.3	-	0.2	-	0.3	-	-	-	0.5	0.3	0.1	-	-	-	0.3	-	0.1	-	-
	Navicula elegans	0.4	4.0	2.8	0.7	1.6	-	2.6	1.8	1.3	1.0	-	0.9	0.2	-	-	-	-	-	-	-	-
	Navicula forcipata	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Navicula liroides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Navicula marina	1.9	2.6	0.8	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Navicula sculpta	0.2	-	-	-	3.2	-	0.4	1.5	1.2	1.9	0.2	0.4	-	-	-	-	-	-	-	-	-

	Navicula sp.	-	-	-	-	-	-	-	0.3	0.5	0.4	0.1	0.3	0.8	0.3	-	0.3	0.3	0.1	0.5	-	-
Marine/brackish aerophilous	*Nitzschia coarctata*	-	0.1	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-
	Nitzschia constricta	0.6	4.0	2.2	0.4	0.6	-	0.3	0.6	1.3	0.4	0.5	0.3	0.9	0.8	0.7	0.3	0.2	0.1	0.1	-	0.4
	Nitzschia granulata	7.0	1.9	1.0	3.4	-	-	-	-	-	-	0.1	-	-	0.2	-	-	-	0.1	0.1	-	-
	Nitzschia lanceola	0.2	0.4	-	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Nitzschia levidensis	-	2.2	0.8	3.2	0.6	-	0.1	0.9	0.4	0.1	-	0.2	-	2.7	1.1	0.7	0.3	0.2	0.1	0.7	-
	Nitzschia longissima	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-
	Nitzschia lorenziana	1.3	1.2	1.0	1.9	0.1	-	-	0.2	0.8	0.8	0.2	0.4	0.1	0.8	1.1	1.0	0.2	0.4	0.2	0.4	-
	Nitzschia navicularis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brackish/fresh aerophilous	*Nitzschia obtusa*	1.9	1.4	1.2	0.7	0.6	-	0.3	0.1	0.1	0.1	0.3	0.5	2.2	1.2	1.1	0.7	0.5	0.3	0.5	1.1	0.8
	Pleurosigma aestuarii	0.3	-	-	-	0.2	0.9	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Surirella circumsuta	0.1	0.2	0.1	0.3	0.5	-	-	0.1	0.1	0.1	-	0.2	-	0.1	-	-	-	-	-	-	-
	Diploneis interrupta	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-
	Hantzschia amphioxys	0.2	-	-	-	0.4	3.8	0.7	0.2	0.2	0.6	4.9	0.8	6.7	11.8	11.8	7.6	3.6	3.7	5.3	9.4	9.5
Marine/brackish epiphytic	*Navicula pusilla*	0.4	0.3	0.1	1.3	0.4	2.5	-	-	-	0.1	0.2	0.2	1.3	0.3	2.2	2.0	0.8	0.5	0.6	3.0	3.6
	Pinnularia microstauron	0.3	2.9	4.6	0.9	-	-	0.5	-	-	0.0	3.4	1.3	3.8	3.2	1.1	0.7	1.8	2.1	3.0	0.7	0.4
	Pinnularia subcapitata	-	-	0.4	0.9	0.6	0.9	0.3	0.1	0.3	0.3	1.0	0.9	0.9	4.3	3.3	2.0	1.3	1.4	2.3	7.5	-
	Pinnularia viridis	0.1	-	0.3	2.4	4.1	1.6	2.1	0.2	1.8	1.5	3.1	2.1	7.1	7.2	4.4	3.3	7.1	7.0	8.4	3.7	5.1
	Achnanthes brevipes	4.4	2.6	2.0	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cocconeis scutellum	0.1	0.1	0.3	-	-	-	-	-	-	-	-	0.3	0.2	-	-	-	-	-	-	-	-
	Melosira jurgensii	3.3	0.3	-	7.8	-	-	-	-	-	-	-	-	-	0.8	0.7	0.3	3.3	0.1	0.4	-	0.8
Brackish/fresh tychoplanktonic	*Rhopalodia gibberula*	28.5	6.1	4.5	7.4	0.8	-	0.7	0.5	1.2	1.6	3.0	0.4	3.6	6.5	1.1	3.3	1.4	1.4	1.3	5.6	4.0
	Synedra crystalliana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Synedra pulchella	-	-	-	-	0.5	-	-	1.9	2.5	1.3	1.9	3.3	-	-	-	-	0.3	-	0.1	-	-
	Synedra tabulata	-	-	-	-	0.3	-	-	-	-	0.2	-	0.3	0.1	-	-	-	-	-	-	-	-
	Fragilaria construens	-	-	-	0.4	0.4	0.6	1.1	0.4	0.2	0.3	2.0	1.1	0.9	0.9	3.3	1.0	1.4	1.3	1.4	1.9	2.4
	Fragilaria var venter	-	-	-	0.4	0.1	1.6	0.8	0.4	0.3	0.4	0.6	0.9	0.6	0.7	4.0	2.6	1.4	1.3	0.8	3.4	2.8
Brackish/fresh epiphytic	*Amphora lybica*	0.5	0.7	1.4	3.8	4.0	2.8	1.2	5.3	3.9	4.5	2.5	2.0	1.7	0.9	3.3	5.0	2.1	2.0	0.9	4.9	4.0
	Cocconeis placentula	1.3	0.3	1.3	2.2	0.5	0.6	1.2	-	0.4	-	1.4	0.3	1.8	2.2	5.5	5.9	1.6	2.3	3.0	5.6	4.7
	Rhopalodia gibba	0.3	1.8	4.2	2.7	9.5	11.3	12.2	21.6	19.1	35.3	6.8	13.2	6.1	4.2	1.1	3.3	7.0	5.9	6.6	1.9	4.7
	Roicosphenia curvata	-	-	-	0.4	0.1	2.5	1.2	-	-	-	0.3	0.3	0.6	1.4	1.1	1.7	1.2	1.2	0.4	0.7	1.2
	Diatom elongatum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brackish/fresh planktonic	*Achnanthes* spp.	0.2	0.5	0.5	-	0.1	1.6	-	0.8	0.6	0.9	1.2	0.4	0.9	0.1	-	0.3	0.4	0.6	0.9	2.2	0.8
	Actinella brasiliensis	-	-	-	-	-	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cymbella sp.	0.1	1.2	2.6	1.5	1.5	2.8	4.1	2.9	3.1	2.1	5.9	2.6	5.6	2.8	2.2	3.0	5.7	7.4	5.3	5.6	1.2
	Cymbella cistula	0.1	0.5	1.7	1.3	1.2	2.8	1.6	1.4	1.3	0.7	1.1	0.9	2.3	0.7	0.7	0.7	1.5	1.4	1.4	3.4	0.8
	Cymbella tumida	0.2	0.6	1.6	0.6	0.8	2.8	1.3	0.6	0.7	0.5	0.9	0.8	1.0	0.7	1.1	1.0	0.8	0.6	0.7	3.4	1.2
	Diatoma hiemale	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	-	-	0.2	0.5	0.1	-	-
Fresh water epiphytic	*Diatoma vulgare*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Diploneis eliptica	0.4	1.7	3.7	2.5	2.0	-	0.4	0.9	0.9	0.8	0.8	0.5	1.4	2.0	0.7	1.0	0.2	0.9	0.2	0.7	-
	Diploneis ovalis	0.2	0.1	1.3	1.6	0.1	3.8	0.1	0.1	0.1	0.4	1.2	1.3	1.4	6.8	4.8	4.0	2.3	2.5	2.2	1.1	3.6
	Epithemia sorex	-	0.5	1.3	0.7	-	-	-	-	-	-	-	-	-	0.2	-	-	0.3	0.2	0.3	-	-
	Epithemia turgida	0.3	1.6	3.5	1.2	17.4	14.1	5.5	11.0	13.2	6.2	6.7	13.4	7.3	3.9	9.2	5.9	5.1	4.8	9.8	5.6	9.1
	Eunotia pectinalis	0.2	1.4	2.6	0.9	0.5	3.8	1.6	0.3	0.4	0.1	6.2	1.3	2.8	2.5	2.2	2.0	2.9	4.9	3.9	3.7	3.6
	Frustulia vulgaris	-	-	0.3	-	-	-	0.5	0.1	-	-	0.3	0.3	0.7	1.8	2.2	3.0	0.9	1.6	1.7	1.1	2.4

