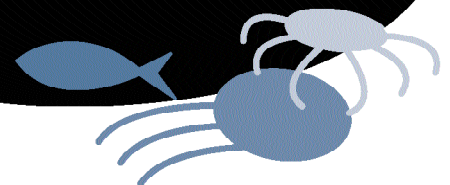


Phytoplankton Atlas

DECEMBER 2004

Sepetiba Bay, Brazil

D.R. Tenenbaum, M.C. Villac, S.C. Viana,
M. Matos, M. Hatherly, I.V. Lima
& M. Menezes



Phytoplankton Atlas of Sepetiba Bay, Rio de Janeiro, Brazil

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The Global Ballast Water Management Programme (GloBallast) is a cooperative initiative of the Global Environment Facility (GEF), United Nations Development Programme (UNDP) and International Maritime Organization (IMO) to assist developing countries to reduce the transfer of harmful organisms via ships' ballast water.

The GloBallast Monograph Series is published to disseminate information about and results from the programme, as part of the programme's global information clearing-house functions.

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The programme aims to provide technical assistance, capacity building and institutional strengthening to remove barriers to ballast water management arrangements in developing countries through six initial demonstration sites: Sepetiba (Brazil), Dalian (China), Mumbai (India), Kharg Island (Iran), Saldanha (South Africa) and Odessa (Ukraine). These sites are intended to be representative of the six main developing regions of the world: South America, Asia/Pacific, South Asia, ROPME Sea area & Red Sea, Africa and Eastern Europe. As the programme proceeds, it is intended to replicate these initial demonstration sites throughout each region. The GloBallast Programme will carry on its activities from March 2000 to December 2004.

One of the activities implemented by GloBallast at each demonstration site is the assessment of local marine biodiversity in and around the port, across all habitat types and for all taxonomic groups. This survey, based on standardized methodologies, provides baseline data on the presence and distribution of native and invasive aquatic species. This allows any existing invasion to be monitored and managed, any new invasion to be detected and responded to, and also assists port States to notify outbreaks of harmful species.

In Brazil, the Lead Agency for the GloBallast Programme is the Secretaria de Qualidade Ambiental nos Assentamentos Humanos of the Ministério do Meio Ambiente (SQA-MMA) and the coordination of the port survey is carried out by the Instituto de Estudos do Mar Almirante Paulo Moreira (IEAPM). In this regard, we are indebted to Robson José Calixto (SQA-MMA) and Flavio da Costa Fernandes (IEAPM) for their support. Special thanks are also due to Alexandre de Carvalho Leal Neto, the Country Focal Point Assistant, for his sterling efforts to provide us the means to carry out this task.

The survey of the phytoplankton, carried out in November 2001 and April 2002, was land-based in the city of Itacuruçá which was, for our sampling purposes, strategically located on the coast of Sepetiba Bay, State of Rio de Janeiro. We are thankful to the Port Captaincy of Itacuruçá and the Yacht Club of Itacuruçá for kindly providing fast motor boats, at no cost, for our sampling. The phytoplankton group also used the laboratory and housing facilities of the marine station of the Universidade Federal Rural do Rio de Janeiro (UFRRJ) in Itacuruçá. Sample analysis was done at the Instituto de Biologia (IB) and the Museu Nacional (MN), both in the Universidade Federal do Rio de Janeiro (UFRJ).

The opportunity to create this Phytoplankton Atlas was made possible by the dedication and initial work of Simone de Castro Viana and Maria Gouveia Matos, who used part of this data set in their undergraduate final research reports. The countless hours they spent doing microscopy work and photographing organisms is at the core of this publication.

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The layout, formatting and image enhancing of the figures and plates were done by Carlos Artêmio (CR2 Design). The line drawings were made by Benjamin Paul Shaw and the maps were plotted by Gustavo de M. Figueiredo. These are "final touches" that require a great deal of skill — they add precision and beauty to this work.

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1. Introduction

The knowledge about the occurrence, distribution and abundance of organisms in port areas is a prerequisite for any attempt to manage the introduction and spread of non-indigenous species by shipping activities. To this end, a standardized set of survey methods that can provide a consistent basis on which to assess the status of introduced species of individual ports was developed under the coordination of the CSIRO Center for Research on Introduced Marine Pests (CRIMP) (Hewitt & Martin, 2001). The study that led to this Phytoplankton Atlas of Sepetiba Bay is part of a baseline port survey carried out based on this set of procedures, here referred to as the CRIMP Protocol.

Sepetiba Bay is located in the State of Rio de Janeiro, Brazil (Figure 1). Its unique geomorphology is created by the presence of the 40km-long Restinga da Marambáia, a sandbar that separates the bay from the Atlantic Ocean. The northern margins of the bay have small sandy beaches separated by rocky headlands, as well as mangrove vegetation that renders this a very productive ecosystem. The climate in the area is tropical and humid: rainy in the summer and drier in the winter (Figure 2).

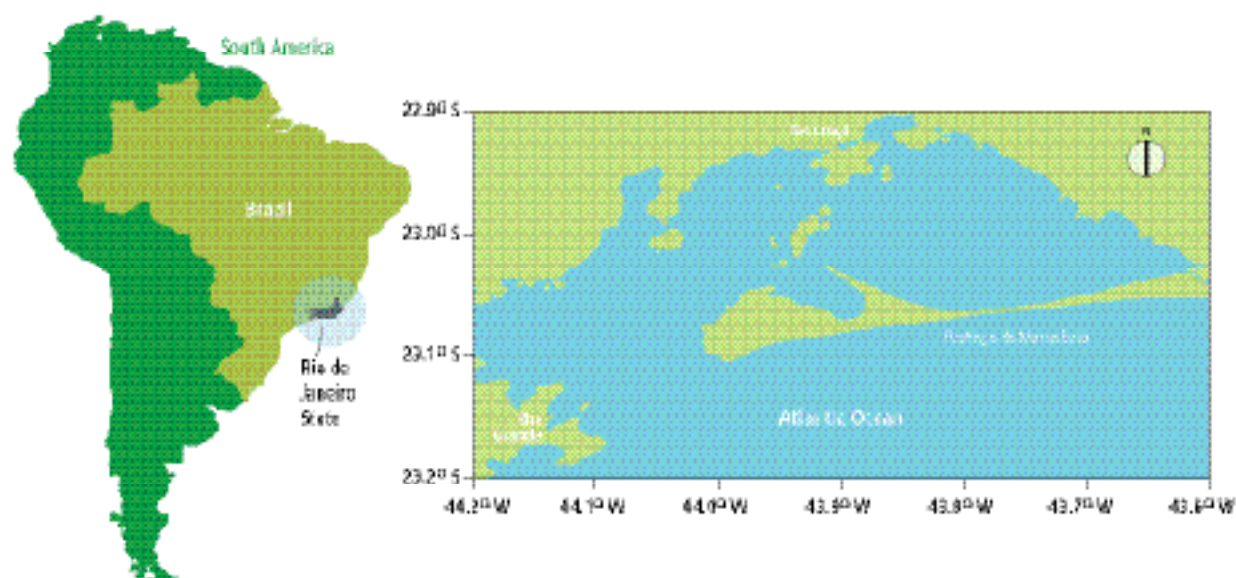


Figure 1. Sepetiba Bay, State of Rio de Janeiro, Brazil.

On the northeastern portion, rivers and channels that flow into the bay drain a watershed of about 2,654 km² that includes agricultural, industrial and urban areas. Marine water contribution is most effective from the western portion of the bay, where a wide and deep channel is found between Ilha Grande and the edge of the Restinga da Marambáia. This channel leads to the Port of Sepetiba, located on the northeastern portion of the bay (43° 50'W and 22° 56'S). Except for this navigation channel, Sepetiba Bay is a fairly shallow system, that is, most of the ca. 300 km² of the bay area is less than 10 meters deep.

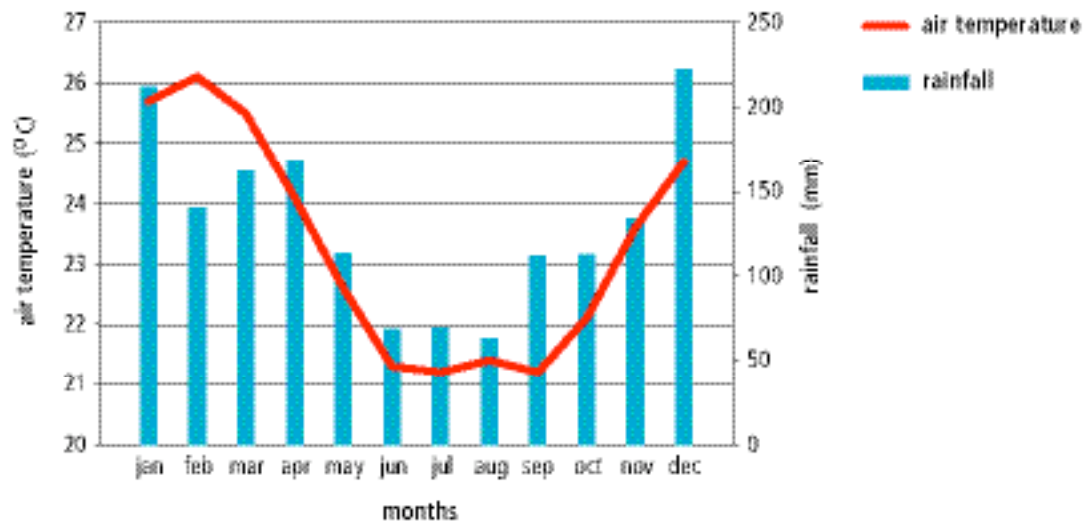


Figure 2. Air temperature and rainfall in Sepetiba Bay area: monthly averages for 1960-1990 time series (Instituto Nacional de Meteorologia, INMET/ Brazil).

Sepetiba Bay can, therefore, be divided into two zones according to its estuarine nature: an innerbay area to the east, shallower and less saline (28, in average), and an outerbay area to the west, with more transparent waters and higher salinity (33, in average) (Cruz Filho *et al.*, 2000). A chain of small islands creates a natural divider between the innerbay and the outerbay. Mean spring tide range is 1.1 m and mean neap tide range is 0.3 m.

For those who are familiar with phytoplankton work, it is known that to produce a complete species list in a short period of time is an impossible task. Several of the specimens are still under study. This atlas presents a species list of 246 taxa, 103 of which come with illustrations, some of these with information on their distribution in the study area. It may serve as an identification guide to those interested in the phytoplankton of Sepetiba Bay and elsewhere.

2. Methods

The CRIMP Protocol applied to our study area determined the establishment of a total of 44 sampling sites that comprised all habitat types (water, hard substrate, soft bottom) and taxonomic groups (represented in the plankton, microalgae cysts, seaweeds, zoobenthos, and fish). For the phytoplankton, sampling was carried out at 13 sites distributed along two major areas of the bay: in the outer bay, where marine influence is more effective, and in the inner bay which is subject to direct freshwater inflow (Figure 3). These sites were selected so as to represent the environmental gradients found in Sepetiba Bay.

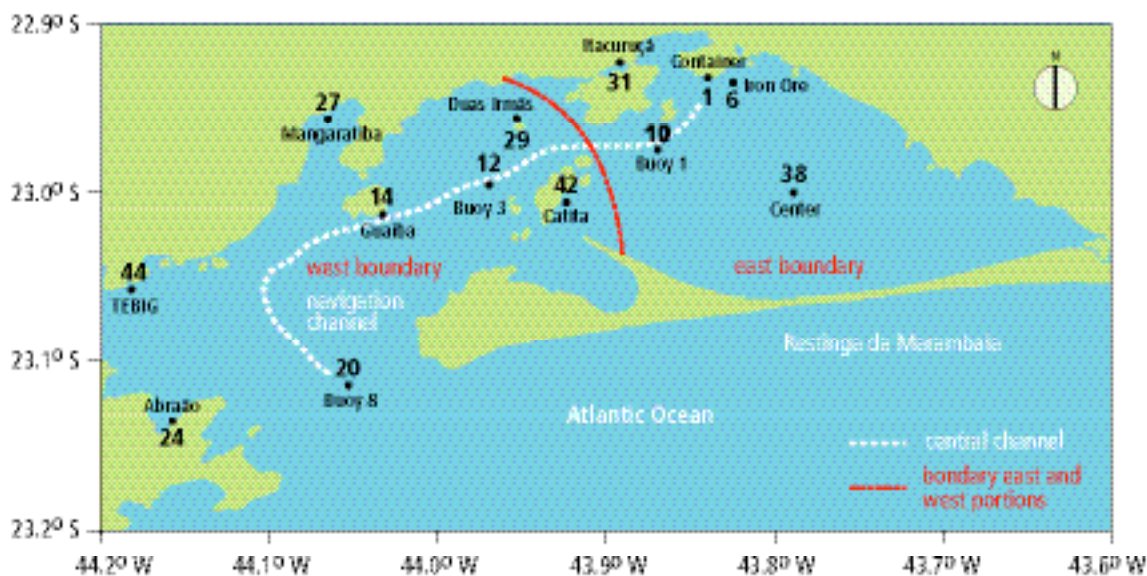


Figure 3. Phytoplankton sampling sites.

The CRIMP Protocol requires a descriptive coding to identify each site, which also has corresponding arabic numbers (Table 1). For sake of simplicity, these sites are hereafter referred to by their numbers only.

Table 1. List of sampling sites.



SITE Nº	SITE CODE	SITE NAME	LOCAL DEPTH (m)
1	BRJSBIBCOT1	Container Terminal 1	15.0
6	BRJSBIBO RET	Iron Ore Terminal	7.5
10	BRJSBIBBUO1	Channel Buoy 1	15.5
12	BRJSBIBBUO3	Channel Buoy 3	16.5
14	BRJSBIBGUPI	Gualba Pier	15.0
20	BRJSBIBBUO8	Channel Buoy 8	15.0
24	BRJSBIBABRO	Abraço Bay	10.0
27	BRJSBIBMAPI	Margaratiba Pier	2.5
29	BRJSBIBIRRO	Duas Irmãs Island	5.6
31	BRJSBIBHIPI	Itacuruçá Pier / Historical Piles	5.0
38	BRJSBIBSECE	Sepetiba Bay (Center)	6.5
42	BRJSBIBCARO	Catita Beach	14.0
44	BRJSBIBTBS1	TEBIG Oil Terminal 1	10.0

The period chosen for the port survey was November 2001 (representative of spring), when biodiversity was expected to be at its highest point during the annual cycle. This survey was complemented by another field trip carried out in April 2002 (representative of autumn). Both field trips were done during two consecutive days, outerbay on the first and innerbay on the second. The methods recommended in the CRIMP Protocol were also complemented by the use of an additional type of sampling gear. Our goal was to provide the most accurate picture possible of the biodiversity of the phytoplankton of Sepetiba Bay to serve as a record for this baseline port survey.

The recommendations of the CRIMP Protocol for the phytoplankton study (Hewitt & Martin, 2001) were followed very closely (Table 2). It emphasizes qualitative analysis of samples collected with net hauls. It was complemented with another method that allows for a better evaluation of the quantitative attributes of the populations (Table 2). Objectives, advantages and disadvantages of both types of sampling, and the sample analysis that followed, is thoroughly discussed in Sourina (1978). The effect of the sampling methods applied on our diagnosis of the local phytoplankton biodiversity will be presented in the "results & discussion" section.

The equipment used for the analysis were an upright Zeiss Axiophot light microscope with Media Cybernetics Image-Pro Plus 4 image analysis software, an upright Olympus BH2 light microscope, an inverted Olympus IX 70 light microscope and a Jeol JSM-5310 Scanning Electron Microscope.

Table 2. Methods used to sample and to analyse the phytoplankton.

	CRIMP PROTOCOL	COMPLEMENTATION
Sampler	20µm-mesh net 	Van Dorn bottle 
Depth	Vertical tow: 0.5m from the bottom to the surface	Two depths: surface and 0.5m from the bottom
Fixative	Formaldehyde buffered with borax (final concentration of 2%)	Formaldehyde buffered with borax (final concentration of 2%)
Analysis (qualitative)	1) water mounts 2) acid-clean permanent mounts for diatoms (Kasle & Fryxell, 1970), observation in phase contrast 3) water mounts with hypochlorite of sodium to help to distinguish and/or dissociate dinoflagellate plates (Bolotovskoy, 1973), observation in phase contrast 4) water-washed permanent mounts with calcofluor to help distinguish dinoflagellate plates (Fritz & Themer, 1985), observation with epifluorescence using UV-light 5) Scanning Electron Microscopy of acid-clean or water-washed material (sputtered with gold-palladium)	Settling technique (Utermohl, 1958): identification during cell count, with final magnification of 200X or 400X, using bright field and phase contrast
Analysis (quantitative)	Relative abundance in 1,5mL of sample settled in Utermohl's counting chambers: cells were counted until the curve determined by the number of new taxa by the number of new counting fields became stable (Uehlinger, 1964); coordinates of counting fields were pre-determined at random	Absolute abundance using the settling technique (Utermohl, 1958): counting of at least 300 settling units (one cell-chain of cells), which allowed the count of 100 cells of the best represented taxon (counting error of 20% according to Lund <i>et al.</i> , [1958]), and a 95% chance of finding a species that represents 1% of the community according to Shaw (1964)

3. Results and Discussion

The species list of Sepetiba Bay (spring/2001 and autumn/2002) included a total of 246 taxa, of which 150 were diatoms (Bacillariophyta), 86 dinoflagellates (Dinoflagellata), 5 silicoflagellates (Chromophyta, Dictyocophyceae), 3 coccolithophorids (Chromophyta, Primmnesiophyceae), 1 euglenophycean (Euglenophyta) and 1 ebrniidean (Zoomastigophora, Ebrniidea). Of the 246 taxa found, 155 were identified to species level to date (Appendix 1).

The taxa found were organized according to the following systems of classification: Round *et al.* (1990) for the diatoms, Fensome *et al.* (1993) for the dinoflagellates, Throndsen (1997) for the silicoflagellates and the ebrniideae, Leedale (1967) for the euglenophycean, and Heimdal (1997) for the coccolithophorids.

The in-depth discussion of phytoplankton distributional patterns and their ecological implications is beyond the scope of this publication. It is important, however, to understand that the environmental settings where the phytoplankton populations were found presented space-time gradients.

The sampling periods were quite different in terms of temperature and salinity, which reflected well the seasonal variations of rainfall and air temperature: late spring had cooler and less saline waters, while autumn had higher salinity and warmer waters (Figure 4). The data presented here are a composite of the whole water column, although one can expect to find vertical stratification of the phytoplankton populations in systems of estuarine nature such as Sepetiba Bay.

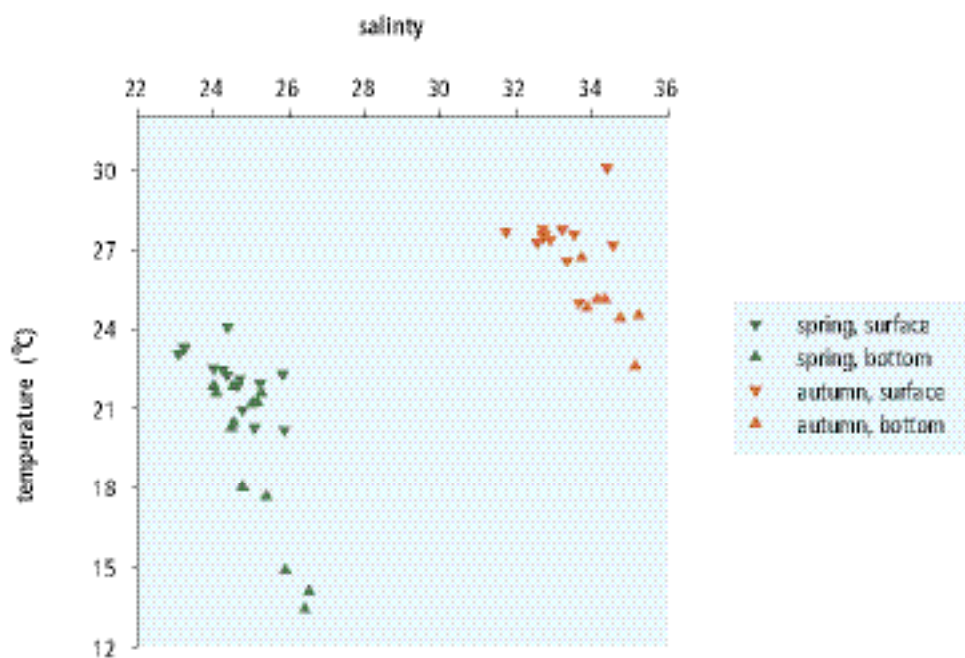


Figure 4. T-S diagram of Sepetiba Bay for 19-20 November 2001 and 25-26 April 2002.

Another indicator of seasonal differences can be established by analyzing nutrient concentrations (Table 3). Spring had more eutrophic waters than autumn, probably due to increasing river input and overall runoff that take place during the beginning of the rainy season (see Figure 2). The wide range found for all nutrients within one single field trip reveals spatial gradients that can be associated with the estuarine nature of Sepetiba Bay, as can be also confirmed by the wide range found for surface salinity on both field trips (Figure 4). As already explained, the eastern portion of the Bay is subjected to direct river discharge, some of them with organic pollution, while the western portion receives the contribution of more saline and cleaner waters.

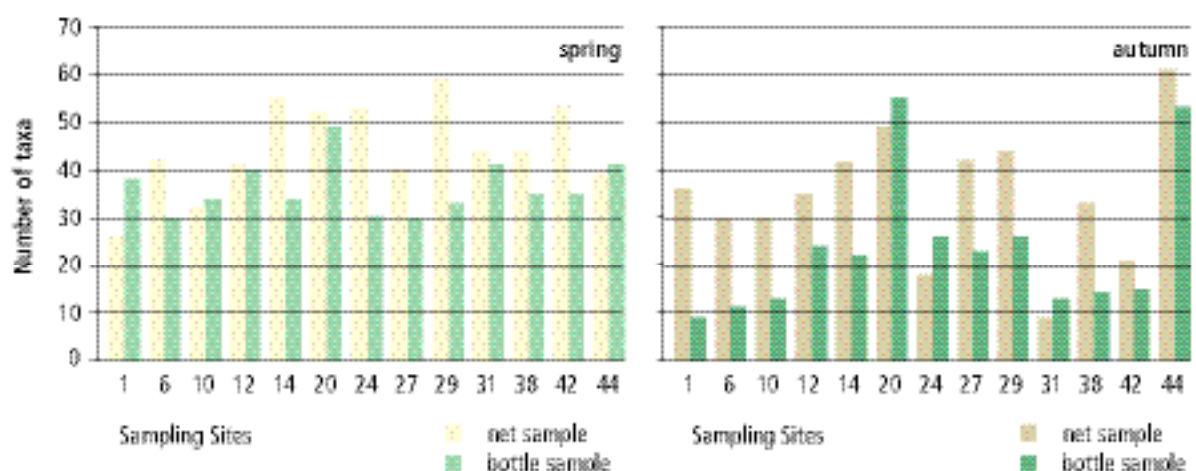
Table 3. Characterization of Sepetiba Bay waters in terms of nutrient concentrations for 19-20 November 2001 and 25-26 April 2002.

		Phosphate (μM)	Total Nitrogen (μM)	Silicate (μM)
Spring	range	0.04 – 3.23	0.08 – 7.28	0.60 – 14.83
	mean	0.61 \pm 0.60	1.60 \pm 1.90	6.45 \pm 3.98
Autumn	range	0.06 – 1.10	0.13 – 4.54	nd – 8.04
	mean	0.38 \pm 0.29	1.59 \pm 1.30	2.92 \pm 2.23

We believe that the sampling sites selected have included different environmental conditions that can be found in the study area, and their respective phytoplankton populations. Therefore, we feel confident that the sampling sites chosen, although apparently restricted in number, provided a species list that can serve as a good baseline for future studies.

It is interesting to note that, except for a few occasions, the net captured a higher number of taxa than the bottle at any given sampling site (Figure 5). However, when all taxa found at all sampling sites are combined, the bottle was able to capture a higher number of taxa than the net (Figure 6a). The distribution of taxa is not consistent in Sepetiba Bay. There are gradients in terms of temperature, salinity and nutrients that determine the heterogeneous distribution of the phytoplankton populations according to their preferences and tolerances. The net concentrates material during the hauls, but it is selective. It was probably consistently selective against some organisms, mostly flagellates, at some sites. It is beyond the scope of this study to discuss ecological and community structure aspects. From a qualitative point of view, however, it became clear that the use of the bottle greatly enhanced our perception of the phytoplankton biodiversity of Sepetiba Bay.

The second field trip, carried out in April 2002, also complemented our understanding of the biodiversity of Sepetiba Bay (Figure 6b). The difference, however, was not as great as the one found in the comparison made between sampling methods. This comparison exercise indicates that, for management purposes, if the study area presents horizontal gradients, using the bottle as an additional sampling gear can be more cost-effective than adding another field trip at a different season of the year.

**Figure 5.** Number of taxa found in each sampling site during the spring and the autumn field trips.

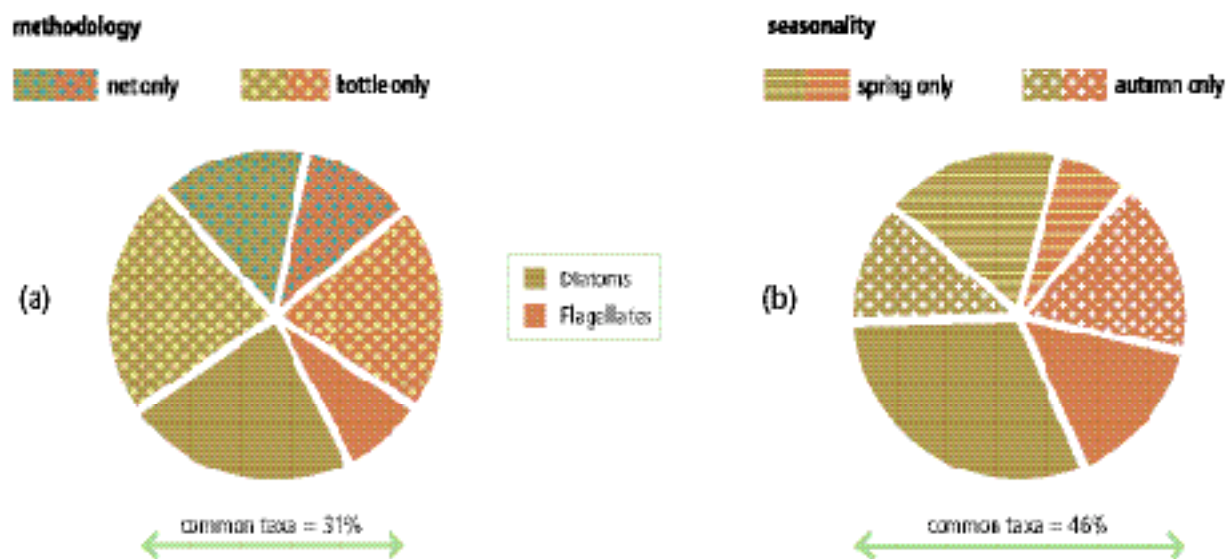


Figure 6. Comparison of the number of taxa found: (a) net versus bottle and (b) spring versus autumn.

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PLATES

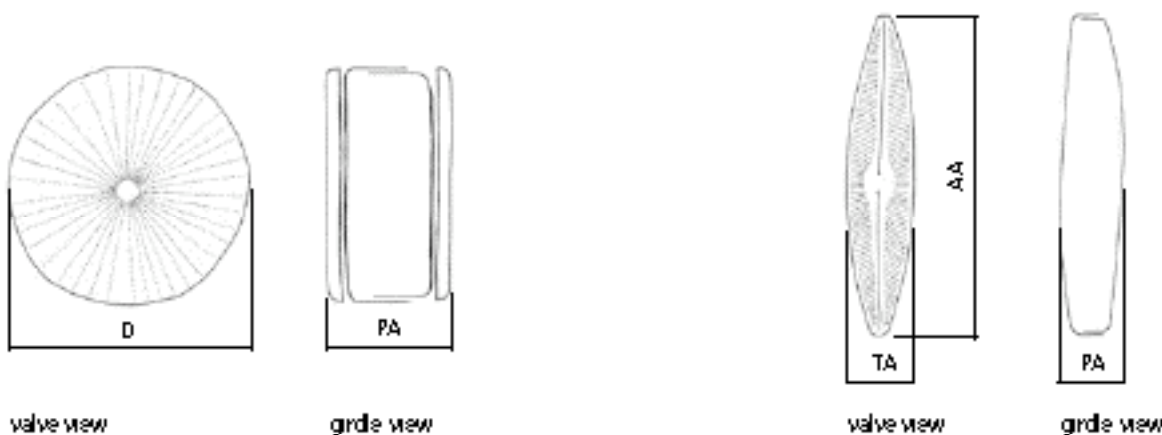
The taxa considered in this section were those collected with the net hauls.

Maps of their distribution in the Bay have been included only for those taxa that were considered the most important in terms of their relative abundance (over 50% of the average concentration in any given sample). The complete list of taxa can be found in Appendix 1.

The legends of the figures indicate the type of microscopy used to illustrate the taxa: light microscopy (LM), scanning electron microscopy (SEM) or fluorescence microscopy (FM).

MORPHOMETRICS GUIDE

DIATOMS



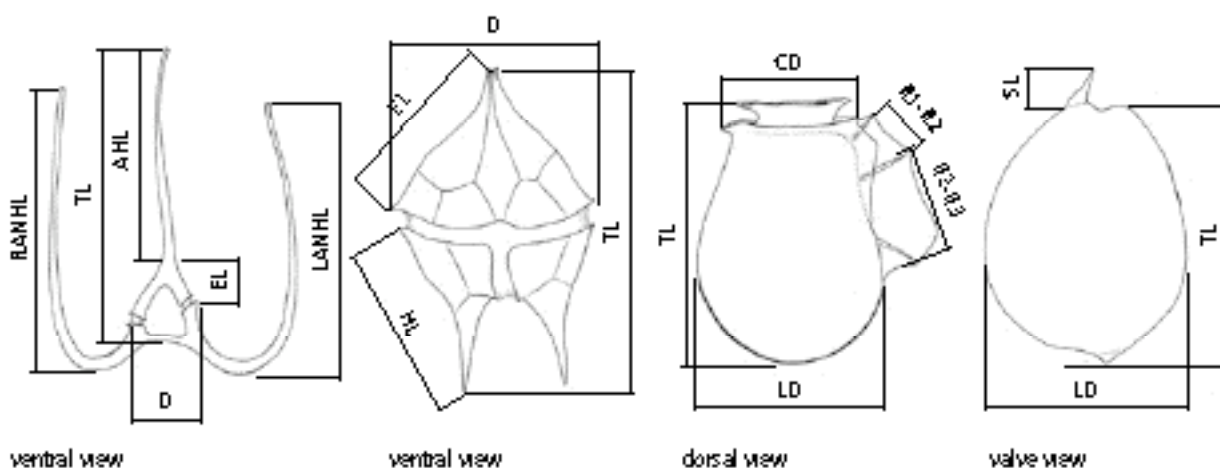
Centric Diatoms

D Diameter
PA Perivalvar axis

Pennate Diatoms

TA Transapical axis
PA Perivalvar axis
AA Apical axis

DINOFLAGELLATES



Ceratium

TL Total length
D Diameter
EL Epicone length
AHL Apical horn length
RANHL Right antapical horn length
LANHL Left antapical horn length

Protoperidinium

TL Total length
D Diameter
EL Epicone length
HL Hypotheca length

Dinophysis

TL Total length
CD Cingulum diameter
LD Larger diameter
R1-R2 Space between nbs
R2-R3 Space between nbs

Prorocentrum

TL Total length
LD Larger diameter
SL Spine length

DIATOMS

Plate 1

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Thalassiosirales
 Family Thalassiosiraceae

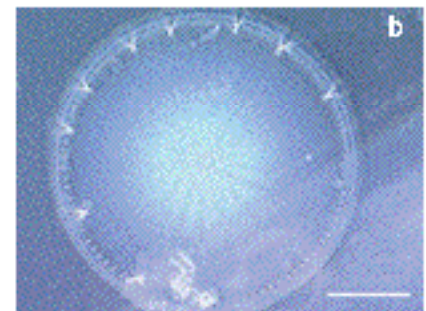
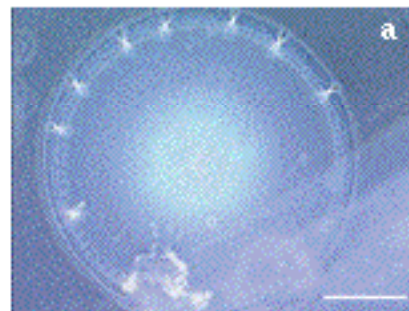
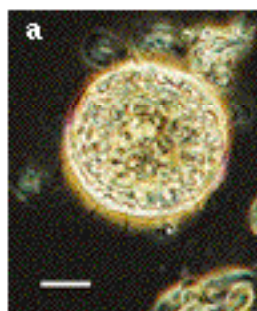
Thalassiosira punctigera (Castracane) Hasle, 1983

Figure 2. Single valve showing (a) areolation fasciculate and (b) densely spaced strutted processes close to valve margin and larger widely spaced occluded processes more away from valve margin (LM, bright field, Hyrax mount of cleaned material). Scale bars = 20µm.

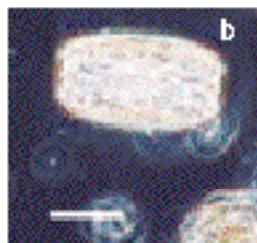


Figure 1. Single cell (a) in valve view and (b) in girdle view (LM, phase contrast, water mount). Scale bars = 20µm.

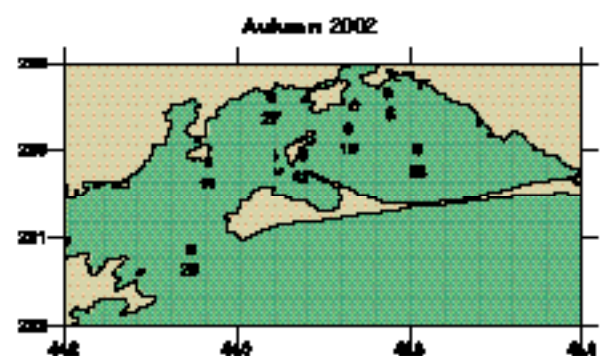
Taxonomic source

Hasle & Syvertsen (1997). Diatoms (p. 58).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	25 - 80	58 ± 17	13
PA	20 - 45	28 ± 8	11



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Thalassiosirales
 Family Thalassiosiraceae

Thalassiosira rotula Meunier, 1910

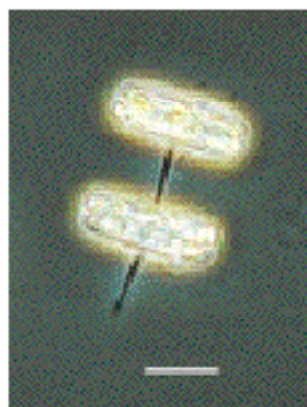


Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 20µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 70).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	35 - 45	29 ± 4	7
PA	10 - 15	11 ± 2	7

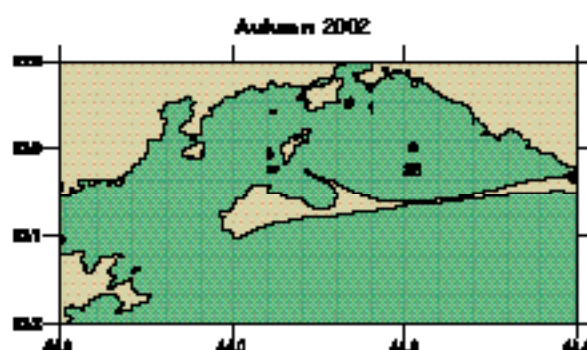


Plate 3

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Thalassiosirales
 Family Skeletonemataceae

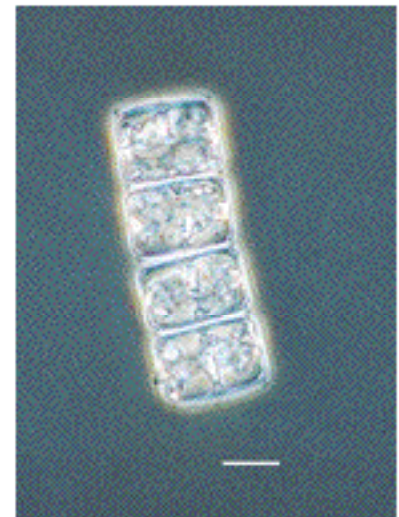
Detonula pumila (Castracane) Schütt, 1934

Figure 1 Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 20µm.

