The phytoplankton biodiversity of the coast of the state of São Paulo, Brazil

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Abstract: The objective of this study is to compile the inventory of nearly 100 years of research about the phytoplankton species cited for the coast of the state of São Paulo, Brazil. A state-of-the-art study on the local biodiversity has long been needed to provide a baseline for future comparisons. This type of data is scattered in old scientific journals and in the so-called "grey literature", and are in need of nomenclature updating. Twenty-six publications are considered. The earliest sampling record is from 1913 (?) and the most recent from 2002. This checklist compiled from the literature was complemented with primary data collected between August 2004 and July 2006, recent surveys of the surf-zone of 20 beaches located along the coast and of a mariculture farm at the Cocanha Beach, Caraguatatuba. The complete species list includes 572 taxa: most are diatoms (82%), seconded by dinoflagellates (16%), with a minor contribution of silicoflagellates, coccolithophorids, ebriideans and cyanobacteria. The most investigated areas were: Ubatuba, São Sebastião, Santos and Cananéia. The recent surveys have a broader spatial coverage. The objectives of the studies have changed over the years from purely taxonomic to process-oriented investigations. Therefore, the longest species lists and most first records for the area were published before the 1980's and later publications, even those in which cell counts were performed, mention only the most abundant/frequent species. Electron microscopy was used for the first time in the present surveys, and new records include 38 diatoms, 42 dinoflagellates, 1 silicoflagellate, 1 ebriidean and 2 cyanobacteria. The use and interpretation of this species list require the perception of some constraints. It is not our role to question the identification made by other researchers. On the other hand, the ability to sample, analyze and identify species has evolved over the years and some considerations in this regard are presented.
Keywords: *marine microalgae, inventory, diatoms, dinoflagellates.*

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Resumo: O objetivo deste estudo é compilar o inventário de quase 100 anos de pesquisa sobre a composição de espécies do fitoplâncton do litoral do Estado de São Paulo, Brasil. O retrato atualizado da biodiversidade local é necessário para estabelecer um dignóstico para comparações futuras. Este tipo de informação encontra-se dispersa em antigas publicações e em material considerado como "literatura cinza" e requer atualização nomenclatural. Vinte e seis publicações foram consideradas neste estudo. O registro mais antigo é de 1913 (?) e o mais recente de 2002. Esta lista de espécies, compilada a partir de dados pretéritos, foi complementada com dados primários coletados entre agosto de 2004 e julho de 2006 nas zonas de arrebentação de 20 praias paulistas e em área de maricultura da praia da Cocanha em Caraguatatuba. A lista de espécies completa inclui 572 táxons: a maioria de diatomáceas (82%), seguidas por dinoflagelados (16%), com uma pequena contribuição de silicoflagelados, cocolitoforídeos, ebriideas e cianobactérias. As áreas mais estudadas foram: Ubatuba, São Sebastião, Santos e Cananéia. O levantamento atual tem uma cobertura espacial mais abrangente. Ao longo dos anos, os objetivos dos estudos pretéritos variaram desde puramente taxonômicos até investigações de aspectos funcionais do ecossistema. Desta forma, os inventários mais longos e a maioria dos primeiros registros foram publicados antes de 1980 e as publicações mais recentes fazem menção apenas a espécies mais abundantes/freqüentes. Microscopia eletrônica foi empregada pela primeira vez no levantamento atual e novos registros incluem 38 diatomáceas, 42 dinoflagelados, 1 silicoflagelado, 1 ebriidea e 2 cianobactérias. O uso e interpretação deste inventário exige cautela. Se por um lado, não é viável questionar a identificação feita por outros pesquisadores, por outro lado, a capacidade de amostrar, analisar e identificar espécies evoluiu ao longo do tempo. Algumas considerações sobre esta questão são apresentadas.
Palavras-chave: *microalgas marinhas, inventário, diatomáceas, dinoflagelados.*

Introduction

Phytoplankton studies include a variety of taxonomic groups (cyanobacteria, diatoms, dinoflagellates, silicoflagelates, coccolithophorids, and many other flagellates) that inhabit the water column. This is an artificial category, that is, the organisms are not phylogenetically related (Adl et al. 2005). Although these organisms are regarded as unicellular microalgae and most of them are indeed autotrophs, several species or even whole genera (e.g., the dinoflagellates *Protoperidinium* Bergh) are known to be heterotrophs (Steidinger & Tangen 1997). An extreme case is that of the ebriideans, *Ebria tripartita* (Schumann) Lemmermann and *Hermesinum adriaticum* Zacharias, which actually belong to the Phylum Sarcomastigophora (according to Lee et al. 1985 in Throndsen 1997); they are traditionally considered in phytoplankton counts mostly because their taxonomic status has changed over the years to be considered silicoflagellates (Drebes 1974) or dinoflagellates (Sournia 1986).

According to Sournia et al. (1991), marine phytoplankton of the world may include as many as 17 classes and an estimated number of 498 ± 15 genera and $3{,}910 \pm 465$ species. The authors recognize that taxonomy is a dynamic science and that these numbers were probably already underestimated at the time of their publication. A more recent source of change in our perception of biodiversity, especially in the protistan realm, is due to the introduction of immunochemical and molecular biological methods that can reveal intra- and infraspecific variations that went unnoticed before.