Ecological	Sample number	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
group *	Species name \ depth (m)	30.85	30.95	31.55	35.5	37.55	37.7	37.8	38	38.2	38.5	38.7	39.56	40	40.55	40.69	40.74	41.54	41.85	42.35	42.45	42.95
Fresh water epiphytic	*Gomphonema acuminatum*	0.1	3.2	4.6	1.5	6.0	3.8	4.9	6.8	5.0	2.9	9.2	6.7	4.7	2.5	3.7	8.6	5.7	5.5	3.7	5.6	9.9
	Gomphonema constristum	-	1.7	2.9	1.3	2.6	5.0	2.6	2.1	1.3	1.1	1.2	1.9	2.0	2.1	3.3	4.0	1.3	2.3	1.3	4.1	8.3
	Nitzschia palea	-	-	-	-	-	-	-	0.1	-	-	-	0.2	0.1	0.7	-	-	-	0.6	0.1	-	-
	Synedra ulna	0.6	2.4	6.0	2.2	2.0	2.8	2.6	3.3	3.5	2.1	10.7	6.0	12.2	3.1	2.2	4.0	17.6	20.4	16.5	3.7	5.9
Fresh wate planktonic	*Synedra vaucheriae*	-	-	-	-	-	-	-	-	-	-	1.3	0.3	0.4	0.2	0.7	0.3	1.0	0.8	0.4	-	-
	Tabellaria fenestrata	-	-	-	-	-	-	-	-	-	-	-	-	0.7	0.2	-	-	-	-	-	-	-
	Melosira ambigua	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Melosira granulata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Meridion circulare	-	-	-	0.4	0.2	1.9	0.5	0.1	-	0.1	2.5	0.2	0.8	0.2	1.1	1.7	0.3	1.1	1.3	0.7	1.2
	Stephanodiscus astrea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Caloneis bacillum	0.1	-	-	-	-	-	-	-	-	-	-	-	-	2.3	1.1	-	1.4	2.4	1.5	-	2.0
	Caloneis silicula	-	-	-	-	0.9	-	0.3	-	0.3	0.1	0.4	0.2	0.2	0.2	-	-	0.7	0.2	0.2	-	-
	Gyrosigma acuminatum	0.4	0.5	0.5	1.0	0.6	2.5	1.2	0.8	0.8	0.4	1.0	1.0	0.8	0.8	2.9	4.0	0.7	0.8	0.6	-	-
Fresh water epipelic	*Navicula americana*	-	-	-	0.9	0.5	-	-	0.4	0.3	0.0	0.4	0.4	0.4	0.3	-	-	0.7	-	0.2	-	-
	Navicula elginensis	-	-	-	0.7	-	-	-	-	-	0.1	1.8	0.3	0.5	2.1	1.1	0.7	2.1	2.7	0.9	1.1	0.8
	Navicula placenta	0.6	1.4	1.0	2.2	0.1	0.3	0.3	0.3	0.4	0.1	1.1	0.3	1.2	0.5	3.3	1.7	0.2	0.2	0.2	-	-
	Navicula radiosa	2.5	13.2	8.8	4.7	18.0	7.8	23.0	16.0	18.2	15.5	5.2	16.6	2.8	0.8	0.7	1.0	1.8	0.6	0.8	1.1	-
	Navicula viridula	1.3	5.9	2.6	1.6	7.0	1.9	-	4.9	7.2	6.4	0.9	3.8	1.1	0.2	0.4	0.7	1.3	0.8	0.7	-	-
	Neidium iridis	0.1	0.2	0.1	-	0.2	-	4.5	0.9	0.3	0.3	0.3	0.2	0.8	1.4	1.1	2.0	0.8	1.1	0.7	-	-
	Nitzschia dissipata	-	-	-	-	0.2	0.9	-	0.3	0.3	0.2	0.6	0.9	0.9	1.1	1.1	0.7	0.3	0.2	0.7	0.7	0.8
	Stauroneis phoenicenteron	0.1	0.3	0.4	0.4	0.3	0.9	1.4	0.2	0.2	0.3	0.8	0.2	1.6	0.4	0.7	2.0	1.6	0.1	0.8	1.1	-
	Surirele elegans	0.2	-	-	-	0.5	0.6	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Surirella robusta	-	-	-	-	-	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Unknown	3.7	2.1	3.1	2.7	2.0	2.8	3.8	3.2	2.5	2.8	3.0	2.3	2.3	3.0	4.4	4.0	2.3	2.1	2.7	3.4	2.4
Percentage of ecological groups	Marine plankton	1.4	5.7	9.6	3.2	1.4	-	6.3	0.3	0.4	0.4	1.1	1.7	1.6	2.5	0.7	0.3	0.7	0.8	1.3	-	-
	Marine epiphytes	2.6	1.6	1.0	4.7	0.0	-	0.1	-	-	-	-	-	-	-	-	-	-	0.1	0.1	-	-
	Brackish plankton	10.4	1.9	1.6	4.1	0.6	-	0.3	0.3	0.2	0.5	0.0	0.8	0.1	0.2	-	-	0.1	-	-	-	-
	Marine/brackish epipsammon	0.3	-	-	-	0.1	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Marine/brackish epipelon	34.4	36.5	19.4	24.6	11.1	6.0	10.4	11.5	9.1	8.8	2.7	7.5	6.4	9.1	5.1	5.3	4.8	1.7	4.1	3.0	3.2
	Marine/brackish aerophilous	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-
	Brackish/fresh aerophilous	1.0	3.2	5.4	5.5	5.6	8.8	3.5	0.5	2.2	2.4	12.6	5.2	19.8	26.8	22.8	15.5	14.6	14.8	19.6	24.3	18.6
	Marine/brackisk epiphytes	36.3	9.2	6.7	17.7	1.6		0.7	2.4	3.7	3.1	4.9	4.3	3.9	7.3	1.8	3.6	5.0	1.5	1.7	5.6	4.7
	Brackish/fresh tychoplankton	-	-	-	0.9	0.5	2.2	1.8	0.8	0.5	0.6	2.5	2.0	1.5	1.6	7.4	3.6	2.8	2.6	2.2	5.2	5.1
	Brackish/fresh epiphytes	2.1	2.9	7.0	9.1	14.1	17.2	15.8	26.9	23.4	39.8	11.0	15.8	10.2	8.8	11.0	15.8	12.0	11.4	11.0	13.1	14.6
	Brackish/fresh plankton	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fresh water epiphytes	2.6	15.4	32.7	15.3	34.4	44.2	25.2	30.3	30.2	17.8	46.9	36.5	43.4	30.5	33.1	37.6	45.9	54.8	48.5	40.4	46.6
	Fresh water plankton	-	-	-	0.4	0.2	1.9	0.5	0.1	-	0.1	2.5	0.2	0.8	0.2	1.1	1.7	0.3	1.1	1.3	0.7	1.2
	Fresh water epipelon	5.3	21.5	13.5	11.7	28.4	16.9	31.3	23.7	27.9	23.4	12.4	23.7	10.2	10.1	12.5	12.5	11.6	9.2	7.4	4.1	3.6
	Unknown	3.7	2.1	3.1	2.7	2.0	2.8	3.8	3.2	2.5	2.8	3.0	2.3	2.3	3.0	4.4	4.0	2.3	2.1	2.7	3.4	2.4

epipelic, 12 to 30% brackish/fresh epiphytic and 5 to 25% brackish/fresh aerophilous diatom groups. In the upper part of this division (-38.7 to -37.55 m) brackish/fresh epiphytic diatom group increases considerably (15 to 40%). *Synedra ulna* , *Hantzschia amphioxys*, *Pinnularia* spp. and *Gomphonema acuminatum* are dominant in the lower part. *Rhopalodia gibba*, *Navicula radiosa* and *Epithemia turgida* are dominant in the upper part.