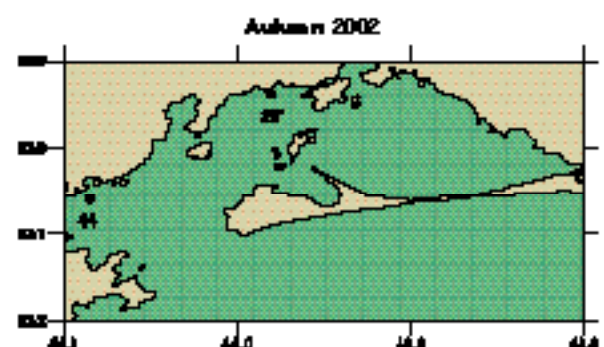
Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 34).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	25 - 31	28 ± 3	14
PA	20 - 43	31 ± 8	14



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Thalassiosirales
 Family Skeletonemataceae

***Skeletonema costatum* (Greville) Cleve, 1878**

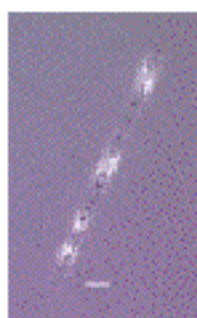


Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 10µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 44).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	4.5 - 6	5 ± 0.6	8
PA	10.0 - 15	13 ± 2.0	8

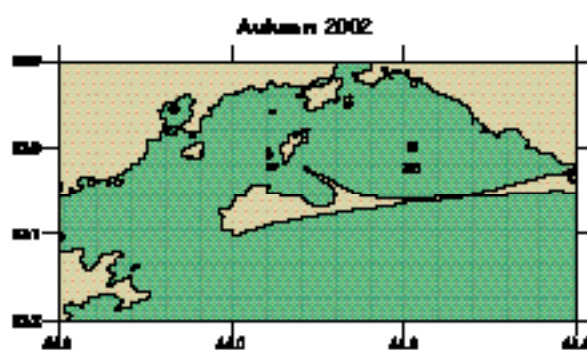
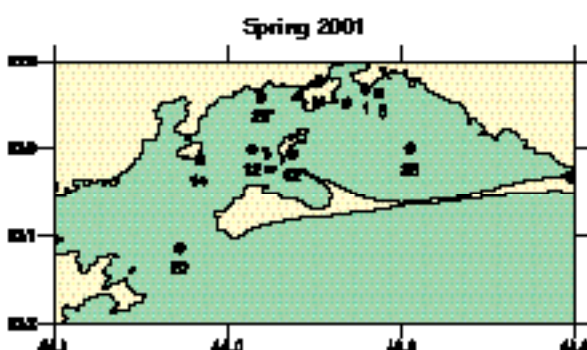


Plate 5

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Thalassiosirales
 Family Stephanodiscaceae

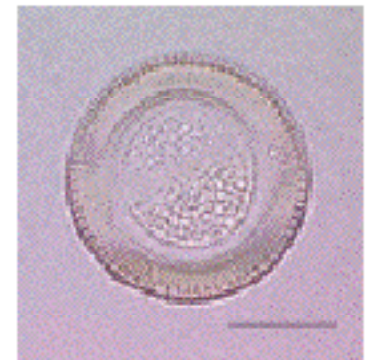
Cyclotella litoralis Lange & Syvertsen, 1989

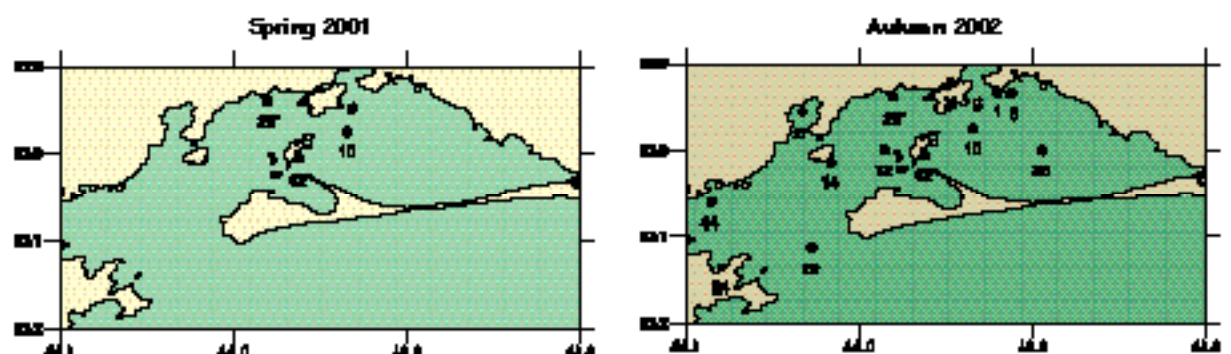
Figure 1. Single valve (LM, brightfield, Hyrax mount of cleaned material). Scale bar = 20µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 34).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	20 - 50	33 ± 8	3
PA	25 - 35	30 ± 7	3



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Thalassiosirales
 Family Stephanodiscaceae

Cyclotella stylorum Brighwell, 1860

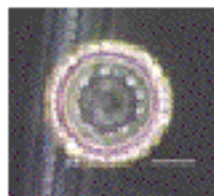


Figure 1. Single valve (LM, phase contrast, Hyrax mount of cleaned material). Scale bar = 20µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 34).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	20 - 50	33 ± 8	3
PA	25 - 35	30 ± 7	3

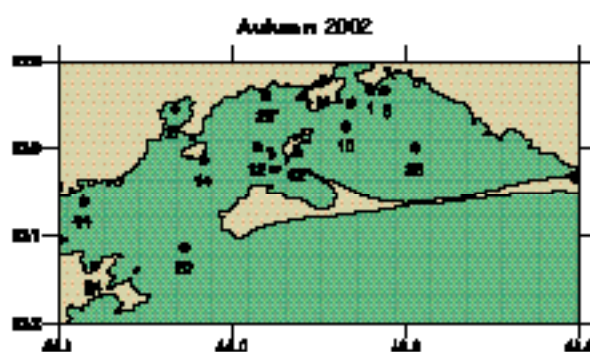
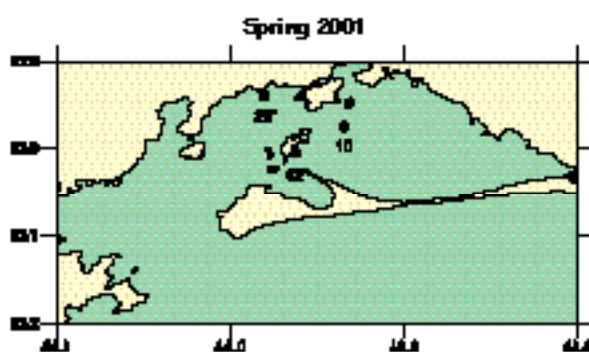


Plate 7

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Melosirales
 Family Stephanopyxidaceae

***Stephanopyxis turris* (Greville & Arnott) Ralfs, 1861**

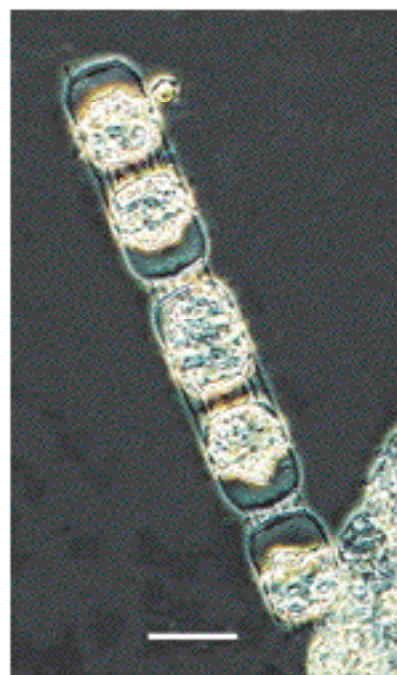


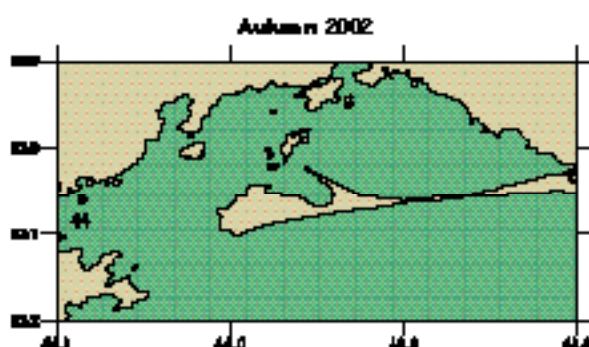
Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 50µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 92).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	(µm)	n
D	40	1
PA	56	1



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Paraliales
 Family Paraliaceae

Paralia sulcata (Ehrenberg) Cleve, 1873

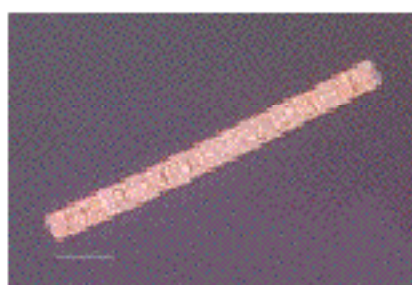


Figure 1 Chain of cells in girdle view (LM, phase contrast, water mount).
 Scale bar = 50µm.

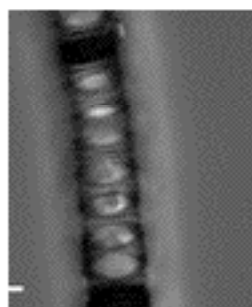


Figure 2 Chain of cells in girdle view (LM, phase contrast, water mount).
 Scale bar = 10µm.



Figure 3 Single valve (LM, bright field, Hyrax mount of cleaned material).
 Scale bar = 20µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 91).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	22 - 30	26 ± 3	15
PA	7 - 20	15 ± 4	15

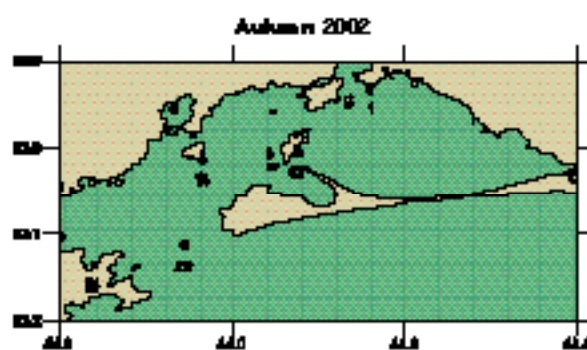
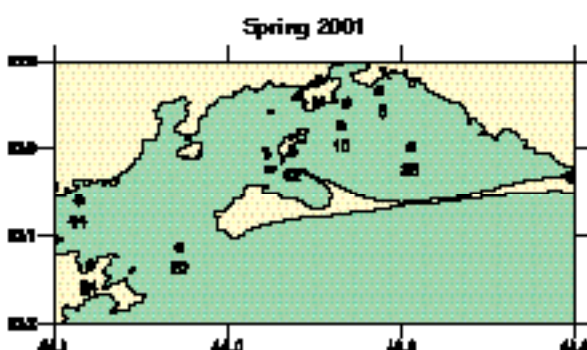


Plate 9

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Coscinodiscales
 Family Coscinodiscaceae

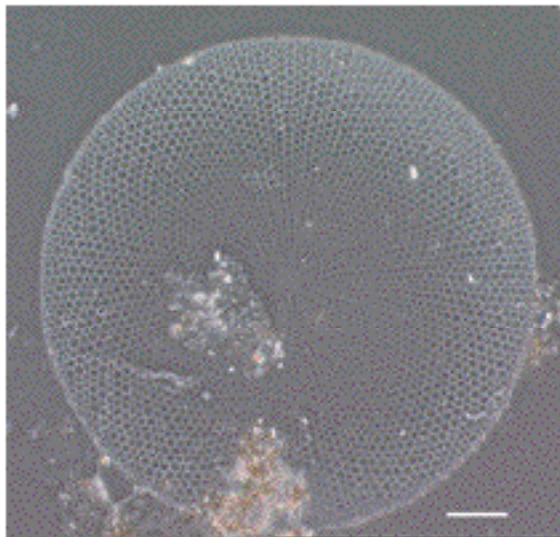
Coscinodiscus gigas Ehrenberg, 1841

Figure 1 Single valve
 (LM, phase contrast, Hyrax mount of
 cleaned material). Scale bar = 20µm.

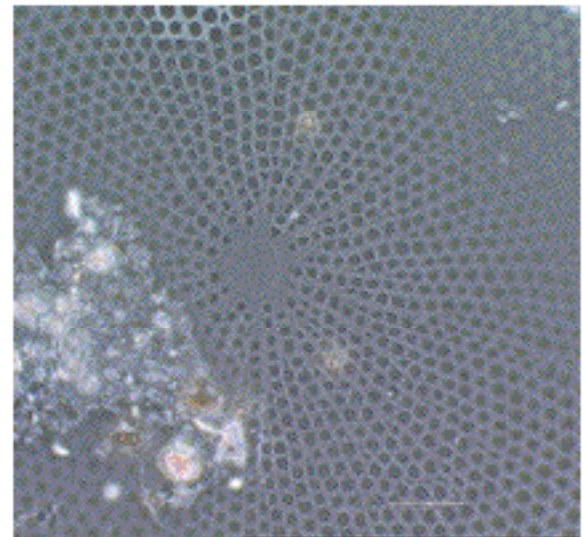


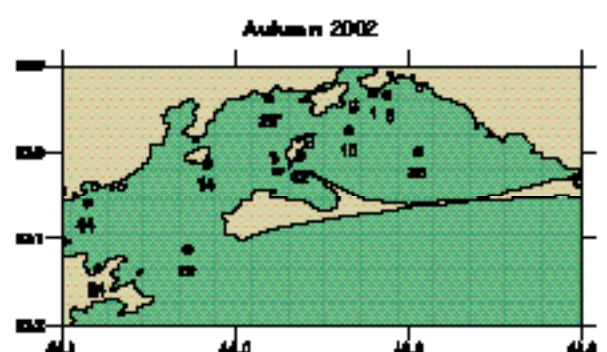
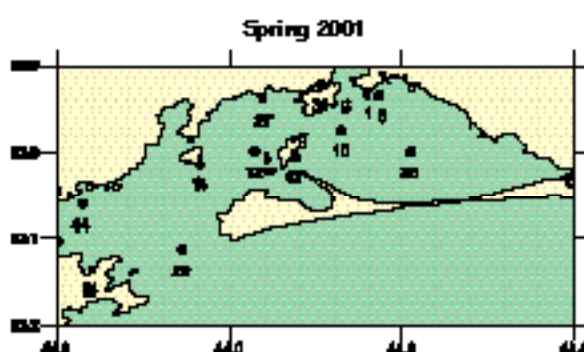
Figure 2 Detail of single valve, central area
 without areola.
 (LM, phase contrast, Hyrax mount of
 cleaned material). Scale bar = 10µm.

Taxonomic source

Navarro, N. (1981). The marine diatoms of Puerto Rico (p. 429).
 Botanica Marina. Vol. 24.

Morphometrics

	range (µm)	mean ± SD	n
D	115 - 310	177 ± 34	87



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Coscinodiscales
 Family Coscinodiscaceae

Plate 10

***Coscinodiscus granii* Gough, 1905**

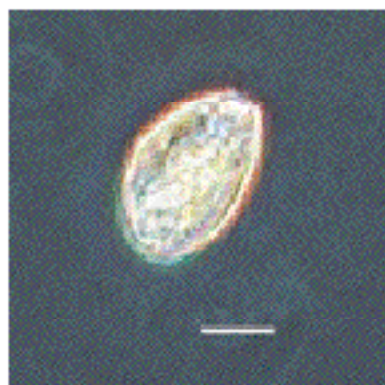


Figure 2. Cell in girdle view (LM, phase contrast, water mount). Scale bar = 20µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 109).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	(µm)	n
D	55	1
PA	30	1

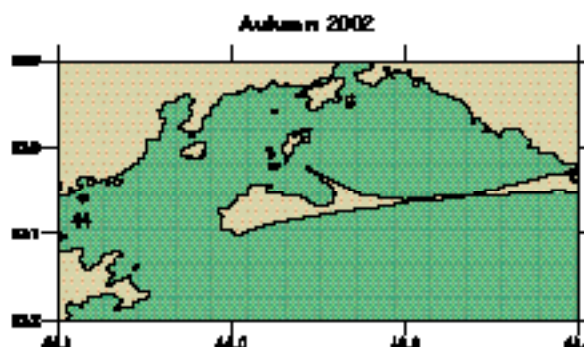


Plate 11

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Coscinodiscales
 Family Coscinodiscaceae

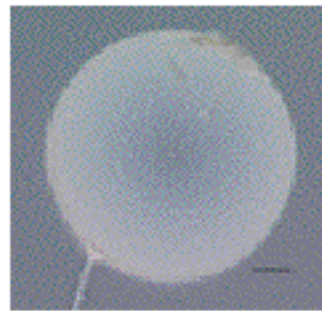
Coscinodiscus cf. asteromphalus Ehrenberg, 1844

Figure 1 Single cell in valve view. (LM, phase contrast, Hyrax mount of cleaned material). Scale bar = 20µm.

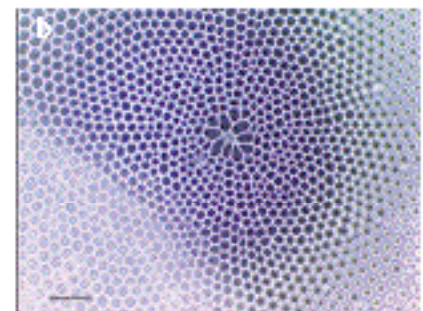
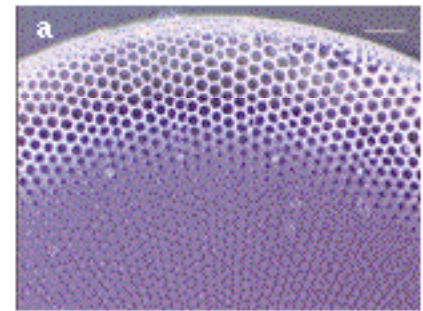


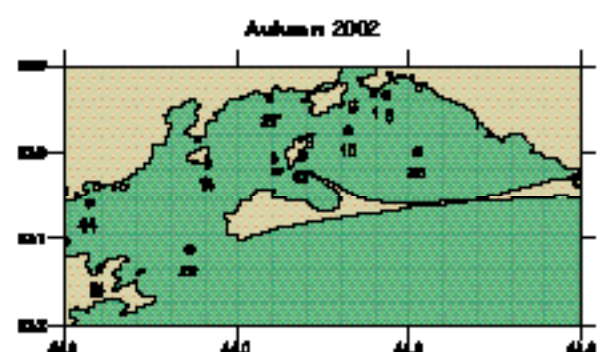
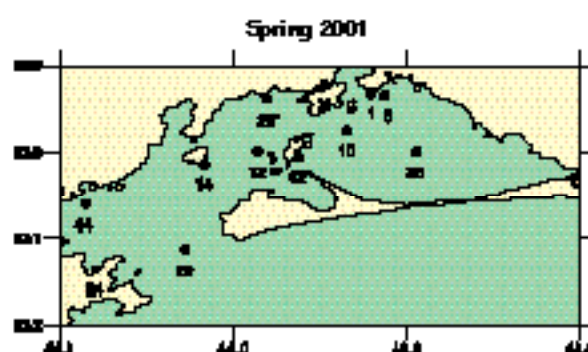
Figure 2 Detail of (a) marginal area and (b) central area (LM, phase contrast, Hyrax mount of cleaned material). Scale bars = 10µm.

Taxonomic source

Hustedt, F. (1971). Kryptogamen - flora von Deutschland, Österreich und der Schweiz (p. 453).
 Johnson Reprint Corporation, New York.

Morphometrics

	range (µm)	mean ± SD	n
D	115 - 310	177 ± 34	87



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Coscinodiscales
 Family Coscinodiscaceae

***Coscinodiscus waillesii* Gran & Angst, 1931**

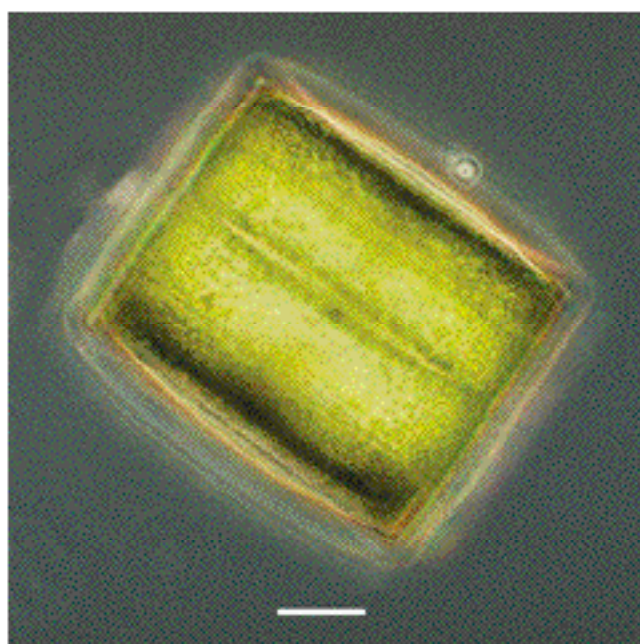


Figure 1. Cell in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 50µm.

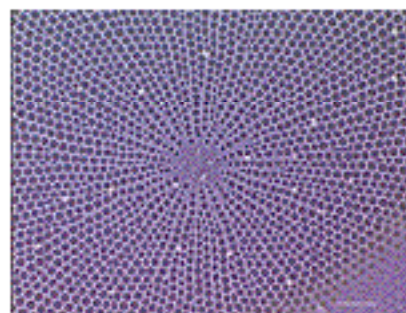


Figure 2. Detail of valve, central area
 without areola.
 (LM, phase contrast, Hyrax mount of
 cleaned material).
 Scale bar = 10µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 106).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	220 - 250	235 ± 27	4
PA	135 - 195	169 ± 12	4

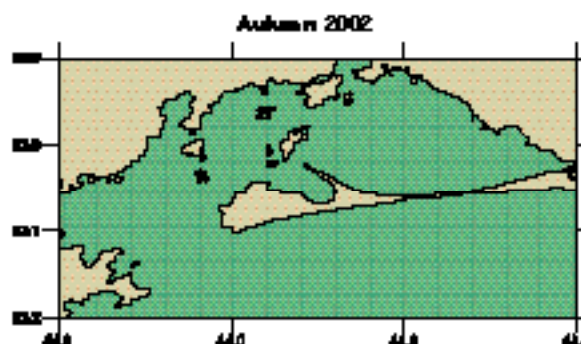


Plate 13

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Coscinodiscales
 Family Heliopeletaceae

***Actinoptychus senarius* (Ehrenberg) Ehrenberg, 1843**

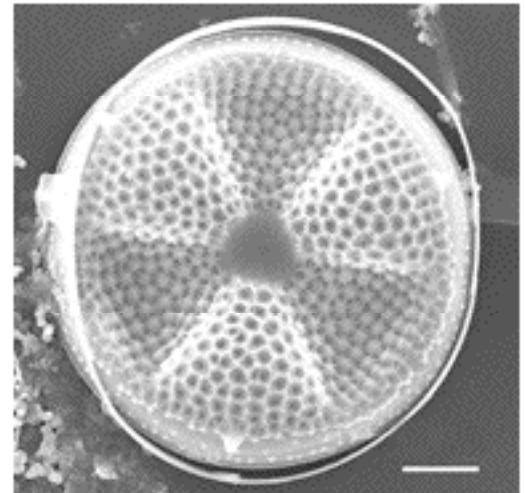


Figure 1. Single valve (SEM).
 Scale bar = 10µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 93).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	(µm)	mean	n
D	55 - 65	60	2

Division Bacillariophyta
Class Coscinodiscophyceae
Order Asterolamprales
Family Asterolampraceae

Plate 14

***Asteromphalus cf. flabellatus* (Brébisson) Greville, 1859**

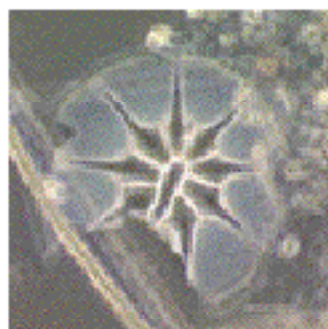


Figure 1 Single valve
(LM, phase contrast, Hyrax
mount of cleaned material).
Scale bar = 10µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p.135).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

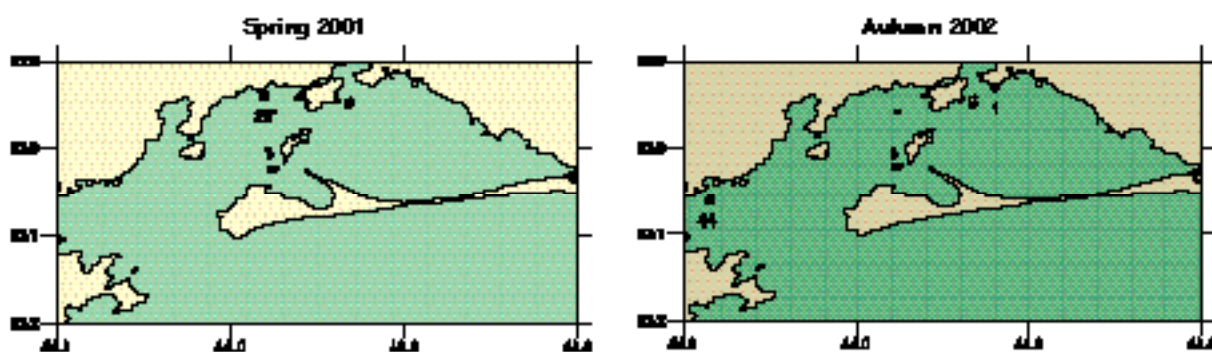


Plate 15

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Triceratales
 Family Triceratiaceae

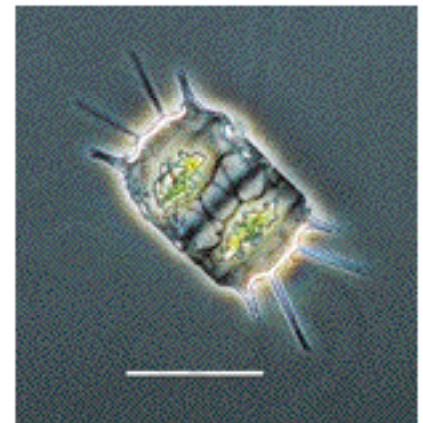
Odontella mobiliensis (Bailey) Grunow, 1884

Figure 1 Dividing cell in girdle view (LM, phase contrast, water mount).
 Scale bar = 50µm.

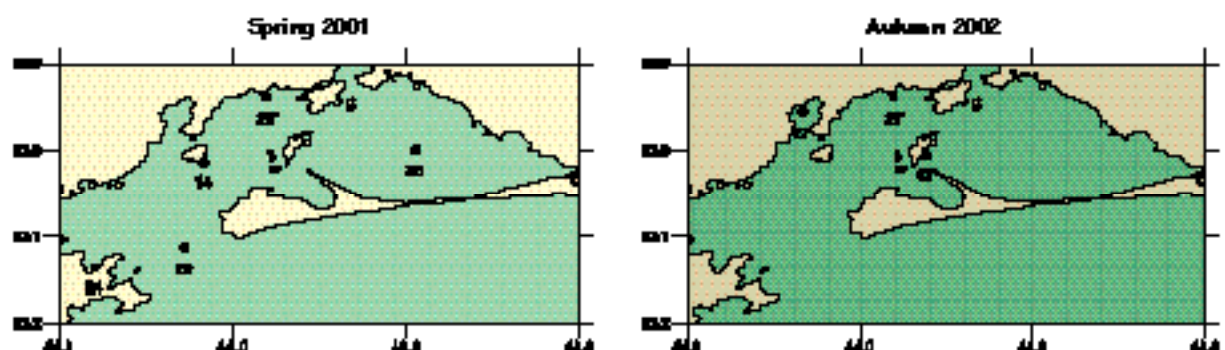
Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 239).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	20.0 - 55.0	28 ± 10	13
PA	26.5 - 107.5	48 ± 19	13



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Triceratales
 Family Triceratiaceae

***Odontella sinensis* (Greville) Grunow, 1884**

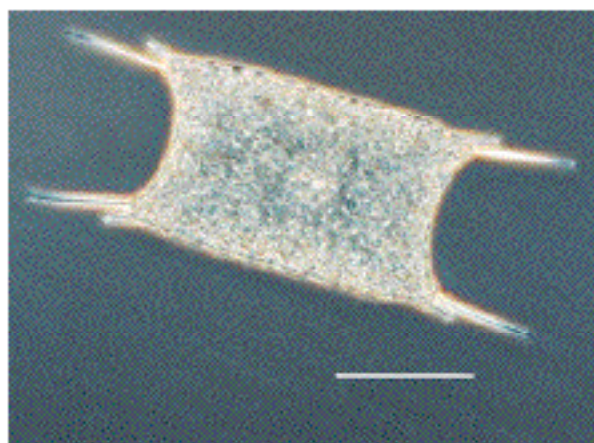


Figure 1. Cell in girdle view (LM, phase contrast, water mount). Scale bar = 100µm.

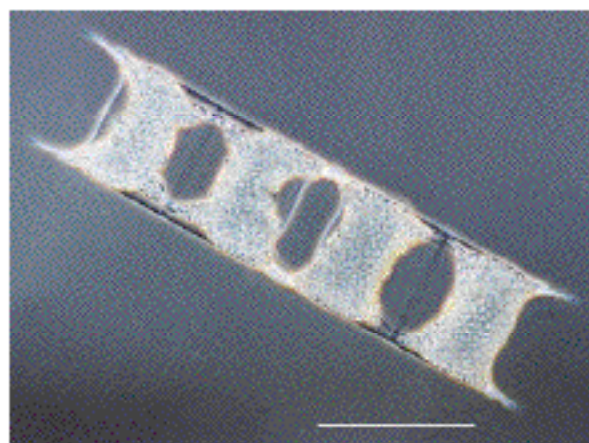


Figure 2. Dividing cells in girdle view (LM, phase contrast, water mount). Scale bar = 100µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 239).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	90 - 265	139 ± 32	62
PA	125 - 360	246 ± 61	62

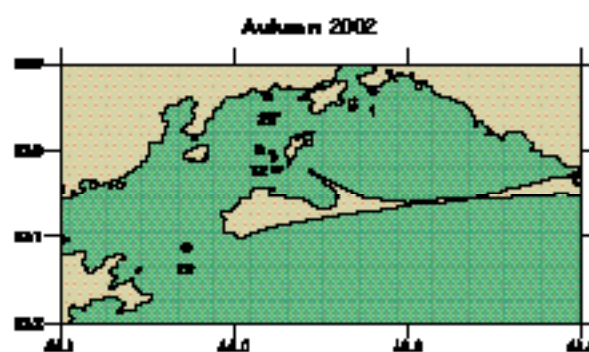
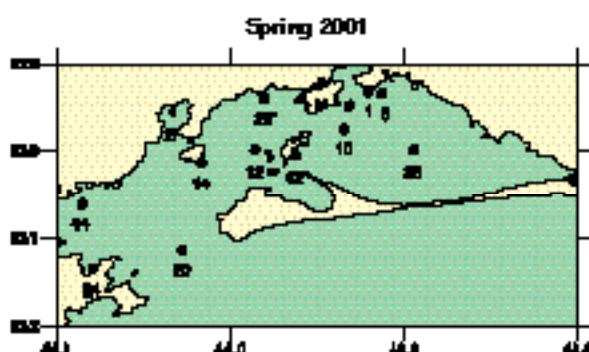


Plate 17

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Triceratiales
 Family Triceratiaceae

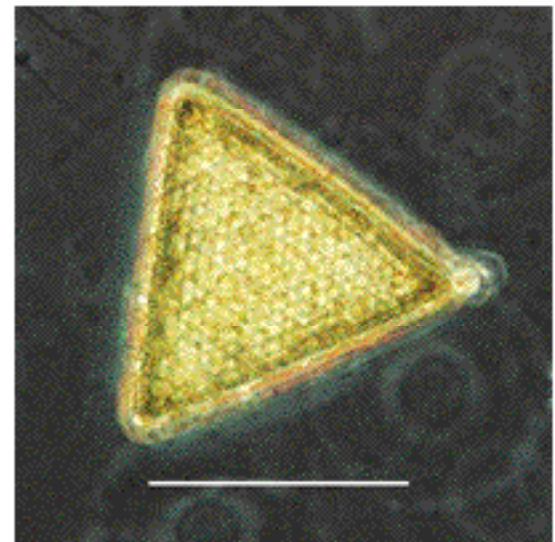
Triceratium favus Ehrenberg, 1839

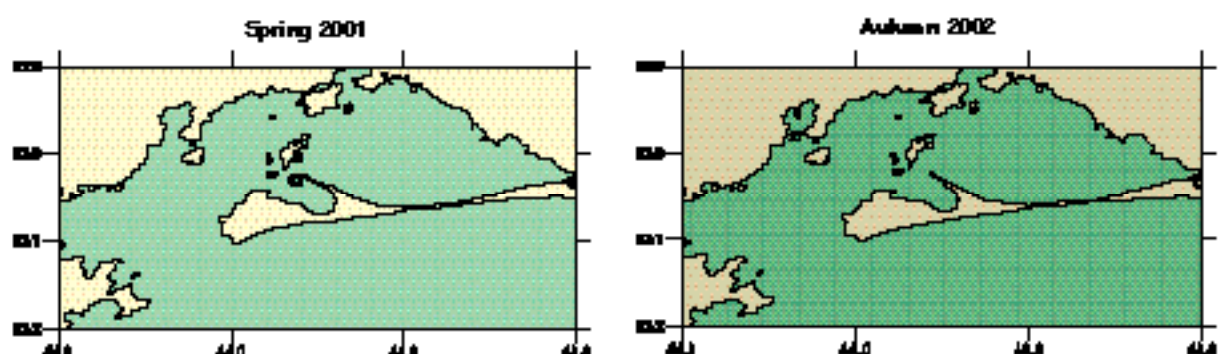
Figure 1 Single valve
 (LM, phase contrast, water mount).
 Scale bar = 100µm.

Taxonomic source

Hustedt, F. (1971). Kryptogamen - flora von Deutschland, Österreich und der Schweiz (p. 798).
 Johnson Reprint Corporation, New York.

Morphometrics

	range (µm)	mean ± SD	n
D	50 - 140	105 ± 48	3



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Hemiaulales
 Family Hemiaulaceae

Plate 18

***Cerataulina pelagica* (Cleve) Hendey, 1937**



Figure 1 Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 20µm.

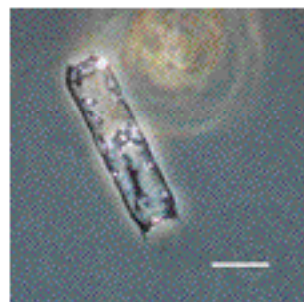


Figure 2 Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 20µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p.171).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	15 - 35	24 ± 5	41
PA	50 - 165	75 ± 19	42

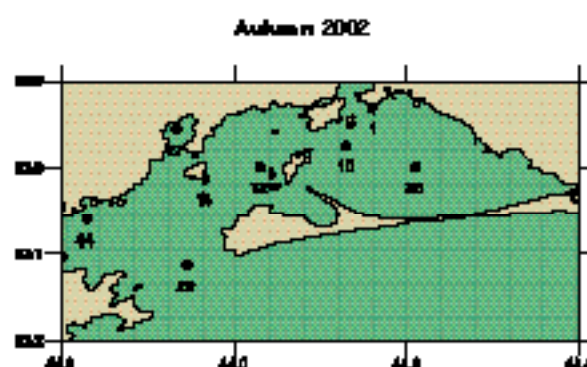
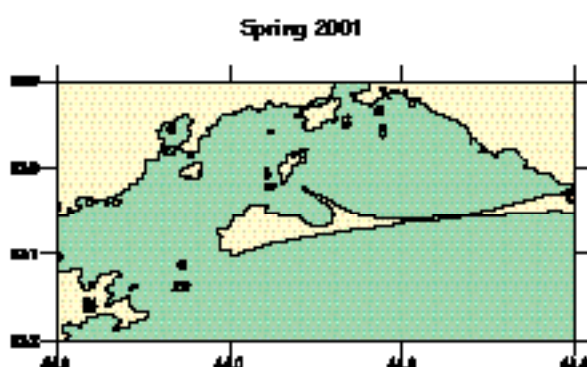


Plate 19

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Hemiaulales
 Family Hemiaulaceae

Climacodium frauenfeldianum Grunow, 1868

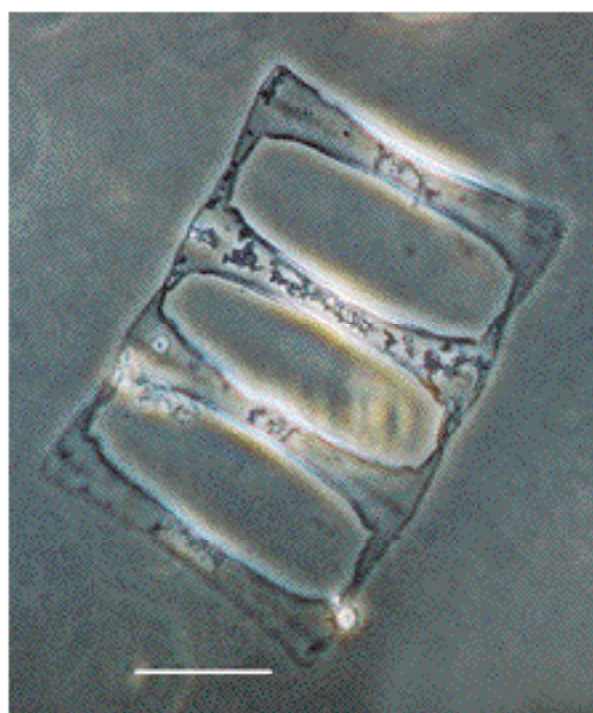


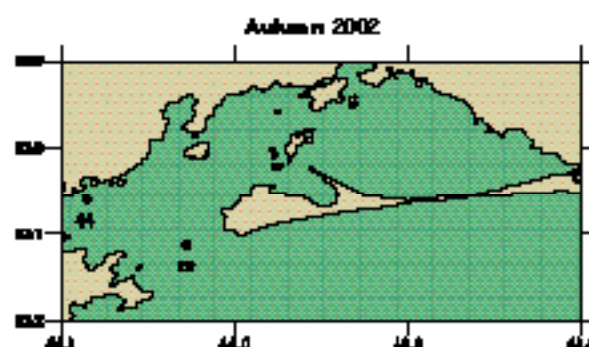
Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 50µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 172).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	125 - 130	128 ± 3	3
PA	40 - 60	53 ± 12	3



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Hemiaulales
 Family Hemiaulaceae

Plate 20

***Eucampia cornuta* (Cleve) Grunow, 1882**

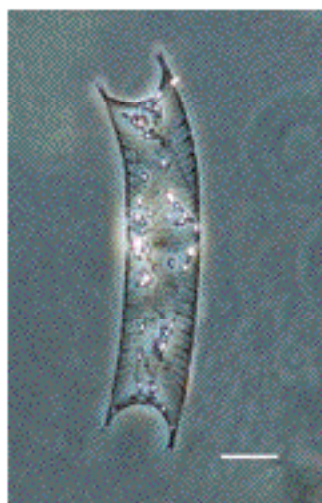


Figure 1. Cell in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 20µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 175).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	10 - 30	21 ± 8	10
PA	35 - 155	75 ± 44	10

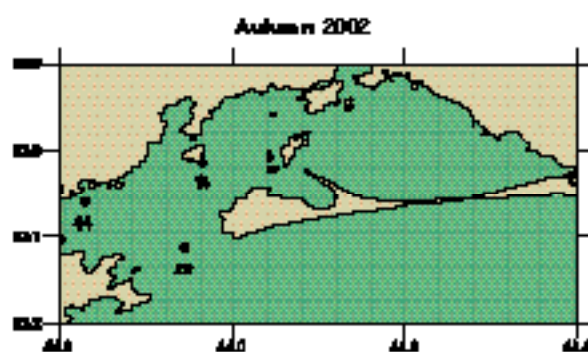
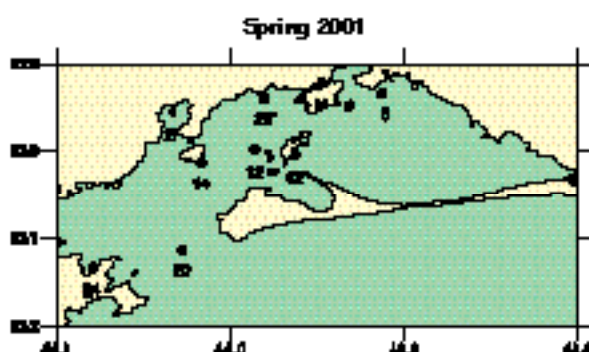


Plate 21

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Hemiaulales
 Family Hemiaulaceae

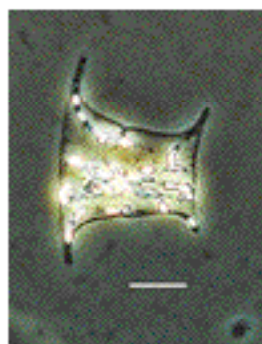
Eucampia zodiacus Ehrenberg, 1839

Figure 1. Cell in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 20µm.