The objective of this study is to compile and make available the inventory of the phytoplankton species cited for the coast of the state of São Paulo, Brazil. As will be demonstrated, there is almost 100 years of research in the area, but this type of data (species lists) is scattered and in need of nomenclature updating. A state-of-the-art assessment of the biodiversity of the local phytoplankton is long needed to provide a baseline for future comparisons.

Material and Methods

This assessment was based on published information available in scientific journals as well as in the so-called "grey literature" (technical reports, academic thesis and dissertation, expanded abstracts from scientific events) for the coast of São Paulo. For this data set, the earliest sampling year is 1913 (?) and the most recent record reports on samples collected in 2002. The objectives, field and laboratory methods used in these surveys are summarized in Table 1 and will be discussed further below. The publications of Zimmerman, dated from 1913 to 1918, were combined as a sole record because there is no reference for sampling dates and, at times, the same article is published in two different issues.

This species checklist compiled from the literature was complemented with primary data collected between August 2004 and July 2006, using data from 2 different sampling schemes. Phytoplankton samples were taken monthly from the surf-zone of 20 beaches located along the coast (Figure 1). Theses samples were taken almost simultaneously (within 24 hours) by surface net hauls (20 μm-mesh). From June 2005 to May 2006, sampling was also carried out at the mussel mariculture located at the Cocanha Beach, in Caraguatatuba. In this case, vertical net hauls (from 3 m depth to surface, same mesh size) were taken monthly at 5 sites (insert of Figure 1). All samples were initially analyzed with the aid of the Utermöhl's settling chambers using a Nikon TS100 inverted microscope equipped with phase contrast. Specific methods for finer taxonomic study were applied for observation in light microscopy (LM, Olympus BX41 equipped with phase contrast and epifluorescence) and also scanning electron microscopy (SEM, LEO 1450VP Zeiss). For diatoms, it was necessary to clean the cells from the organic matter that obscures the structures of the frustules; for LM, permanent slides were prepared with a medium of high refractive index (Naphrax), whereas for SEM a drop of the cleaned material was air-dried on a cover slip that was then sputtered with gold (Hasle & Fryxell 1970). For armored dinoflagellates, observation of plate patterns in LM were done on wet mounts with the use of hypochlorite to separate plates and/or by the addition of the fluorochrome Calcofluor white (Fritz & Triemer 1985, Boltovskoy 1995); SEM study of the more resistant species was also possible. A few unarmored species were identified from live samples. This is still an ongoing research and the species list presented here should be considered as preliminary.

The complete species list is found in the Appendix. Nomenclature was updated to the best of our ability, based on a vast literature and the algae database provided by Guiry & Guiry (2008). The correct names of many taxa should still be regarded under scrutiny, as marked directly on the species list, either because we were unable to locate the validity of the name or the taxonomic status of a genus/species was considered unresolved, as will be illustrated further below. This difficulty is not unexpected, considering that some records are almost 100 years old and collections are not available to verify diagnostic characters. Synonyms were included, although restricted to citations found in the publications considered in this assessment. These shortcomings led to the choice of not adopting a classification system at present and the species list was thus organized in alphabetical order.

The publication of Oliveira (1980) was not taken into account because it dealt with epiphytic diatoms on *Sargassum*, although we do recognize that some species may be shaken off the thallus of the seaweed and can be, at times, detected in the water column. A wealth of publications that focused mostly on primary production and/or pigment concentrations are key to understand phytoplankton dynamics in the study area (e.g., Galvão 1978, Gaeta et al. 1990, Aidar et al. 1993, Gaeta et al. 1995, Lima 1998, Gaeta et al. 1999, Saldanha-Correa & Gianesella 2004, Barrera-Alba et al. 2008), but they were not included in this account because they did not provide information at the species level.

Results and Discussion

1. The species list in a historical perspective

Phytoplankton studies from the coast of the state of São Paulo date back to 1913 (Zimmerman, 1913). Twenty-six publications are considered in this assessment (Table 1). The species list includes 572 taxa (Appendix). The great majority of the species found are diatoms (82%), seconded by dinoflagellates (16%), and a minor contribution of silicoflagellates, coccolithophorids, ebriideans and cyanobacteria was also reported (Table 2). The most investigated areas were, from north to south: Ubatuba, São Sebastião, Santos and Cananéia (refer to Table 1 and names of municipalities on Figure 1). The recent surveys have a broader spatial coverage (refer to Figure 1).

The objectives of the published studies have changed over the years from purely taxonomic studies to process-oriented investigations. Therefore, the longest species lists and most first records for the area are published in the studies carried out before the 1980's (Figure 2) and later publications, even those in which cell counts were performed, mention only the most abundant/frequent species. New records for the coast of São Paulo state (present study: 2004-2006) includes 38 diatoms, 42 dinoflagellates, 1 silicoflagellate, 1 ebriidean and 2 cyanobacteria (Appendix).