(2) B diatom division (-35.5 to -30.85 m) corresponds to the upper part of Unit II and the lower part of subunit IIIa. It is composed of 15 to 32% fresh water epiphytic, 10 to 20% fresh water epipelic, 3 to 10% brackish/fresh epiphytic, 3 to 5% brackish/fresh aerophilous 7 to 17% marine/brackish epiphytic, 20 to 36% marine/brackish epipelic and 3 to 10% marine planktonic diatom groups. *Navicula radiosa, Synedra ulna, Gomphonema acuminatum, Rhopalodia gibba, Rhopalodia gibberula, Diploneis smithii* and *Nitzschia constrista* are dominant.

(3) C diatom division (-30.85 to -30.5 m) corresponds to the middle part of subunit IIIa. It is composed of 30 to 42% marine/brackish epiphytic, 28 to 37% marine/brackish epipelic, 10% brackish planktonic and 2 to 6% marine planktonic diatom groups. *Rhopalodia gibberula* is dominant with *Melosira jurgensii, Diploneis smithii, Coscinodiscus lacustris* and *Navicula viridis.*

(4) D diatom division is divided into four subdivisions, named D1 to D4 as follows:

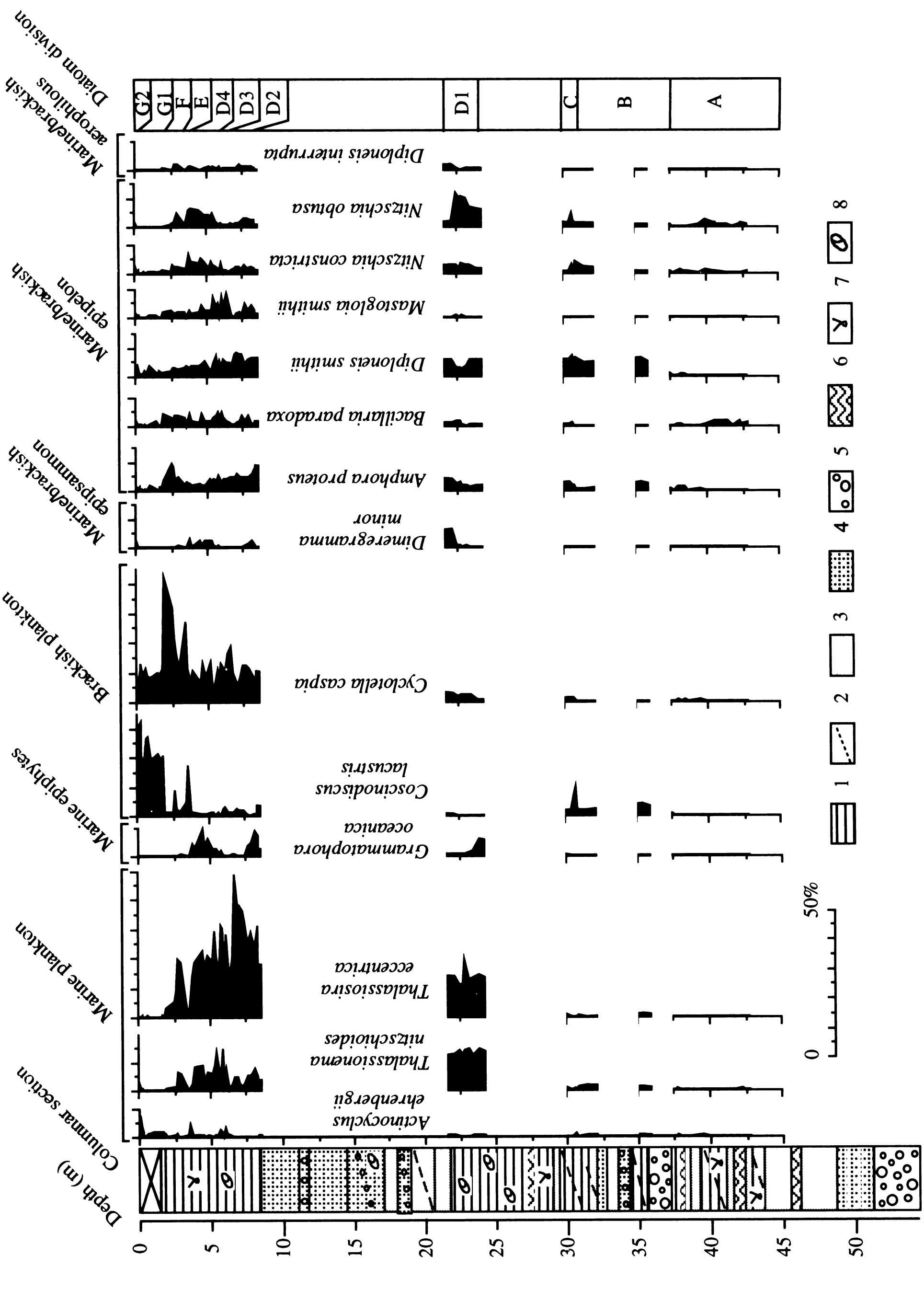
D1 diatom subdivision (-23.9 to -22.2 m) corresponds to the upper part of Unit IV. It is composed of 5% marine/brackish epiphytic, 37 to 50% marine/brackish epipelic, 28 to 35% marine planktonic, 1 to 5% marine epiphytic diatom groups, and especially in the upper part of this subdivision (-22.75 to -22.2 m) marine/brackish epipsammic diatom group increases (8%). *Thalassionema nitzschioides, Thalassiosira eccentrica* and *Nitzschia obtusa* are dominant. *Diploneis smithii, Dimeregramma minor* and *Amphora proteus* are always prominent.

D2 diatom subdivision (-8.42 to -6.75 m) corresponds to the lowest part of Unit VI. It is composed of 7 to 12% marine/brackish epiphytic, 27 to 30% marine/brackish epipelic, 30 to 43% marine planktonic, 1 to 9% marine epiphytic, and 8 to 13% brackish planktonic diatom groups. *Thalassiosira eccentrica* and *Thalassionema nitzschioides* are dominant. *Grammatophora oceanica, Cyclotella caspia, Amphora proteus* and *Diploneis smithii* are always prominent.

D3 diatom subdivision (-6.75 to -6.0 m) corresponds to the lower part of Unit VI. It is composed of 13 to 24% marine/brackish epiphytic, 22 to 26% marine/brackish epipelon, 11 to 35% marine planktonic, 5 to 14% brackish/fresh epiphytic, 5 to 15% fresh epiphytic and 12 to 19% brackish planktonic diatoms. *Thalassiosira eccentrica, Cyclotella caspia* and *Rhopalodia gibberula* are dominat. *Amphora proteus, Mastogloia smithii, Rhopalodia gibba, Cocconeis placentula* and *Epithemia turgida* are always prominent.

D4 diatom subdivision (-6.0 to -3.65 m) corresponds to the lower-middle part of Unit VI. It is composed of 9 to 15% marine/brackish epiphytic, 25 to 40% marine/brackish epipelic, 25 to 45% marine planktonic, 2 to 9% marine epiphytic, and 7 to 15% brackish planktonic diatom groups. *Thalassiosira eccentrica* and *Cyclotella caspia* are dominant. *Grammatophora oceanica, Nitzschia obtusa* and *N. constrista* are always prominent.