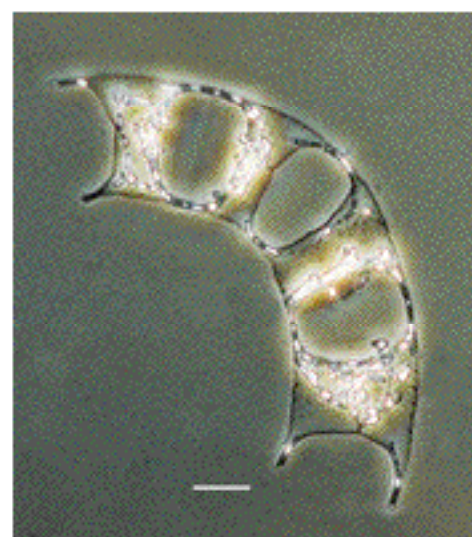


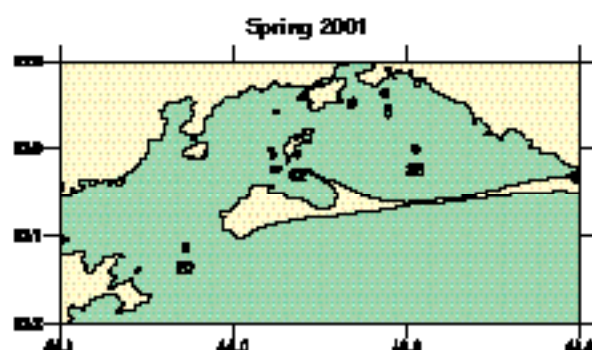
Figure 2. Chain of cells in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 20µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 176).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	10 - 50	26 ± 22	5
PA	30 - 50	36 ± 9	5



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Hemiaulales
 Family Hemiaulaceae

Plate 22

***Hemiaulus hauckii* Grunow, 1881**

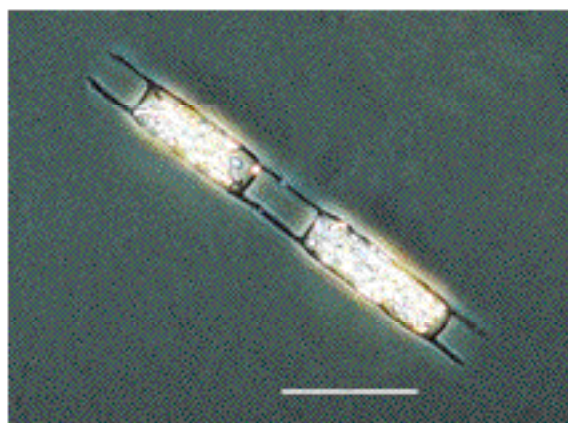


Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 50µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 177).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	10 - 29	16 ± 4	23
PA	30 - 100	56 ± 18	23

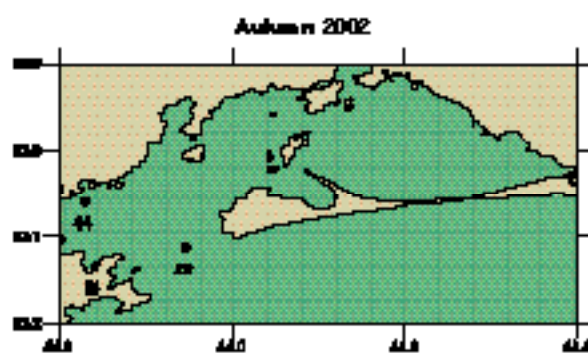
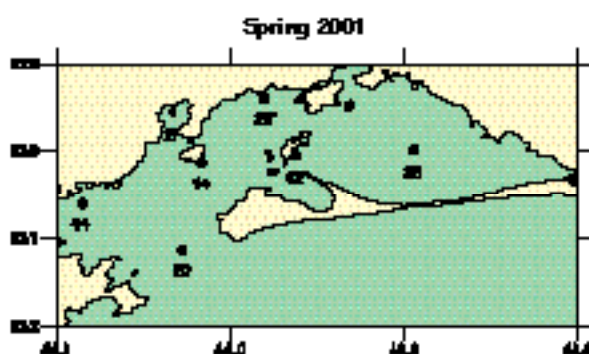


Plate 23

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Hemiaulales
 Family Hemiaulaceae

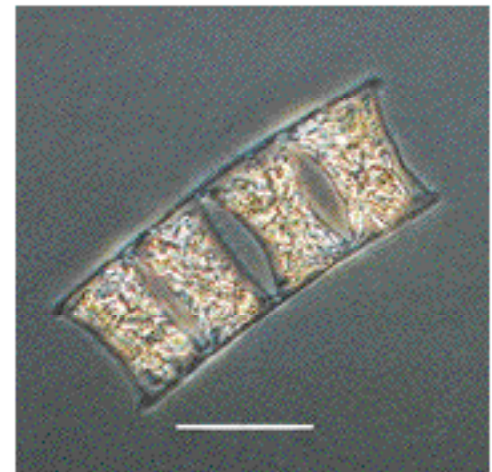
Hemiaulus membranaceus Cleve, 1873

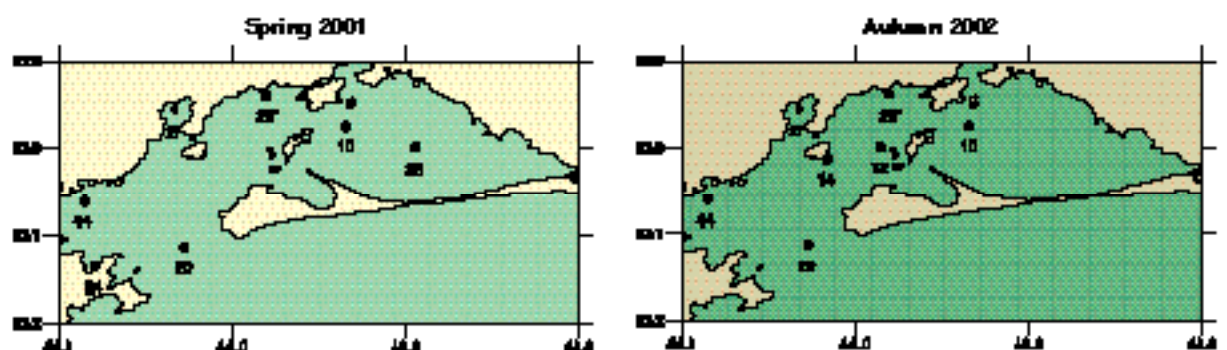
Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 50µm.

Taxonomic source

Hask, G. R. & Syvertsen, E. E. (1997). Diatoms (p 177).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	20 - 82	46 ± 14	72
PA	30 - 175	55 ± 23	72



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Hemiaulales
 Family Hemiaulaceae

Plate 24

***Hemiaulus sinensis* Greville, 1865**

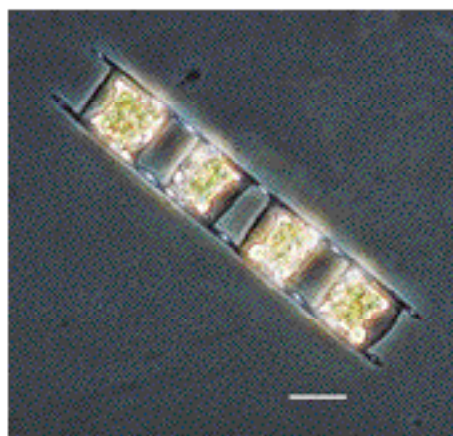


Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 20µm.

Taxonomic source

Hask, G. R. & Syvertsen, E. E. (1997). Diatoms (p 177). In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	18 - 35	26 ± 4	30
PA	30 - 80	49 ± 12	30

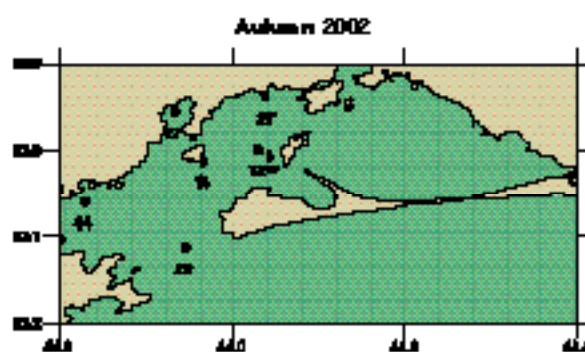
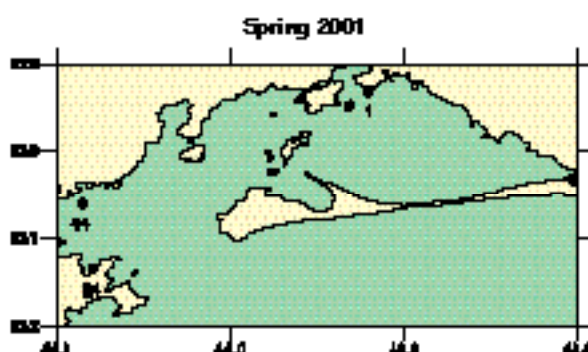


Plate 25

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Lithodesmiales
 Family Lithodesmiaceae

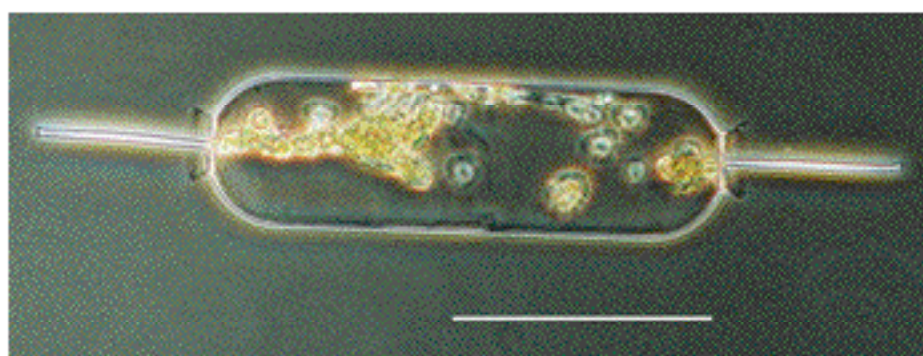
Ditylum brightwellii (T. West) Grunow, 1883

Figure 1. Cell in girdle view (LM, phase contrast, water mount). Scale bar = 100µm.

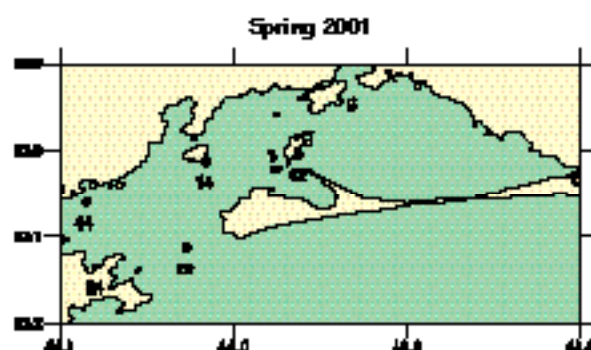
Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 230).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	63		1
PA	136 - 138	137 ± 1	2



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Lithodesmiales
 Family Lithodesmiaceae

Plate 26

***Helicotheca tamesis* (Shrubsole) Ricard, 1987**

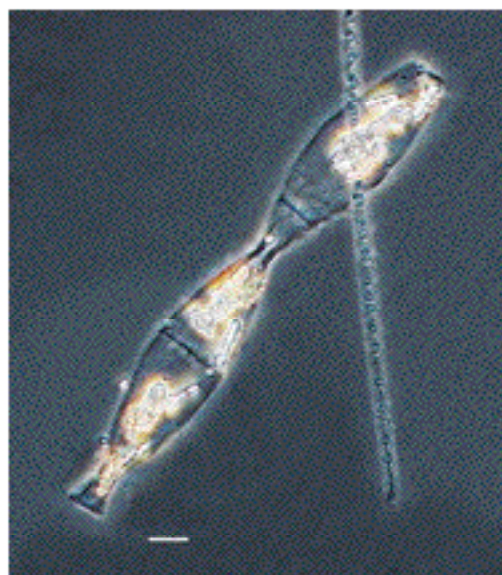


Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 20µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 234).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	9.5 - 60	47 ± 12	24
PA	32.5 - 150	104 ± 31	24

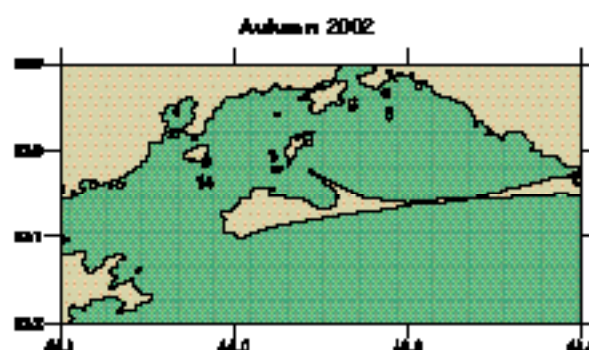
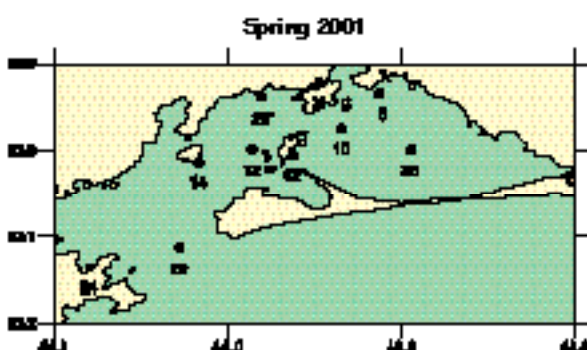


Plate 27

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Lithodesmiales
 Family Lithodesmiaceae

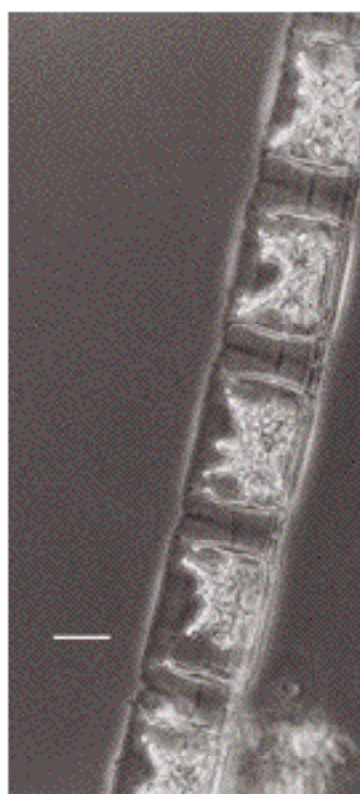
Lithodesmium undulatum Ehrenberg, 1839

Figure 1 Chain of cells in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 20µm.

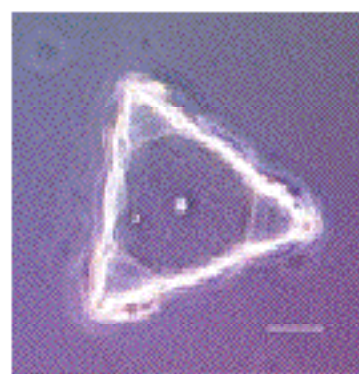


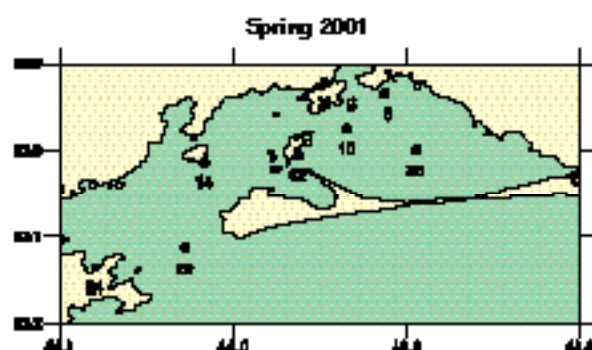
Figure 2 Single valve
 (LM, phase contrast,
 Hyrax mount of cleaned material).
 Scale bar = 10µm

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 234).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	30 - 60	46 ± 6	28
PA	30 - 60	48 ± 9	28



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Rhizosoleniales
 Family Rhizosoleniaceae

***Dactylosolen fragilissimus* (Bergon) Hasle, 1996**

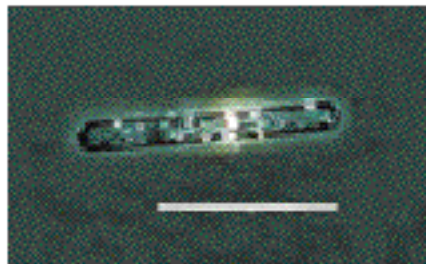


Figure 1. Single cell in girdle view (LM, phase contrast, water mount). Scale bar = 50µm.

Taxonomic source

Hasle & Syvertsen (1997). Diatoms (p. 167).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	5 - 10	7 ± 2	7
PA	50 - 95	65 ± 15	7

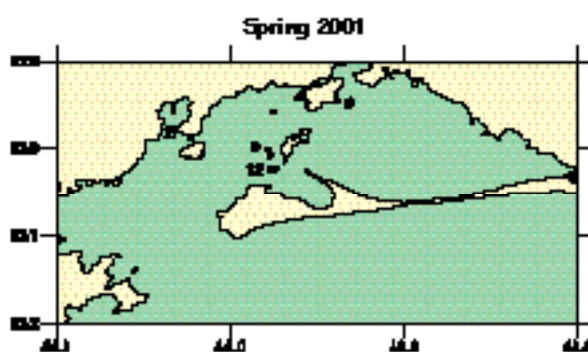


Plate 29

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Rhizosolerales
 Family Rhizosoleniaceae

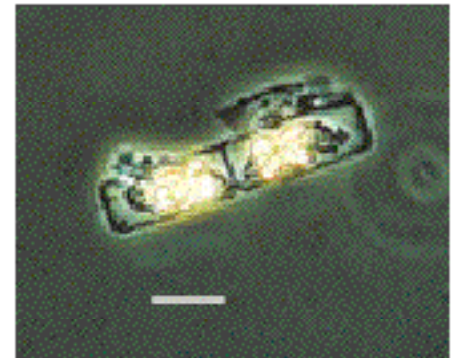
Guinardia delicatula (Cleve) Hasle, 1996

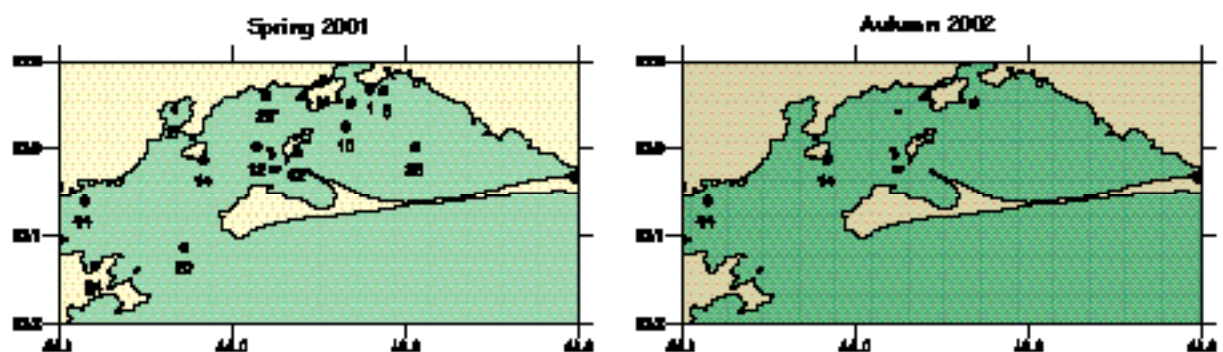
Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 20µm.

Taxonomic source

Hasle & Syvertsen (1997). Diatoms (p. 161).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	15 - 26	17 ± 2	43
PA	25 - 60	43 ± 8	43



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Rhizosolerales
 Family Rhizosoleniaceae

***Guinardia flaccida* (Castracane) H. Peragallo, 1892**

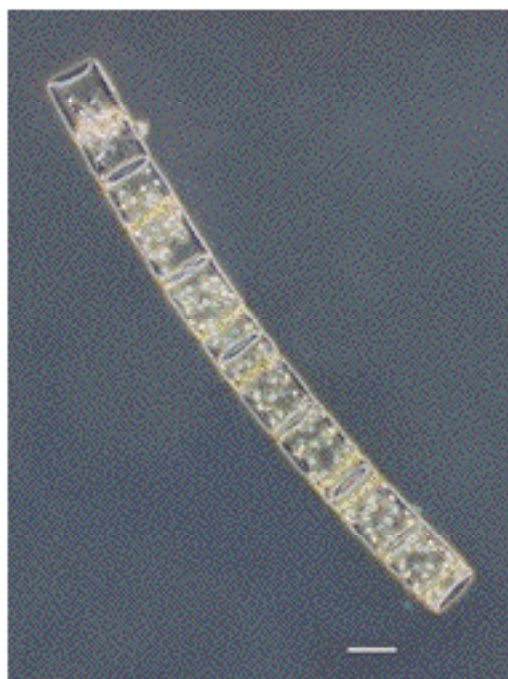


Figure 1 Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 50µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 163).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	12.5 - 92	53 ± 12	76
PA	50.0 - 200	112 ± 298	76

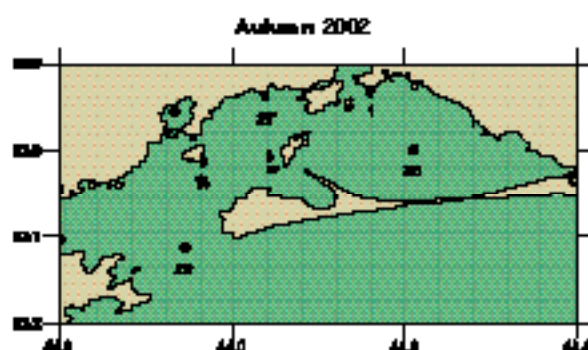
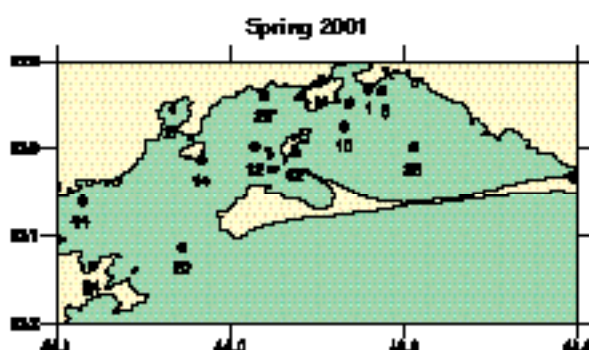


Plate 31

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Rhizosolerales
 Family Rhizosoleniaceae

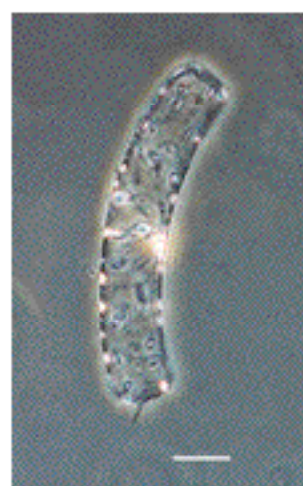
Guinardia striata (Stolterfoth) Hasle, 1996

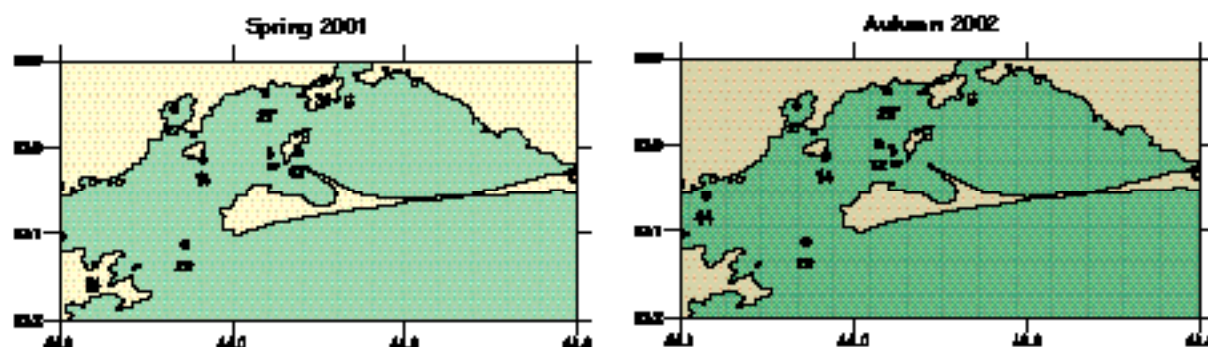
Figure 1. Cell in girdle view. Cells can often form curved, spiraling chains (LM, phase contrast, water mount). Scale bar = 20µm.

Taxonomic source

Hasle & Syvertsen (1997). *Diatoms* (p. 163).
 In: *Identifying marine phytoplankton*. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	5 - 40	19 ± 29	30
PA	30 - 135	85 ± 9	30



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Rhizosoleniales
 Family Rhizosoleniaceae

***Proboscia alata* (Brightwell) Sundström, 1986**

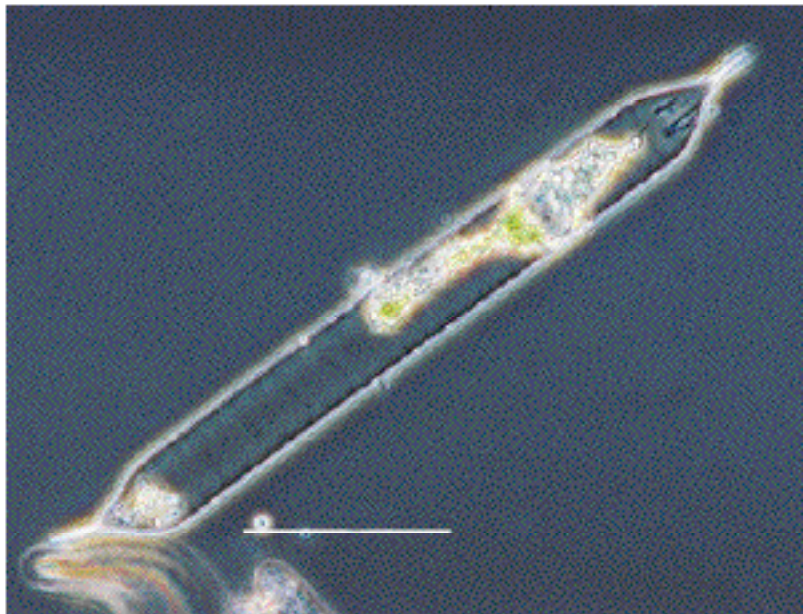


Figure 1 Cell in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 100µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 159).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	6 - 50	18 ± 14	20
PA	295 - 650	442 ± 120	20

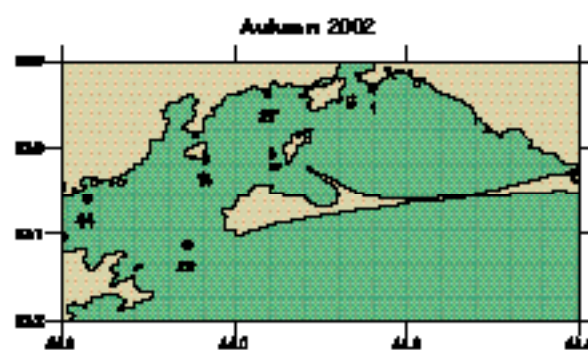
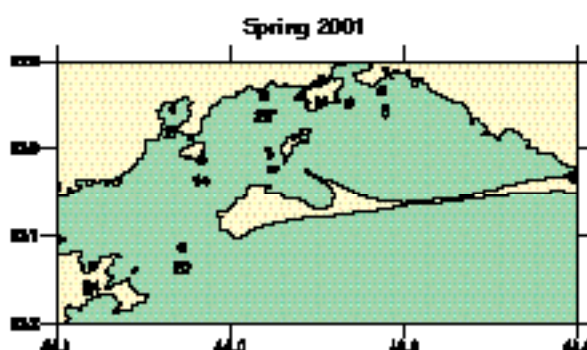


Plate 33

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Rhizosolerales
 Family Rhizosoleniaceae

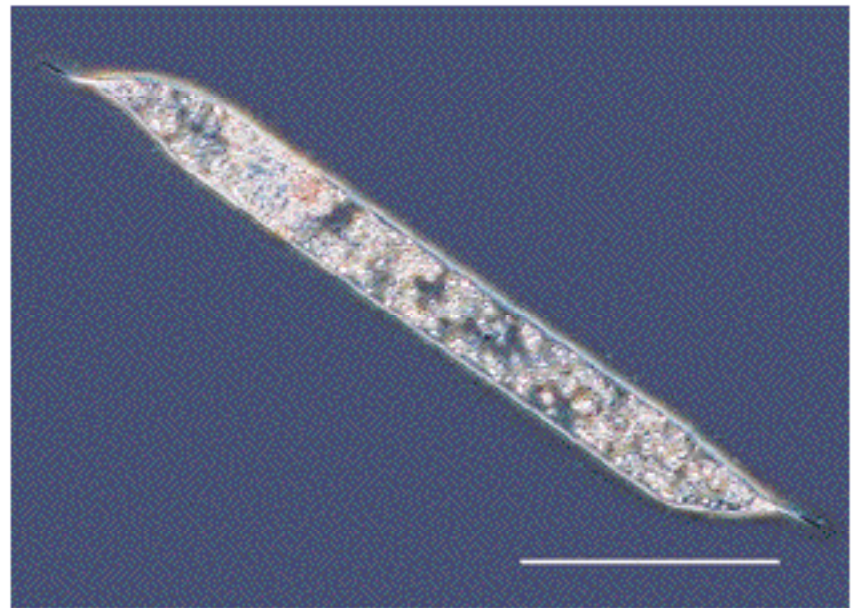
Pseudosolenia calcar-avis (Schultze) Sundström, 1986

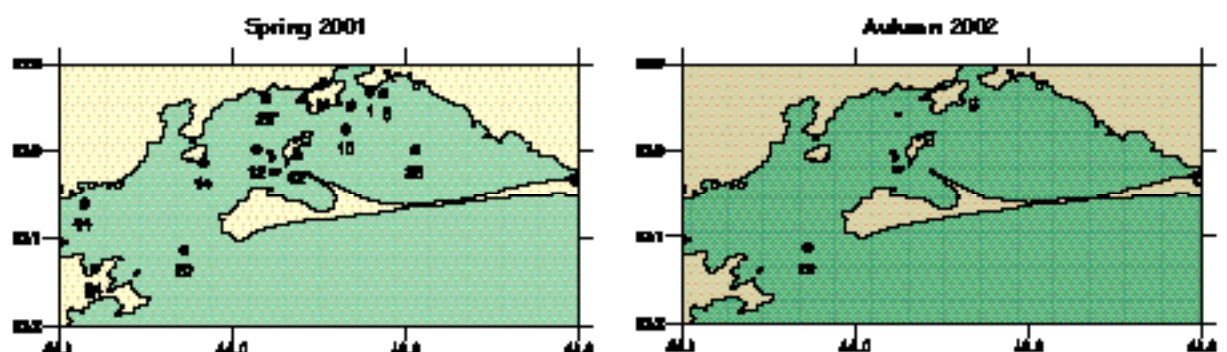
Figure 1 Cell in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 100µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 160).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	15 - 55	43 ± 7	33
PA	315 - 750	470 ± 95	33



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Rhizosoleniales
 Family Rhizosoleniaceae

Plate 34

***Rhizosolenia cf. castracanei* H. Peragallo, 1888**

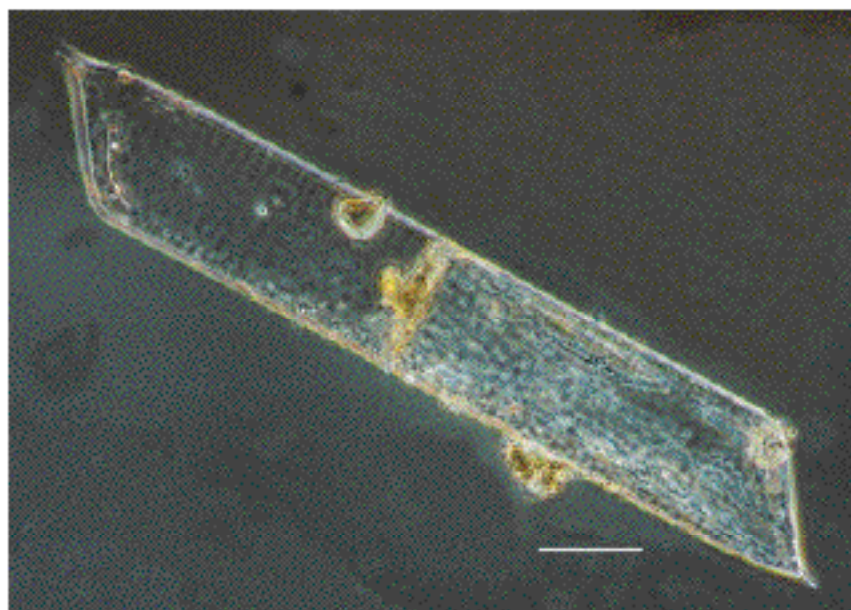


Figure 1. Cell in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 100µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 151).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	105 - 130	118 ± 18	2
PA	360 - 550	455 ± 134	2

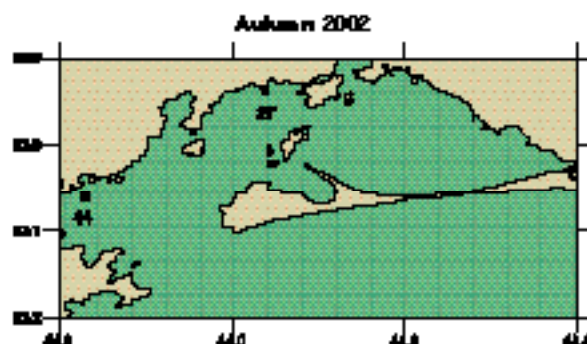


Plate 35

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Rhizosoleniales
 Family Rhizosoleniaceae

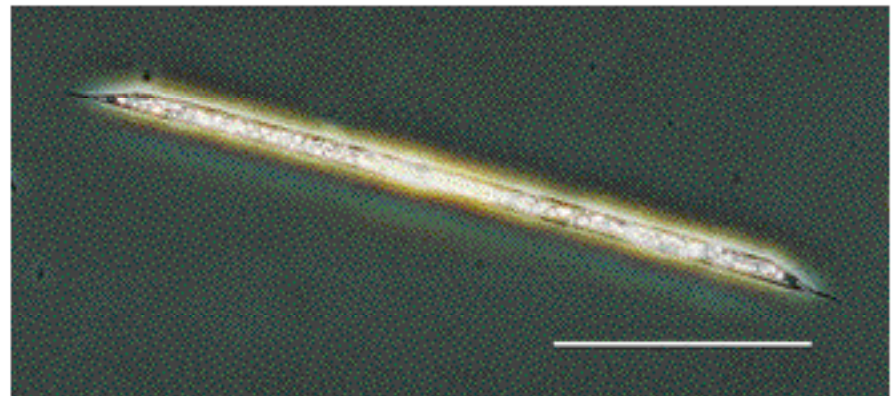
Rhizosolenia hebetata Bailey, 1856

Figure 1. Cell in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 100µm.

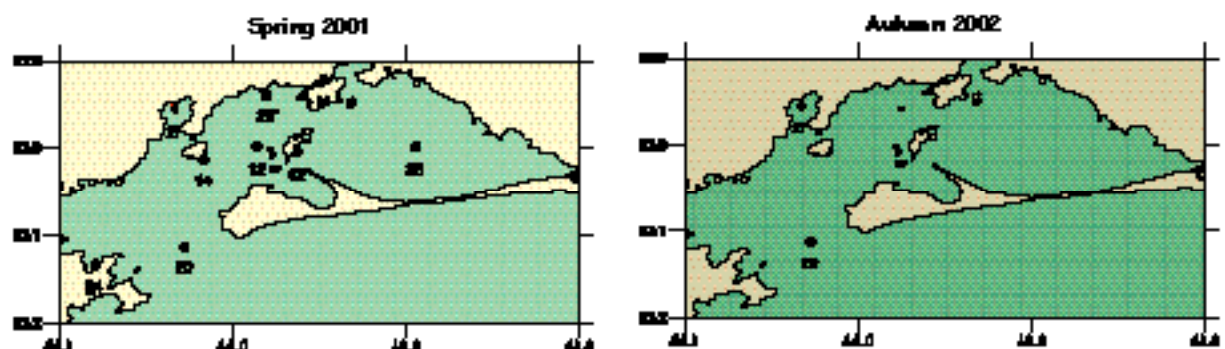
Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 149).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	7 - 30	18 ± 9	15
PA	245 - 640	342 ± 113	15



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Rhizosoleniales
 Family Rhizosoleniaceae

Plate 36

***Rhizosolenia hyalina* Ostenfeld, 1901**

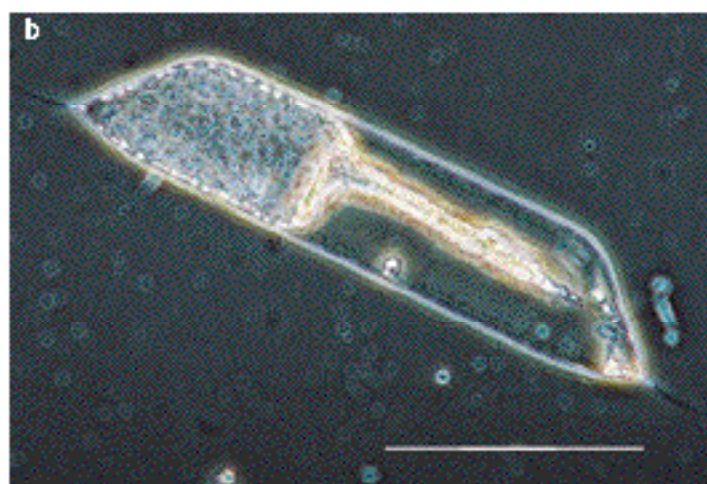
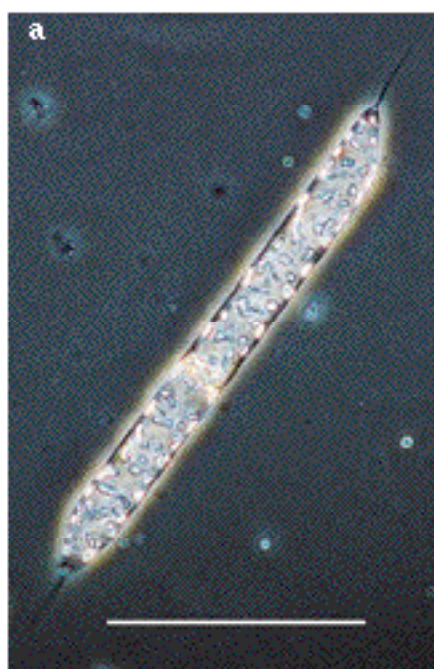


Figure 1 Cells in girdle view, (a) of smaller and (b) wider diameters (LM, phase contrast, water mount). Scale bars = 100µm.