The larger contribution of diatoms and dinoflagellates is expected and is in accordance with the review of Sournia et al. (1991) that

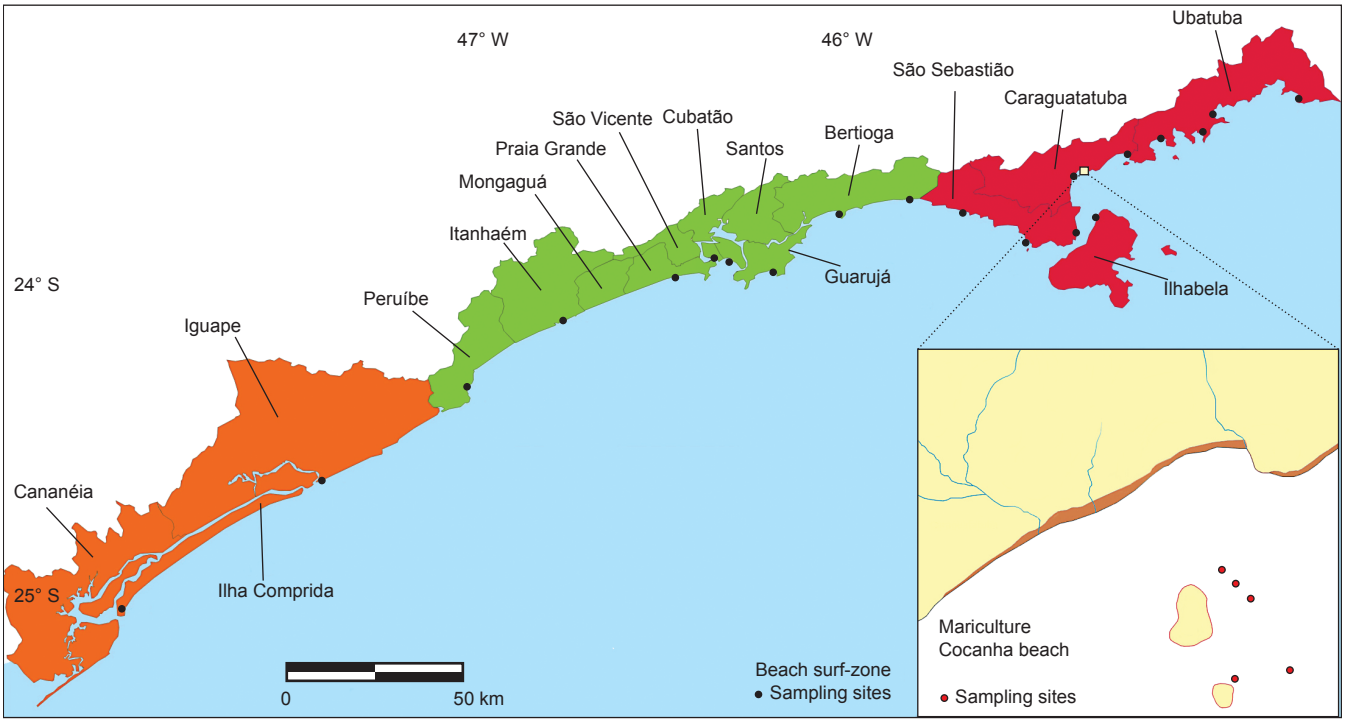

Figure 1. The coastline of the state of São Paulo, including the names of the 16 coastal municipalities, as well as the locations of the sampling sites visited during August/2004 and July/2006 (primary data).

Figura 1. Litoral do Estado de São Paulo, incluindo os nomes das 16 cidades costeiras e os locais dos pontos de coleta visitados no período entre agosto/2004 e julho/2006 (dados primários).

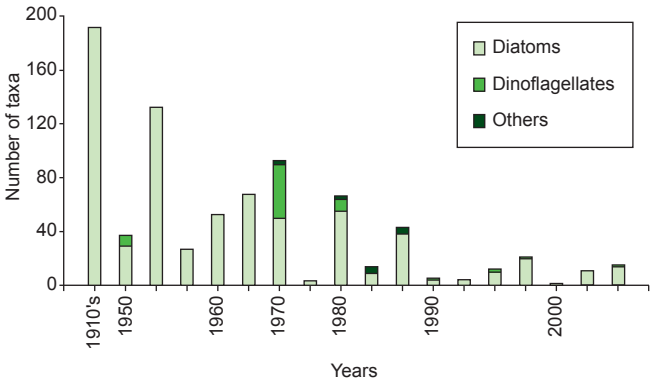

Figure 2. Relative contribution of the number of species of marine microalgae found in the studies published between 1913 and 2002 (listed in Table 1).

Figura 2. Contribuição relative do número de espécies de microalgas encontradas nos estudos publicados entre 1913 e 2002 (listados na Tabela 1).

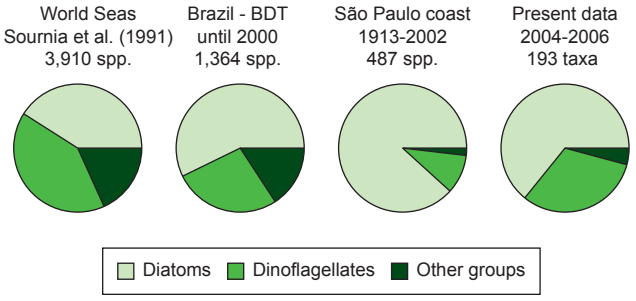

Figure 3. Relative contribution of the main taxonomic groups at different levels: worldwide (Sournia et al. 1991), Brazil (Banco de Dados Tropical - www.bdt.fat.org.br/workshop/costa), pre-existing data for the state of São Paulo (references in Table 1), and primary data for the state of São Paulo.