(5) E diatom division (-3.65 to -3.0 m) corresponds to the middle part of Unit VI. It is composed of 5 to 14% marine/brackish epiphytic, 8 to 23% marine/brackish epipelon, 2 to 5% marine plank-


Depth (m)
Columnar section
Marine plankton
Marine epiphytes
Brackish plankton
Marine/brackish epipsammon
Marine/brackish epipelon
Marine/brackish aerophilous
Diatom division
Actinocyclus ehrenbergii
Thalassionema nitzschioides
Thalassiosira eccentrica
Grammatophora oceanica
Coscinodiscus lacustris
Cyclotella caspia
Dimeregramma minor
Amphora proteus
Bacillaria paradoxa
Diploneis smithii
Mastogloia smithii
Nitzschia constricta
Nitzschia obtusa
Diploneis interrupta
G2 G1 F E D4 D3 D2 D1 C B A
0 50%
1 2 3 4 5 6 7 8
0 5 10 15 20 25 30 35 40 45 50

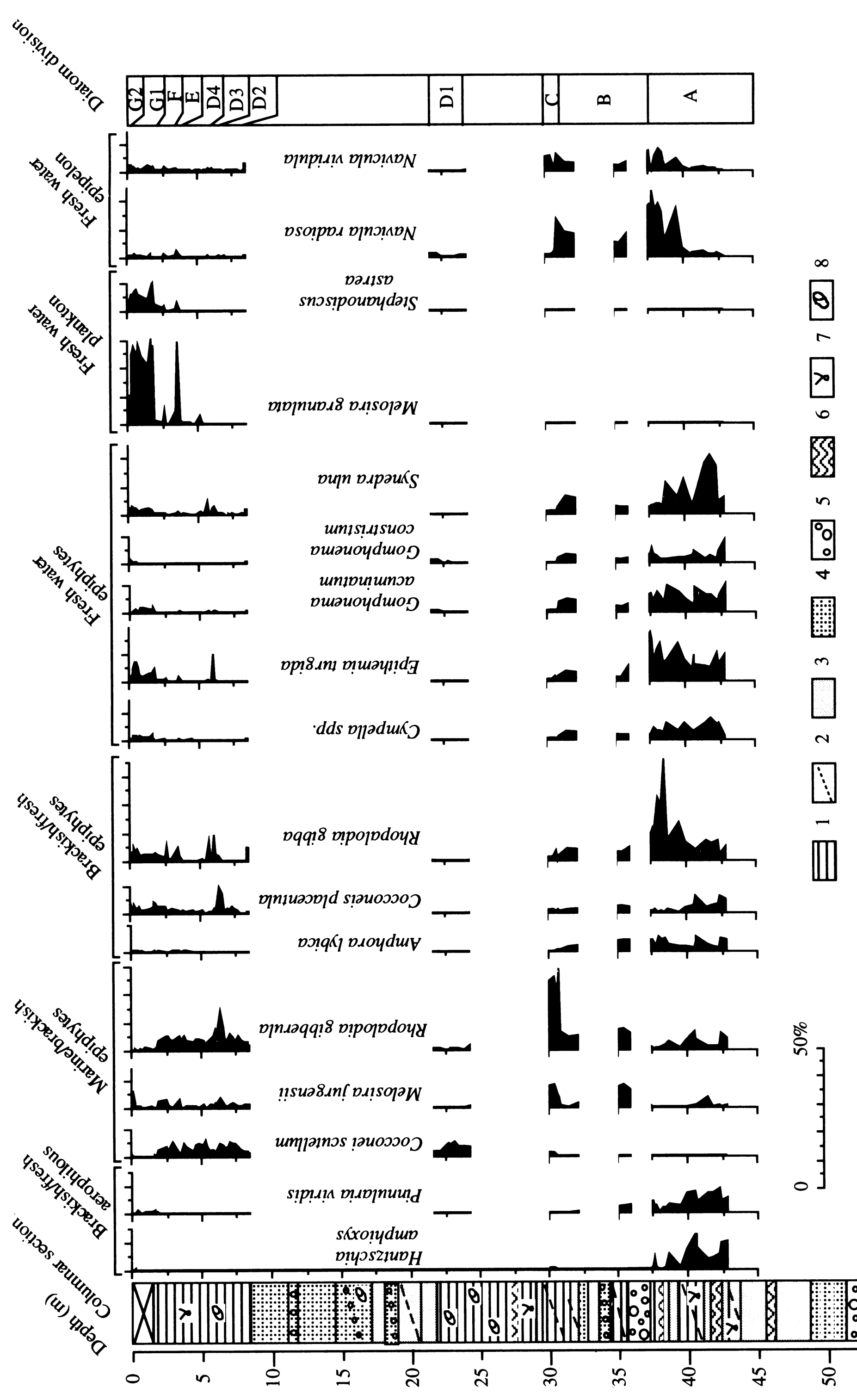


Fig. 3. Diagram showing the relative abundance of the individual diatom species of boring core KM-11 . 1. Clay, 2. Silt, 3. Fine sand, 4. Medium - coarse sand, 5. Gravel, 6. Peat, 7. Plant fragment, 8. Shell fragment