Taxonomic source

Hask & Syvertsen (1997). *Diatoms* (p. 151).

In: *Identifying marine phytoplankton*. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	13 - 50	24 ± 7	26
PA	125 - 340	222 ± 59	26

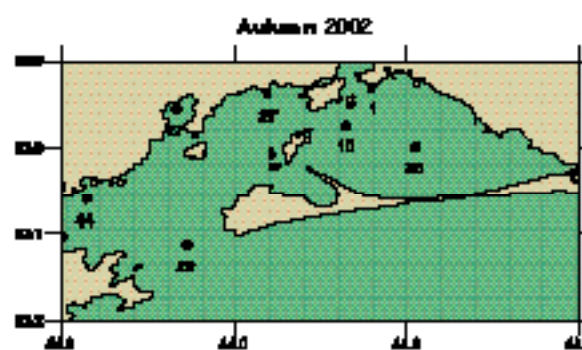
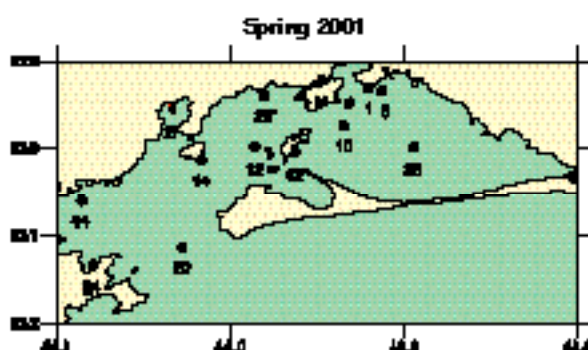


Plate 37

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Rhizosolerales
 Family Rhizosoleniaceae

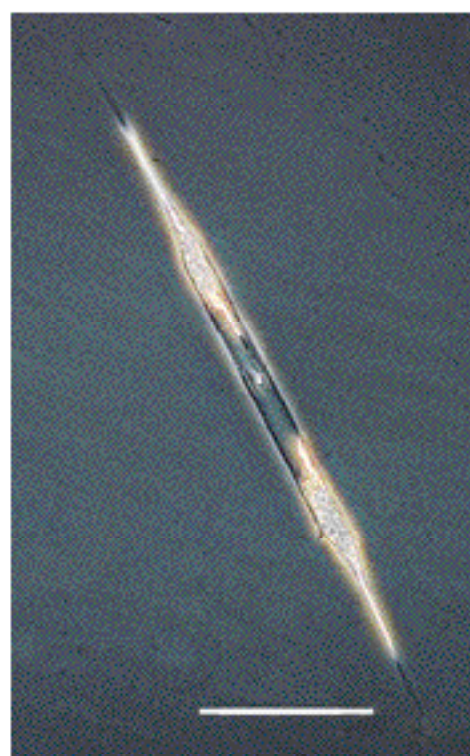
Rhizosolenia pungens Cleve-Euler, 1937

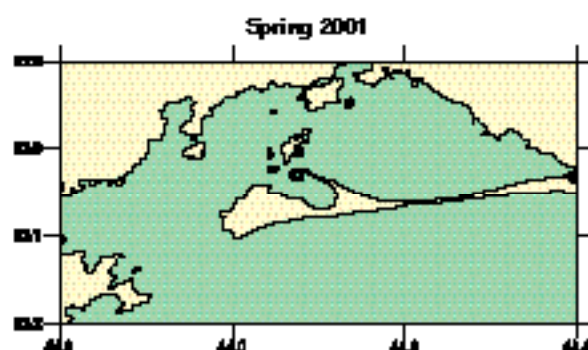
Figure 1. Cell in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 100µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 157).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	8.0 - 15	11 ± 32	9
PA	182.5 - 280	233 ± 3	9



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Rhizosoleniales
 Family Rhizosoleniaceae

Plate 38

***Rhizosolenia robusta* Norman ex Ralfs, 1861**



Figure 1 Cell in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 100µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 159).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	16.0 - 170	74 ± 33	29
PA	67.5 - 475	327 ± 70	29

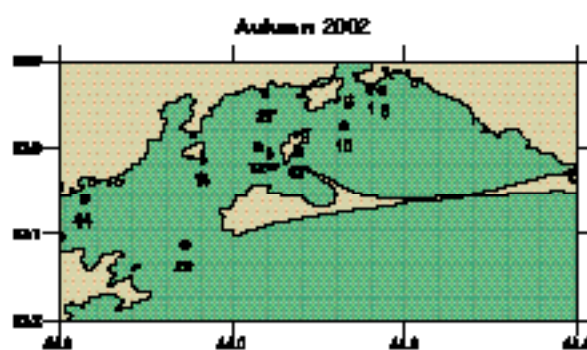
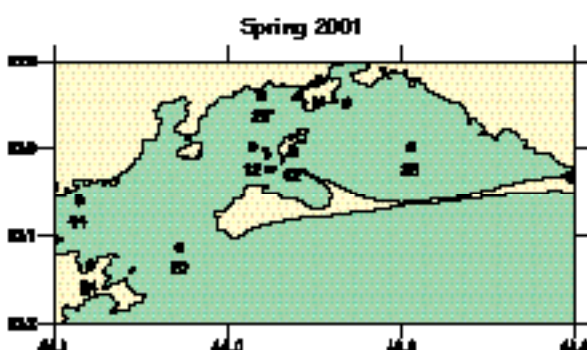


Plate 39

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Rhizosolerales
 Family Rhizosoleniaceae

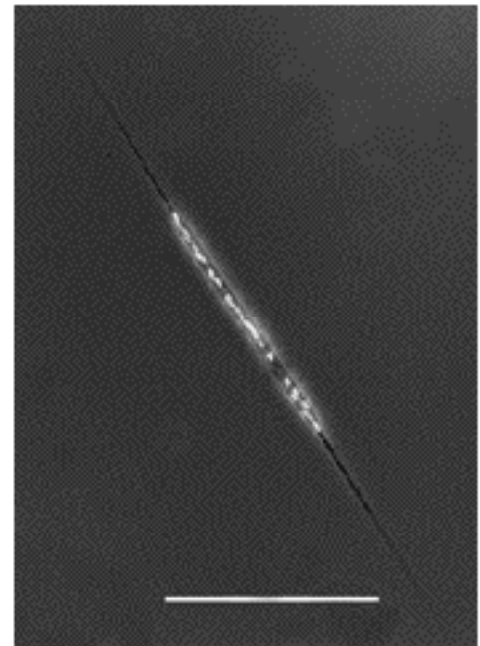
Rhizosolenia setigera Brightwell, 1858

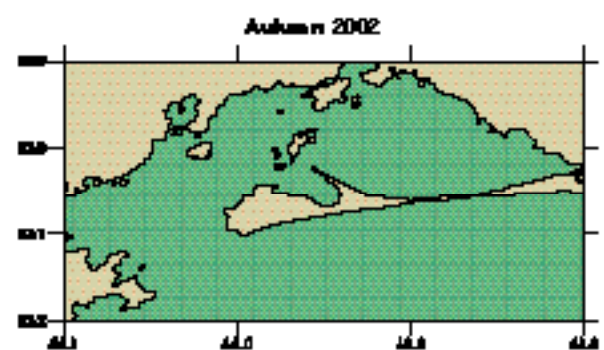
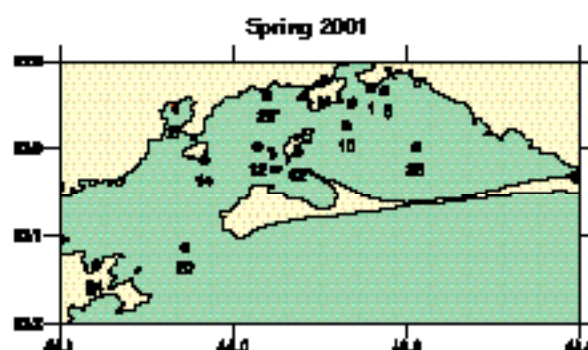
Figure 1. Cell in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 100µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 157).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	3 - 24.5	6 ± 5	30
PA	25 - 475.5	238 ± 100	30



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Rhizosoleniales
 Family Rhizosoleniaceae

Plate 40

***Rhizosolenia cf. styliformis* Brightwell, 1858**



Figure 1 Cell in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 100µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 146).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	13 - 20	15 ± 3	5
PA	225 - 575	404 ± 124	5

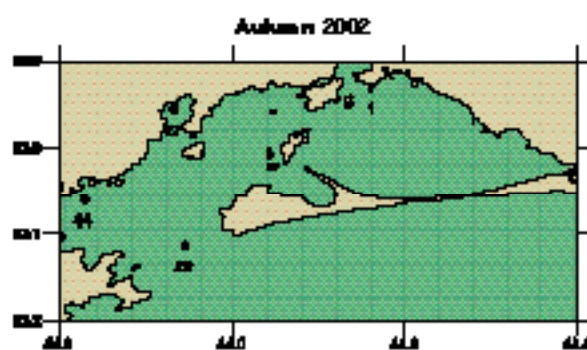
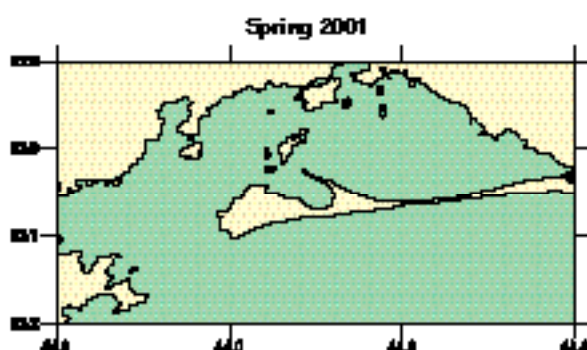


Plate 41

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Chaetoceratales
 Family Chaetocerataceae

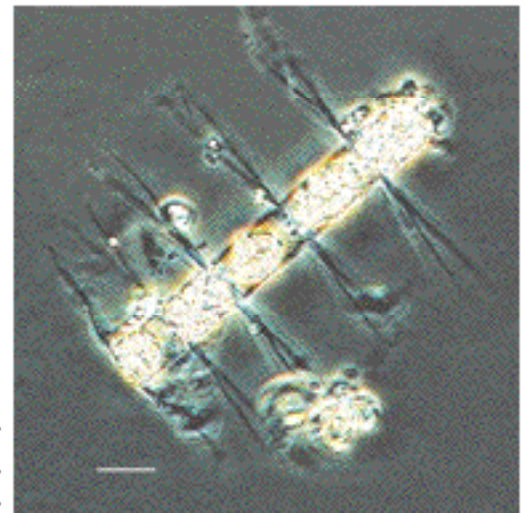
Bacteriastrum cf. delicatum Cleve, 1897

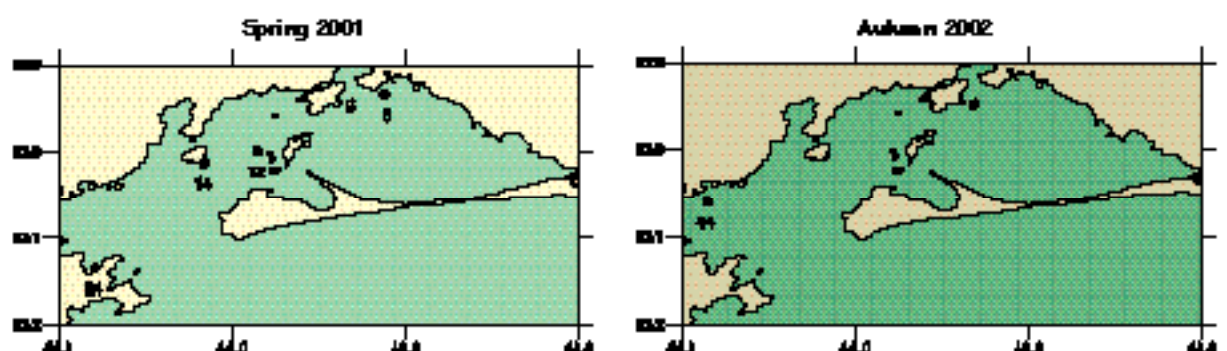
Figure 1. Chain of cells in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 20µm.

Taxonomic source

Hask & Syvertsen (1997). *Diatoms* (p.188).
 In: *Identifying marine phytoplankton*. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	20 - 32.5	22 ± 4	21
PA	20 - 35.0	28 ± 4	21



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Chaetocerales
 Family Chaetocerataceae

Plate 42

***Bacteriastrum hyalinum* Lauder, 1864**



Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 20µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 188).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	20 - 33	27 ± 4	15
PA	20 - 40	27 ± 6	13

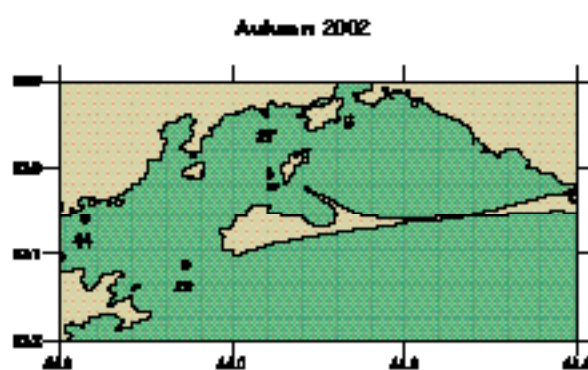
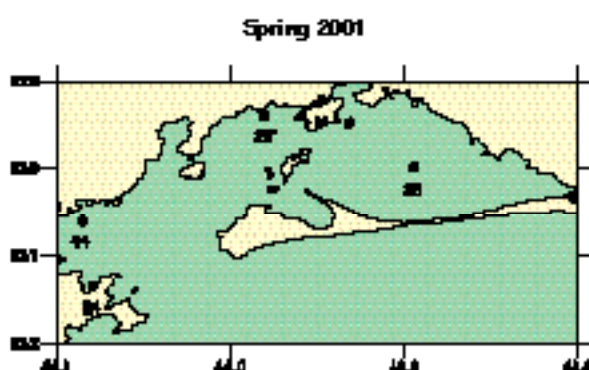


Plate 43

Division Bacillariophyta
Class Coscinodiscophyceae
Order Chaetocerales
Family Chaetoceraceae

Chaetoceros aequatorialis Cleve, 1873

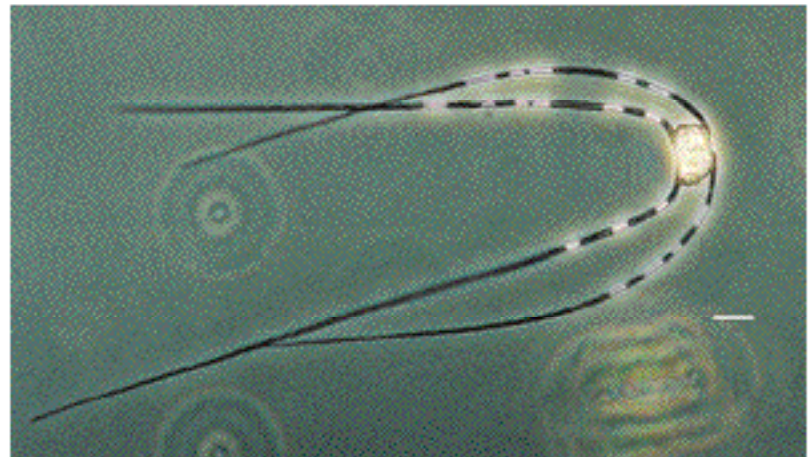
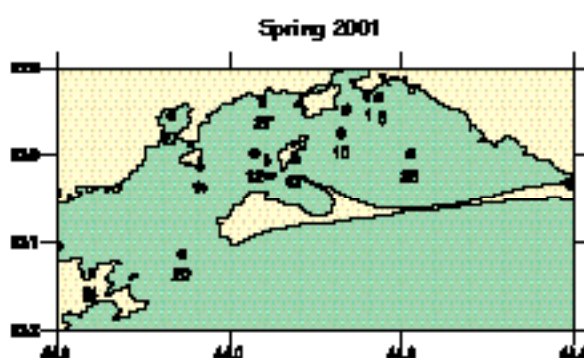


Figure 1. Solitary cell in girdle view
(LM, phase contrast, water mount).
Scale bar = 20µm.

Taxonomic source

Hask, G. R. & Syvertsen, E. E. (1997). Diatoms (p. 193).
In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Chaetoceratales
 Family Chaetocerataceae

Plate 44

***Chaetoceros affinis* Lauder, 1864**

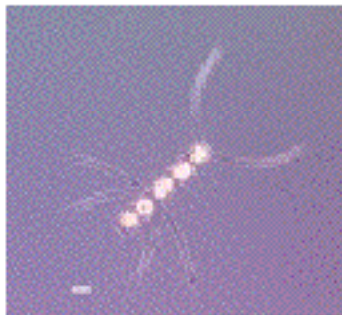


Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 20µm.

Taxonomic source

Hask, G. R. & Syvertsen, E. E. (1997). Diatoms (p. 216).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego

Morphometrics

	range (µm)	mean ± SD	n
D	15 - 26	19 ± 5	5
PA	15 - 20	18 ± 3	5

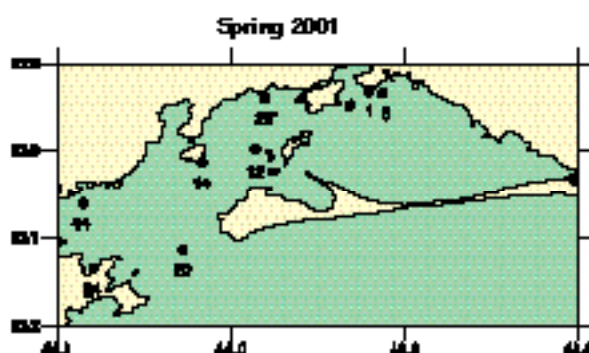
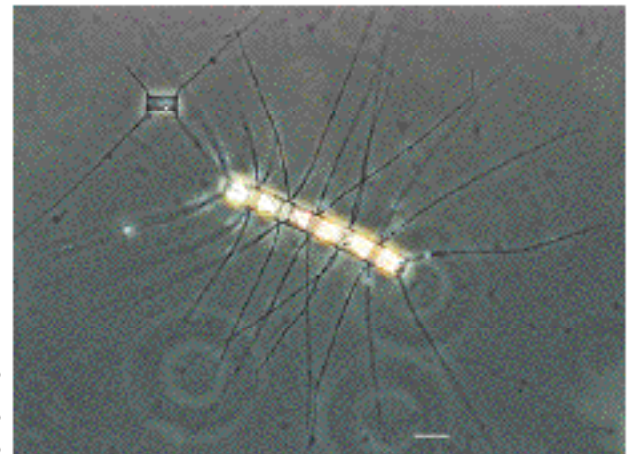


Plate 45

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Chaetocerales
 Family Chaetocerataceae

Chaetoceros cf. brevis Schütt, 1895

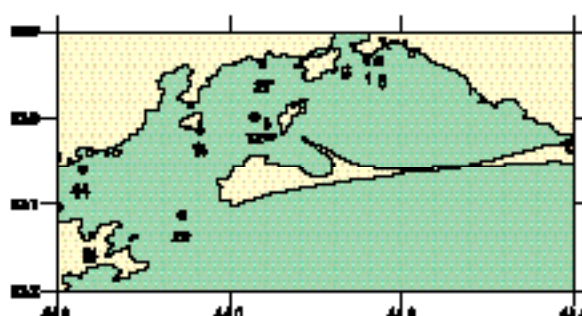
Figure 1. Chain of cells in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 20 μ m.

**Taxonomic source**

Cupp (1943). Marine plankton diatoms of the west coast of North America (p. 129).
 University of California Press, Berkeley and Los Angeles.

Morphometrics

	range (μ m)	mean \pm SD	n
D	15 - 23.0	18 \pm 3	5
PA	12 - 22.5	19 \pm 3	5

Spring 2001

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Chaetoceratales
 Family Chaetocerataceae

Plate 46

***Chaetoceros coarctatus* Lauder, 1864**



Figure 1. Chain of cells in girdle view. Arrow indicates a *Vorticella* sp., an epiphytic flagellate usually found attached on to the cells (LM, phase contrast, water mount). Scale bar = 50µm.

Taxonomic source

Hask, G. R. & Syvertsen, E. E. (1997). Diatoms (p. 199).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	30 - 37	33 ± 4	6
PA	40 - 50	42 ± 5	5

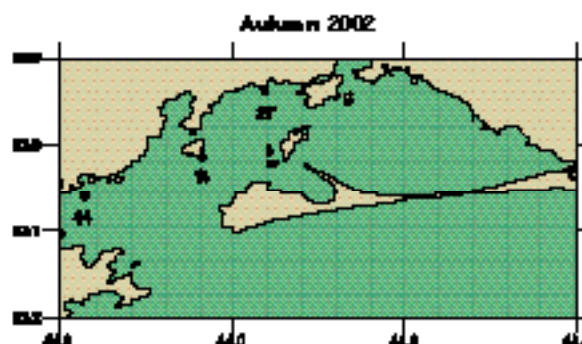


Plate 47

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Chaetocerales
 Family Chaetocerataceae

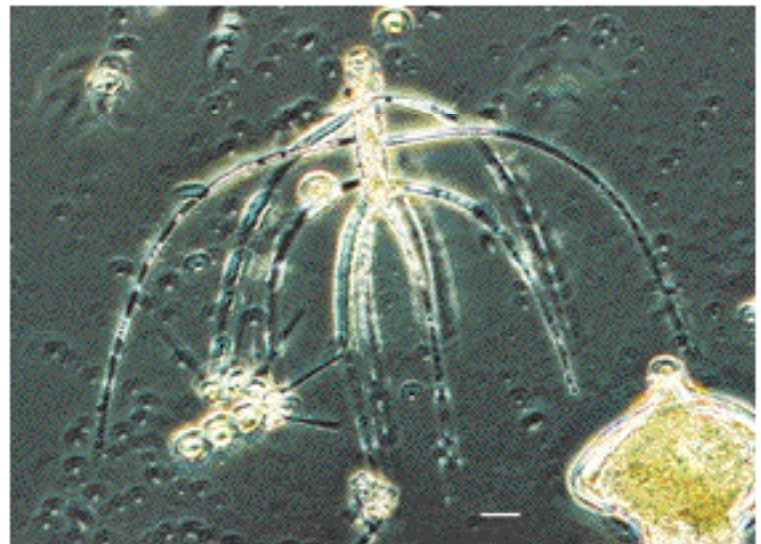
Chaetoceros cf. concavicornis Mangin, 1917

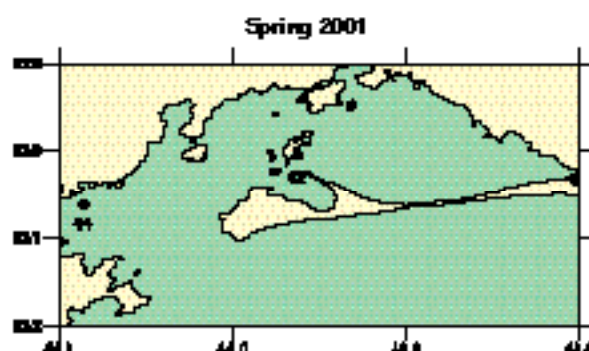
Figure 1. Chain of cells in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 20µm.

Taxonomic source

Hask, G. R. & Syvertsen, E. E. (1997). Diatoms (p. 199).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	20 - 56	32 ± 16	10
PA	25 - 70	36 ± 13	10



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Chaetocerales
 Family Chaetocerataceae

Plate 48

***Chaetoceros curvisetus* Cleve, 1889**

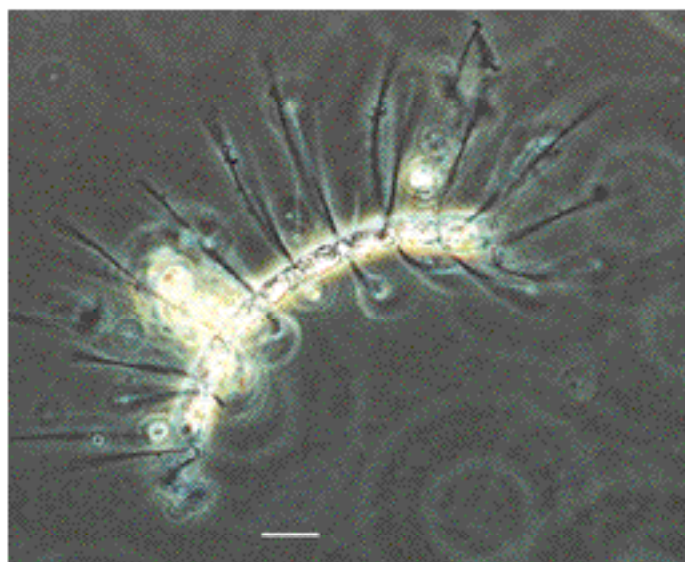


Figure 1 Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 20µm.

Taxonomic source

Hask, G. R. & Syvertsen, E. E. (1997). Diatoms (p. 211).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	8 - 15	12 ± 2	33
PA	15 - 35	21 ± 6	33

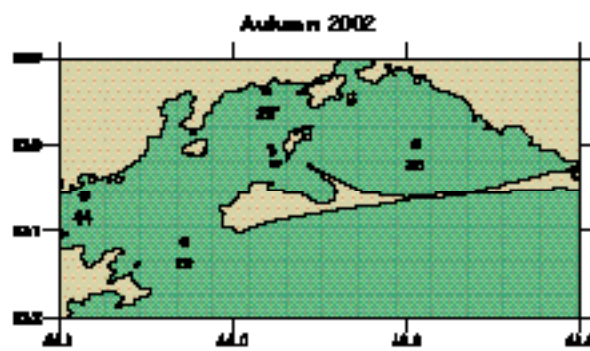
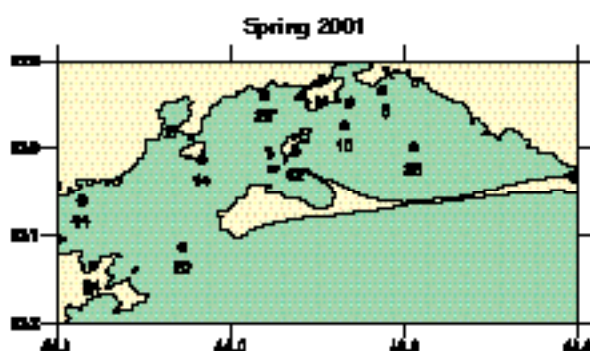


Plate 49

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Chaetocerales
 Family Chaetocerataceae

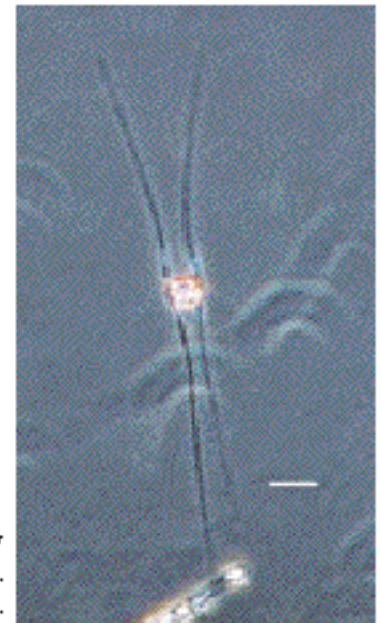
Chaetoceros danicus Cleve, 1889

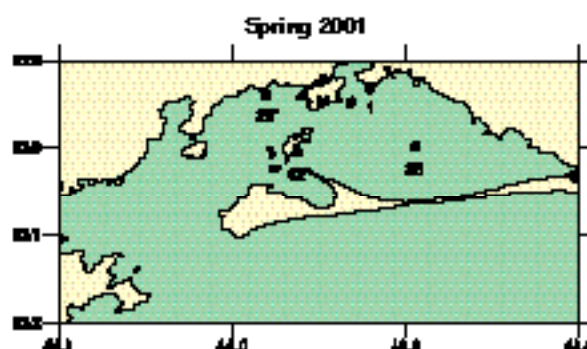
Figure 1. Solitary cell in girdle view (LM, phase contrast, water mount).
 Scale bar = 20µm.

Taxonomic source

Hask, G. R. & Syvertsen, E. E. (1997). Diatoms (p. 195).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	10 - 22.5	14 ± 3	12
PA	9 - 20.0	13 ± 3	12



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Chaetocerales
 Family Chaetocerataceae

***Chaetoceros decipiens* Cleve, 1873**

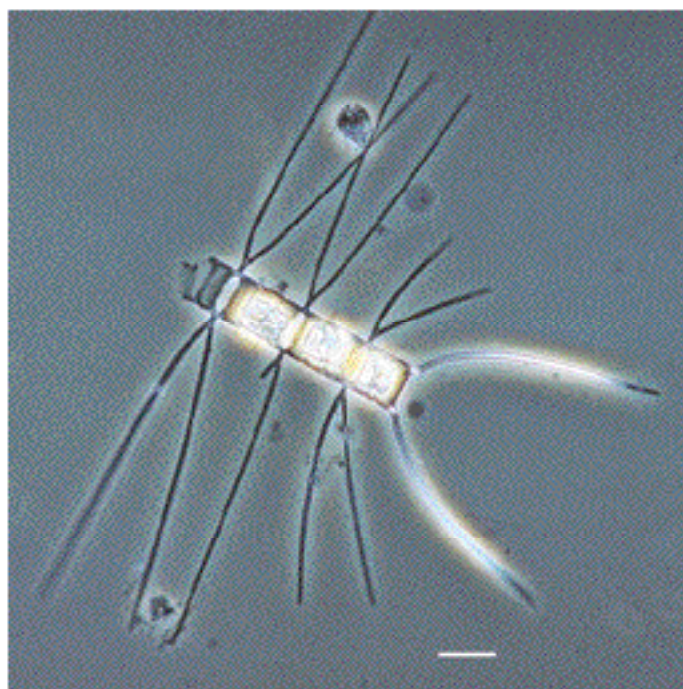


Figure 1 Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 20µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 204).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	17.5 - 45	30 ± 9	21
PA	20.0 - 42	28 ± 6	21

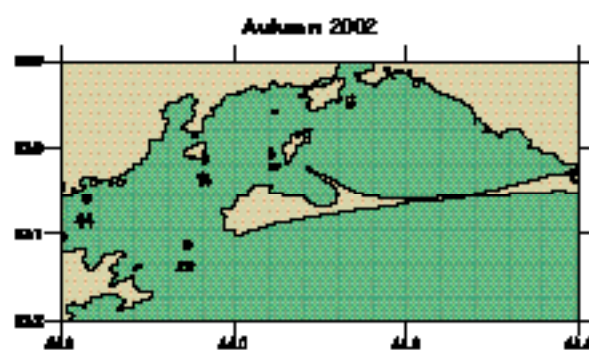
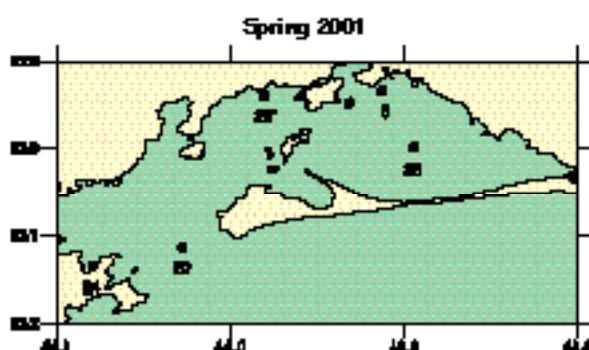


Plate 51

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Chaetocerales
 Family Chaetocerataceae

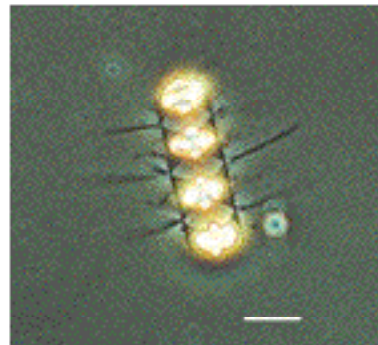
Chaetoceros didymus Ehrenberg, 1845

Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount).
 Scale bar = 20µm.

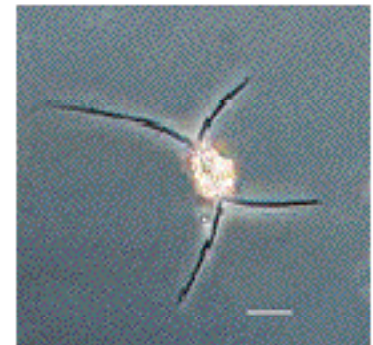


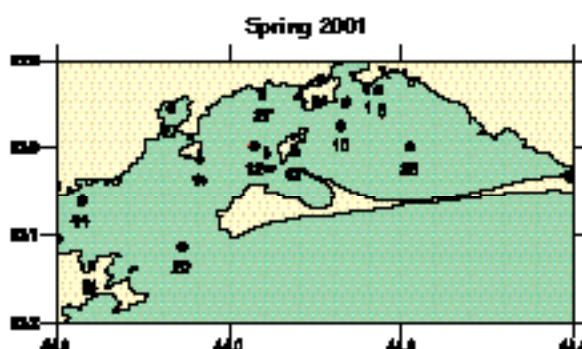
Figure 2. Typical resting spores free from parent cells (LM, phase contrast, water mount).
 Scale bar = 20µm.

Taxonomic source

Hask, G. R. & Syvertsen, E. E. (1997). Diatoms (p. 207).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	14.0 - 35	23 ± 6	18
PA	12.5 - 20	16 ± 2	18



Division Bacillariophyta
Class Coscinodiscophyceae
Order Chaetoceratales
Family Chaetocerataceae

Chaetoceros peruvianus Brightwell, 1856



Figure 1 Solitary cell in girdle view (LM, phase contrast, water mount). Scale bar = 20µm.

Taxonomic source

Hask, G. R. & Syvertsen, E. E. (1997). Diatoms (p. 195).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

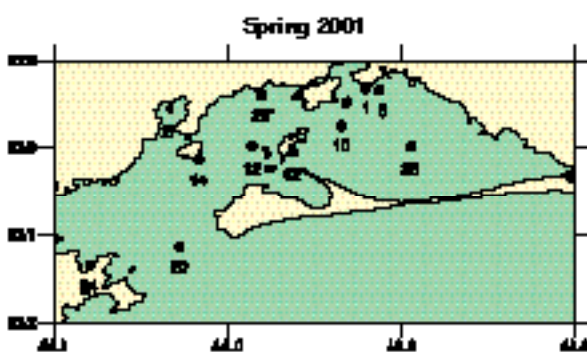


Plate 53

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Chaetocerales
 Family Chaetocerataceae

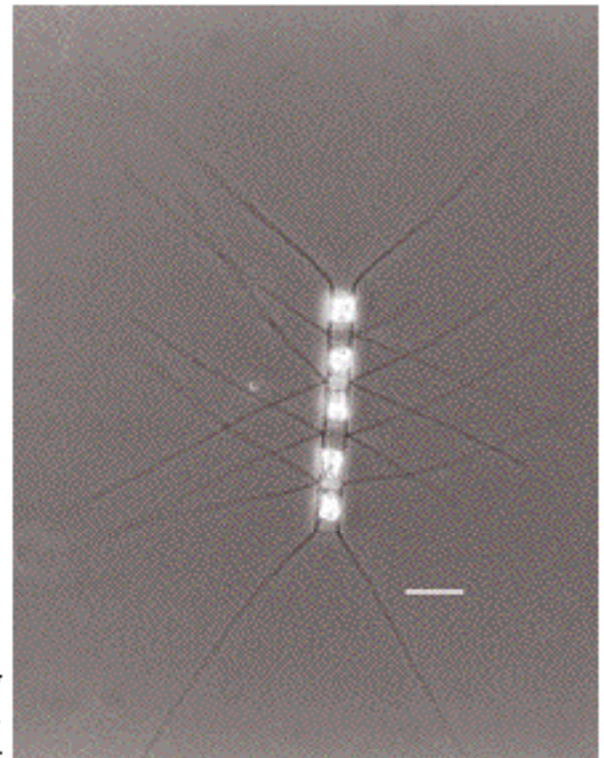
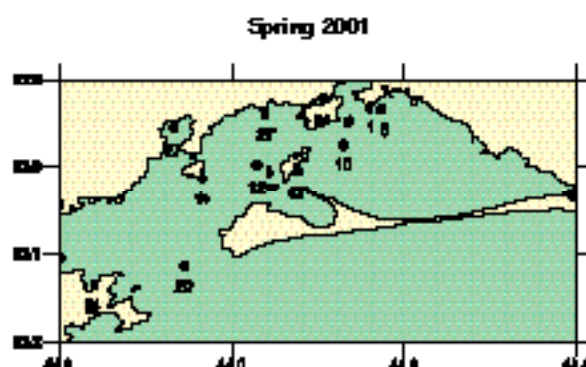
Chaetoceros sp. 1

Figure 1. Chain of cells in girdle view
 (LM, phase contrast, water mount).
 Scale bars = 20µm.