Figura 3. Contribuição relativa dos principais grupos taxonômicos em diferentes níveis: distribuição mundial (Sournia et al. 1991), no Brazil (Bando de Dados Tropical - www.bdt.fat.org.br/workshop/costa), dados pretéritos para o Estado de São Paulo (referências na Tabela 1) e dados primários para o Estado de São Paulo.

estimates numbers of species for the marine phytoplankton: diatoms (1365-1783), dinoflagellates (1424-1772), coccolithophorids (239-298), chlorophytes (106-121), prasinophytes (95-128), cryptophytes (56-73), euglenophytes (35-36), silicoflagellates (1-3), cyanobacteria (6-9), among others. Brazil (and the state of São Paulo) has a stronger tradition of diatomists, which explains our greater knowledge of diatom species composition (Figure 3). For the state of São Paulo, only the study of Sassi (1978) and the recent surveys made a special effort to augment our understanding of dinoflagellate species composition (Table 2; Figure 3). As a general rule, the identification of flagellates, including naked dinoflagellates, requires the study of live samples and/or electron microscopy, which is not routinely possible in many laboratories. We are still a long ways from grasping the true biodiversity of such taxonomic groups in Brazilian waters.

The most frequently cited species are listed in Table 3 and they are all diatoms commonly found in coastal waters (Hasle & Syvertsen 1997). Except for *Phaeodactylum tricornutum* Bohlin, *Pseudo-nitzschia* Hassal and *Skeletonema costatum* Greville, whose taxonomy will be discussed further below, the other 26 species can be readily identified in wet mounts with light microscopy.

Table 1. List of publications that cite the occurrence of microalgae species for the coast of the state of São Paulo, organized by sampling date and indicating locality, sampling period, approach of the study, and methods used. Locality includes the name of the municipality that can be located on Figure 1. Each reference is given a code that is referred to in other figures and tables. Publications by Zimmermann are combined as one record (Z).

Tabela 1. Lista de publicações que citam a ocorrência de espécies de microalgas para o litoral do Estado de São Paulo, organizada segundo a data de coleta e indicando local e período de coleta, abordagem do estudo e métodos utilizados. Local de coleta inclui nome da cidade que pode ser localizada na Figura 1. Cada referência recebeu um código que é utilizado em outras figuras e tabelas. As publicações de Zimmermann foram reunidas de modo a corresponder a um único registro (código Z).

Sampling year	Locality	Period	Approach	Field work	Type of analysis	Reference	Code
1913-1918 ?	Guarujá & Santos	?	species composition	?	?	Zimmermann (1913, 1914, 1915a,b, 1916a,b, 1917, 1918a,b)	Z
1949	River Maria Rodrigues, Cananéia	7 June - 20 October	species composition	surface tow, net of No00 mesh (?)	qualitative, no details provided	Carvalho (1950)	1
1949-1950	São Sebastião, Santos, Cananéia	10 samples provided by J. Paiva Carvalho	species composition	net ?	observation of wet mounts and diatom permanent mounts	Müller-Melchers (1955)	2
1957 ?	Ubatuba, Cananéia	?	species composition	- net, surface haul; - seaweed, picked manually; - stomach content (fish); - sediment	diatom permanent mounts	Andrade & Teixeira (1957)	3
1968	Cananéia	2-3 February 17-18 July	primary production with species list	bottle (?); surface & bottom	?	Teixeira (1969)	4
1969-1970	Cananéia	December-October every other month	space-time distribution in species composition & abundance	5 sites along the estuarine gradient; Nansen bottle; surface and at 1% light; some of the material concentrated in 30 µm mesh	Utermöhl's settling technique for bottle samples and Sedwick-Rafter for net samples	Kutner (1972)	5
1974/1975	Saco da Ribeira, Ubatuba	June-September monthly	space-time distribution in species composition & abundance	1 site; surface, Secchi and bottom; Van Dorn bottle; surface tow with net of 65 µm mesh	Utermöhl's settling technique (bottle samples in cells per liter, net samples in percentage)	Sassi (1978)	6
1977-1978	Cananéia	Aug/77 Nov/77 Feb/78 May/78	diel variation of ecological parameters	1 site; 13 consecutive samplings within a 24-hour period during spring tides; surface & 9m; Nansen and Van Dorn bottles	Utermöhl's settling technique	Brandini (1982)	7
1982-1983	River Una do Prelado, Juréia	August-July monthly ebb & flood tides	space-time distribution in species composition & abundance	6 sites along the estuarine gradient; surface and bottom; Van Dorn bottle; surface tows with net of 45 µm	Utermöhl's settling technique for bottle samples; common species from net samples in microscope slides	Oliveira (1988)	8
1985-1988	Between Island Anchieta & Island Vitória, Ubatuba	4 cruises Oct/85, Jan/86, Jul/86, Apr/88	space-time distribution in species composition & abundance	6 sites; surface, 10 m, 20 m and 30 m; Niskin bottle	Utermöhl's settling technique	Zillmann (1990)	9

Table 1. Continued...