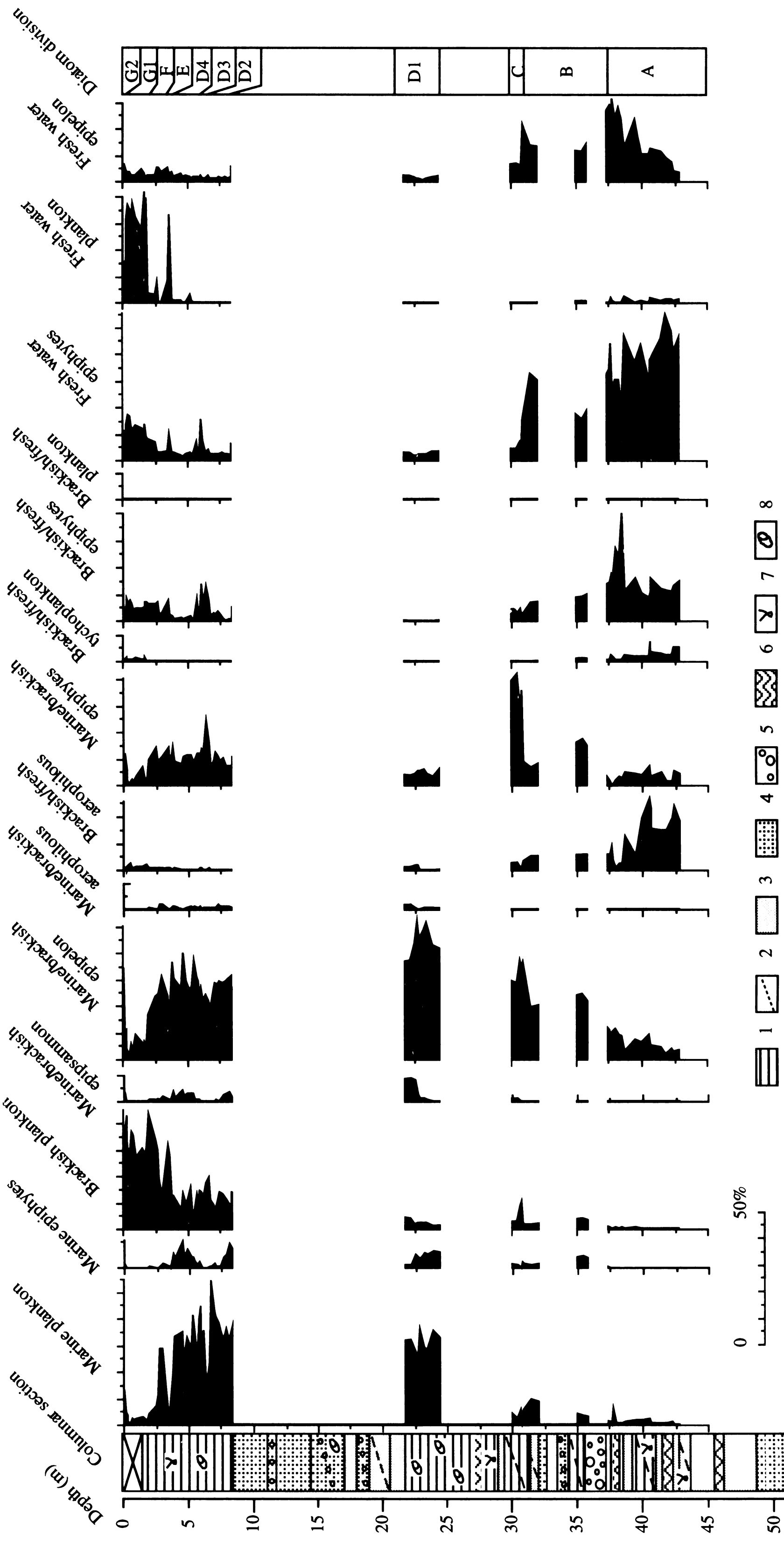


Fig. 4. Diagram showing the relative abundance of the ecological groups of boring core KM-11. 1. Clay, 2. Silt, 3. Fine sand, 4. Medium-coarse sand, 5. Gravel, 6. Peat, 7. Plant fragment, 8. Shell fragment.

tonic, 28 to 32% brackish planktonic, 3 to 9% fresh water epiphytic, 8 to 33% fresh water planktonic and 2 to 7% brackish/fresh epiphytic diatom groups. *Cyclotella caspia*, *Coscinodiscus lacustris* and *Melosira granulata* are dominant.

(6) F diatom division (-3.0 to -2.0 m) corresponds to the middle-upper part of Unit VI. It is composed of 8 to 14% marine/brackish epiphytic, 16 to 31% marine/brackish epipelic, 5 to 28% marine planktonic and 11 to 43% brackish planktonic diatom groups. *Cyclotella caspia* and *Thalassiosira eccentrica* are dominant. *Amphora proteus* and *Bacillaria paradoxa* occur with low frequency.

(7) G diatom division is divided into two subdivisions, named G1 and G2 as follows:

G1 diatom subdivision (-2.0 to -0.3 m) corresponds to the upper part of Unit VI. It is composed of 2 to 5% marine/brackish epipelic, 27 to 37% brackish planktonic, 10 to 17% fresh water epiphytic and 30 to 42% fresh water planktonic diatom groups. *Melosira granulata* and *Coscinodiscus lacustris* are dominant. *Cyclotella caspia* and *Stephanodiscus astrea* are always prominent.

G2 diatom subdivision (-0.3 to 0 m) corresponds to the uppermost part of Unit VI. It is composed of 5 to 10% marine/brackish epiphytic, 10 to 34% marine/brackish epipelic, 4 to 13% marine planktonic, 18 to 43% brackish planktonic, 6 to 10% fresh water epiphytic, 11 to 14% fresh water planktonic and 4 to 5% brackish/fresh epiphytic diatom groups. *Cyclotella caspia* , *Actinocyclus ehrenbergii*, *Nitzschia granulata*, *N. lanceola*, *Diploneis smithii* , *Melosira jurgensii*, *Synedra pulchella* and *Melosira granulata* are dominant.

VI. Sedimentary environment

On the basis of sediment properties and diatom divisions, sedimentary environments of the KM-11 are inferred as follows (Fig. 5).

(1) Unit I consists of coarser sediments in the lower part and alternated beds of fine sands and sandy silts in the upper part. Diatoms occurred from fine sediments and correspond to A diatom division. Fresh water epiphytic, fresh water epipelic brackish/fresh epiphytic and brackish/fresh aerophilous diatom groups are dominant. It is probable that sedimentation took place under fluvial environment.

(2) The upper part of Unit II and lower part of subunit IIIa consist of alternated beds of sandy silts and fine sands, and correspond to B diatom division. Marine/brackish epipelic, marine/brackish epiphytic, marine planktonic, fresh water epiphytic and fresh water epipelic diatom groups are intermixed complicately. High relative abundances of marine/brackish epipelic, epiphytic diatom groups and the appearance of marine planktonic diatoms indicate marine influence in the site. It seems likely that sedimentation took place in a tidal brackish environment of middle estuary indicating the beginning of the Holocene transgression.

(3) The middle part of subunit IIIa consists of gray silty clays and corresponds to C diatom division. Marine/brackish epiphytic and epipelic diatom groups are dominat (80%). It seems likely that the sedimentation took place in a marine/brackish environment at the Holocene transgression. An embayment appeared with low sea-water level.

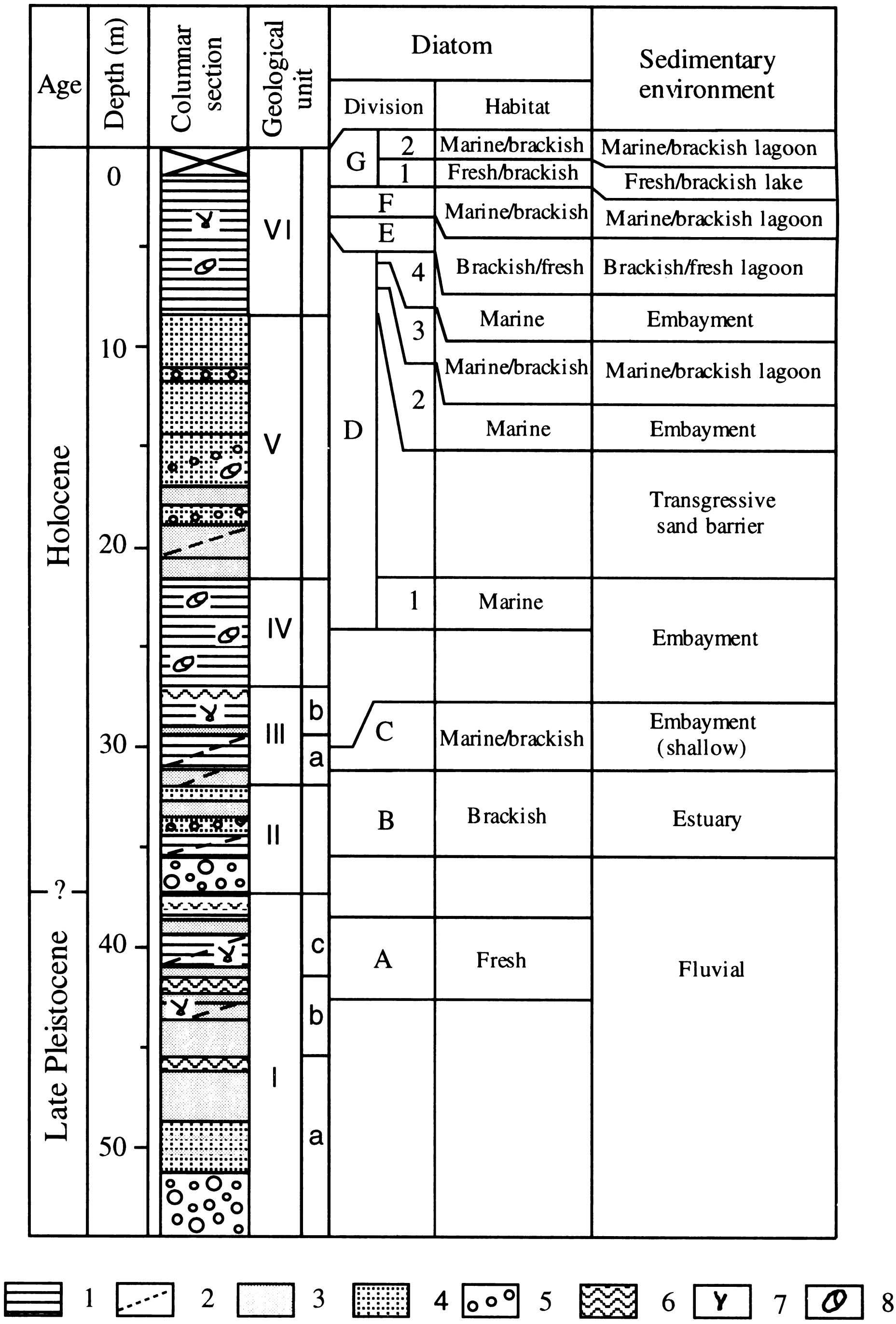


Fig. 5. Summary of the lithology, diatom division and sedimentary environment of boring core KM-11. 1. Clay, 2. Silt, 3. Fine sand, 4. Medium-coarse sand, 5. Gravel, 6. Peat, 7. Plant fragment, 8. Shell fragment.