Morphometrics

	range (µm)	mean ± SD	n
D	10 - 20	12 ± 3	18
PA	17 - 25	20 ± 2	18



Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Leptocylindrales
 Family Leptocylindraceae

Plate 54

***Leptocylindrus danicus* Cleve, 1889**

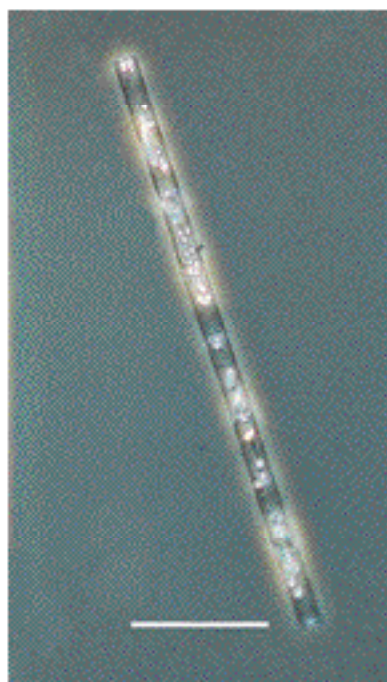


Figure 1. Chain of cells in girdle view; cells with numerous chloroplasts (LM, phase contrast, water mount). Scale bar = 50µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 93).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	5.0 - 20	10 ± 3	110
PA	22.5 - 80	46 ± 10	111

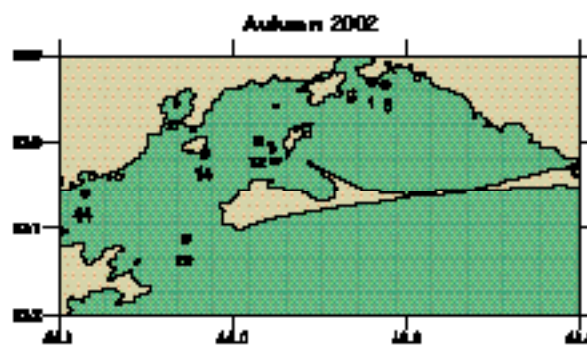
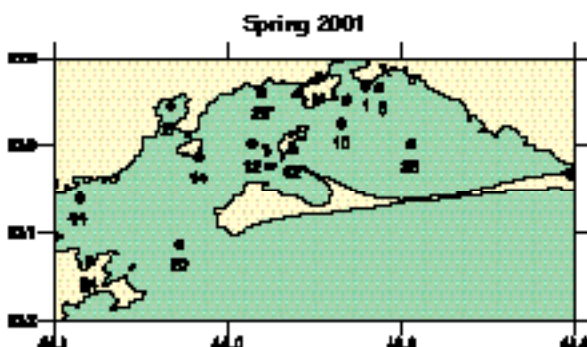


Plate 55

Division Bacillariophyta
 Class Coscinodiscophyceae
 Order Leptocyindrales
 Family Leptocyindraceae

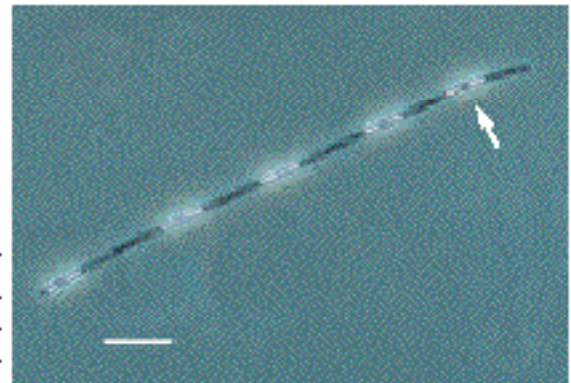
Leptocyindrus minimus Gran, 1915

Figure 1. Chain of cells in girdle view; arrow indicates presence of 2 chloroplasts per cell (LM, phase contrast, water mount). Scale bar = 20µm.

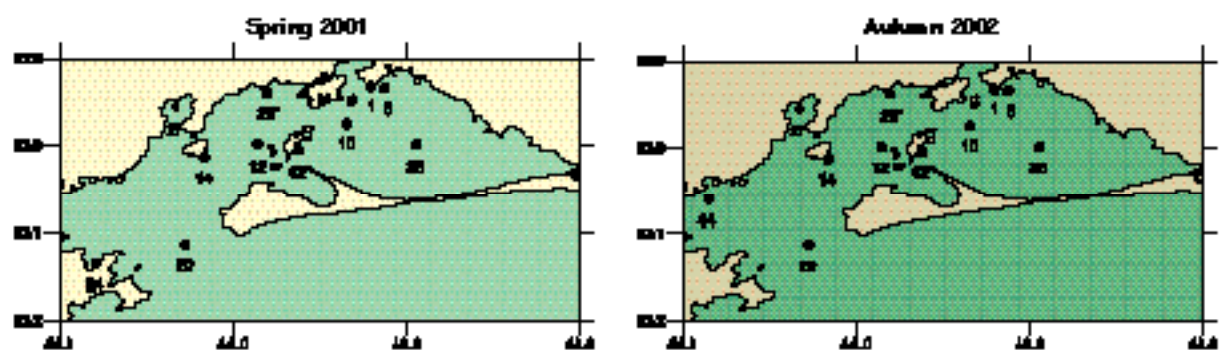
Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 94).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	2 - 5	3 ± 0.8	100
PA	4 - 65	42 ± 10.0	101



Division Bacillariophyta
 Class Fragilariophyceae
 Order Fragilariales
 Family Fragilariaceae

Plate 56

***Asterionellopsis glacialis* (Castracane) Round, 1990**

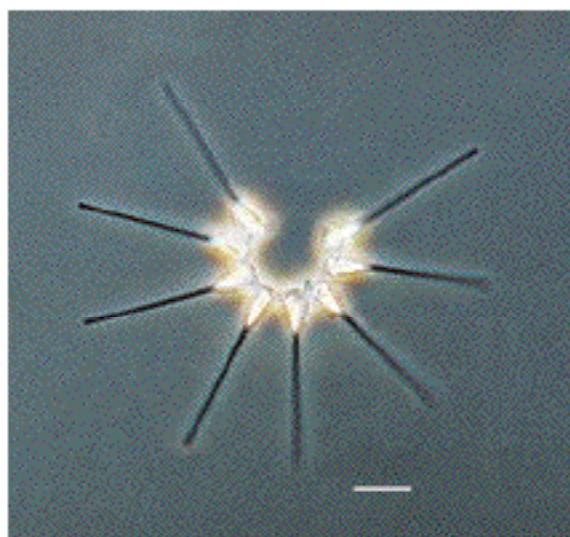


Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 20µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 243).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
D	50 - 60	55 ± 4	7
PA	7 - 15	10 ± 2	7

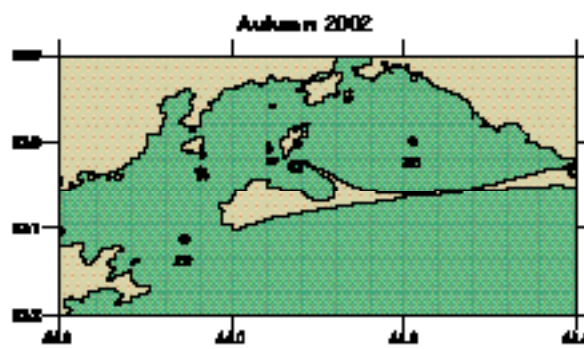
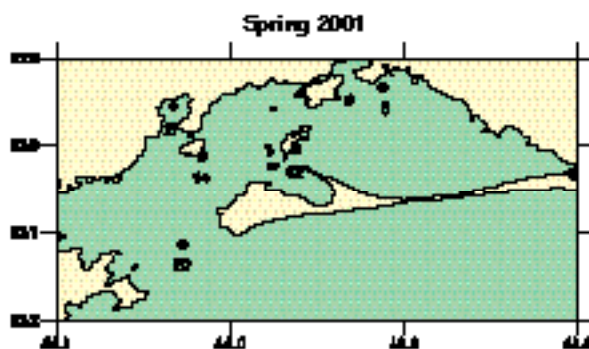


Plate 57

Division Bacillariophyta

Class Fragilariophyceae

Order RhaPHONEIDALES

Family RhaPHONEIDACEAE

Delphineis sp.

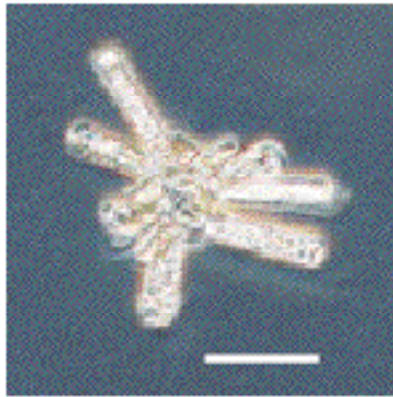


Figure 1. Chain of cells in girdle view, attached to a particle (LM, phase contrast, water mount). Scale bar = 50µm.

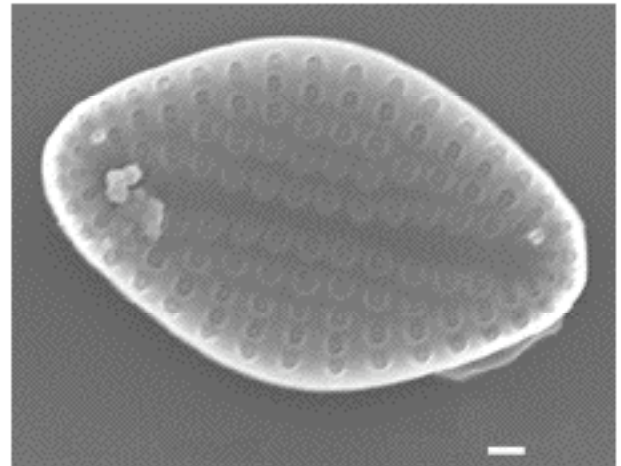
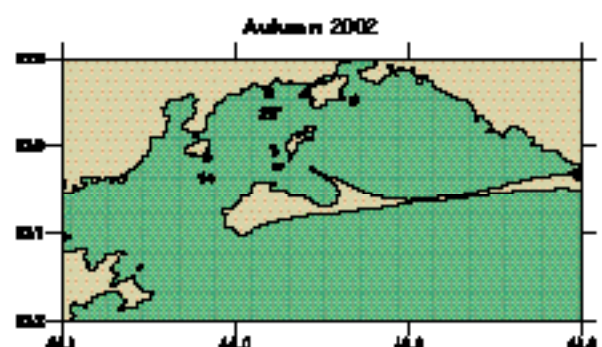
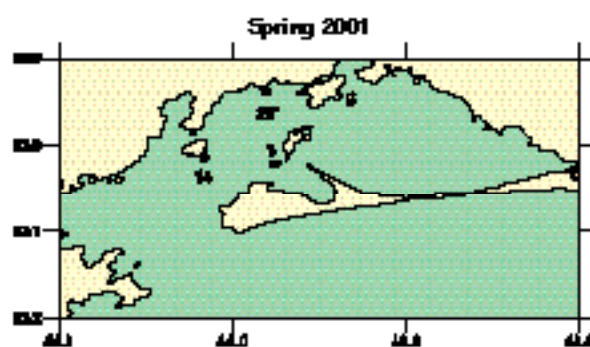


Figure 2. Single valve (SEM). Scale bar = 1µm.



Division Bacillariophyta
 Class Fragilariophyceae
 Order Thalassionematales
 Family Thalassionemataceae

Plate 58

***Lioloma pacificum* (Cupp) Hasle, 1996**

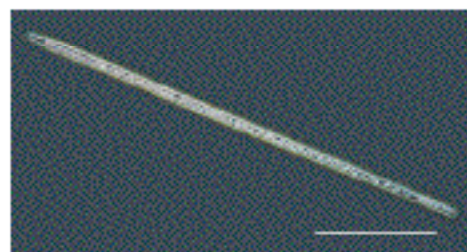


Figure 1. Cell in valve view (LM, phase contrast, water mount). Scale bar = 100µm.

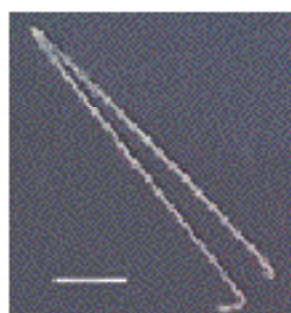


Figure 2. Colony of cells in valve view (LM, phase contrast, water mount). Scale bar = 20µm.



Figure 3. Detail of a head pole with two apical spines (LM, phase contrast, Hyrax mount of cleaned material). Scale bar = 10µm.



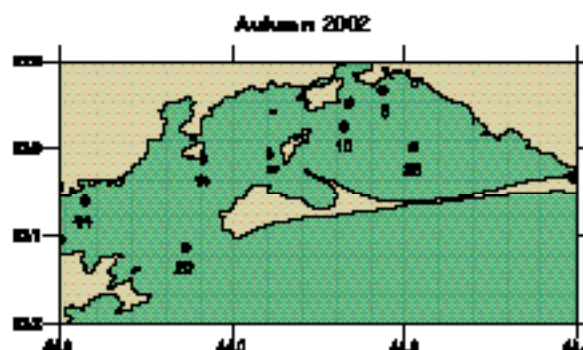
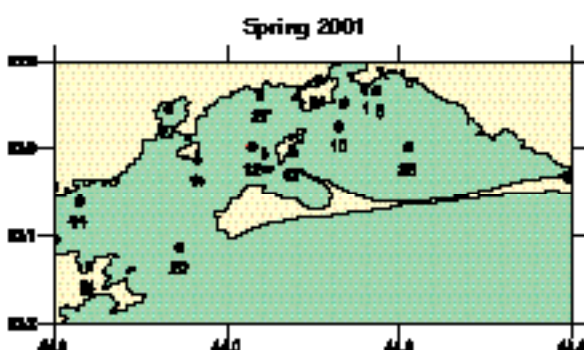
Figure 4. Detail of the foot pole of a valve (LM, phase contrast, Hyrax mount of cleaned material). Scale bar = 10µm.

Taxonomic source

Hasle, G. R. & Syvertsen, E. E. (1997). Diatoms (p. 257). In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
AA	257.50 - 990	530 ± 2	62
TA	1.25 - 11	8 ± 171	62



Thalassionema nitzschioides (Grunow) Grunow ex Hustedt, 1932

Figure 1. Chains of cells in girdle view, showing (a) zig-zag formation and (b) fan-like formation (LM, phase contrast, water mount). Scale bars = (a) 10 μ m; (b) 20 μ m.

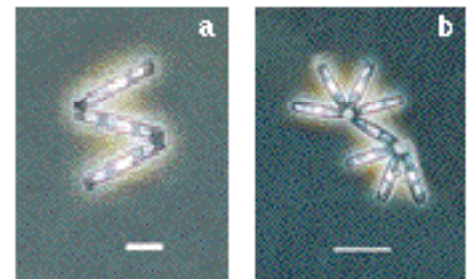


Figure 2. Single valve (LM, phase contrast, Hyrax mount of cleaned material). Scale bar = 10 μ m.

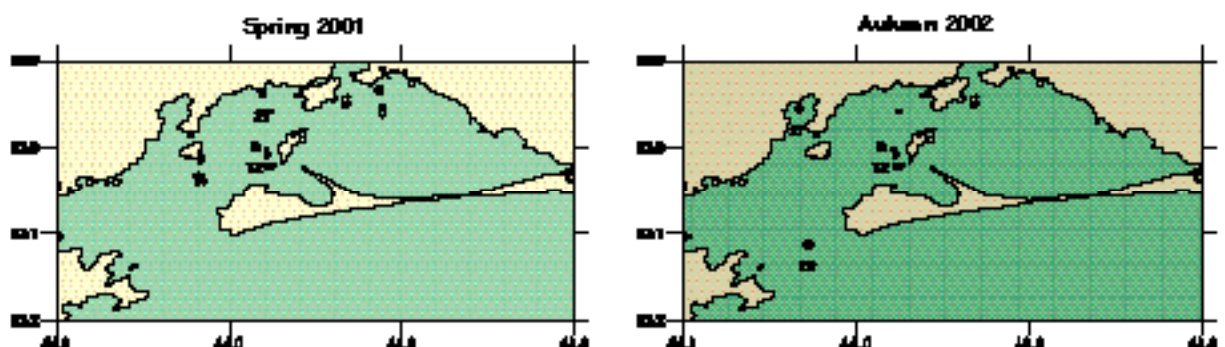


Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 261).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (μ m)	mean \pm SD	n
AA	20 - 75	49 \pm 20	28
TA	4 - 10	6 \pm 2	28



Division Bacillariophyta
 Class Fragilariophyceae
 Order Thalassionematales
 Family Thalassionemataceae

Thalassionemataceae 1

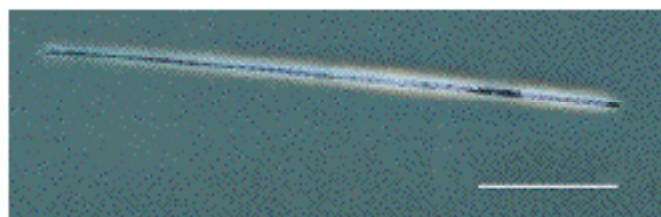


Figure 1 Cell in valve view
 (LM, phase contrast, water mount).
 Scale bar = 100µm.

Morphometrics

	range (µm)	mean ± SD	n
AA	270.0 - 550	423 ± 76	36
TA	1.5 - 6	4 ± 1	36

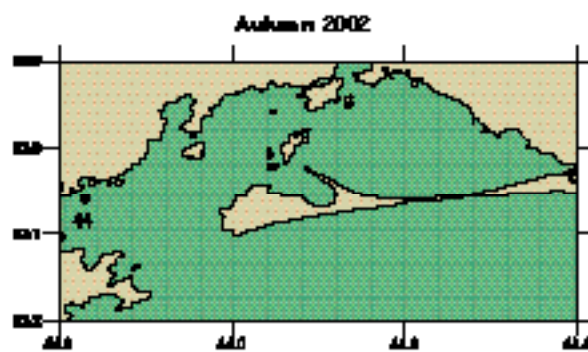
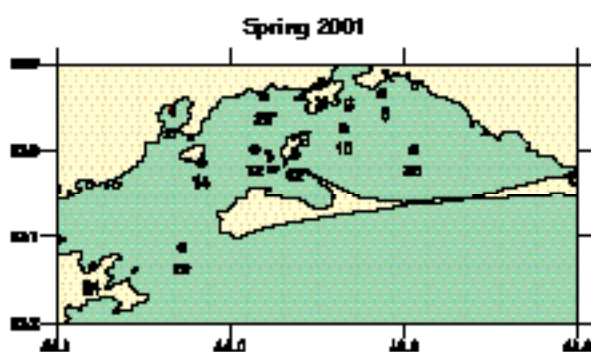


Plate 61

Division Bacillariophyta

Class Bacillariophyceae

Order Naviculales

Family Naviculaceae

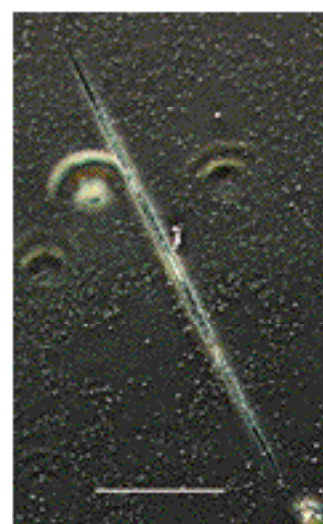
Haslea wawrikan (Hustedt) Simonsen, 1974

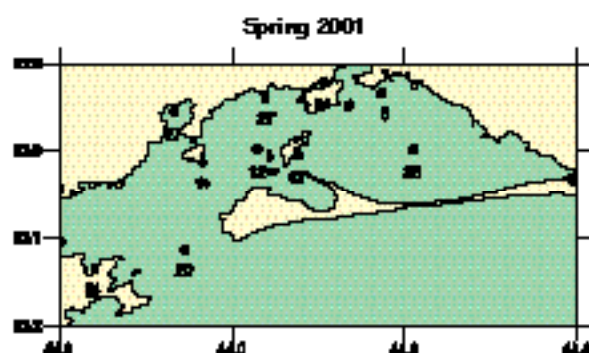
Figure 1. Cell in valve view (LM, phase contrast, water mount).
Scale bar = 100µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 278).
In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
AA	295 - 625	392 ± 52	31
TA	4 - 8	6 ± 1	31



Division Bacillariophyta
Class Bacillariophyceae
Order Naviculales
Family Naviculaceae

Plate 62

***Haslea* sp.1**

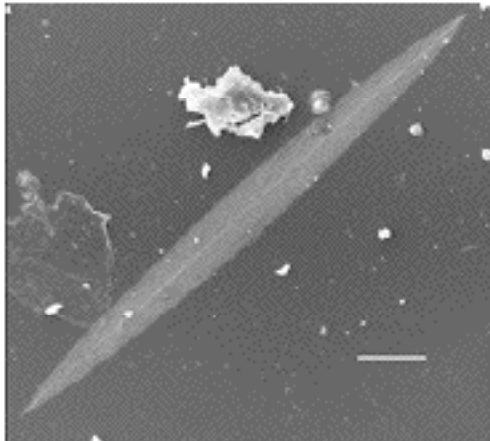


Figure 1. Single valve, internal view (SEM).
Scale bar = 20µm.

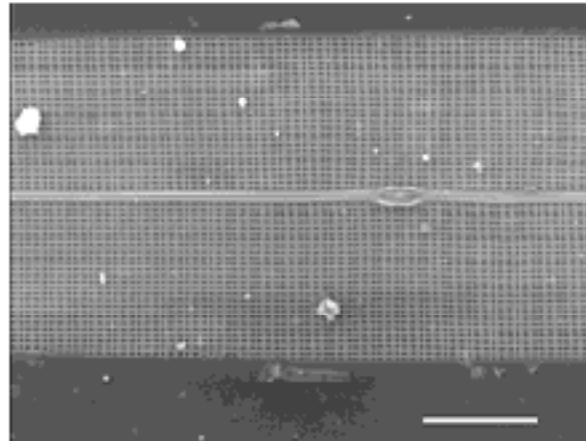


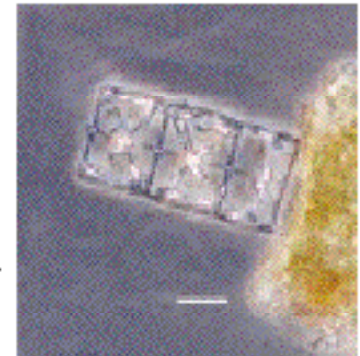
Figure 2. Detail of the central part of the valve (SEM).
Scale bar = 5µm.

Plate 63

Division Bacillariophyta
 Class Bacillariophyceae
 Order Naviculales
 Family Naviculaceae

Meuniera membranacea (Cleve) P.C. Silva, 1996

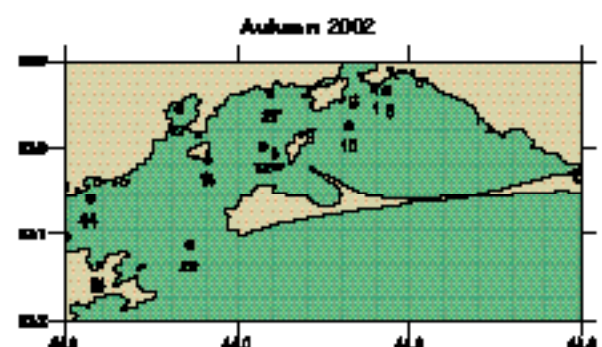
Figure 1. Chain of cells in girdle view
 (LM, phase contrast, water mount).
 Scale bar = 20µm.

**Taxonomic source**

Hask & Syvertsen (1997). Diatoms (p. 273).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

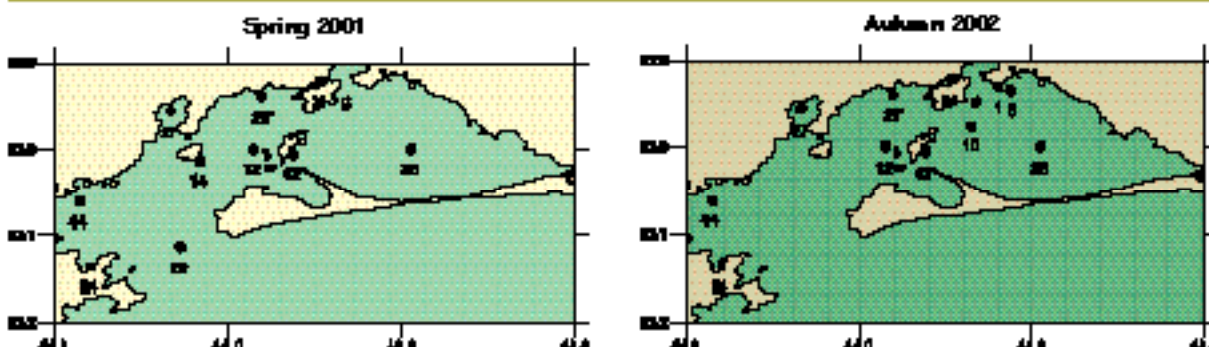
Morphometrics

	range (µm)	mean ± SD	n
AA	20 - 60	33 ± 6	53
TA	30 - 67	48 ± 11	53



Division Bacillariophyta
 Class Bacillariophyceae
 Order Naviculales
 Family Pleurosigmataceae

Pleurosigmataceae



The distribution of the Pleurosigmataceae includes taxa of the genera *Pleurosigma*, *Gyrosigma* and *Dontkoria*, as presented in Plates 64-67.

Pleurosigma angulatum
 (Quekett) Wm. Smith, 1852

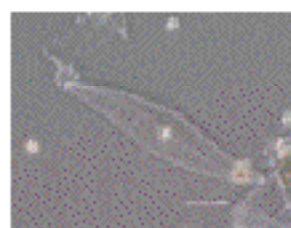


Figure 1 Single valve (LM, phase contrast, Hyrax mount of cleaned material). Scale bar = 20µm.

Pleurosigma diverse striatum
 Meister, 1935



Figure 2 Single valve (LM, phase contrast, Hyrax mount of cleaned material). Scale bar = 20µm.

Pleurosigma cf. strigosum
 Wm. Smith, 1852

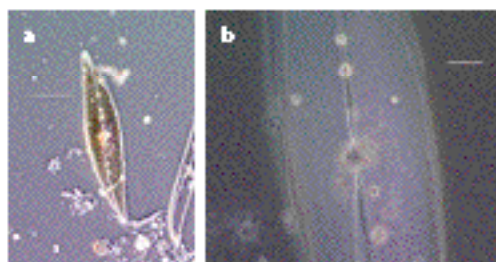


Figure 3 (a) Whole valve and (b) detail of the central raphe endings. (LM, phase contrast, Hyrax mount of cleaned material). Scale bars = (a) 50µm; (b) 10µm.

Taxonomic source

Navarro, N. (1982). A survey of the Marine diatoms of Puerto Rico V. Suborder Raphidineae: Families Achmanthaceae and Naviculaceae (excluding Navicula and Mastogloia) (p. 325). *Botanica Marina*, 25.

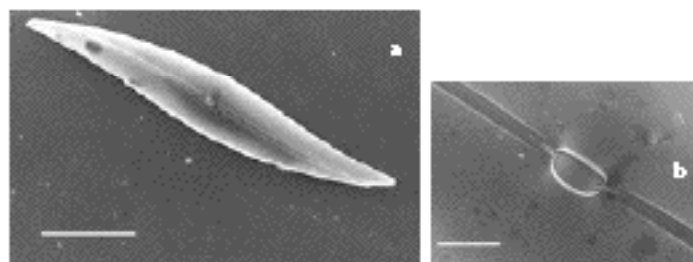


Figure 4 (a) Inside view of whole valve and (b) of a detail of the central raphe endings (SEM). Scale bars = (a) 50µm; (b) 5µm.

Taxonomic source

Peragallo, H. & Peragallo, M. (1965). *Diatomées marines de France et des districts maritimes voisins* (p.163). A. Ascher & Co. Amsterdam.
 Cardinal, A.; Poulin, M. & Bérard-Therriault (1989). New criteria for species characterization in the genera *Dontkoria*, *Gyrosigma* and *Pleurosigma* (Naviculaceae, Bacillariophyceae) (p.15-27). *Phycologia*. Vol 28 (1).

Plate 65

Division Bacillariophyta
 Class Bacillariophyceae
 Order Naviculales
 Family Pleurosigmaaceae

Pleurosigmaaceae

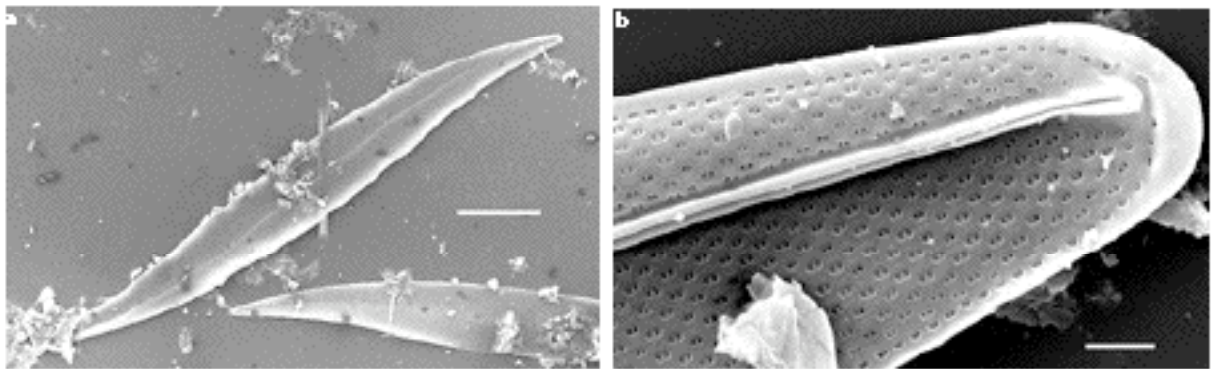
Pleurosigma sp. 1

Figure 1 (a) Inside view of whole valve and (b) of a detail of the valve apex with terminal raphe ending (SEM).
 Scale bars = (a) 50 μ m; (b) 2 μ m.

Pleurosigma sp. 2

Figure 2 (a) Whole valve and
 (b) detail of the
 central raphe endings.
 (LM, phase contrast, Hyrax
 mount of cleaned material).
 Scale bars = (a) 20 μ m;
 (b) 10 μ m.

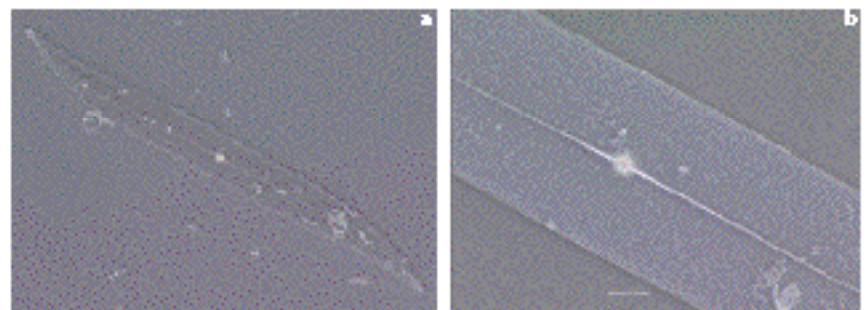
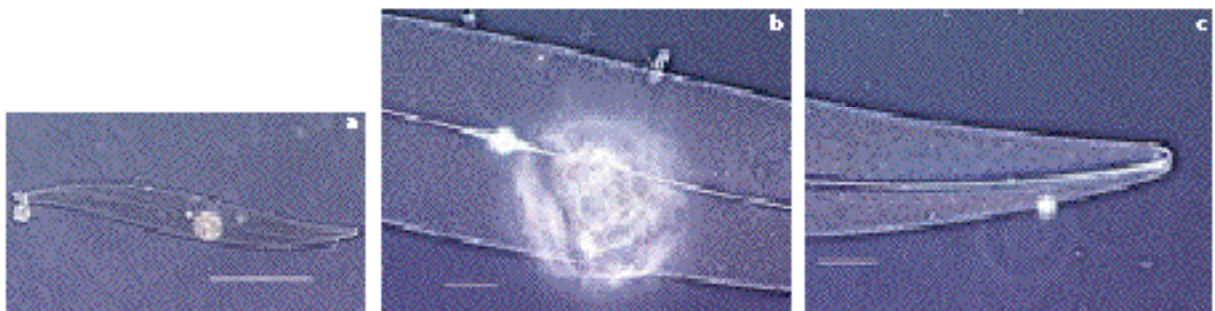
*Pleurosigma* sp. 3

Figure 3 (a) Whole valve, (b) detail of the central raphe endings, and (c) of the valve apex with terminal raphe ending (LM, phase contrast, Hyrax mount of cleaned material).
 Scale bars = (a) 100 μ m; (b) 10 μ m; (c) 10 μ m.

Division Bacillariophyta
 Class Bacillariophyceae
 Order Naviculales
 Family Pleurosigmataceae

Pleurosigmataceae

***Pleurosigma* sp. 4**

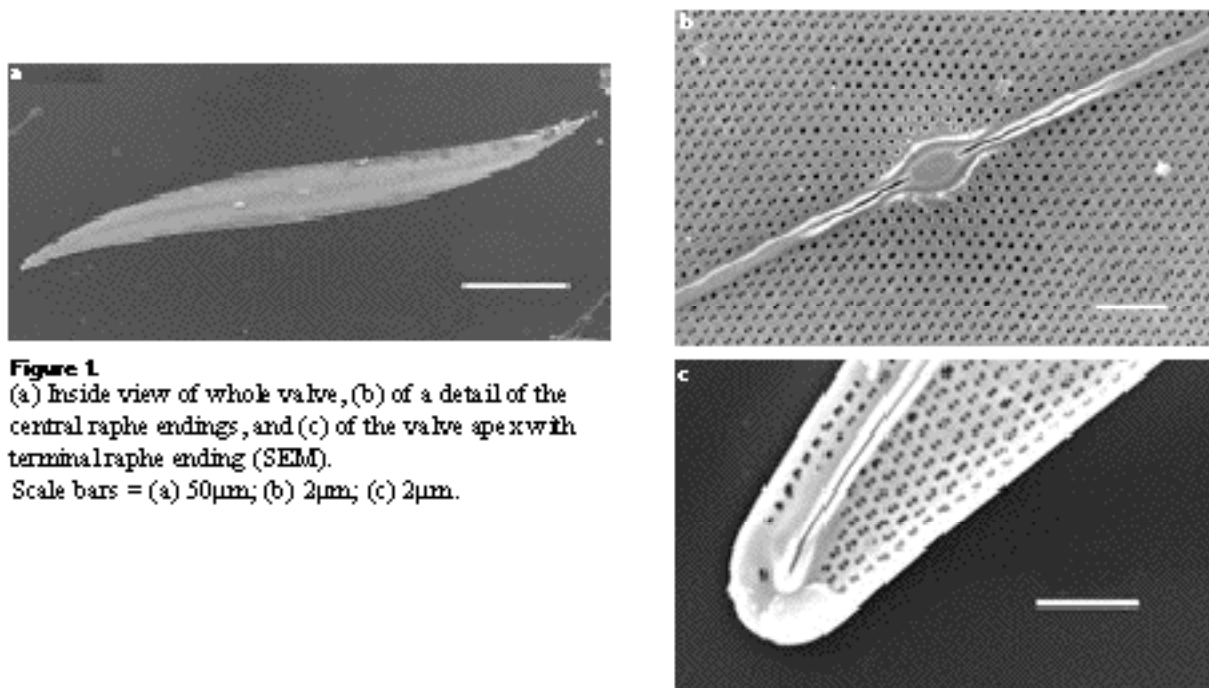


Figure 1
 (a) Inside view of whole valve, (b) of a detail of the central raphe endings, and (c) of the valve apex with terminal raphe ending (SEM).
 Scale bars = (a) 50µm; (b) 2µm; (c) 2µm.

Pleurosigmataceae 1



Figure 3 Single valve
 (LM, phase contrast, Hyrax mount of cleaned material).
 Scale bar = 10µm.

Pleurosigmataceae 2

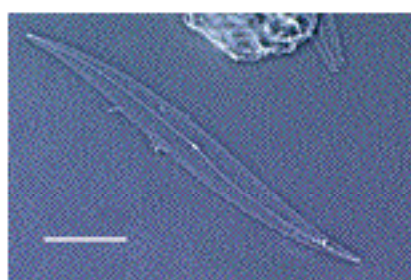


Figure 2 Single valve
 (LM, phase contrast, Hyrax mount of cleaned material).
 Scale bar = 50µm.

Plate 67

Division Bacillariophyta
 Class Bacillariophyceae
 Order Naviculales
 Family Pleurosigmataceae

Pleurosigmataceae

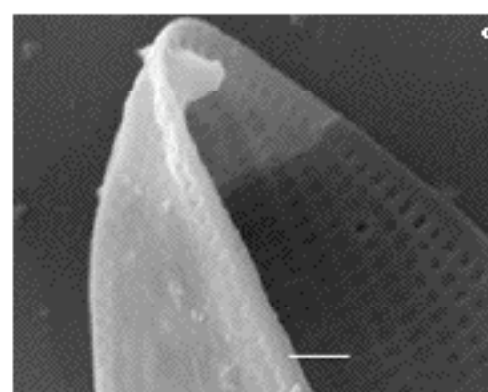
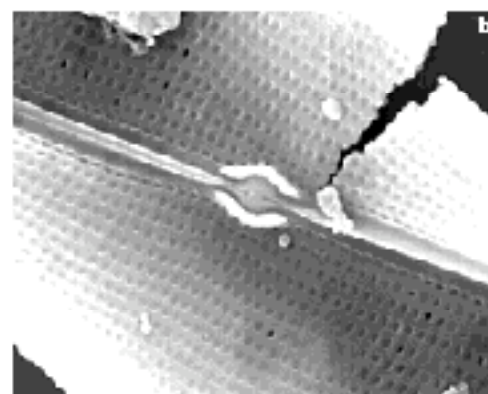
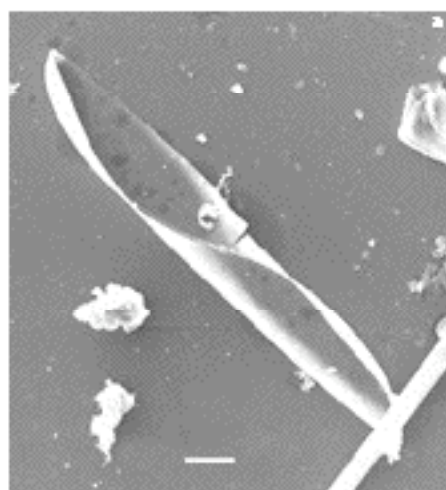
Donkinia sp.

Figure 1 (a) Inside view of whole valve, (b) of a detail of the central raphe endings and (c) of the valve apex with terminal raphe ending (SEM).
 Scale bars = (a) 10 μm; (b) 1 μm; (c) 1 μm.

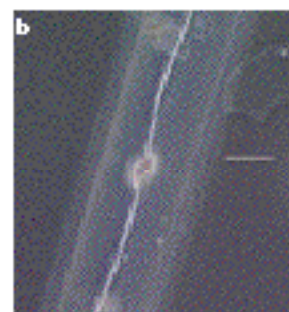
Gyrosigma balticum (Ehrenberg) Rabenhorst, 1853

Figure 2 (a) Whole valve and (b) detail of the central raphe endings (LM, phase contrast, Hyrax mount of cleaned material).
 Scale bars = (a) 50 μm; (b) 10 μm.

Taxonomic source

Hustedt, F. (1985). The pennate diatoms.
 A translation of Hustedt's "Die Kieselalgen, 2. Teil" (p. 783). Koeningstein, Germany.