Sampling year	Locality	Period	Approach	Field work	Type of analysis	Reference	Code
1988-1989	Boqueirão and South of Island Vitória, Ubatuba	daily sampling 1988: 12/ Feb-15/Mar & 10/Aug-4/ Sep 1989: 17/Jan-27/ Feb & 8-28/ Jul	space-time distribution in phytoplankton abundance	4 sites; surface, 50% and 1% light; Van Dorn bottle	Utermöhl's settling technique	Francos (1996)	10
1990	Between Ubatumirim & Flamengo, Ubatuba	30 Nov-16 Dec every other day	observation of bloom patch evolution	20 sites; surface; sampling with bottle (?); 1 site with vertical sampling	Utermöhl's settling technique	Gianesella-Galvão et al. (1995)	11
1991	São Sebastião Channel	October	assessment of plankton community and environmental parameters	one sampling at each of the 20 sites; surface, mid-water & bottom; bottle (?); surface tows with net of 30 µm mesh	Utermöhl's settling technique for bottle samples; common species from net samples in microscope slides	Gianesella et al. (1999)	12
1991	Bertioga Channel, Santos	18 July (neap tide) & 27 July (spring tide)	assessment of plankton community and environmental parameters	nine sampling sites; surface & near bottom; bottle (?); one series at ebb tide and another at flood tide	Utermöhl's settling technique only for sites 1, 5 and 9 (pigment analysis for all 9 sites)	Gianesella et al. (2000)	13
1998	Ubatuba, Santos, Praia Grande	5-8 March & 5-7 April	eutrophication vs. phytoplankton (emphasis in primary production, pigments, overall cell abundances and environmental parameters)	27 sites in Ubatuba, 12 sites in Santos, 20 sites in Praia Grande; surface; Van Dorn bottle	Utermöhl's settling technique	Frazão (2001)	14
1999-2000	Santos & São Vicente	August 1999 & January 2000	tide vs. phytoplankton (emphasis in overall cell abundances and environmental parameters)	3 sites; neap and spring tides; surface, mid-photic layer, Secchi depth; Van Dorn bottle	Utermöhl's settling technique	Moser et al. (2002)	15
2002	Capela Beach, Ilha Bela	January & July	eutrophication vs. phytoplankton (emphasis in pigments, overall cell abundances and environmental parameters)	10 sites; surface; Van Dorn bottle	Utermöhl's settling technique	Saldanha-Correa & Gianesella (2003)	16
2002	Enseada Beach, Guarujá	January & July	eutrophication vs. phytoplankton (emphasis in pigments, overall cell abundances and environmental parameters)	10 sites; surface; Van Dorn bottle	Utermöhl's settling technique	Gianesella & Saldanha-Corrêa (2003)	17

Table 2. Total number of microalgae species found on the coast of the state of São Paulo per taxonomic group. Codes/numbers in the heading refer to the studies published between 1913 and 2002 (refer to Table 1) and present survey refers to 2004-2006.

Table 2. Número total de espécies de microalgas encontradas no litoral do Estado de São Paulo, segundo grupo taxonômico. Códigos/números no cabeçalho correspondem aos estudos publicados entre 1913 e 2002 (vide Tabela 1) e levantamento atual corresponde ao período de 2004-2006.

Total		Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Present survey
Diatoms	469	192	29	132	27	52	68	50	3	55	9	38	4	4	10	20	1	11	14	120
Dinoflagellates	90	-	8	-	-	-	-	40	-	9	-	-	1	-	2	1	-	-	1	65
Silicoflagellates	3	-	-	-	-	-	-	2	-	1	1	1	-	-	-	-	-	-	-	3
Coccolithophorids	5	-	-	-	-	-	-	-	-	-	4	3	-	-	-	-	-	-	-	-
Ebriideans	2	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	2
Cyanobacteria	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	3
Total	572	192	37	132	27	52	68	92	3	66	14	43	6	4	12	21	1	11	15	193

Table 3. List of species that were most frequently cited in the studies considered in this assessment (published between 1913 and 2002, refer to Table 1) and also recorded in the present data set (2004-2006).

Tabela 3. Lista de espécies mais citadas, considerando tanto os estudos pretéritos (publicados entre 1913 e 2002, listados na Tabela 1) como o presente levantamento (2004-2006).

Cited in 30-50% of the studies	Cited in 51-80% of the studies
Actinoptychus senarius	*Asterionellopsis glacialis*
Bacteriastrum delicatulum	*Guinardia striata*
Cerataulina pelagica	*Leptocylindrus danicus*
Chaetoceros curvisetus	*Paralia sulcata*
Chaetoceros laevis	*Thalassionema nitzschioides*
Chaetoceros lorenzianus	
Corethron pennatum	
Coscinodiscus oculus-iridis	
Cyclotella stylorum	
Cylindrotheca closterium	
Dactyliosolen fragilissimus	
Ditylum brightwellii	
Guinardia delicatula	
Guinardia flaccida	
Gyrosigma balticum	
Hemiaulus sinensis	
Odontella mobiliensis	
Phaeodactylum tricornutum	
Proboscia alata	
Pseudo-nitzschia "seriata"	
Rhizosolenia imbricata	
Rhizosolenia setigera	
Skeletonema costatum	
Stephanopyxis turris	