(4) Subunit IIIb and the lower part of Unit IV consist of gray silty clays and only several diatom species of marine planktonic and marine/brackish epipelic diatom groups were found. *Thalassionema nitzschioides*, *Thalassiosira eccentrica*, *Amphora* sp., *Diploneis smithii* and *Nitzschia obtusa* occur with low frequency. The upper part of Unit IV and the lowest part of Unit VI consist of silty clays, and correspond to D1 and D2 diatom subdivisions. The predominance of marine planktonic and marine/brackish epipelic diatom groups in the sediments suggests a strong marine influence in the site. It is considered that sedimentation took place under a marine environment such as an embayment. The maximum Holocene transgression (the Jomon transgression) extended to the site.

(5) Unit V consists of coarse-fine sands and pebbly sands with shell fragments in the upper part and fine sands and sandy silts in the lower part. Several diatom species are found in sandy silts. *Dimeregramma minor, Plagiogramma staurophorum* and *Nitzschia obtusa* occurred with low frequency. It is likely that these sands were deposited during a rising trend of sea-water level.Sedimentation took place in a transgressive sand barrier.

(6) The lower part of Unit VI consists of silts, very fine sandy silts, and corresponds to D3 diatom subdivision. The intermixture of marine planktonic, marine/brackish epipelic, epiphytic, brackisk planktonic, brackish/fresh epiphytic and fresh water epiphytic diatom groups indicate a small regression during the Holocene transgression. Sedimentation took place under a marine/brackish lagoon environment.

(7) The lower-middle part of Unit VI consists of clayey silts with common shell fragments, and corresponds to D4 diatom subdivision. Marine planktonic and marine/brackish epipelic diatom groups are dominant with the occurence of marine, marine/brackisk epiphytic and brackish planktonic diatom groups. It is considered that the sedimentation took place under a marine embayment environment.

(8) The middle part of Unit VI consists of clayey silts and fine sandy silts with common humus matters, and corresponds to E diatom division. Fresh and brackish water planktonic diatom groups are dominant together with marine/brackish epipelic diatom group indicating a small regression. Sedimentation took place under a brackish/fresh lagoon environment.

(9) The middle-upper part of Unit VI consists of silts with common humus matters and corresponds to F diatom division. Brackish and marine planktonic diatom groups are dominant with marine/brackish epipelic and epiphytic diatom groups. It suggests that the temporary rising sea level corresponds to a small transgression after the Jomon transgression. It indicates that sedimentation took place under marine/brackish lagoon.

(10) The upper part of Unit VI consists of silts and sandy silts with common humus matters and corresponds to G1 diatom subdivision. Fresh and brackish water planktonic diatom groups are dominant with a fresh water epiphytic group. Sedimentation took place under a fresh/brackish lacustrine environment.

(11) The uppermost part of Unit VI consists of a very soft mud bed, 0.3 m in thickness, and corresponds to G2 diatom subdivision. Marine/brackish epipelic and brackish planktonic diatom

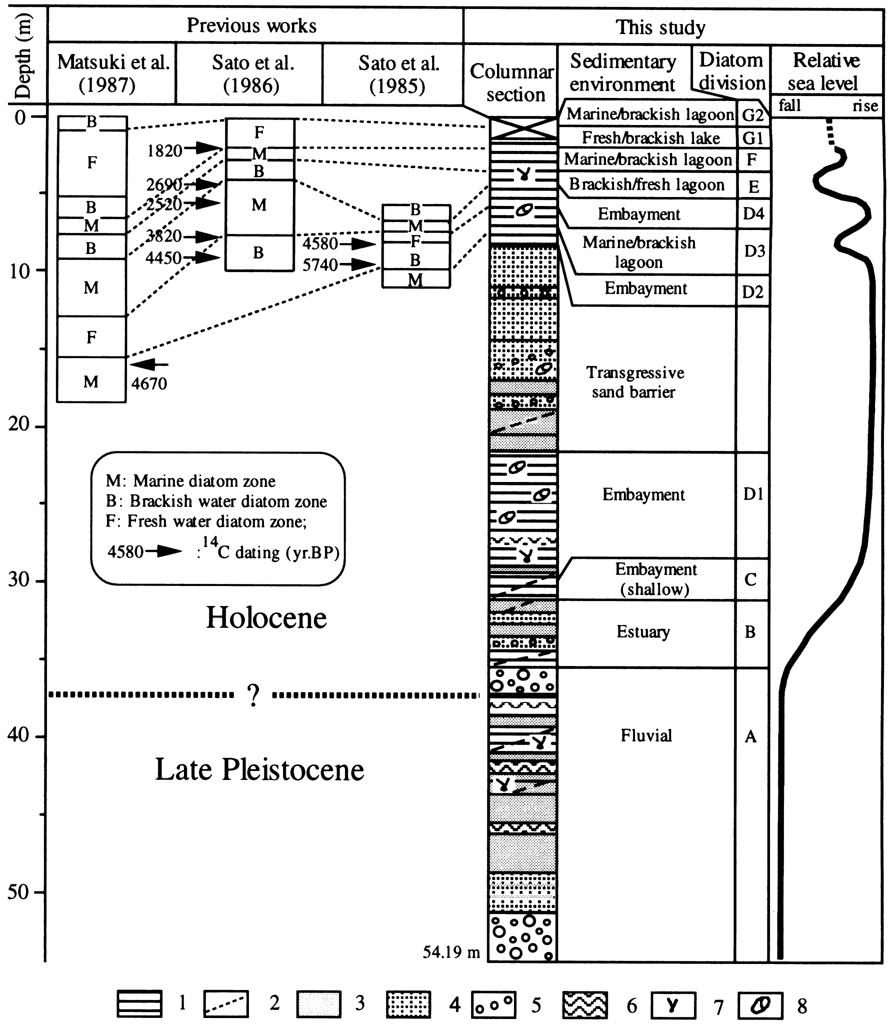


Fig. 6. Correlation data of previous works and boring core KM-11. 1. Clay, 2. Silt, 3. Fine sand, 4. Medium-coarse sand, 5. Gravel, 6. Peat, 7. Plant fragment, 8. Shell fragment.

groups are dominant together with marine/brackish epiphytic and marine planktonic groups. It suggests that the sea water entered into the site and sedimentation took place again under marine/brackish a marine/brackish lagoon environment.

VII. Comparison with previous works

A comparison among this study and previous works (Sato *et al.*, 1985, 1986; Matsuki ., 1987) is shown in Fig. 6. The lowest part of these reports was dated at about 5,000 yr.BP. The boring core of this study, 54.19 m in depth, reached down to Late Pleistocene sediments.

Sediments of Late Pleistocene to 5,000 yr.BP. are not studied in previous works. This study shows that the Late Pleistocene fluvial sediments probably occupied below -37.10 m in depth and were covered by estuary sediments which bear B diatom division representing the beginning of the Holocene transgression.

Sediments of the maximum Holocene transgression were reported in previous works and can be correlated with this study as follows:

The maximum Holocene transgression was recognized by marine sediments showing 5,740 yr.BP. (Sato *et al.*, 1985) and 4,670 yr.BP. (Matsuki *et al.*, 1987). The transgression may correspond to embayment sediments bearing D2 diatom subdivision.