Division Bacillariophyta
Class Bacillariophyceae
Order Thalassiosiphonales
Family Catenulaceae

Plate 68

***Amphora cf. arenaria* Donkin, 1853**

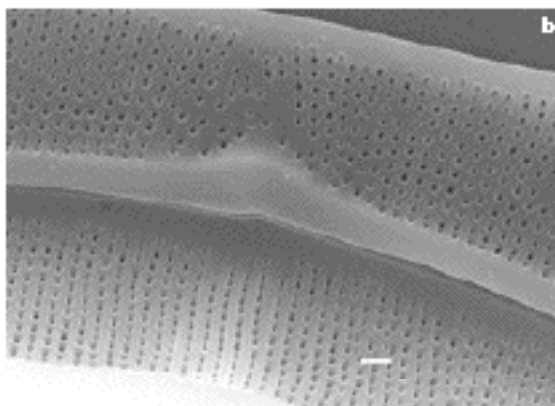
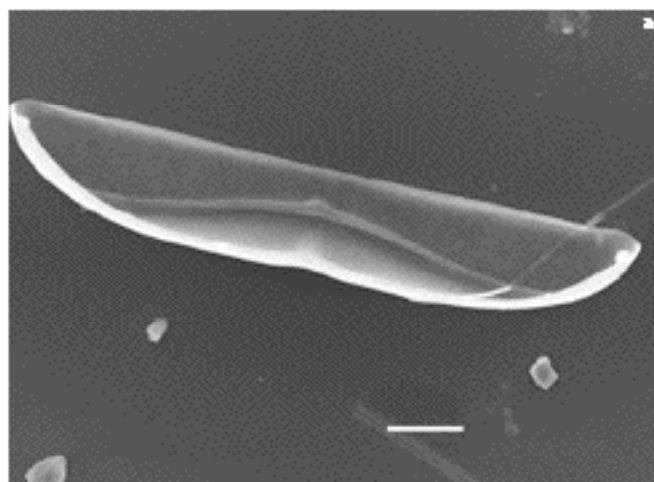


Figure 1 (a) Inside view of whole valve and (b) detail of the central part of the valve (SEM).
Scale bar = (a) 10µm; (b) 1µm.

Taxonomic source

Peragallo, H. & Peragallo, M. (1965). Diatomées marines de France et des districts maritimes voisins (p.217).
A. Ascher & Co. Amsterdam.

Plate 69

Division Bacillariophyta
 Class Bacillariophyceae
 Order Bacillariales
 Family Bacillariaceae

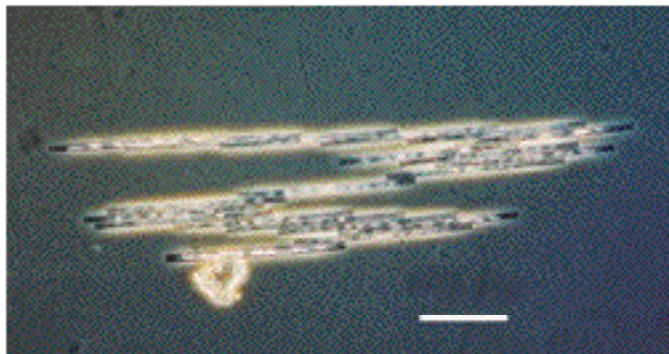
Bacillaria paxillifera (O. F. Müller) Hendeey, 1951

Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount).
 Scale bar = 50µm.

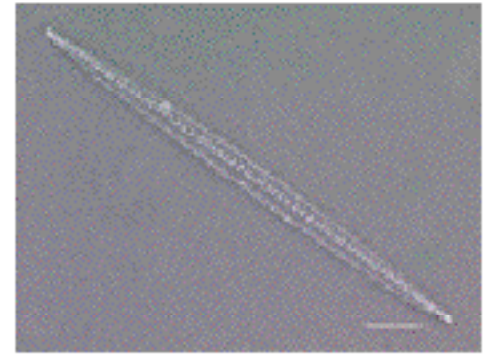


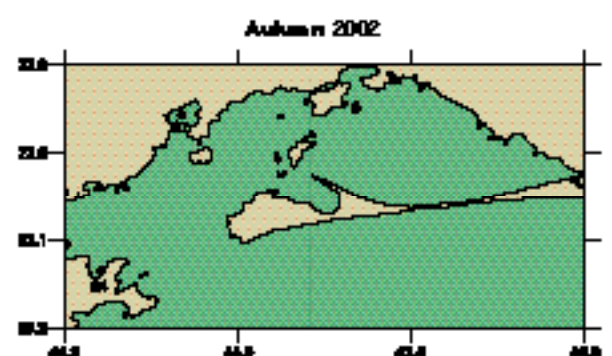
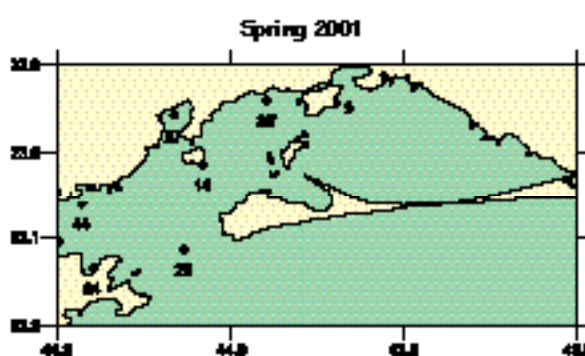
Figure 2. Single valve, showing raphe along its main axis (LM, phase contrast, Hyrax mount of cleaned material).
 Scale bar = 10µm.

Taxonomic source

Hask, G. R. & Syvertsen, E. E. (1997). Diatoms (p. 293).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
AA	95.0 - 115	106 ± 9.0	5
TA	4.5 - 5	5 ± 0.2	5



Division Bacillariophyta
 Class Bacillariophyceae
 Order Bacillariales
 Family Bacillariaceae

***Cylindrotheca closterium* (Ehrenberg) Lewin & Reimann, 1964**



Figure 1. Two solitary cells in valve view (LM, phase contrast, water mount). Scale bar = 20µm.

Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 294).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
AA	40 - 165.5	83 ± 23.0	159
TA	2 - 5.5	4 ± 0.8	159

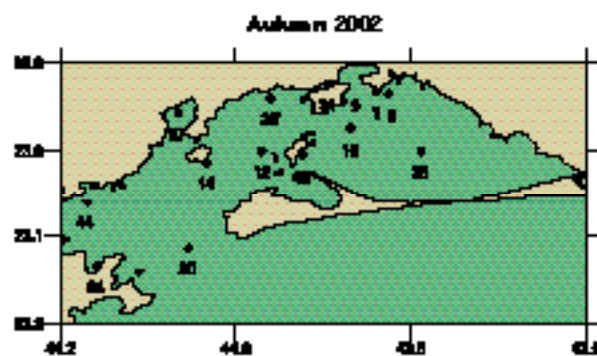
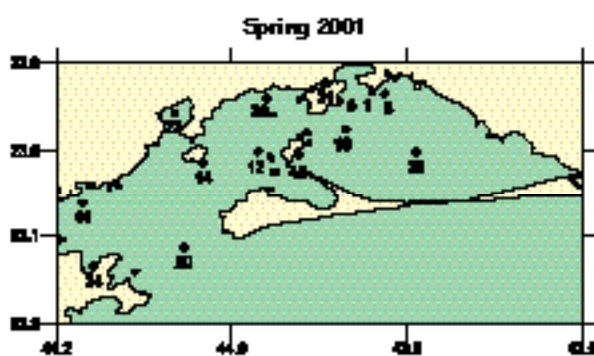


Plate 71

Division Bacillariophyta
 Class Bacillariophyceae
 Order Bacillariales
 Family Bacillariaceae

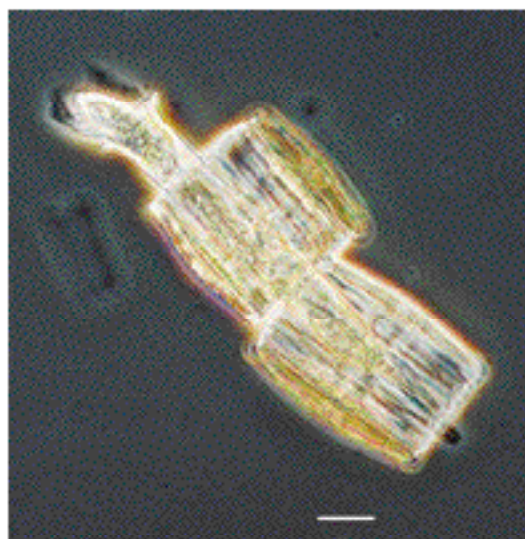
Fragilariopsis doliolus (Wallich) Medlin & Sims, 1993

Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount).
 Scale bar = 20µm.

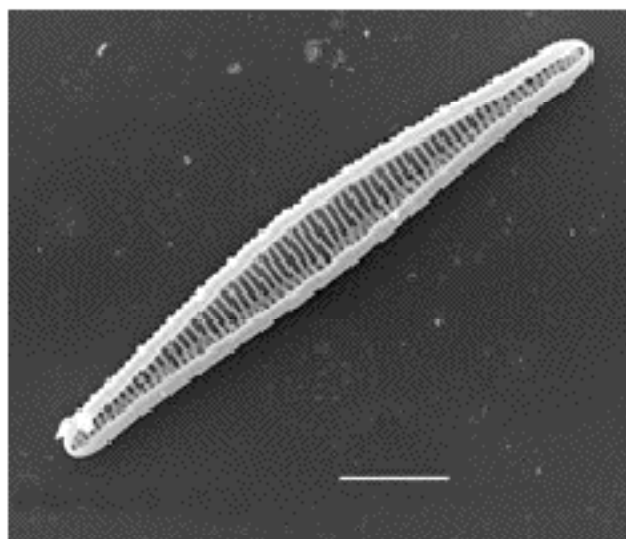


Figure 2. Inside view of single valve (SEM).
 Scale bar = 10µm.

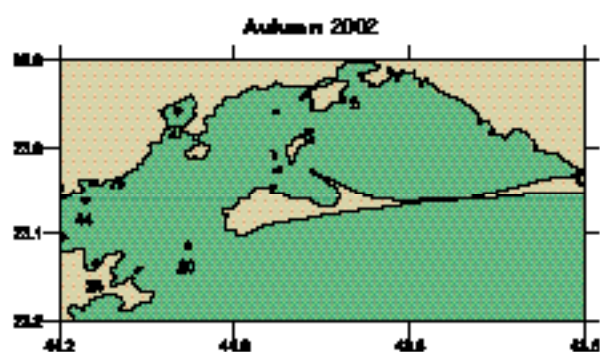
Taxonomic source

Hask & Syvertsen (1997). Diatoms (p. 303).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
AA	47 - 80	65 ± 101	22
TA	5 - 12	10 ± 1	22



Division Bacillariophyta

Class Bacillariophyceae

Order Bacillariales

Family Bacillariaceae

Plate 72

Nitzschia constricta (Gregory) Grunow, 1880

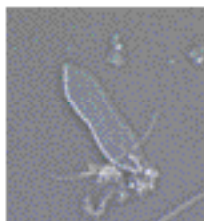


Figure 1. Single valve
(LM, phase contrast, Hyrax mount of cleaned material).
Scale bar = 10µm.

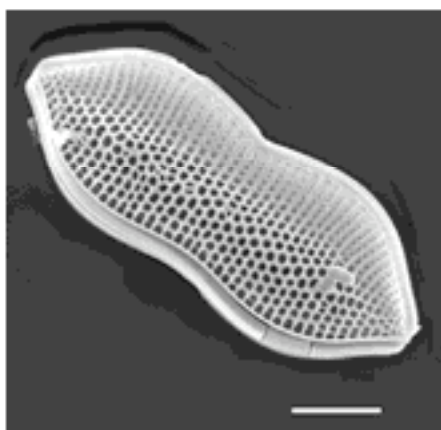


Figure 2. External view of single valve (SEM).
Scale bar = 5µm.

Taxonomic source

Navarro, N. (1982). A survey of the Marine diatoms of Puerto Rico VII. Suborder Raphidineae: Families Auriculaceae, Epithemiaceae, Nitzschiaceae and Surirellaceae (p. 394). *Botanica Marina*, 25.

Plate 73

Division Bacillariophyta
 Class Bacillariophyceae
 Order Bacillariales
 Family Bacillariaceae

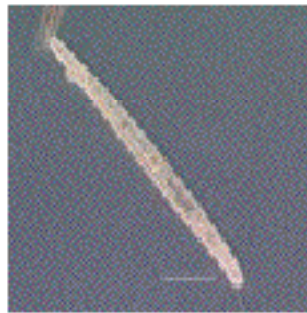
Nitzschia lorenziana var. *subtilis* Grunow, 1880

Figure 1 Single cell (LM, phase contrast, water mount).
 Scale bar = 50µm.

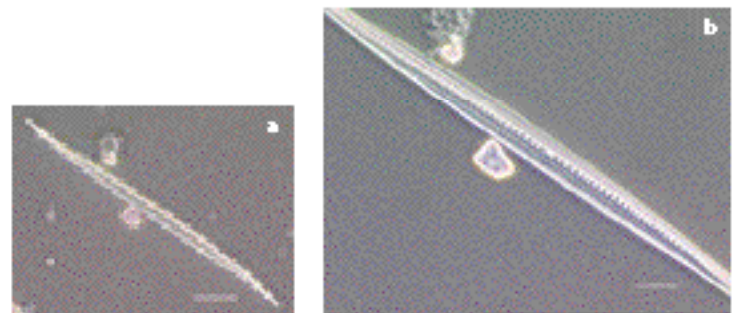


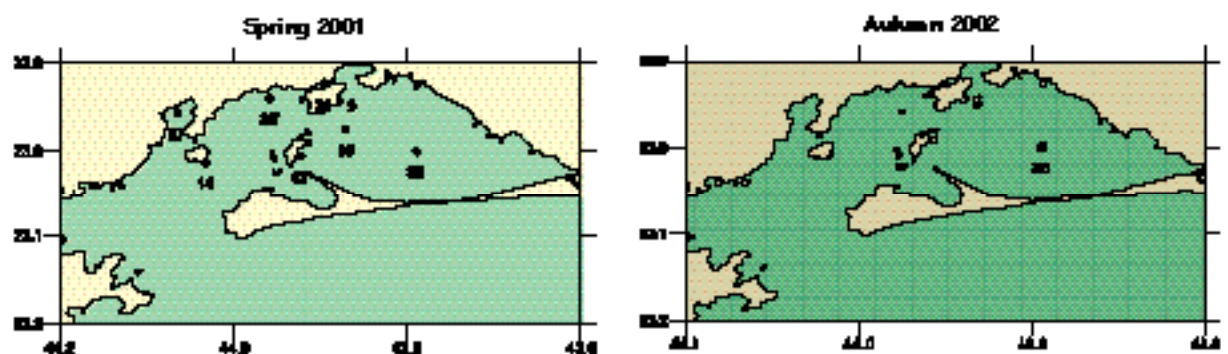
Figure 2 (a) Whole valve and (b) detail of the central part of the valve (LM, phase contrast, Hyrax mount of cleaned material).
 Scale bars = (a) 20µm; (b) 10µm.

Taxonomic source

Peragallo, H. & Peragallo, M. (1965). Diatomées marines de France et des districts maritimes voisins (p. 294).
 A. Ascher & Co. Amsterdam.

Morphometrics

	(µm)	mean	n
AA	170	170	2
TA	15	15	2



Division Bacillariophyta
 Class Bacillariophyceae
 Order Bacillariales
 Family Bacillariaceae

***Nitzschia* morphotype *Nitzschiella* (sensu H. Peragallo, 1965)**

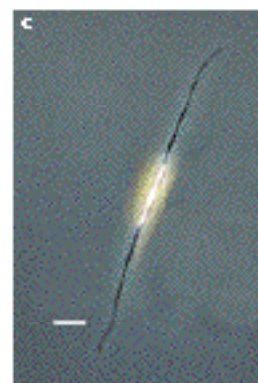
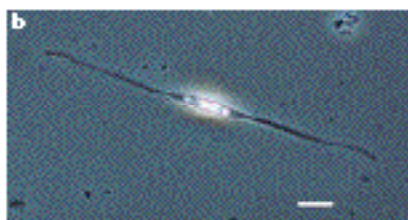
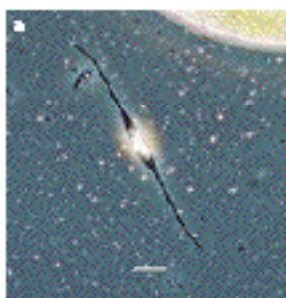


Figure 1a-c. Solitary cells (LM, phase contrast, water mount).
 Scale bar = 20µm.

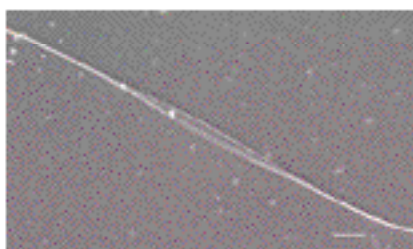


Figure 2. Single valve (LM, phase contrast, Hyrax mount of cleaned material). Scale bar = 20µm.

Taxonomic source

Peragallo, H. & Peragallo, M. (1965). *Diatomées marines de France et des districts maritimes voisins* (p. 292). A. Ascher & Co. Amsterdam.

Morphometrics

	range (µm)	mean ± SD	n
AA	50 - 160.0	95 ± 35	12
TA	6 - 7.5	6 ± 1	12

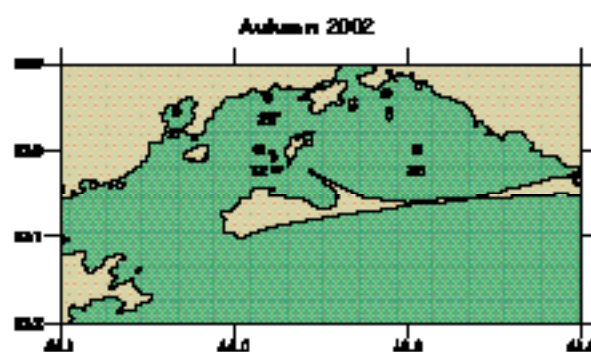
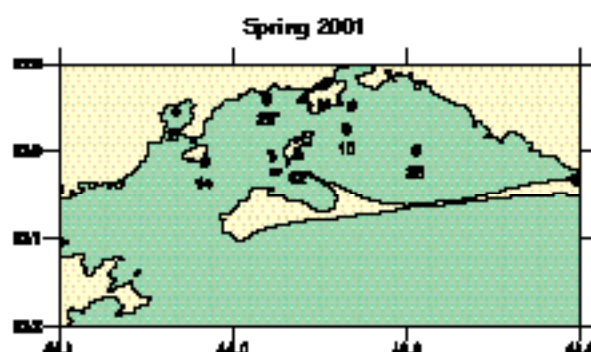


Plate 75

Division Bacillariophyta

Class Bacillariophyceae

Order Bacillariales

Family Bacillariaceae

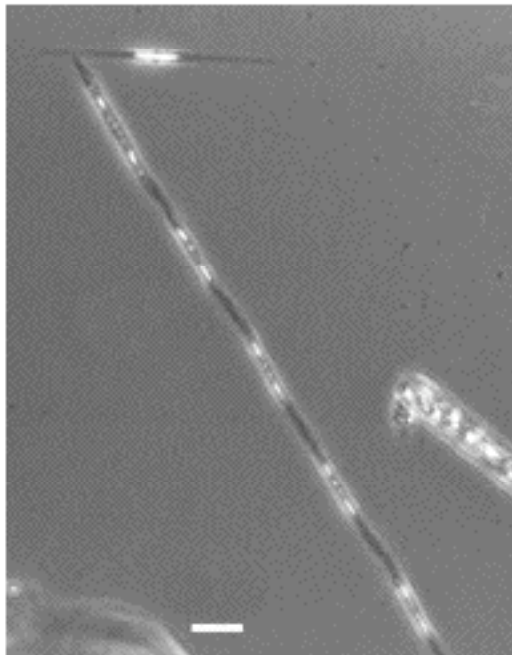
"Nitzschia delicatissima complex" (sensu Hasle, 1965)*Pseudo-nitzschia "delicatissima" sp.1*

Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 20µm.

Pseudo-nitzschia "delicatissima" sp.2

Figure 2. Chain of cells in girdle view, showing truncated cell ends (LM, phase contrast, water mount). Scale bar = 20µm.

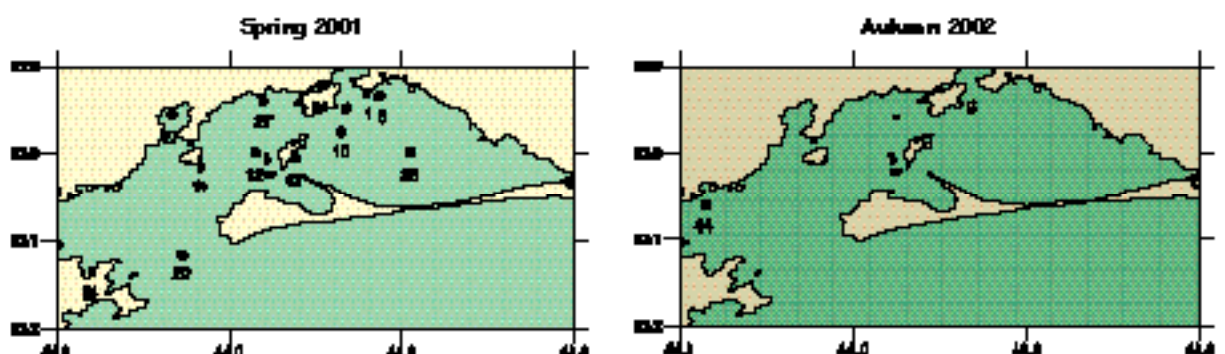
Morphometrics

	range (µm)	mean ± SD	n
PA	30 - 65.0	49 ± 12	13
AA	2 - 2.5	2 ± 12	13

Taxonomic source

Hasle & Syvertsen (1997). Diatoms (p. 307).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.



Division Bacillariophyta
 Class Bacillariophyceae
 Order Bacillariales
 Family Bacillariaceae

"Nitzschia seriata complex" (sensu Hasle, 1965)

Pseudo-nitzschia
'seriata' sp.1

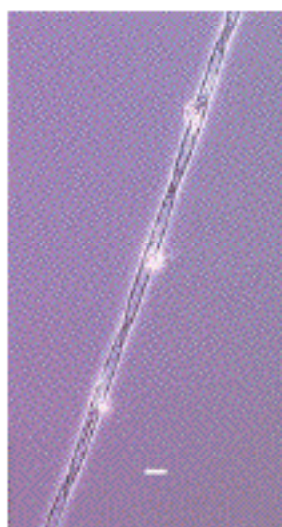


Figure 3. Chain of cells in girdle and valve views (LM, phase contrast, water mount). Scale bar = 10µm.

Pseudo-nitzschia "seriata" sp.2

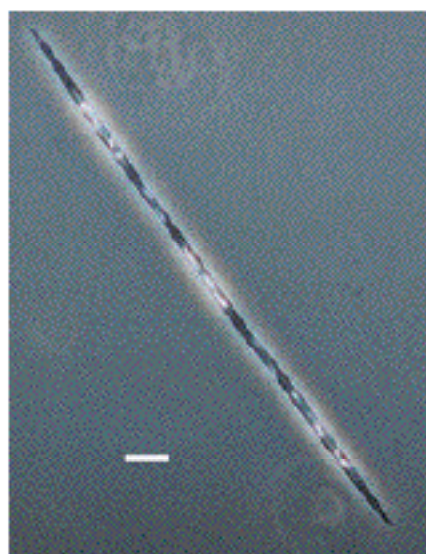


Figure 1. Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 20µm.

Pseudo-nitzschia
'seriata' sp.3

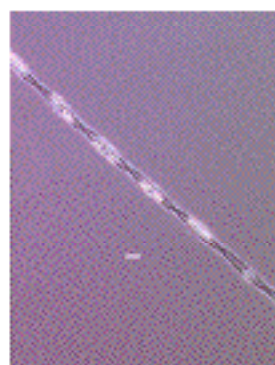


Figure 2. Chain of cells in girdle view (LM, phase contrast, water mount). Scale bar = 10µm.

Taxonomic source

Hasle & Syvertsen (1997). Diatoms (p. 307).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

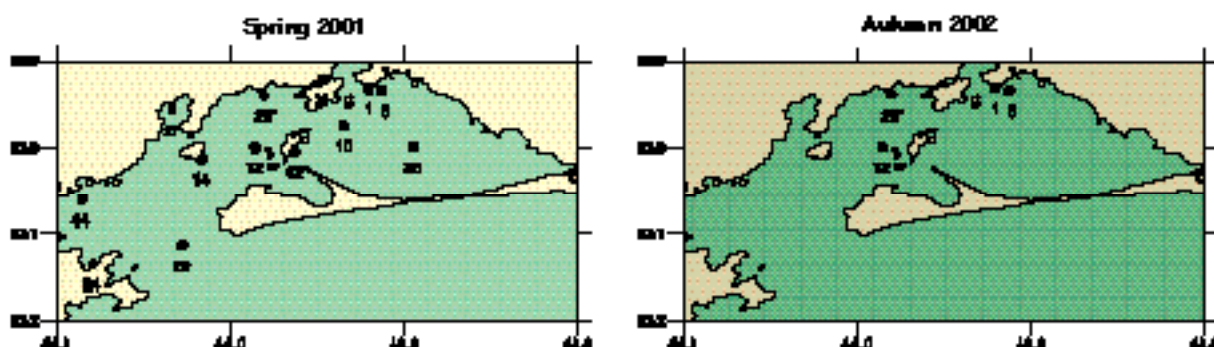


Plate 77

Division Bacillariophyta

Class Bacillariophyceae

Order Bacillariales

Family Bacillariaceae

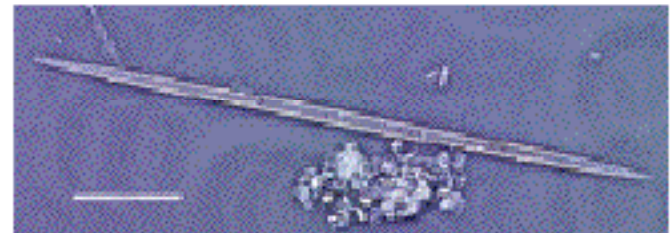
Pseudo-nitzschia pungens (Grunow ex Cleve) Hasle, 1993

Figure 1. Single valve; 2 rows of poroids (not shown here) were seen during analysis (LM, phase contrast, Hyrax mount of cleaned material). Scale bar = 20 μ m.

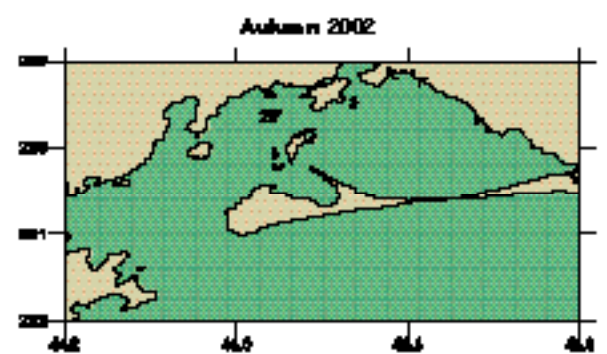
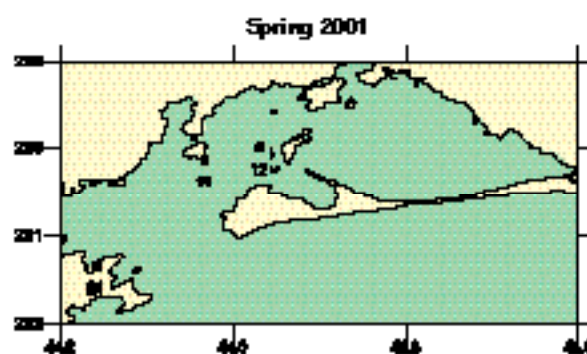
Taxonomic source

Hasle & Syvertsen (1997). Diatoms (p. 312).

In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (μ m)	mean \pm SD	n
AA	76 - 123.75	96 \pm 18.0	10
TA	4 - 4.50	4 \pm 0.2	10



DINOFLAGELLATES

Gonyaulax spinifera (Claparède & Lachmann) Diesing, 1866

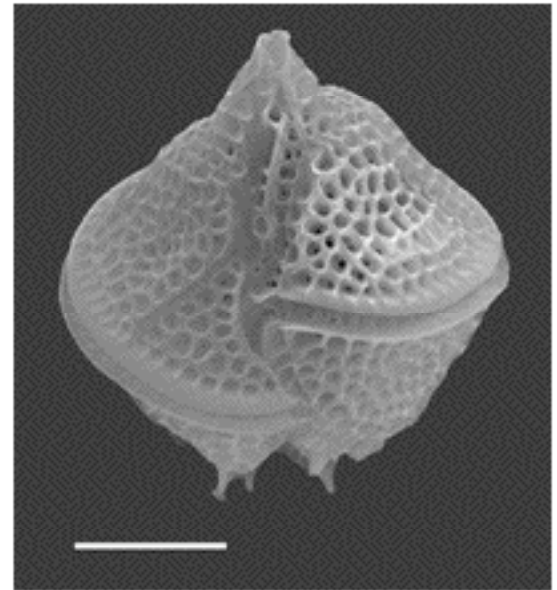


Figure 1. Cell in ventral view (SEM).
 Scale bar = 20µm.

Taxonomic source

Dodge, J. D. (1982). Marine Dinoflagellates of the British Isles (p. 214).
 Her Majesty's Stationery Office, London.

Morphometrics

	range (µm)
TL	39 - 45
D	32 - 37

Division Dinophyta
 Class Dinophyceae
 Order Gonyaulacales
 Family Ceratiaceae

***Ceratium breve* (Ostenfeld & Schmidt) Schröder, 1906**



Figure 1. Chain of cells in dorsal view (LM, phase contrast). Scale bar = 100µm.



Figure 2. Chain of cells in dorsal view (LM, phase contrast). Scale bar = 100µm.

Taxonomic source

Dodge, J. D. (1982). Marine Dinoflagellates of the British Isles (p. 232). Her Majesty's Stationary Office, London.

Morphometrics

	range (µm)	mean ± SD	n
TL	210 - 275	244 ± 22	6
D	65 - 120	82 ± 20	6
EL	35 - 50	42 ± 5	6
AHL	130 - 185	157 ± 20	6
RANHL	105 - 140	116 ± 13	6
LANHL	110 - 130	123 ± 7	6

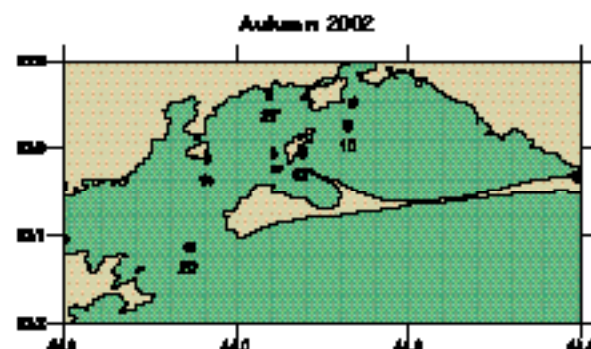
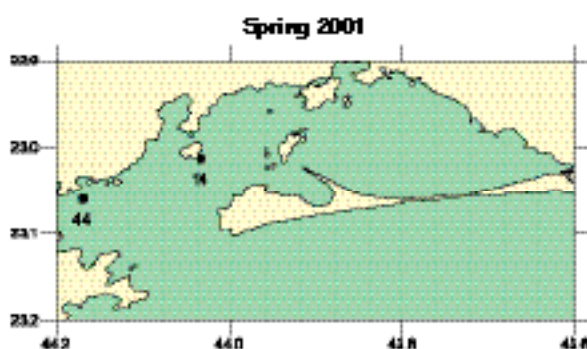


Plate 80

Division Dinophyta
 Class Dinophyceae
 Order Gonyaulacales
 Family Ceratiaceae

Ceratium furca (Ehrenberg) Claparède & Lachmann, 1858

Figure 1
 Cell in dorsal view
 (LM, phase contrast).
 Scale bar = 50µm.

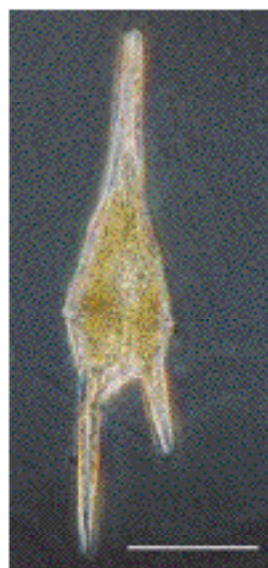
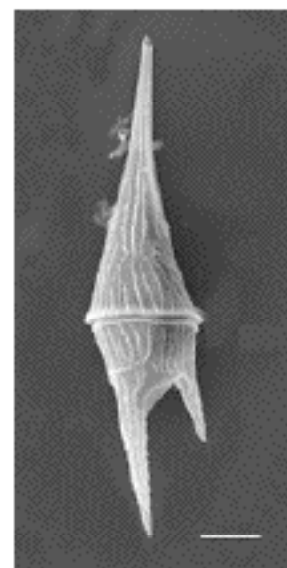


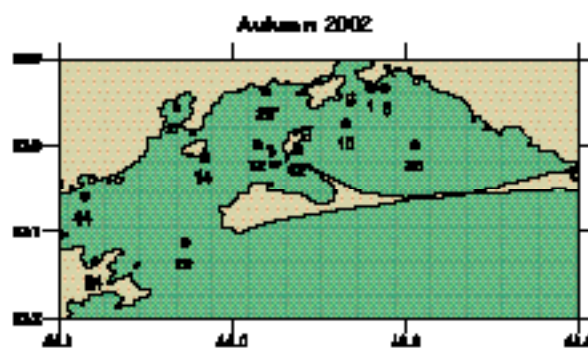
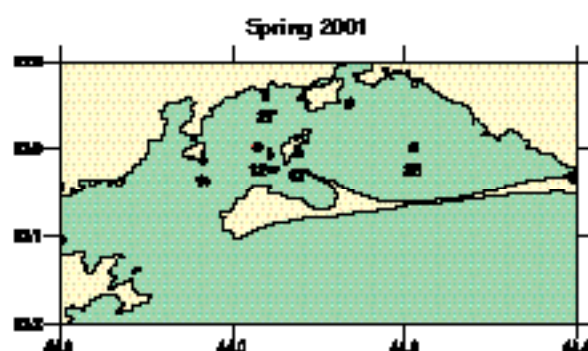
Figure 2
 Cell in dorsal view
 (SEM).
 Scale bar = 20µm.

**Taxonomic source**

Dodge, J. D. (1982). Marine Dinoflagellates of the British Isles (p. 228).
 Her Majesty's Stationery Office, London.

Morphometrics

	range (µm)	mean ± SD	n
TL	210 - 275	244 ± 22	6
D	65 - 120	82 ± 20	6
EL	35 - 50	42 ± 5	6
AHL	130 - 185	157 ± 20	6
RANHL	105 - 140	116 ± 13	6
LANHL	110 - 130	123 ± 7	6



Division Dinophyta
 Class Dinophyceae
 Order Gonyaulacales
 Family Ceratiaceae

Plate 81

***Ceratium fusus* (Ehrenberg) Dujardin, 1841**

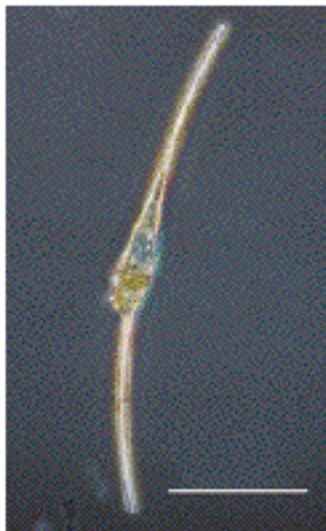


Figure 1 Cell in ventral view (LM, phase contrast). Scale bar = 100µm.

Taxonomic source

Dodge, J. D. (1982). Marine Dinoflagellates of the British Isles (p. 231). Her Majesty's Stationery Office, London.

Morphometrics

	range (µm)	mean ± SD	n
TL	155 - 475	349 ± 47	86
D	22 - 40	29 ± 4	86
EL	25 - 115	66 ± 17	75
AHL	85 - 200	121 ± 21	85
RANHL	1 - 10	3 ± 1	71
LANHL	102 - 245	147 ± 20	71

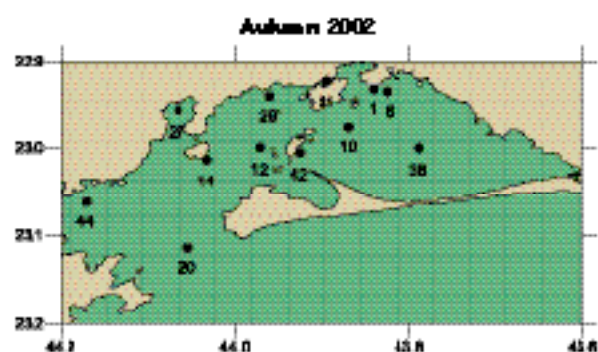


Plate 82

Division Dinophyta
 Class Dinophyceae
 Order Gonyaulacales
 Family Ceratiaceae

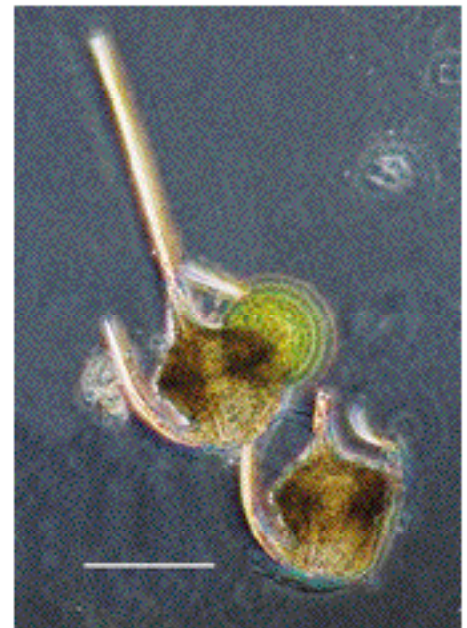
Ceratium gibberum Gourret, 1883

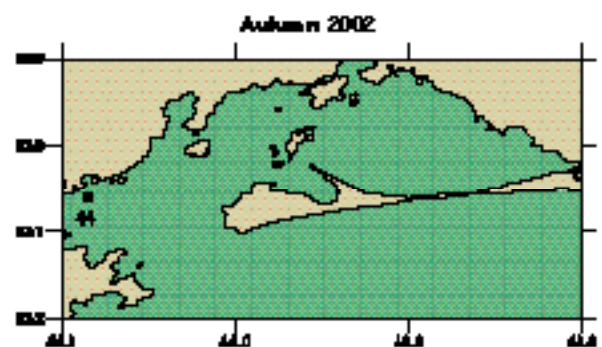
Figure 1. Cell in dorsal view
 (LM, phase contrast).
 Scale bar = 100µm.