The following taxa have been cited in the literature as bloom-forming species, some of them as potentially toxic (according to Hallegraeff et al. 2003, Fukuyo et al. 1990, Odebrecht et al. 2002, Moestrup 2004): the diatoms *Asterionellopsis glacialis* (Castracane) Round, *Cerataulina pelagica* (Cleve) Hendey, *Coscinodiscus wailesii* Gran & Angst, *Cylindrotheca closterium* (Ehrenberg) Lewin & Reimann, *Guinardia delicatula* (Cleve) Hasle, *Leptocylindrus minimus* Gran, *Pseudo-nitzschia calliantha* Lundholm, Moestrup & Hasle, *Pseudo-nitzschia delicatissima* (Cleve) Heiden, *Pseudo-nitzschia fraudulenta* (Cleve) Hasle, *Pseudo-nitzschia multistriata* (Takano) Takano, *Pseudo-nitzschia pungens* (Grunow ex Cleve) Hasle; the dinoflagellates *Ceratium fusus* (Ehrenberg) Dujardin, *Ceratium hircus* Schröder, *Dinophysis acuminata* Claparède & Lachmann, *Dinophysis caudata* Saville-Kent, *Dinophysis rotundata* Claparède & Lachmann, *Dinophysis tripos* Gourret, *Noctiluca scintillans* (Macartney) Kofoid et Swezy, *Peridinium quinquecorne* Abé, *Prorocentrum micans* Ehrenberg; the silicoflagellate *Dictyocha fibula* Ehrenberg; and the cyanobacteria *Trichodesmium erythraeum* Ehrenberg ex Gomont and *Trichodesmium thiebautii* Gomont ex Gomont. Although some of them have been recorded for many years, only *A. glacialis* has been implicated in patch formation on the surf-zone that has caused a negative effect to tourism (M.C. Villac, personal observation) and was possibly associated with a fishkill event in Itanhaém in 1978 (Zavala-Camin & Yamanaka 1980). The recent report of *C. wailesii*, a large size and thus conspicuous diatom, is in conformity with the contention of Fernandes et al. (2001) that this is indeed a recently introduced species to the Brazilian coast.

2. Interpreting the species list

The use and interpretation of this species list require the perception of some constraints. It is not our role to question the identification made by other researchers. On the other hand, the ability to sample, analyze and identify species has evolved over the years and some considerations in this regard are called for.

Some difficulties in updating nomenclature, for instance, are due to the fact that the genera of the nominate species have changed but the revision of all forms/varieties has not been carried out. The reader will find several examples of this case in the species list, such as:

Diploneis crabro Ehrenberg (= *Navicula crabro*) was updated,
BUT *Navicula crabro* var. *multicostata* (Grunow) Grunow was maintained;

Lyrella hennedyi (W. Smith) Stickle & Mann (= *Navicula hennedyi* W. Smith) was updated,
BUT *Navicula hennedyi* var. *campechiana* Peragallo and *Navicula hennedyi* var. *clavata* Cleve were maintained;

Pinnularia stauroptera (Grunov) Rabenhorst (= *Navicula stauroptera*) was updated,
BUT *Navicula stauroptera* var. *parva* (Ehrenberg) Grunow was maintained;

Psammodictyon panduriforme (Gregory) Mann (= *Nitzschia panduriformis*) was updated,
BUT *Nitzschia panduriformis* var. *minor* Gregory was maintained.

Other cases are even more difficult to resolve as Round et al. (1990; pg. 232) states: "genera in the order Biddulphiales is still in a state of flux. *Amphipentas* is possibly to be included within *Amphitetras* but a position in *Stictodiscus* also needs consideration". The genera *Biddulphia* Gray, *Odontella* Agardh and *Triceratium* Ehrenberg, which are often mentioned in the older literature, fall into this nomenclature/taxonomic problem.

Special taxonomic cases are those regarding the diatoms *P. tricorcutum, S. costatum* and the genus *Pseudo-nitzschia*. Frequently considered in the literature as cosmopolitan and opportunistic, *S. costatum* was the subject of a taxonomic review that revealed that the biodiversity of the genus at any given place is most likely underestimated and it may include more than one species among *S. ardens* Sarno & Zingone, *S. dohrnii* Sarno & Koistra, *S. grethae* Zingone & Sarno, *S. grevillei* Sarno & Zingone, *S. japonicum* Zingone & Sarno, *S. marinoi* Sarno & Zingone, *S. menzelii* Guillard, Carpenter & Reimann, *S. potamus* (Weber) Hasle, *S. pseudocostatum* Medlin, *S. subsalsum* (Cleve) Bethge and/or *S. costatum* itself (Sarno et al. 2007). Electron microscopy and/or molecular biology are required to study the biodiversity of *Skeletonema* species (Kooistra et al. 2008).

The record of *Pseudo-nitzschia* requires some explanation. Most reports for Brazilian waters follow the nomenclature suggested in Hasle (1965) that divides the species of the genus *Nitzschia* that form stepped colonies into two complexes: those cells whose widths are equal or smaller than 3 µm belong to the "delicatissima complex" and those wider than 3 µm belong to the "seriata complex". Alternatively, some publications actually refer just to the occurrence of *N. delicatissima* and/or *N. seriata*. All these can be considered questionable identifications because the methods of analysis used (counting by the settling technique with the inverted microscope) are not adequate for the definite identification, which requires electron microscopy. Therefore, all records were here combined into the two categories suggested by Hasle (1965) and the nomenclature updated to *Pseudo-nitzshia* (Hasle 1994). The present survey is making an effort to determine the biodiversity of this genus, especially because several species are neurotoxin producers, as mentioned above.