A small regression indicated by brackish sediments in 4,500 yr.BP (Sato *et al.*, 1985, 1986; Matsuki *et al.*, 1987) is correlated with marine/brackish sediments bearing D3 diatom subdivision that also indicates a small regression.

A transgression was recognized by marine sediments in 3,000 yr.BP. (Sato *et al.*, 1985, 1986; Matsuki *et al.*, 1987). It corresponds to embayment sediments bearing D4 diatom subdivision.

A small regression occurred after 2,690 yr.BP. (Sato *et al.*, 1985, 1986; Matsuki *et al.*, 1987). Sato (1986) supposed that this regression was not caused by sea level change but should be in a series of transgression from 3,000 to 1,800 yr.BP. However this study shows that the brackish/fresh lagoonal sediments bearing E diatom division indicate a separate regression that may have occurred after 2690 yr.BP.

A small transgression occurred in 2,000 yr.BP. (Sato *et al.*, 1985, 1986; Matsuki *et al.*, 1987). This corresponds to marine/brackish sediments bearing F diatom division.

After 1,800 yr. BP., Lake Kamo was completely separated from the sea at the time of regression (Sato *et al.*, 1985, 1986; Matsuki *et al.*, 1987). It corresponds to the fresh/brackish lacustrine sediments bearing G1 diatom subdivision.

In 1902 due to the construction of an artificial water way, brackish sediments (Matsuki *et al.*, 1987) were replaced in Lake Kamo. They correspond to the marine/brackish sediments bearing G2 diatom subdivision.

VIII. Conclusion

The findings of this study support the following conclusions:

The boundary of Late Pleistocene and Holocene sediments is probably located at -37.10 m in depth. In the Late Pleistocene, fluvial sediments occupied the site.

There were three Holocene transgressions and regressions respectively as follows:

The beginning of the Holocene transgression is represented by the estuary sediments, and the transgression rapidly progressed until 5,500 to 5,000 yr.BP to complete the first Holocene transgression. The second and the third ones were in 3,000 and 2,000 yr.BP. respectively. Embayment sediments occupied the site during these transgressions.

The first Holocene regression occurred in 4,500 yr.BP., the second is considered to correspond roughly to the Yayoi regression (c.a. 3,000 to 2,000 yr.BP.) and the third occurred after 1,800 yr.BP. Marine/ brackish, brackish/fresh lagoonal and fresh/brackish lacustrine sediments were formed in the site respectively.

Lake Kamo has been occupied by marine/brackish lagoonal sediments since 1902, because an artificial water way was constructed in connecting Ryotsu Bay.

Acknowledgements

The authors wish to express gratitude to Niigata Prefecture Office and Kowa Co., Ltd. for offering materials. And we would like to express sincere thanks to Prof. M. Tateishi, Niigata University, Mr. Y. Kamoi, Kowa Co. Ltd., members of our research group for their suggestions and Dr. Hein De Volf, Geological Survey of The Netherlands for taxonomical and ecological suggestions.

This study was supported in part by Grant - in - Aid for Scientific Research from the Ministry of Education, Science and Culture, project no. (c)(2) 07640597.

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Plate I

1, 2:. ***Actinocyclus ehrenbergii***
3: *Actinoptychus undulatus*
4: *Asteromphalus heptactis*
5 - 6: *Coscinodiscus nodulifer*
7 - 11: *Thalassiosira eccentrica*
12 - 13: *Coscinodiscus radiatus*

Plate I

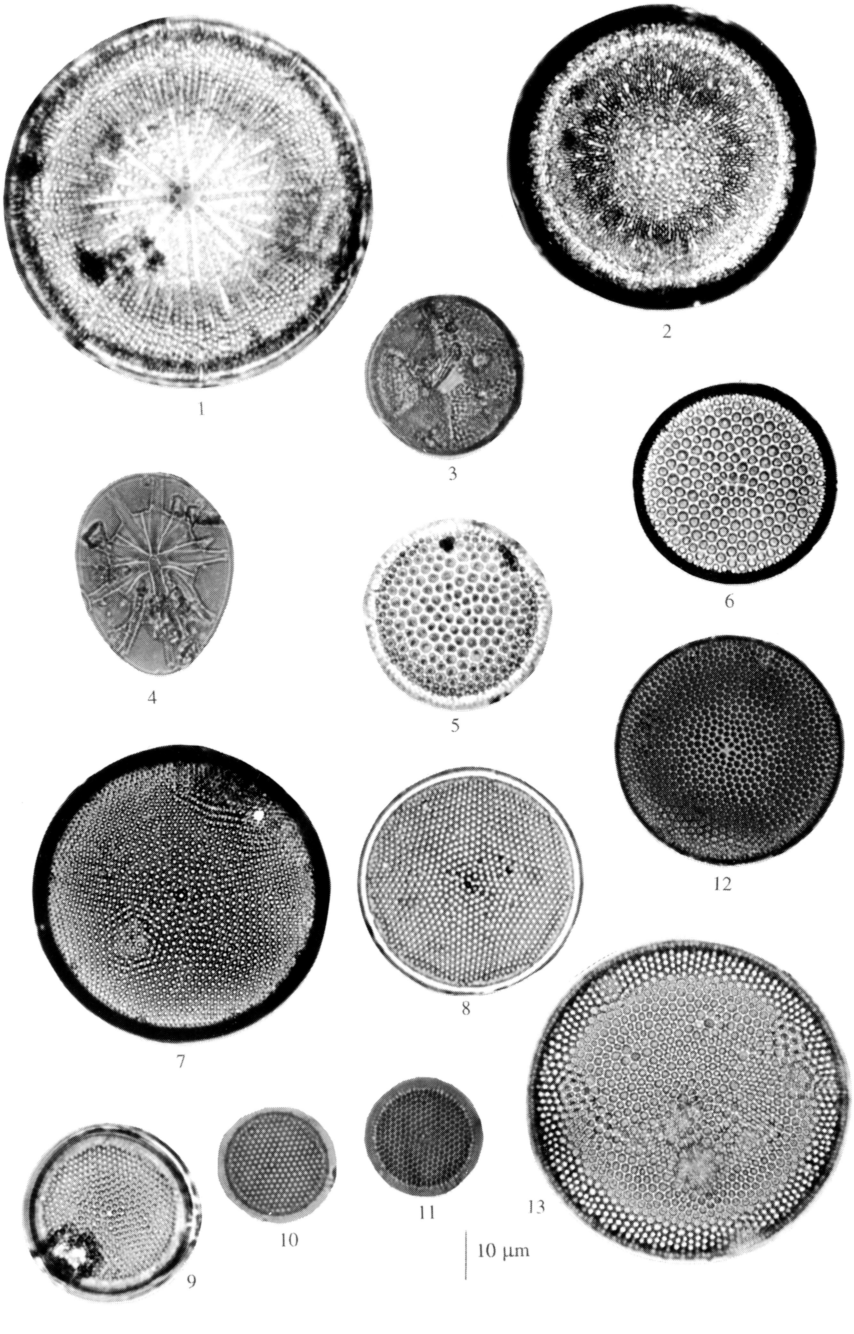

Plate II

1 - 5: *Coscinodiscus lacustris*
6 - 8: *Paralia sulcata*
9 - 15: *Cyclotella caspia*
16 - 18: *Cyclotella striata*