Taxonomic source

Graham, H. W. & Bronikowsky, N. (1944). The genus *Ceratium* in the Pacific and North Atlantic Oceans. Carnegie Institute of Washington Publ., Ser. Biol., (p 33).

Morphometrics

	range (µm)	mean ± SD	n
TL	105 - 340	245 ± 134	2
D	95 - 95	95 ± 0	2
EL	50 - 50	50 ± 0	2
AHL	40 - 230	135 ± 134	2
LANHL	110 - 120	115 ± 7	2



Division Dinophyta
 Class Dinophyceae
 Order Gonyaulacales
 Family Ceratiaceae

***Ceratium horridum* (Cleve) Gran, 1902**



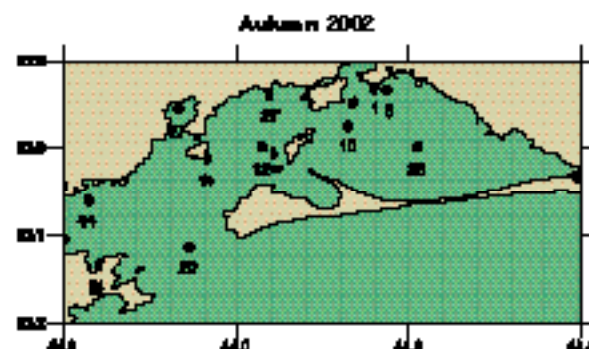
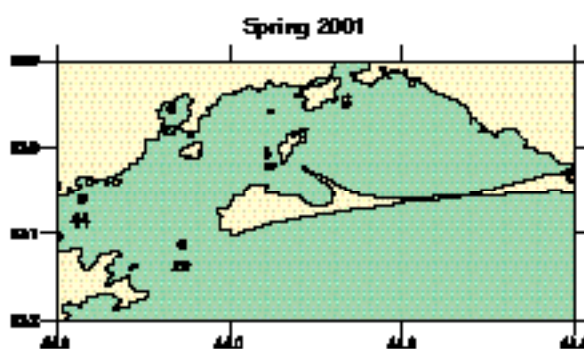
Figure 1 Cell in dorsal view (LM, phase contrast). Scale bar = 100µm.

Taxonomic source

Dodge, J. D. (1982). Marine Dinoflagellates of the British Isles (p. 240). Her Majesty's Stationery Office, London.

Morphometrics

	range (µm)	mean ± SD	n
TL	145 - 375	214 ± 53	38
D	32 - 70	44 ± 6	38
EL	15 - 40	26 ± 5	38
AHL	85 - 310	151 ± 50	38
RANHL	60 - 195	110 ± 35	38
LANHL	15 - 195	110 ± 37	38



Ceratium massiliense (Gourret) Jörgensen, 1911

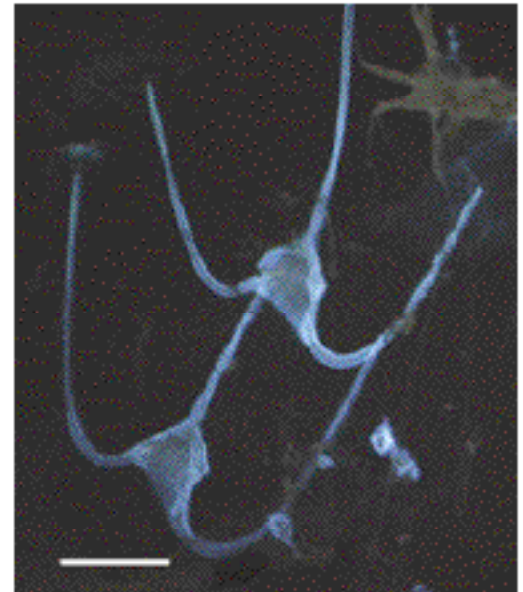


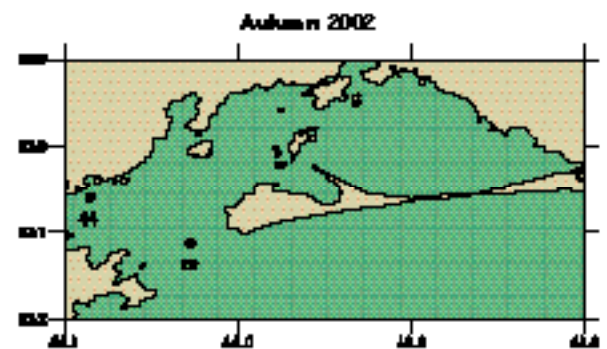
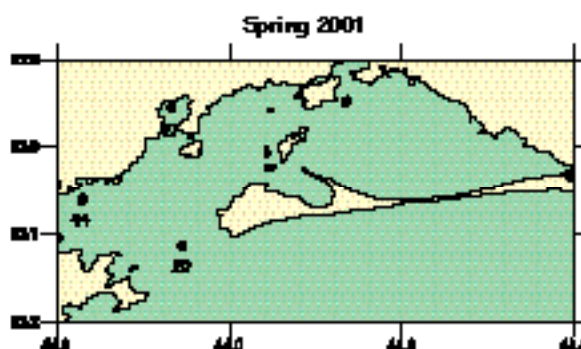
Figure 1. Chain of cells in dorsal view (FM, calcofluor stained cells).
 Scale bar = 50µm.

Taxonomic source

Dodge, J. D. (1982). Marine Dinoflagellates of the British Isles (p. 236).
 Her Majesty's Stationery Office, London.

Morphometrics

	range (µm)	mean ± SD	n
TL	35 - 385	272 ± 94	12
D	35 - 80	46 ± 12	11
EL	20 - 55	31 ± 12	12
AHL	125 - 330	237 ± 57	12
RANHL	100 - 310	186 ± 67	12
LANHL	120 - 305	190 ± 63	11



Division Dinophyta
 Class Dinophyceae
 Order Gonyaulacales
 Family Ceratiaceae

***Ceratium cf. trichoceros* (Ehrenberg) Kofoid, 1908**

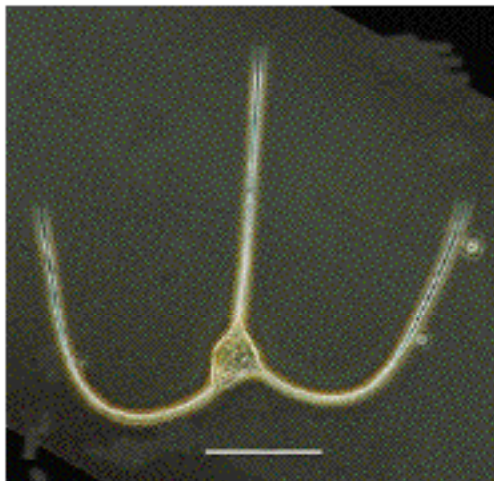


Figure 1. Cell in dorsal view (LM, phase contrast). Scale bar = 100µm.

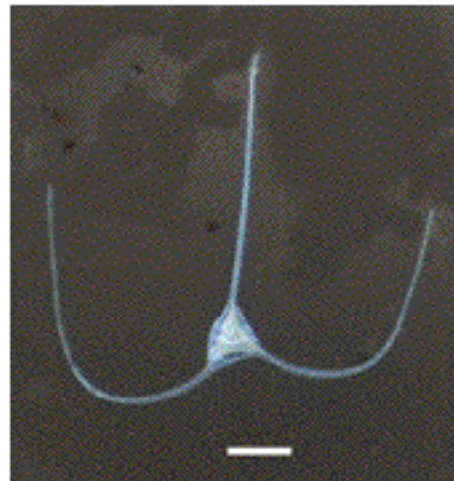


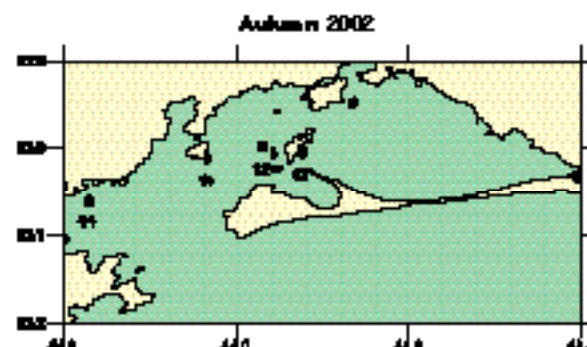
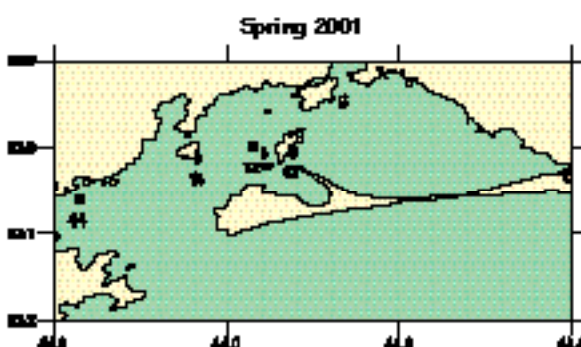
Figure 2. Cell in dorsal view (FM, calcofluor stained cell). Scale bar = 20µm.

Taxonomic source

Dodge, J. D. (1982). Marine Dinoflagellates of the British Isles (p. 236). Her Majesty's Stationery Office, London.

Morphometrics

	range (µm)	n
TL	265	1
D	45	1
EL	25	1
AHL	190	1
RANHL	195	1
LANHL	215	1



***Alexandrium cf. fraterculus* (Balech) Balech, 1985**

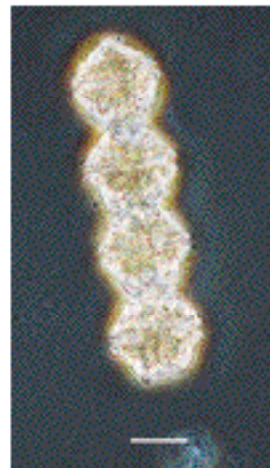


Figure 1. Chain of cells in ventral view (LM, phase contrast). Scale bar = 20µm.

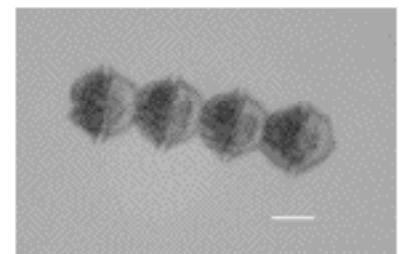


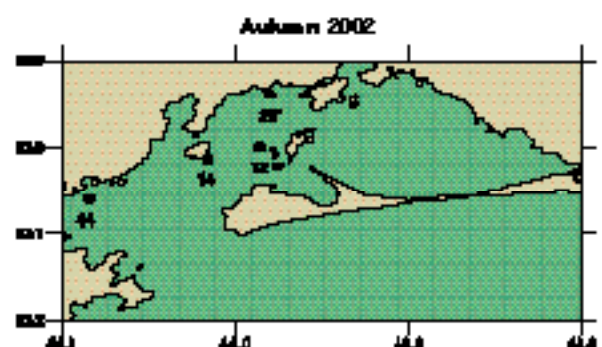
Figure 2. Chain of cells in ventral view (LM, brightfield). Scale bar = 25µm.

Taxonomic source

Steindinger, K. A. & Tangen, K. (1997). Dinoflagellates (p. 494). In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
TL	32 - 50	40 ± 7	16
D	35 - 55	41 ± 8	16



Division Dinophyta
 Class Dinophyceae
 Order Peridinales
 Family Peridiniaceae

***Scrippsiella spinifera* Honsell & Cabrini, 1991**

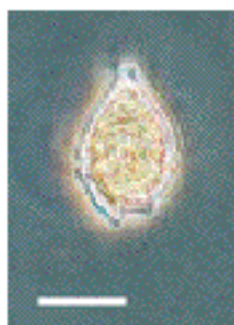


Figure 1 Cell in ventral view (LM, phase contrast). Scale bar = 10µm.

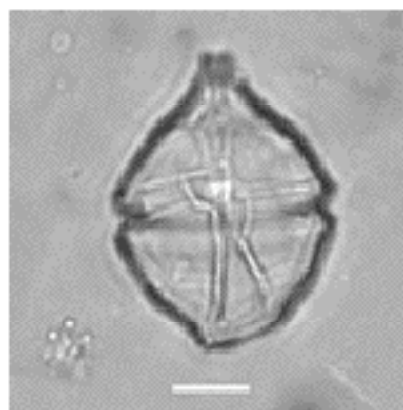


Figure 2 Cell in ventral view (LM, bright field). Scale bar = 10µm.

Taxonomic source

Honsell, G. & Cabrini, M. (1991). *Scrippsiella spinifera* sp. nov. (Pyrhophyta): A New Dinoflagellate from the Northern Adriatic Sea. *Botanica Marina* Vol. 34, pp. 167 - 175.

Morphometrics

	range (µm)	mean ± SD	n
TL	30 - 80	41 ± 6	294
D	21 - 55	29 ± 4	294
EL	15 - 42	24 ± 4	273
HL	10 - 40	17 ± 3	273

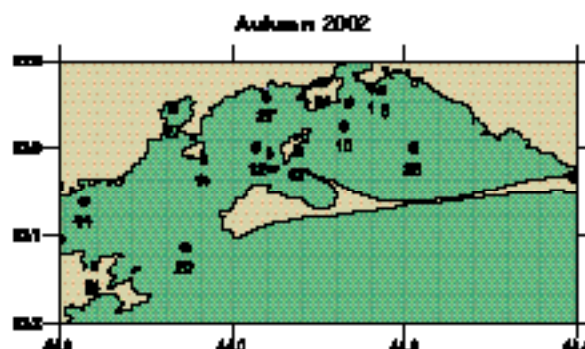
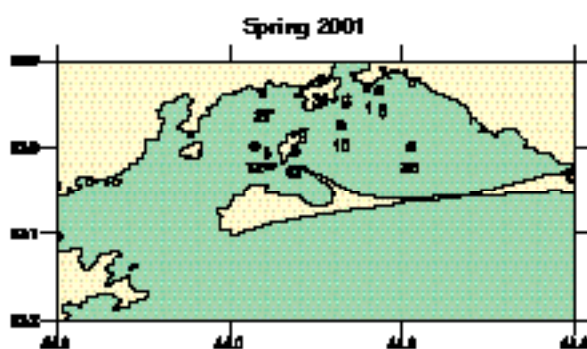


Plate 88

Division Dinophyta
 Class Dinophyceae
 Order Peridinales
 Family Peridiniaceae

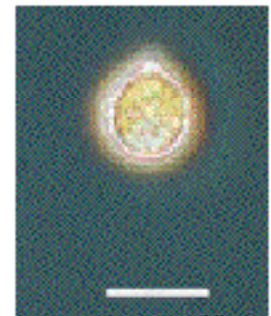
Scrippsiella trochoidea (Stein) Loeblich III, 1976

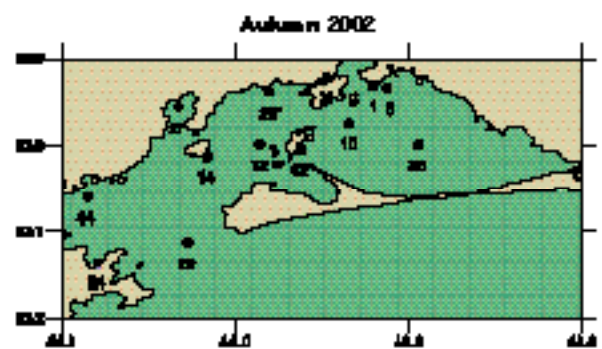
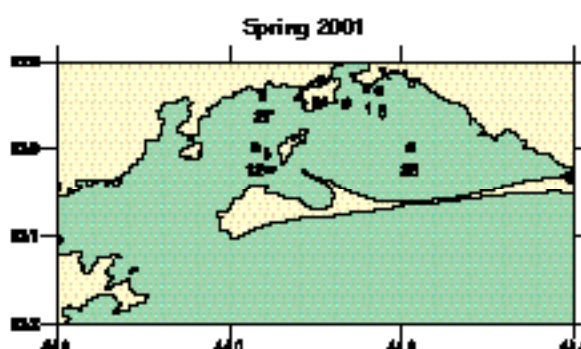
Figure 1. Cell in dorsal view
 (LM, phase contrast).
 Scale bar = 20µm.

Taxonomic source

Dodge, J. D. 1982. Marine Dinoflagellates of the British Isles (p. 163).
 Her Majesty's Stationary Office, London

Morphometrics

	range (µm)	mean ± SD	n
TL	23 - 45	34 ± 3	81
D	20 - 35	27 ± 3	81
EL	8 - 25	20 ± 3	81
HL	10 - 25	14 ± 3	81



Division Dinophyta
 Class Dinophyceae
 Order Peridinales
 Family Congruentiaceae

***Protoperidinium divergens* (Ehrenberg) Balech, 1974**

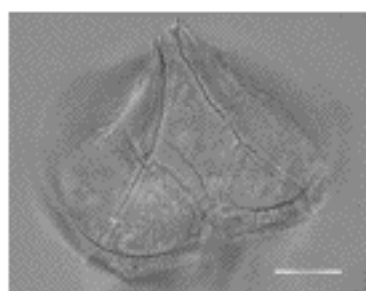


Figure 1. Epitheca in ventral view (LM, bright field, cleared material). Scale bar = 20µm.

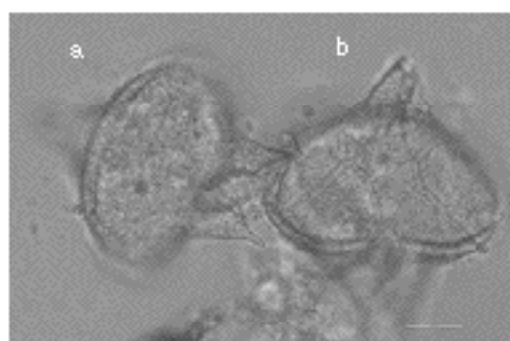


Figure 3. Hypotheca in (a) dorsal view and (b) Epitheca in ventral view (LM, bright field, cleared material). Scale bar = 20µm.

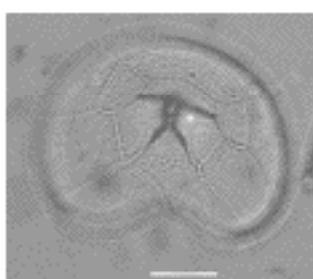


Figure 2. Apical view (LM, bright field, cleared material). Scale bar = 20µm.

Taxonomic source

Dodge, J. D. (1982). Marine Dinoflagellates of the British Isles (p. 193). Her Majesty's Stationery Office, London.

Morphometrics

	range (µm)	mean ± SD	n
TL	40		1
D	40 - 48	43 ± 5	3
EL	28		1
HL	12		1

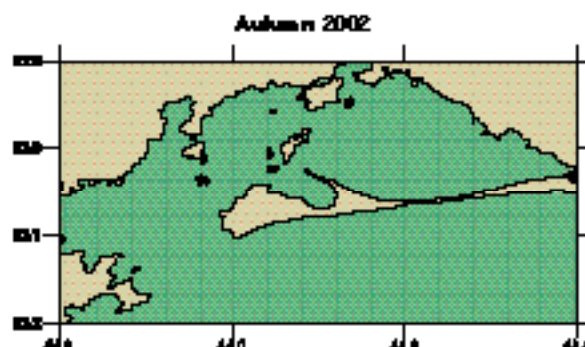
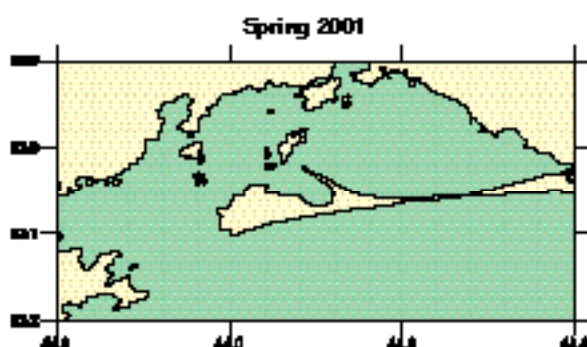


Plate 90

Division Dinophyta
 Class Dinophyceae
 Order Peridinales
 Family Congruentiaceae

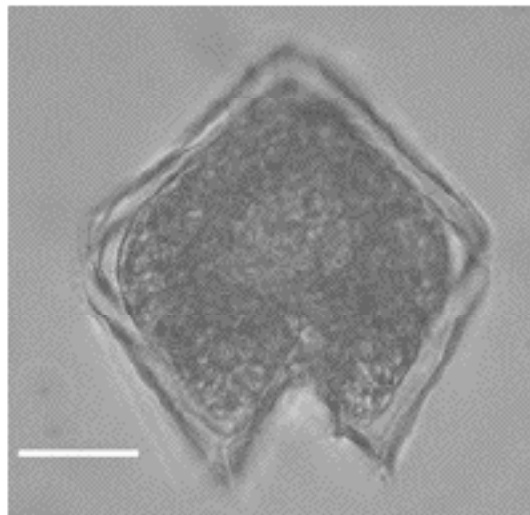
Protoperidinium leonis (Pavillard) Balech, 1974

Figure 1. Cell in ventral view, cyst formation (LM, bright field). Scale bar = 20µm.

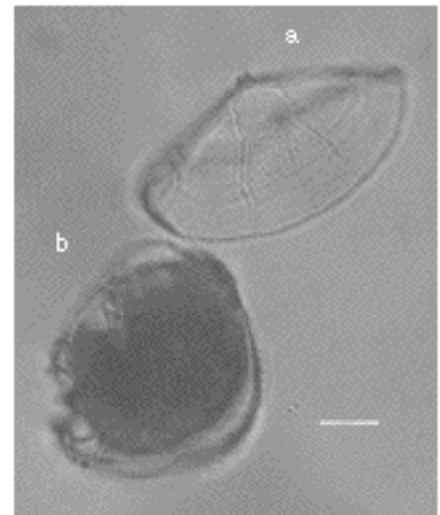


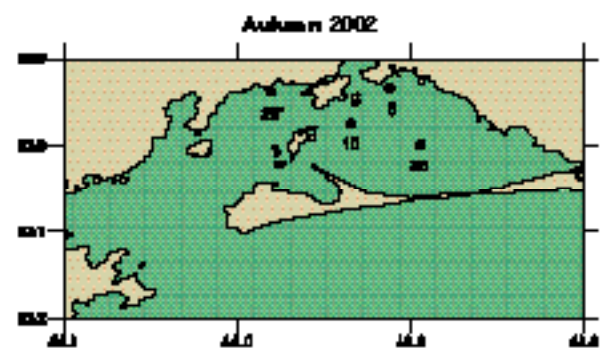
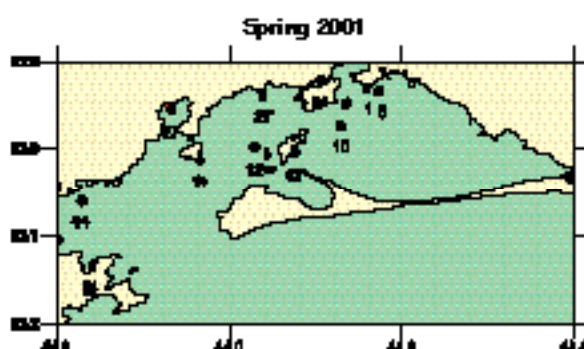
Figure 1. Dissociated cell: (a) epitheca in dorsal view, (b) hypotheca with cyst (LM, bright field). Scale bar = 20µm.

Taxonomic source

Dodge, J. D. (1982). Marine Dinoflagellates of the British Isles (p. 187). Her Majesty's Stationery Office, London.

Morphometrics

	range (µm)	mean ± SD	n
TL	72.0 - 145	92 ± 20	30
D	66.5 - 165	87 ± 18	30
EL	30.0 - 65	45 ± 11	22
HL	30.0 - 80	51 ± 13	22



Division Dinophyta
 Class Dinophyceae
 Order Peridinales
 Family Congruentiaceae

***Protoperidinium mariaelebouriae* (Paulsen) Balech, 1974**



Figure 1. Cell in dorsal view (LM, bright field, cleared material). Scale bar = 20µm.

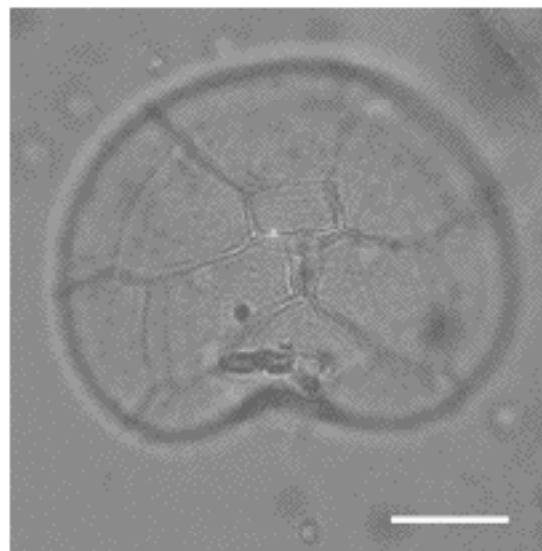


Figure 2. Apical view (LM, bright field, cleared material). Scale bar = 20µm.

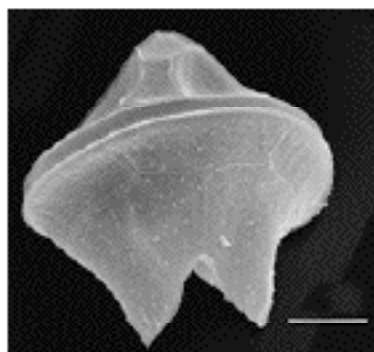


Figure 3. Cell in dorsal view (SEM). Scale bar = 20µm.

Taxonomic source

Dodge, J. D. (1982). Marine Dinoflagellates of the British Isles (p. 178). Her Majesty's Stationery Office, London.

Morphometrics

	range (µm)
TL	100 - 112
D	90 - 94

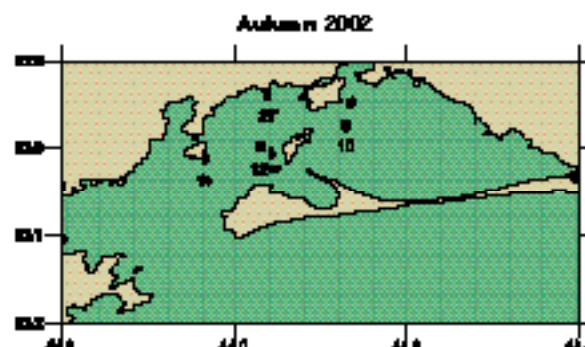


Plate 92

Division Dinophyta
 Class Dinophyceae
 Order Peridinales
 Family Congruentiaceae

***Protoperidinium oblongum* (Aurivillius) Parke & Dodge, 1976**



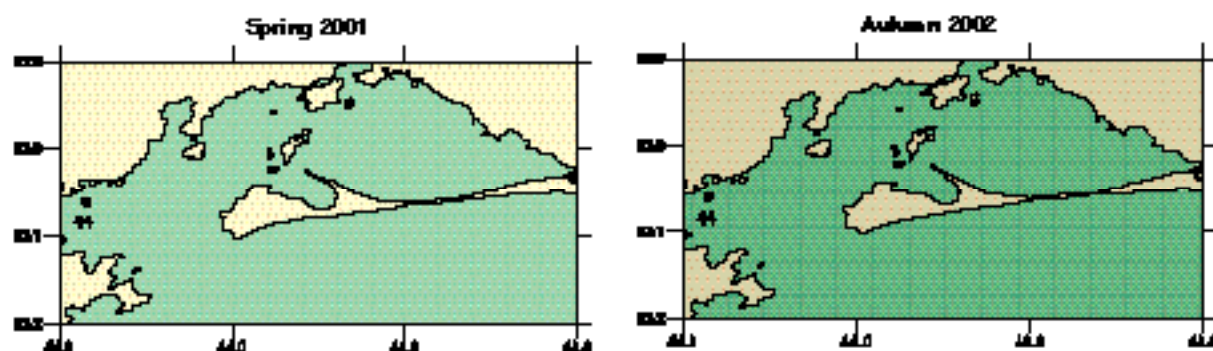
Figure 1 Cell in dorsal view
 (LM, bright field).
 Scale bar = 20µm.

Taxonomic source

Steindinger, K. A. & Tangen, K. (1997). Dinoflagellates (p. 541).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	n
TL	155	1
D	90	1



Division Dinophyta
 Class Dinophyceae
 Order Peridinales
 Family Congruentiaceae

Protoperidinium parviverter Balech, 1978

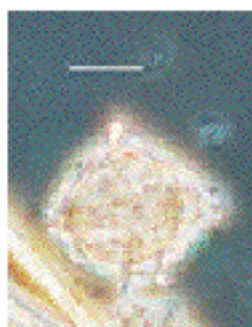


Figure 1. Cell in ventral view (LM, phase contrast). Scale bar = 20µm.

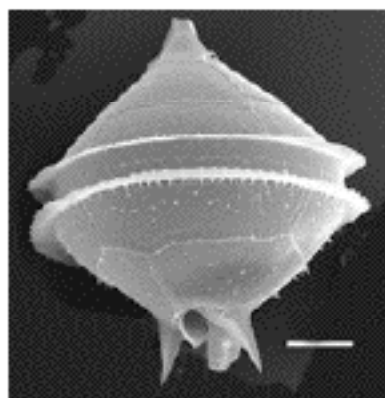


Figure 2. Cell in dorsal view (SEM). Scale bar = 10µm.

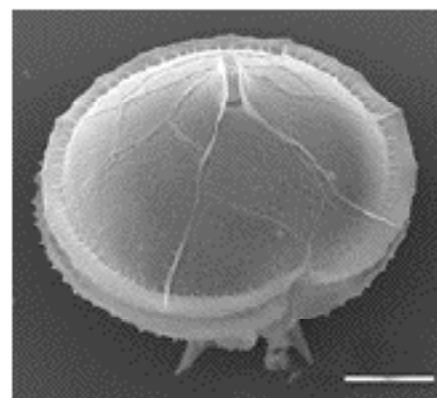


Figure 3. Epitheca in ventral view (SEM). Scale bar = 10µm.

Taxonomic source

Balech, E. (1988). Los dinoflagelados del Atlantico Sudoccidental (p. 105). Publ. Espec. Inst. Esp. Oceanogr., n. 1. Ministerio de Agricultura Pesca y Alimentación, Madrid.

Morphometrics

	range (µm)	mean ± SD	n
TL	40 - 57	49 ± 5	11
D	40 - 55	47 ± 4	11
EL	15 - 26	23 ± 4	11
HL	15 - 26	18 ± 4	11

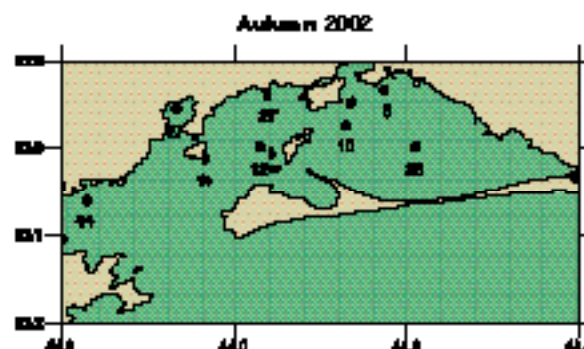


Plate 94

Division Dinophyta
 Class Dinophyceae
 Order Peridinales
 Family Congruentiaceae

***Protoperidinium cf. pentagonum* (Gran) Balech, 1974**

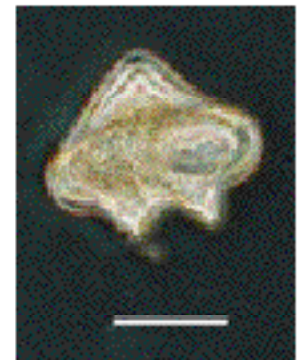


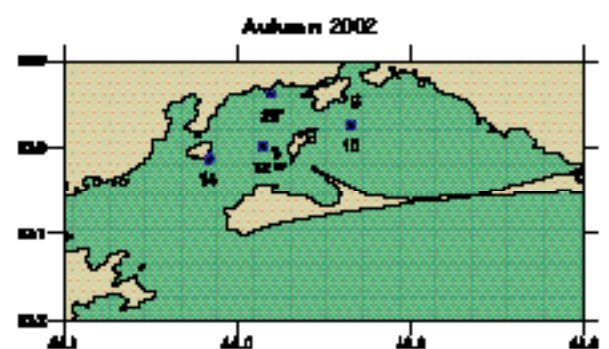
Figure 1. Cell in ventral view
 (LM, phase contrast).
 Scale bar = 50µm.

Taxonomic source

Dodge, J. D. (1982). Marine Dinoflagellates of the British Isles (p. 188).
 Her Majesty's Stationery Office, London.

Morphometrics

	range (µm)	mean ± SD	n
TL	80 - 90	85 ± 7	2
D	95 - 100	98 ± 4	2
EL	30		1
HL	50		1



Division Dinophyta
 Class Dinophyceae
 Order Peridinales
 Family Congruentiaceae

***Protoperidinium simulum* (Paulsen) Balech, 1974**

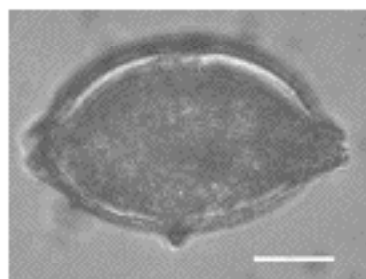


Figure 1. Cell in dorsal view (LM, brightfield). Scale bar = 20µm.

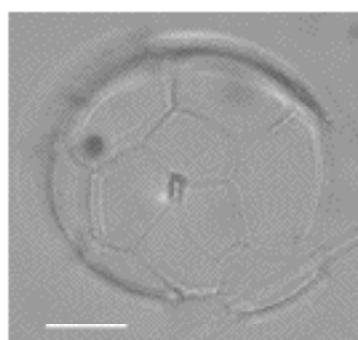


Figure 2. Apical view (LM, brightfield). Scale bar = 20µm.

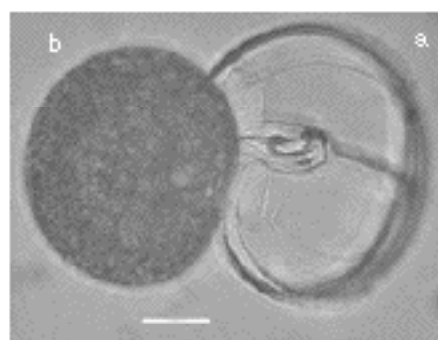


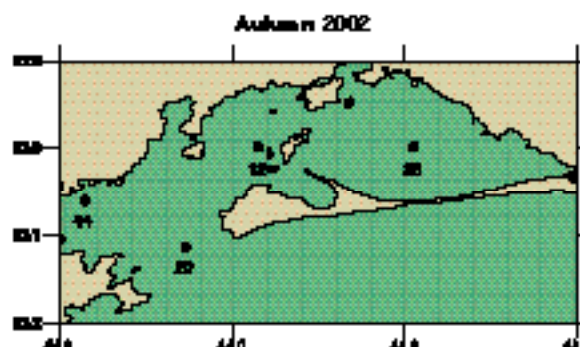
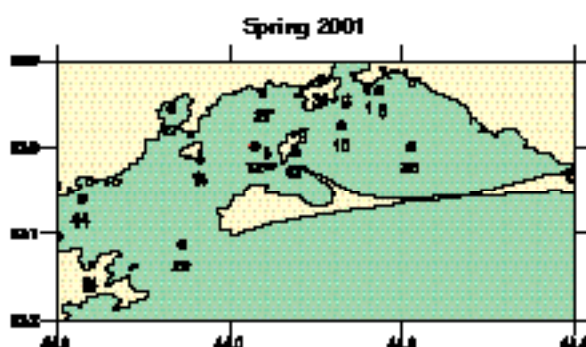
Figure 3. Dissociated cell: (a) hypotheca and (b) protoplasm encysted (LM, brightfield). Scale bar = 20µm.

Taxonomic source

Balech, E. (1988). Los dinoflagelados del Atlantico Sudoccidental (p. 112). Publ. Espec. Inst. Esp. Oceanogr., n. 1. Ministerio de Agricultura Pesca y Alimentacion, Madrid.

Morphometrics

	range (µm)	mean ± SD	n
AA	35 - 89.1	64 ± 12	26
TA	43 - 99.0	70 ± 14	26



Protoperidinium steinii (Jørgensen) Balech, 1974

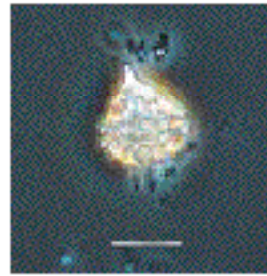


Figure 1 Cell in ventral view (LM, phase contrast). Scale bar = 20µm.

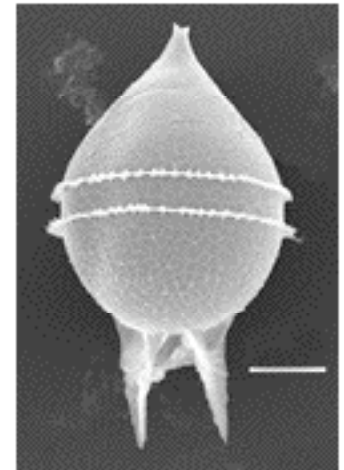


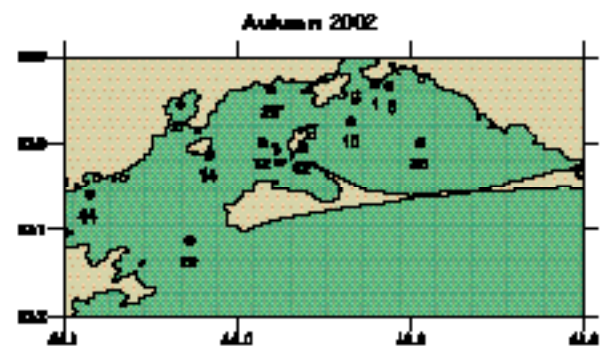
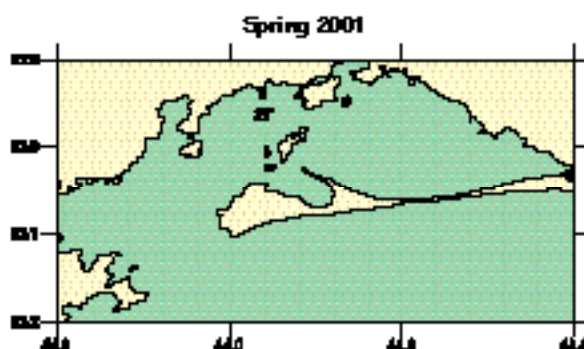
Figure 1 Cell in dorsal view (SEM). Scale bar = 10µm.

Taxonomic source

Dodge, J. D. 1982. Marine Dinoflagellates of the British Isles (p. 303). Her Majesty's Stationery Office, London.