The frequent record of *P. tricornutum* is also troublesome because its minute size would necessarily require the use of electron microscopy to differentiate its fusiform form from other small pennate diatoms, a technique that was not used by any of the published studies considered in this assessment. The presence of the triradiate form (see Hasle & Syvertsen 1997, page 269) would certainly confirm the report of this species, but the studies in which *P. tricornutum* was found (refer to Appendix) did not make any reference to detailed morphology.

The listing of some species may raise some questioning in regard to ecological issues. This will be especially true for the oldest records from Zimmermann's publications. There is no information about the exact sampling date and the exact locations are not clear. There is mention of "Santos", "Port of Santos" and "Guaruja beach across from Island Santo Amaro", which is the city of Santos. We suspect that some of the samples might have been taken from places of strong freshwater influence, as indicated by the occurrence of the following genera: *Amphicampa* (Ehrenberg) Ralfs in Pritchard, *Cymbella* Agardh, *Cystopleura* Brébisson ex Kuntze, *Dicladia* Ehrenberg, *Encyonema* Kützing, *Gomphonema* Ehrenberg, *Hantzschia* Grunow, *Melosira* Agardh, *Navicula* Bory de Saint-Vincent, *Nitzschia* Hassall, *Stauroneis* Ehrenberg, *Surirella* Turpin. His species list also includes several genera that are usually epiphytic on marine plants or epipelic on sand or silt, such as *Licmophora* Agardh, *Cocconeis* Ehrenberg and *Surirella* Turpin. We also chose not to exclude the mention of *Stictodiscus californicus* Greville and *Campyloneis curvirotunda* Tempère et Brun that have been cited in the literature as fossil, nor *Goniothecium gastridium* Ehrenberg and *Goniothecium hispidum* Ehrenberg that have been considered as resting spores of *Chaetoceros* Ehrenberg (Round et al. 1990).

Conclusion

The composition and abundance of the phytoplankton of a certain region is certainly associated with the local hydrography. The southern portion of the Brazilian coast, where the state of São Paulo is located, is fairly well studied in terms of meso-scale circulation patterns and contribution of water masses on the continental shelf (Emilsson 1960, Matsuura 1986, Castro Filho & Miranda 1998). The studies considered in this assessment, however, took place in inshore areas where small-scale features should be taken into account. The contribution of warm and oligotrophic waters transported by the Brazil Current will have to be understood in association with different types of land-sources of freshwater, and corresponding levels of nutrient enrichment, coupled with various scenarios of local geomorphology. The northern area of the coast, between Ubatuba and Guarujá, is located in more sheltered areas of half-heart small bays with several points of minor freshwater contribution when compared with the much more conspicuous input of freshwater and nutrient enrichment that come from the metropolitan area of Santos, as well as the Cananéia estuarine system at the southernmost limit of the state (Lamparelli & Moura 1999). Nonethelesss, intrusions of the colder and nutrient-rich South Atlantic Central Water have been related to higher productivity at inshore areas of the northern portion of the coast, especially during the prevailing NE winds of summer months (Castro Filho et al. 1987, Aidar et al. 1993, Gaeta et al. 1995).

The species list provided at present is, therefore, a composite of a very broad spectrum of environmental conditions, dating back to those times of more pristine waters sampled by Zimmermann in the early 1900's. It is beyond the scope of this study to evaluate, case by case, the relationship between species composition and their possible environmental controls. Nevertheless, the results are structured in such a way as to allow the cross-reference between the information provided in Table 1 and the Appendix. A future user will be able to create a species list for a given location, appropriate for a specific need. The understanding of biodiversity and environmental conditions for a particular area of interest could thus result.

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Appendix. Check list of microalgae cited for the coast of the state of São Paulo. Code Z and numbers 1-17 in the heading refer to the code of the publications listed in Table 1.

Apêndice. Inventário das microalgas citadas para o litoral do Estado de São Paulo. Código Z e números 1-17 do cabeçalho correspondem aos códigos das publicações listadas na Tabela 1.