Plate II

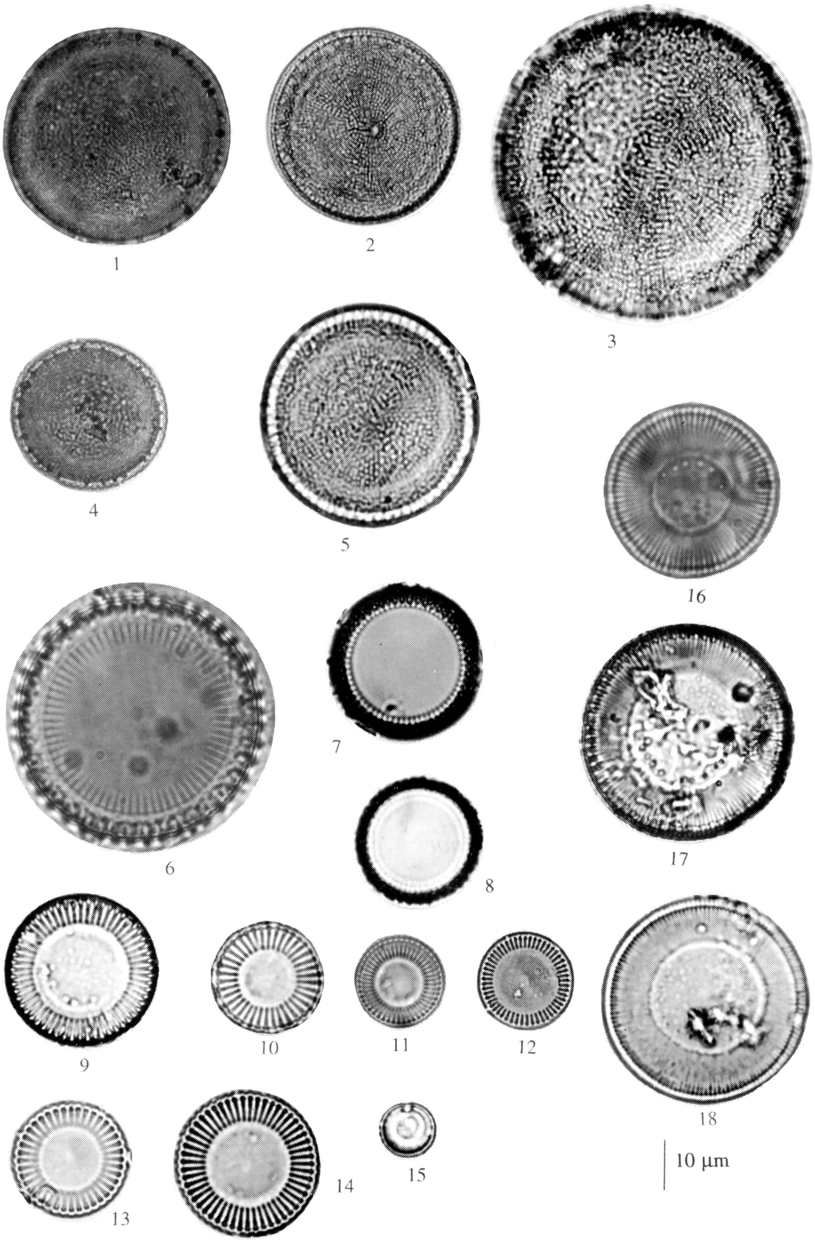

Plate III

1 - 3: *Diploneis smithii*
4: *Navicula radiosa*
5: *Diploneis bombus*
6 - 7: *Cocconeis scutellum*
8: *Diploneis suborbicularis*
9: *Cocconeis pseudo-marginata*
10: *Navicula marina*
11: *Nitzschia lanceola*
12: *Amphora acuta*
13: *Nitzschia coarctata*
14: *Amphora proteus*
15: *Cymbella tumida*
16: *Opephora martyi*
17 - 18: *Achnanthes hauckiana*
19: *Navicula lyroides*
20: *Nitzschia constricta*
21: *Dimeregramma minor*
22: *Plagiogramma staurophorum*
23 - 24: *Achnanthes brevipes*
25: *Trachyneis aspera*

Plate III

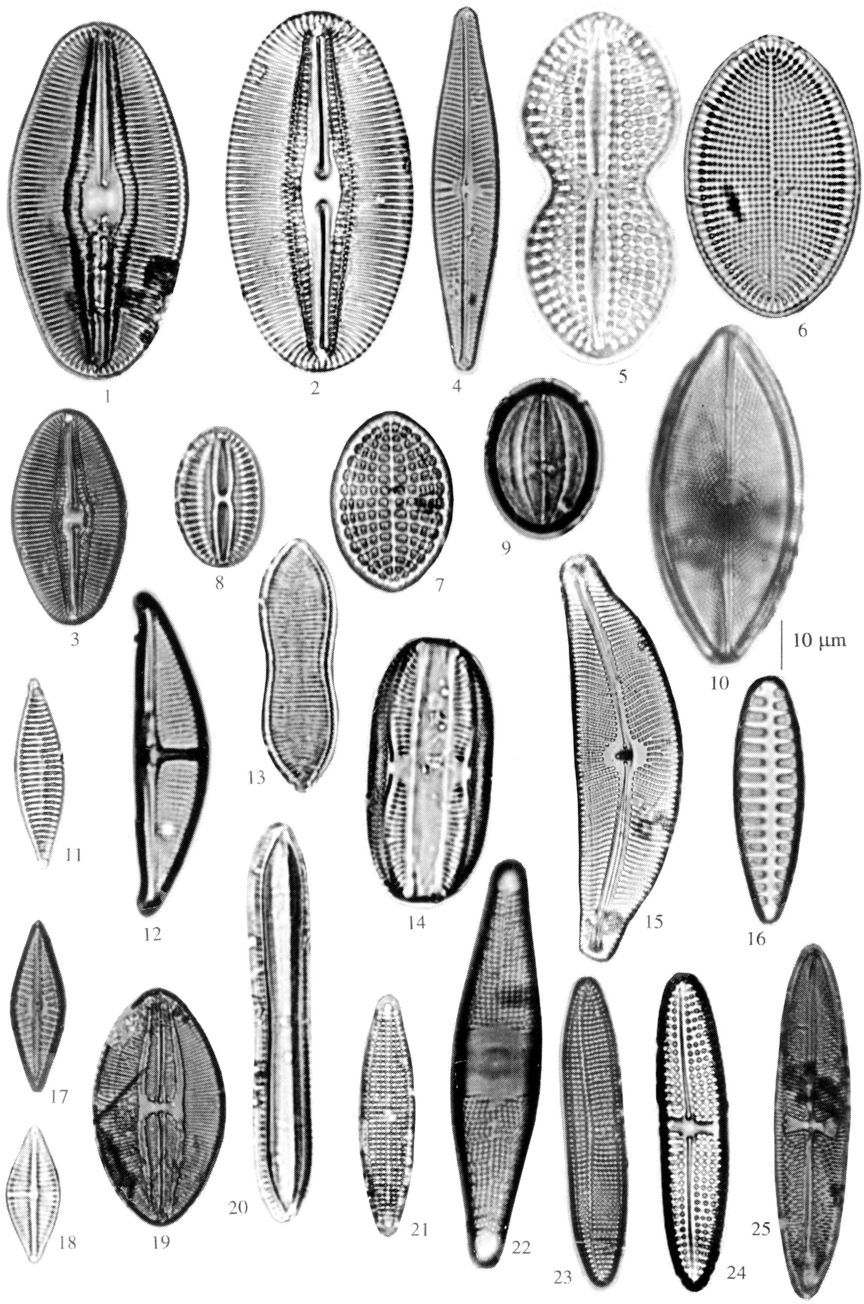

Plate IV

1 - 4: *Thalassionema nitzschioides*
5 - 6: *Grammatophora oceanica*
7 - 8: *Synedra pulchella*
9: *Gyrosigma acuminatum*
10: *Nitzschia* sp.
11: *Synedra ulna*
12: *Roicosphenia curvata*
13: *Bacillaria paradoxa*
14: *Melosira granulata*
15 - 16: *Rhopalodia gibba*
17: *Nitzschia levidensis*
18: *Cocconeis placentula*
19: *Meridion circulare*
20: *Mastogloia smithii*
21 - 23: *Rhopalodia gibberula*

Plate IV