Morphometrics

	range (µm)	mean ± SD	n
TL	27 - 70	40 ± 8	61
D	20 - 55	28 ± 7	61
EL	13 - 30	21 ± 3	59
HL	8 - 25	12 ± 3	59



Division Dinophyta
 Class Dinophyceae
 Order Peridinales
 Family Congruentiaceae

Plate 97

***Protoperidinium symmetricum* (Halim) Balech, 1974**

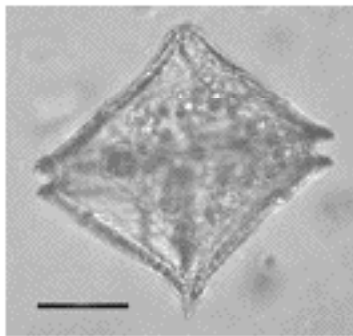


Figure 1 Cell in lateral view (LM, brightfield).
 Scale bar = 20µm.

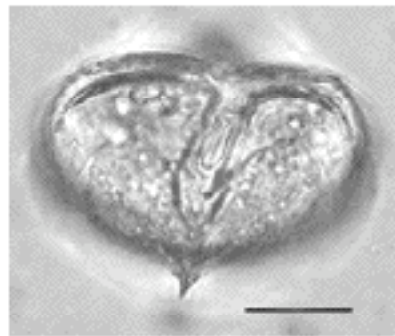


Figure 2 Detail of sulcus (LM, brightfield).
 Scale bar = 20µm.

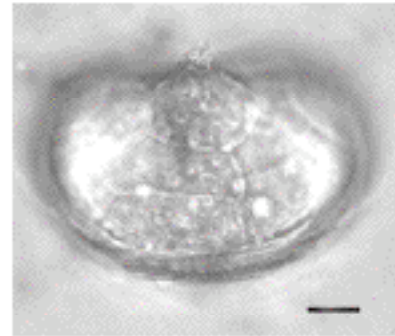


Figure 3 Epitheca in dorsal view (LM, brightfield).
 Scale bar = 10µm.

Taxonomic source

Balech, E. (1988). Los Dinoflagelados del Atlantico Sudoccidental (p. 189).
 Publ. Espec. Inst. Esp. Oceanogr., n. 1. Ministerio de Agricultura Pesca y Alimentacion, Madrid.

Morphometrics

	range (µm)	n
TL	65	1
D	60	1

Dinophysis acuminata Claparède & Lachmann, 1859



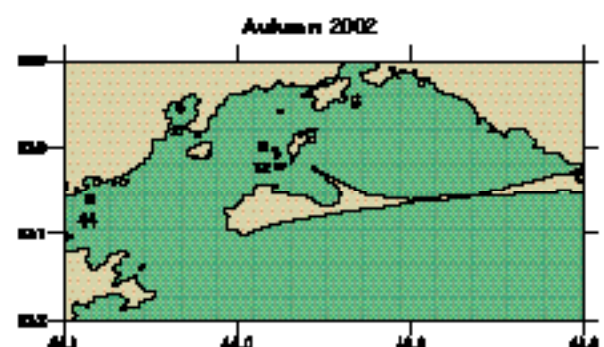
Figure 1. Cell in left lateral view (LM, phase contrast). Scale bar = 20µm.

Taxonomic source

Dodge, J. D. (1982). Marine Dinoflagellates of the British Isles (p. 44). Her Majesty's Stationery Office, London.

Morphometrics

	range (µm)	mean ± SD	n
TL	40 - 60	45 ± 8	6
CD	10 - 25	17 ± 6	6
LD	25 - 40	32 ± 6	5
R1-R2	5 - 50	17 ± 22	4
R2-R3	2 - 15	9 ± 5	4



Division Dinophyta
 Class Dinophyceae
 Order Dinophysiales
 Family Dinophysiaceae

Plate 99

***Dinophysis caudata* Saville-Kent, 1881**

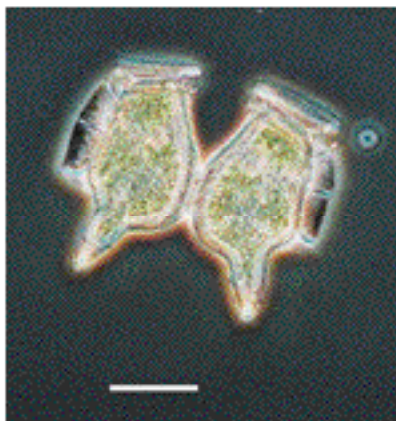


Figure 1 Cell in dorsal view (LM, phase contrast). Scale bar = 50µm.

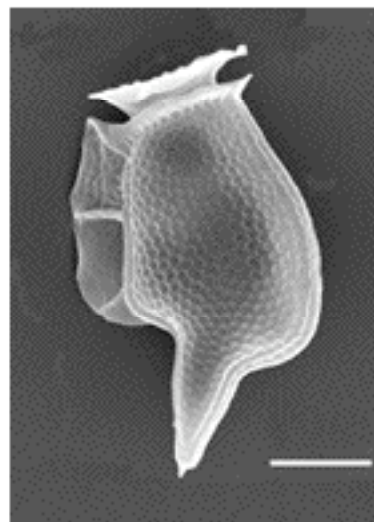


Figure 1 Cell in left lateral view (SEM). Scale bar = 10µm.

Taxonomic source

Dodge, J. D. (1982). Marine Dinoflagellates of the British Isles (p. 45). Her Majesty's Stationery Office, London.

Morphometrics

	range (µm)	mean ± SD	n
TL	45 - 115	88 ± 15	32
CD	15 - 55	34 ± 11	32
LD	8 - 65	47 ± 10	32
R1-R2	6 - 15	12 ± 3	12
R2-R3	5 - 20	13 ± 4	12

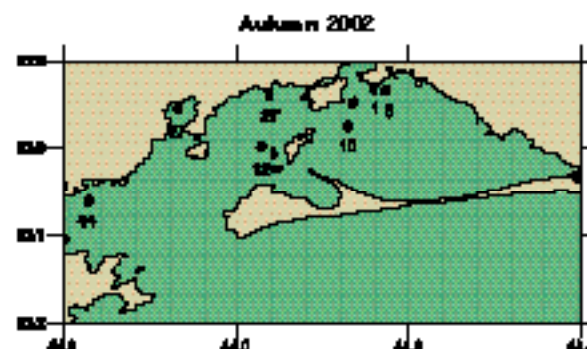
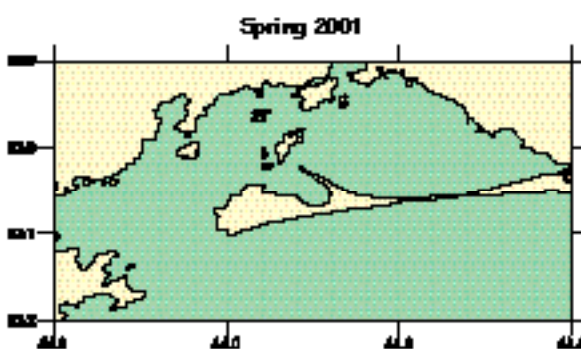


Plate 100

Division Dinophyta
 Class Dinophyceae
 Order Prorocentrales
 Family Prorocentraceae

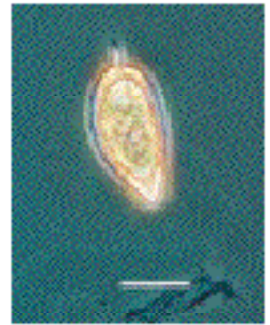
Prorocentrum gracile Schütt, 1895

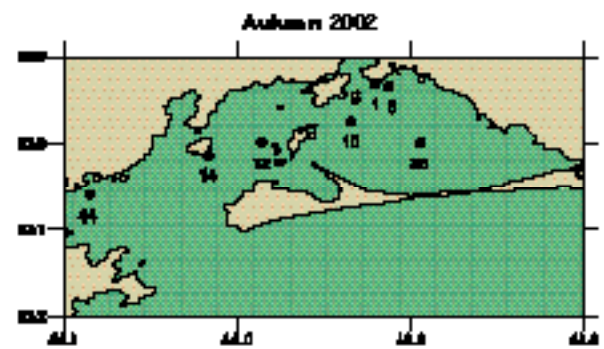
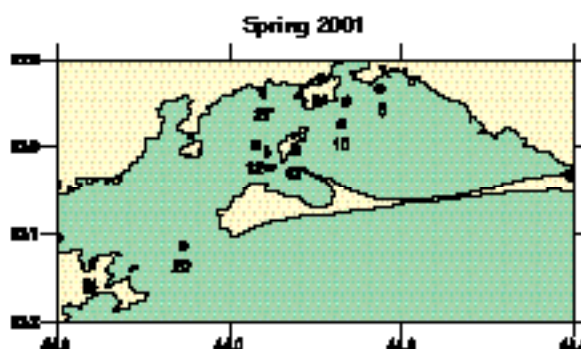
Figure 1. Cell in valve view (LM, phase contrast).
 Scale bar = 20µm.

Taxonomic source

Dodge, J. D. (1982). Marine Dinoflagellates of the British Isles (p. 33).
 Her Majesty's Stationery Office, London.

Morphometrics

	range (µm)	mean ± SD	n
TL	22.5 - 60	48 ± 9	16
LD	10.0 - 27	22 ± 4	16
SL	2.5 - 10	7 ± 2	16



Division Dinophyta
 Class Dinophyceae
 Order Prorocentrales
 Family Prorocentraceae

***Prorocentrum mexicanum* Tafall, 1942**

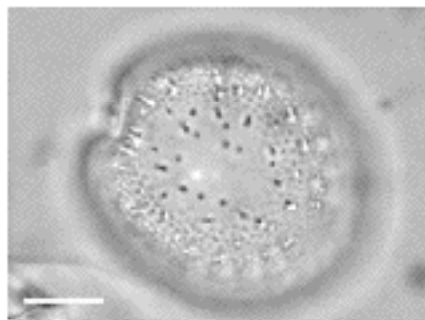


Figure 1. Cell in valve view, showing rows of pores (LM, bright field, cleared material). Scale bar = 10µm.

Taxonomic source

Steidinger, K. A. & Tangen, K. (1997). Dinoflagellates (p. 424). In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
TL	35 - 50	40 ± 4	28
LD	30 - 45	34 ± 3	28

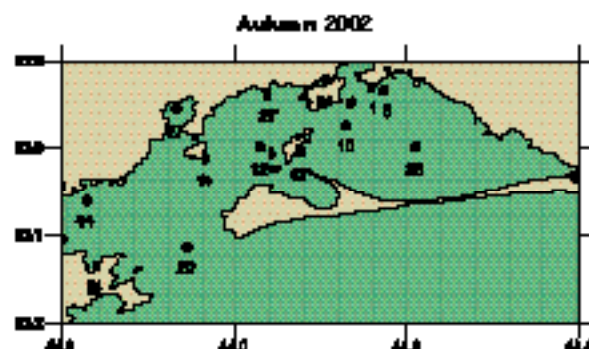


Plate 102

Division Dinophyta
Class Noctiluiphyceae
Order Noctilucales
Family Noctilucaeae

Noctiluca scintillans (Macartney) Kofoid & Swezy, 1921

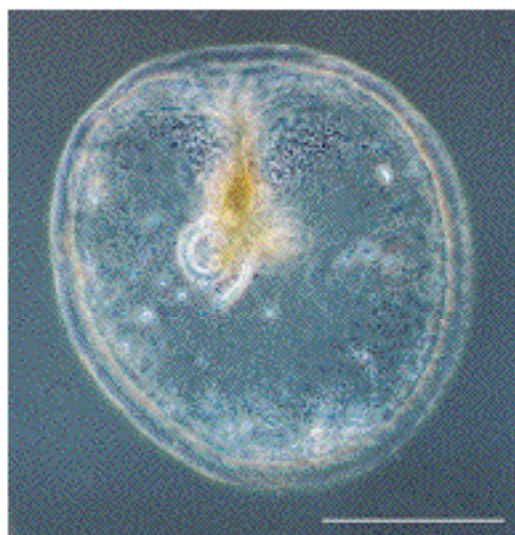


Figure 1 Cell in general view, showing tentacle (LM, phase contrast).
Scale bar = 100µm.

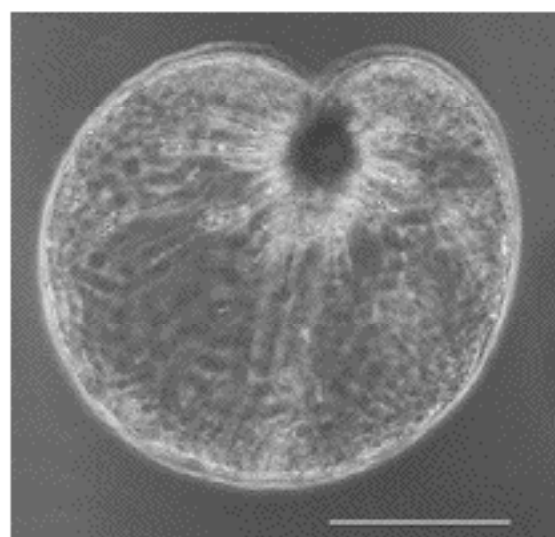
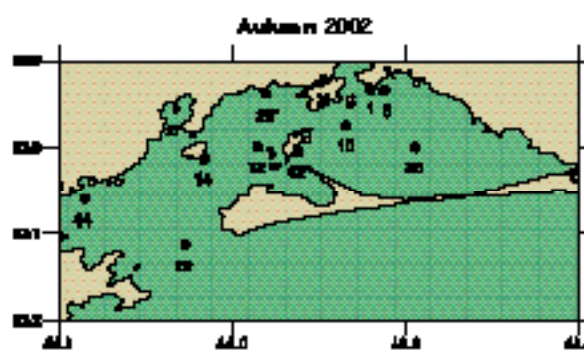
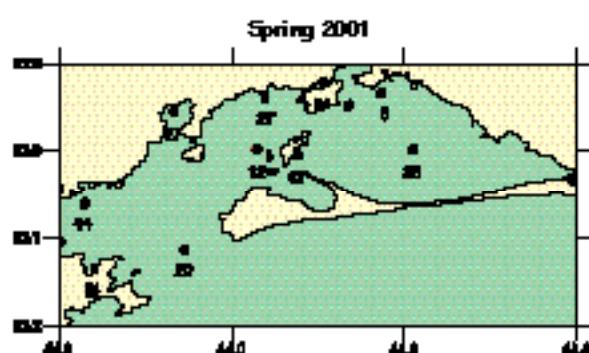


Figure 2 Cell in general view (LM, phase contrast).
Scale bar = 100µm.

Taxonomic source

Dodge, J. D. (1982). Marine Dinoflagellates of the British Isles (p. 135).
Her Majesty's Stationery Office, London.



SILICOFLAGELLATES

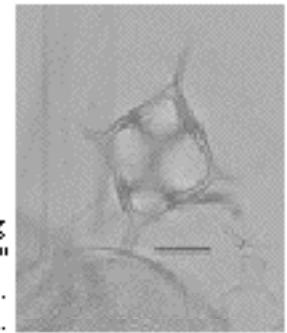
Dictyocha fibula Ehrenberg, 1839

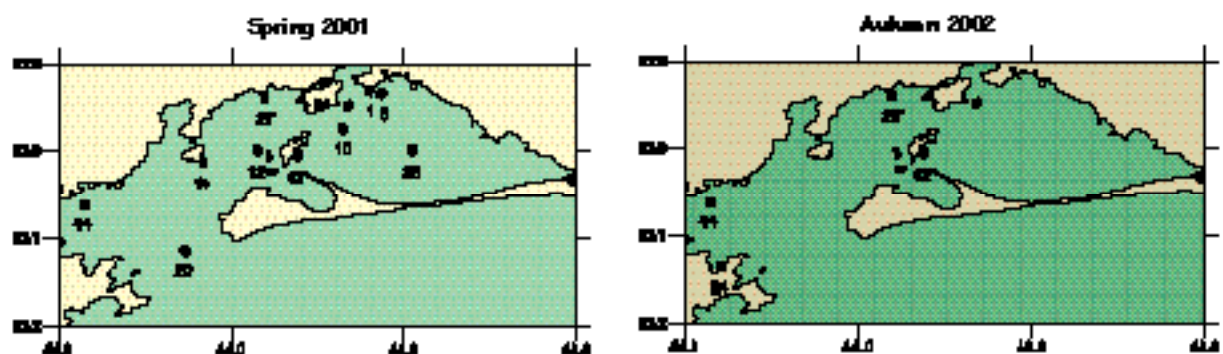
Figure 1. Skeleton with four protruding spines and four "windows" (LM, bright field, water mount). Scale bar = 10µm.

Taxonomic source

Thronsdon, J. (1997). The planktonic marine flagellates (p. 632).
 In: Identifying marine phytoplankton. Tomas, C. R. (ed). Academic Press, San Diego.

Morphometrics

	range (µm)	mean ± SD	n
TL	30 - 60	43 ± 7	40
D	20 - 35	28 ± 4	40



APPENDIX 1

Complete list of the phytoplankton taxa found in Sepetiba Bay.

spring  Bottle  Net

autumn  Bottle  Net

A - stands for abundant: taxon that reached more than the average cell number in a given sample.

D - stands for dominant: taxon that reached more than 50% of the cell number in a given sample.

autumn

1	6	10	12	14	20	24	27	29	31	38	42	44	sampling sites
DIVISION BACILLARIOPHYTA													
Class Coscinodiscophyceae													
Order Thalassiosirales													
Family Thalassiosiraceae													
													<i>Thalassiosira punctigera</i> (Castracane) Hasle
													<i>Thalassiosira rotula</i> Meunier
													<i>Thalassiosira</i> sp.1
													<i>Thalassiosira</i> sp.2
													<i>Thalassiosira</i> sp.3
													<i>Thalassiosira</i> sp.4
													<i>Thalassiosira</i> sp.5
Family Skeletonemataceae													
													<i>Deonula pumila</i> (Castracane) Schütt
													<i>Skeletonema costatum</i> (Greville) Clevé
Family Stephanodiscaceae													
													<i>Gyrodinium aureolum</i> (Lange & Sverdrup) + <i>C. stylorum</i> Brightwell
Order Melosirales													
Family Stephanopyxidaceae													
													<i>Stephanopyxis curvis</i> (Greville & Amott) Ralfs
Order Paraliales													
Family Paraliaceae													
													<i>Paralia sulcata</i> (Ehrenberg) Clevé
Order Coscinodiscales													
Family Coscinodiscaceae													
													<i>Coscinodiscus</i> cf. <i>centralis</i> Ehrenberg
													<i>Coscinodiscus granii</i> Gough
													<i>Coscinodiscus</i> cf. <i>perforatus</i> Ehrenberg
													<i>Coscinodiscus walesii</i> Gran & Angst
													<i>Coscinodiscus gigas</i> Gough + <i>C. cf. asteromphalus</i> Ehrenberg
													<i>Coscinodiscus</i> sp.
Family Heliopeltaceae													
													<i>Azinopychus senarius</i> (Ehrenberg) Ehrenberg
Order Asterolamprales													
Family Asterolampraceae													
													<i>Asteromphalus</i> cf. <i>fabellatus</i> (Brébisson) Greville
Order Triceratiales													
Family Triceratiaceae													
													<i>Odontella mobilensis</i> (Bailey) Grunow
													<i>Odontella regia</i> (Schultze) Simonsen
													<i>Odontella sinensis</i> (Greville) Grunow
													<i>Triceratium fevus</i> Ehrenberg
Order Biddulphiiales													
Family Biddulphiaceae													
													<i>Biddulphia rhombus</i> (Ehrenberg) W. Smith
Order Hemiaulales													
Family Hemiaulaceae													
													<i>Cerataulina</i> cf. <i>bicornis</i> (Ehrenberg) Hasle
													<i>Cerataulina</i> cf. <i>denticata</i> Hasle
													<i>Cerataulina pelagica</i> (Clevé) Hervey
													<i>Cerataulina</i> sp.
													<i>Climacodum frauenfeldianum</i> Grunow
													<i>Eocampia cornuta</i> (Clevé) Grunow
													<i>Eocampia zodiacus</i> Ehrenberg
													<i>Hemiaulus bauckii</i> Grunow
													<i>Hemiaulus membranaceus</i> Clevé
													<i>Hemiaulus sinensis</i> Greville
Family Bellerophonaceae													
													<i>Bellerophon horologicalis</i> von Stosch
Order Lithodesmiales													
Family Lithodesmiaceae													
													<i>Dicylum brightwellii</i> (T. West) Grunow
													<i>Helicotheca zamesis</i> (Shrubsole) Ricard
													<i>Lithodesmium undulatum</i> Ehrenberg
Order Corethrales													
Family Corethraceae													
													<i>Corethron corythium</i> Castracane
													<i>Corethron</i> sp.

autumn

1	6	10	12	14	20	24	27	29	31	38	42	44	sampling sites
													Order Rhizosoleniales
													Family Rhizosoleniaceae
													<i>Dactylosolen fragilissimus</i> (Bergoni) Hasle
													<i>Dactylosolen phuketensis</i> (Sundström) Hasle
													<i>Guinardia cf. gilchristi</i> (Cleve) Hasle
				A									<i>Guinardia delicatula</i> (Cleve) Hasle
													<i>Guinardia floccida</i> (Castracane) H. Peragallo
			A										<i>Guinardia striata</i> (Stolterfoth) Hasle
													<i>Proboscia alata</i> (Brightwell) Sundström
													<i>Pseudosolenia calcar-avis</i> (Schultze) Sundström
													<i>Rhizosolenia cf. castracanei</i> H. Peragallo
													<i>Rhizosolenia hebetata</i> J.W. Bailey
													<i>Rhizosolenia hebetata</i> f. <i>semispina</i> (Hensen) Gran
													<i>Rhizosolenia hyalina</i> Osterfeld
													<i>Rhizosolenia cf. imbricata</i> Brightwell
													<i>Rhizosolenia pungens</i> Cleve-Euler
													<i>Rhizosolenia robusta</i> Norman ex Ralfs
													<i>Rhizosolenia setigera</i> Brightwell
													<i>Rhizosolenia cf. styliformis</i> Brightwell
													Order Chaetocerales
													Family Chaetocerotaceae
													<i>Bacteriastrium cf. delicatulum</i> Cleve
													<i>Bacteriastrium elongatum</i> Cleve
													<i>Bacteriastrium furcatum</i> Shadbolt
													<i>Bacteriastrium hyalinum</i> Lauder
													<i>Chaetoceros aequatorialis</i> Cleve
													<i>Chaetoceros affinis</i> Lauder
													<i>Chaetoceros atlanticus</i> Cleve
													<i>Chaetoceros cf. brevis</i> Schütt
				A									<i>Chaetoceros coarctatus</i> Lauder
													<i>Chaetoceros compressus</i> Lauder
													<i>Chaetoceros cf. concavicornis</i> Mangin
													<i>Chaetoceros costatus</i> Pavillard
													<i>Chaetoceros curvatus</i> Cleve
													<i>Chaetoceros danicus</i> Cleve
													<i>Chaetoceros decipiens</i> Cleve
													<i>Chaetoceros cf. densus</i> (Cleve) Cleve
													<i>Chaetoceros diadymus</i> Ehrenberg
													<i>Chaetoceros diversus</i> Cleve
													<i>Chaetoceros cf. ebneri</i> Grunow
													<i>Chaetoceros cf. gracilis</i> (Schroder) Hustedt
													<i>Chaetoceros jordanicus</i> Grunow
													<i>Chaetoceros penolus</i> Karsten
													<i>Chaetoceros peruvianus</i> Brightwell
													<i>Chaetoceros cf. tetrastichon</i> Cleve
													<i>Chaetoceros</i> sp.1
													<i>Chaetoceros</i> sp.2
													<i>Chaetoceros</i> sp.3
													<i>Chaetoceros</i> sp.4
													<i>Chaetoceros</i> sp.5
													Order Leptocylindrales
													Family Leptocylindraceae
A	A												<i>Leptocylindrus danicus</i> Cleve
A	A												<i>Leptocylindrus minimus</i> Gran
													Class Fragilariophyceae
													Order Fragilariales
													Family Fragilariaceae
													<i>Asterionellopsis glacialis</i> (Castracane) Round
													<i>Synedra</i> sp.
													<i>Fragilariaceae</i> 1
													<i>Fragilariaceae</i> 2
													<i>Fragilariaceae</i> 3
													Order Rhaphoneidales
													Family Rhaphoneidaceae
													<i>Rhaphoneidaceae</i>
													<i>Delphinis</i> sp.

spring

sampling sites 1 6 10 12 14 20 24 27 29 31 38 42 44

	1	6	10	12	14	20	24	27	29	31	38	42	44
Order Thalassionematales													
Family Thalassionemataceae													
<i>Lioluma pacificum</i> (Cupp) Hasle		A	A	A	A	A			A	A	A	A	
<i>Thalassionema bacillare</i> (Heiden) Kolbe													
<i>Thalassionema frauenfeldii</i> (Grunow) Hallegraeff													
<i>Thalassionema nitzschii</i> (Grunow) Grunow ex Hustedt		A											
<i>Thalassiothrix cf. gibberula</i> Hasle													
<i>Thalassiothrix cf. longissima</i> Cleve & Grunow													
Thalassionemataceae 1		A	A	A					A		A	A	
Thalassionemataceae 2													
Thalassionemataceae 3													
Order Naviculales													
Family Diploneidaceae													
<i>Diploneis</i> sp.1													
<i>Diploneis</i> sp.2													
<i>Diploneis</i> sp.3													
Family Naviculaceae													
<i>Haslea wainwalei</i> (Hustedt) Simonen													
<i>Haslea</i> sp.1													
<i>Haslea</i> sp.2													
<i>Navicula membranacea</i> (Cleve) P. C. Silva													
<i>Navicula cf. distorta</i> (W. Smith) Ralfs													
Naviculaceae sp.1													
Naviculaceae sp.2													
Naviculaceae sp.3													
Naviculaceae sp.4													
Naviculaceae sp.5													
Naviculaceae sp.6													
Naviculaceae sp.7													
Naviculaceae sp.8													
Naviculaceae sp.9													
Naviculaceae sp.10													
Naviculaceae sp.11													
Tropidoneis sp.1													
Tropidoneis sp.2													
Tropidoneis sp.3													
Tropidoneis sp.4													
Family Pleurosigmales													
Pleurosigmales													
Order Thalassiosiphales													
Family Catenulaceae													
<i>Amphora cf. arenaria</i> Donlin													
Order Bacillariales													
Family Bacillariaceae													
<i>Bacillaria paxillifera</i> (O.F. Müller) Hensley													
<i>Cylindrotheca closterium</i> (Ehrenberg) Lewin & Raimann		A	A	A	A	A	A	A	A	A	A	A	A
<i>Eragulopsis albidulus</i> (Wallich) Medlin & Sims													
<i>Nitzschia constricta</i> Gregory													
<i>Nitzschia longissima</i> (Brebisson) Ralfs													
<i>Nitzschia lorentziana</i> var. <i>subtilis</i> Grunow													
<i>Nitzschia morphotype</i> <i>Nitzschia</i> Lasenby, Peragallo													
<i>Nitzschia</i> sp.													
<i>Pseudo-nitzschia multistriata</i> Takano													
<i>Pseudo-nitzschia pungens</i> (Grunow ex Cleve) Hasle													
<i>Pseudo-nitzschia "delicatissima" sp.1</i>													
<i>Pseudo-nitzschia "delicatissima" sp.2</i>		A			A	A				A	A	A	
<i>Pseudo-nitzschia "delicatissima" spp</i>													
<i>Pseudo-nitzschia "seniata" sp.1</i>													
<i>Pseudo-nitzschia "seniata" sp.2</i>		A			A	A							
<i>Pseudo-nitzschia "seniata" sp.3</i>													
<i>Pseudo-nitzschia "seniata" spp</i>	A		A	A			A		A			A	

autumn

1	6	10	12	14	20	24	27	29	31	38	42	44	sampling sites
													Order Thalassionematales
													Family Thalassionemataceae
													<i>Lioloma pacificum</i> (Cupp) Hasle
													<i>Thalassionema bacillare</i> (Haiden) Kolbe
													<i>Thalassionema frauenfeldii</i> (Grunow) Hallegraff
													<i>Thalassionema nitzschoides</i> (Grunow) Grunow ex Hustedt
													<i>Thalassiothrix cf. gibberula</i> Hasle
													<i>Thalassiothrix cf. longissima</i> Cleve & Grunow
													Thalassionemataceae 1
													Thalassionemataceae 2
													Thalassionemataceae 3
													Order Naviculales
													Family Diploneideaceae
													<i>Diploneis</i> sp.1
													<i>Diploneis</i> sp.2
													<i>Diploneis</i> sp.3
													Family Naviculaceae
													<i>Haslea wawiniae</i> (Hustedt) Simonsen
													<i>Haslea</i> sp.1
													<i>Haslea</i> sp.2
													<i>Meuniera membranacea</i> (Cleve) P. C. Silva
													<i>Navicula cf. distans</i> Ralfs
													Naviculaceae sp.1
													Naviculaceae sp.2
													Naviculaceae sp.3
													Naviculaceae sp.4
													Naviculaceae sp.5
													Naviculaceae sp.6
													Naviculaceae sp.7
													Naviculaceae sp.8
													Naviculaceae sp.9
													Naviculaceae sp.10
													Naviculaceae sp.11
													<i>Tropidoneis</i> sp.1
													<i>Tropidoneis</i> sp.2
													<i>Tropidoneis</i> sp.3
													<i>Tropidoneis</i> sp.4
													Family Pleurosigmaeae
													Pleurosigmaeae
													Order Thalassiosiphysales
													Family Catenulaceae
													<i>Amphora cf. arenaria</i> Donkin
													Order Bacillariales
													Family Bacillariaceae
													<i>Bacillaria pavilifera</i> (O.F. Müller) Hendey
													<i>Cylindrotheca closterium</i> (Ehrenberg) Lewin & Riemann
													<i>Fragilaropsis dolioles</i> (Wallich) Medlin & Sims
													<i>Nitzschia constricta</i> Gregory
													<i>Nitzschia longissima</i> (Brébisson) Ralfs
													<i>Nitzschia lorenziana</i> var. <i>subtilis</i> Grunow
													<i>Nitzschia</i> morphotype <i>Nitzschialla</i> (sensu H. Peragallo)
													<i>Nitzschia</i> sp.
													<i>Pseudo-nitzschia multistriata</i> Takano
													<i>Pseudo-nitzschia pungens</i> (Grunow ex Cleve) Hasle
													<i>Pseudo-nitzschia</i> "delicatissima" sp.1
													<i>Pseudo-nitzschia</i> "delicatissima" sp.2
													<i>Pseudo-nitzschia</i> "delicatissima" spp
													<i>Pseudo-nitzschia</i> "senata" sp.1
													<i>Pseudo-nitzschia</i> "senata" sp.2
													<i>Pseudo-nitzschia</i> "senata" sp.3
													<i>Pseudo-nitzschia</i> "senata" spp

1	6	10	12	14	20	24	27	29	31	38	42	44	sampling sites
													DIVISION DINOFLAGELLATA
													Class Dinophyceae
													Order Gymnodiniales
													Family Gymnodiniaceae
													Gymnodinium sp.1
													Gymnodinium sp.2
													Gyrodinium sp.1
													Gyrodinium sp.2
													Gyrodinium sp.3
													Order Gonyaulacales
													Family Gonyaulacaceae
													<i>Gonyaulax spinifera</i> (Claparède & Lachmann) Biesing
													<i>Gonyaulax</i> sp.1
													<i>Gonyaulax</i> sp.2
													<i>Gonyaulax</i> sp.3
													Family Ceratocoryaceae
													cf. <i>Ceratocorys</i>
													Family Ceratiaceae
													<i>Ceratium breve</i> (Ostenfeld & Schmidt) Schröder
													<i>Ceratium</i> cf. <i>candelabrum</i> (Ehrenberg) Stein
													<i>Ceratium contortum</i> var. <i>karstenii</i> (Pavillard) Sourin
													<i>Ceratium</i> cf. <i>contrarium</i> (Gouret) Pavillard
													<i>Ceratium deflexum</i> (Kofoid) Jörgensen
A	A	A	A	A	A			A	A				<i>Ceratium furca</i> (Ehrenberg) Claparède & Lachmann
A	A	A											<i>Ceratium fuscus</i> (Ehrenberg) Dujardin
													<i>Ceratium gibberum</i> Gouret
													<i>Ceratium</i> cf. <i>hexacanthum</i> Gouret
													<i>Ceratium homidum</i> (Cleve) Gran
													<i>Ceratium humile</i> Jörgensen
													<i>Ceratium</i> cf. <i>laxale</i> (Schimper) Jörgensen
													<i>Ceratium macroceros</i> (Ehrenberg) Vanhöffen
													<i>Ceratium massiliense</i> (Gouret) Jörgensen
													<i>Ceratium</i> cf. <i>trichoceros</i> (Ehrenberg) Kofoid
													<i>Ceratium</i> cf. <i>trios</i> (O.F.Müller) Nitzsch
													<i>Ceratium</i> sp.1
													<i>Ceratium</i> sp.2
													<i>Ceratium</i> sp.3
													Family Goniidomaceae
													<i>Alexandrium</i> cf. <i>fraterculus</i> (Balech) Balech
													<i>Alexandrium</i> sp.
													Family Pyrocystaceae
													<i>Pyrocystis</i> cf. <i>fusiformis</i> (W.Thompson) Murray
													<i>Pyrocystis lunula</i> (Schütt) Schütt
													Order Peridinales
													Family Peridiniaceae
A	A	D	A	D	D	A	A	A	A	A	A	A	<i>Scopimella spinifera</i> Horsell & Cabrini
A	A	A	A	A	D	A	A	A	A	A	A	A	<i>Scopimella trochoidea</i> (Starb) Loeblich III
													Family Congruentiaceae
													<i>Protopendinium</i> cf. <i>conicum</i> (Gran) Balech
													<i>Protopendinium</i> cf. <i>crassipes</i> (Kofoid) Balech
													<i>Protopendinium</i> cf. <i>depressum</i> (Bailey) Balech
													<i>Protopendinium</i> cf. <i>divergens</i> (Ehrenberg) Balech
													<i>Protopendinium</i> cf. <i>elegans</i> (Cleve) Balech
													<i>Protopendinium</i> cf. <i>grande</i> (Kofoid) Balech
													<i>Protopendinium</i> cf. <i>hirsutis</i> Abé
													<i>Protopendinium</i> cf. <i>inflatum</i> Okamura
													<i>Protopendinium leonis</i> (Pavillard) Balech
													<i>Protopendinium mariae-bourise</i> (Paulsen) Balech
													<i>Protopendinium oblongum</i> (Aumilieu) Parke & Dodge
													<i>Protopendinium</i> cf. <i>oceanicum</i> (Vanhöffen) Balech
													<i>Protopendinium</i> cf. <i>ovatum</i> Pouchet
													<i>Protopendinium perwenter</i> Balech
													<i>Protopendinium</i> cf. <i>pellucidum</i> Bergh
													<i>Protopendinium</i> cf. <i>pentagonum</i> (Gran) Balech
													<i>Protopendinium roseum</i> (Paulsen) Paulsen
													<i>Protopendinium simulium</i> (Paulsen) Balech
A	A	A	A	A									<i>Protopendinium steinii</i> (Jörgensen) Balech
													<i>Protopendinium symmetricum</i> (Halim) Balech
													<i>Protopendinium variegatum</i> Peters
													<i>Protopendinium</i> sp.1
													<i>Protopendinium</i> sp.2
													<i>Protopendinium</i> sp.3

autumn

1	6	10	12	14	20	24	27	29	31	38	42	44	sampling sites
													<i>Protoperidinium</i> sp.4
													<i>Protoperidinium</i> sp.5
													<i>Protoperidinium</i> sp.6
													<i>Protoperidinium</i> sp.7
													<i>Protoperidinium</i> sp.8
													<i>Protoperidinium</i> sp.9
													<i>Protoperidinium</i> sp.10
													<i>Protoperidinium</i> sp.11
													<i>Protoperidinium</i> sp.12
													<i>Protoperidinium</i> sp.13
													<i>Protoperidinium</i> sp.14
													<i>Protoperidinium</i> sp.15
													<i>Protoperidinium</i> sp.16
													<i>Protoperidinium</i> sp.17
													<i>Protoperidinium</i> sp.18
													<i>Protoperidinium</i> sp.19
													<i>Protoperidinium</i> sp.20
													Order uncertain
													Family Oxytoxaceae
													<i>Oxytoxum</i> cf. <i>elegans</i> Pavillard
													<i>Oxytoxum</i> cf. <i>gladius</i> Stein
													<i>Oxytoxum</i> cf. <i>mitra</i> (Stein) Schiller
													Order Dinophysiales
													Family Dinophysiaceae
													<i>Dinophysis acuminata</i> Claparède & Lachman
													<i>Dinophysis caudata</i> Saville-Kent
													<i>Dinophysis tripos</i> Gouret
													Family Oxyphysiaceae
													<i>Oxyphysis oxytoxoides</i> Koloid
													Order Prorocentrales
													Family Prorocentraceae
													<i>Prorocentrum</i> cf. <i>balteum</i> (Lohmann) Loeblich III
													<i>Prorocentrum gracile</i> Schütt
													<i>Prorocentrum mexicanum</i> Tafall
													<i>Prorocentrum micans</i> Ehrenberg
													<i>Prorocentrum</i> sp.
													Class Noctiluiphyceae
													Order Noctilucales
													Family Noctilucaeae
													<i>Noctiluca scintillans</i> (Macartney) Koloid & Swezy
													DIVISION CHROMOPHYTA
													Class Dictyochophyceae
													Order Dictyochaales
													Family Dictyochaecae
													<i>Dictyocha cruz</i> Ehrenberg
													<i>Dictyocha fibula</i> Ehrenberg
													<i>Dictyocha octonana</i> Ehrenberg
													<i>Dictyocha speculum</i> Ehrenberg
													<i>Mesocena polymorpha</i> var. <i>bioclonaria</i> (Ehrenberg) Lemmermann
													Class Prymnesiophyceae
													Order Coccosphaerales
													Family Calciosoleniaceae
													<i>Angulosolenia brasiliensis</i> (Lohmann) Dellandre
													<i>Calciosolenia murrayi</i> Gran
													Family Rhodospaeraceae
													<i>Dicoccosphaera tubifer</i> (Murray & Blackman) Ostenfeld
													DIVISION EUGLENOPHYTA
													Class Euglenophyceae
													Order Euglenales
													Family Euglenaceae
													<i>Euglena</i> cf. <i>occlusiformis</i> Schiller
													PHYLUM ZOOMASTIGOPHORA
													Class Ebridae
													Order Ebrida
													Family Ebrionidae
													<i>Hermesinium adriaticum</i> Zacharias



More Information?

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