	Present	Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DIATOMS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Achnanthes brevipes Agardh	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Achnanthes brevipes var. *intermedia* (Kützing) Cleve (= *Achnanthes subsessilis*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Achnanthes longipes Agardh	-	x	-	x		x	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Achnanthes pulchra* Zimmermann	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Actinocyclus alienus Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Actinocyclus divisus (Grunow) Hustedt (= *Coscinodiscus divisus*)	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Actinocyclus octonarius Ehrenberg (= *Actinocyclus ehrenbergi*? var. *moniliformis*?)	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Actinocyclus octonarius Ehrenberg (= *Actinocyclus ehrenbergi*)	-	-	-	x	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-
Actinocyclus octonarius var. *crassus* (W. Smith) Hendey (= *Actinocyclus crassus*)	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Actinocyclus platensis Müller Melchers	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Actinoptychus adriaticus var. *pumila* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Actinoptychus campanulifer Schmidt	-	-	-	-	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-
Actinoptychus crepido Schmidt	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Actinoptychus glabratus var. *glabratus* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Actinoptychus ranunculus Brun	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
* *Actinoptychus senarius* (Ehrenberg) Ehrenberg (= *Actinopthycus undulatus*)	x	x	x	x		x	x	x	-	x	-	-	-	-	-	-	-	-	x
Actinoptychus splendens (Shadbolt) Ralfs ex Pritchard	-	x	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Actinoptychus vulgaris Schumann	x	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Actynocyclus curvatulus Janisch in Schmidt (= *Coscinodiscus curvatulus*)	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphicampa eruca Ehrenberg	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
†*Amphipentas juncta* (Schmidt) De Toni	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphiprora alata Kützing	-	-	-	-	-	x	x	x	-	x	-	-	-	-	-	-	-	-	-
Amphiprora conspicua Greville	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphiprora pulchra Bailey	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Amphitetras antediluviana* Ehrenberg (= *Biddulphia antediluviana*)	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphora acutiuscula Kützing	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphora decussata Grunow	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphora javanica Schmidt	-	-	-	-	-	-	-	x		-	-	-	-	-	-	-	-	-	-
Amphora ovalis (Kützing) Kützing	-	-	-	-	-	-	-	x		-	-	-	-	-	-	-	-	-	-
Amphora salina W. Smith	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Anaulus australis* Drebes & D. Schulz	x		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arachnoidiscus ehrenbergii Bailey ex Ehrenberg	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Ardissonia formosa* (Hantzsch) Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ardissonia fulgens (Greville) Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ardissonia fulgens var. *gigantea* (Lobarz.) Rabenhorst	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
** *Asterionellopsis glacialis* (Castracane) Round (= *Asterionella glacialis*; *Asterionella japonica*)	x	-	x	x	-	x	x	-	x	x	-	x	-	-	x	x	-	-	x

Appendix. Continued...

	Present	Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Asteromphalus elegans Greville	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asteromphalus flabellatus (Brébisson) Greville	x	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
Asteromphalus heptactis (Brébisson) Ralfs	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asteromphalus hookerii Ehrenberg	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asteroplanus karianus (Grunow) Gardner & Crawford (= *Asterionellopsis kariana*; = *Asterionella kariana*)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-
Aulacodiscus argus (Ehrenberg) Schmidt	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Aulacoseira granulata* (Ehrenberg) Simonsen	x		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Auliscus caelatus var. *latecostata* Schmidt	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Auliscus punctatus Bailey	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Auliscus sculptus (W. Smith) Ralfs ex Pritchard (= *Auliscus caelatus*)	-	x	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Bacillaria paxillifera (Müller) Hendey (= *Bacillaria paradoxa*; *Nitzschia paradoxa*)	x	-	-	x	-	x	-	-	-	x	-	-	-	-	-	-	-	-	-
* *Bacteriastrum delicatulum* Cleve	x	-	-	x	-	x	x	x	-	-	x	x	-	-	-	-	-	-	-
Bacteriastrum furcatum Shadbolt (= *Bacteriastrum varians*)	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bacteriastrum hyalinum Lauder	x	-	x	x	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-
§ *Bellerochea malleus* (Brightwell) Van Heurck	x	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Berkeleya scopulorum (Brébisson ex Kützing) Cox (= *Navicula scopulorum*)	-	-	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biddulphia alternans (Bailey) Van Heurck (= *Triceratium alternans*)	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Biddulphia antediluviana* (Ehrenberg) Van Heurck (?var. *excavata*? Frenguelli)	-	-	-	x		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biddulphia biddulphiana (J.E. Smith) Boyer (= *Biddulphia pulchella*)	x	x	-	x		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biddulphia dubia (Brightwell) Cleve	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Biddulphia obtusa (Kützing) Ralfs (= *Biddulphia roperiana*)	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Biddulphia reticulata* Roper	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biddulphia reticulum (Ehrenberg) Boyer (= *Triceratium punctatum*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biddulphia tuomeyii (Bailey) Roper (= *Biddulphia tuomezii*)	x	x	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
§ *Bleakeleya notata* (Grunow) Round	x		-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Caloneis bivittata* (Pantocsek) Cleve	-		-		-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Caloneis westii (W. Smith) Hendey (= *Navicula formosa*)	-	x	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Campylodiscus clypeus (Ehrenberg) Ehrenberg ex Kützing	-	x	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Campylodiscus daemelianus Grunow	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Campylodiscus fastuosus Ehrenberg (= *Campylodiscus thuretii*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Campylodiscus guarujanus* Zimmermann	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Campyloneis curvirotunda* Tempère et Brun	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Campyloneis maxima* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Catacombus gaillonii (Bory) Williams & Round (= *Synedra gaillonii*)	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cerataulina dentata Hasle	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-
* *Cerataulina pelagica* (Cleve) Hendey (= *Cerataulina bergonii*)	x	-	-	-		x	x	x	-	x	-	x	-	-	-	x	-	-	-
Cerataulus smithii Ralfs ex Pritchard	-	-	-	x	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-

Appendix. Continued...

	Present	Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Chaetoceros abnormis Proshkina-Lavrenko	x	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
§ *Chaetoceros aequatorialis* Cleve	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chaetoceros affinis Lauder	-	-	-	x	-	x	-	-	-	-	-	x	-	-	-	x	-	-	-
Chaetoceros apendiculatus Müller Melchers	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chaetoceros atlanticus Cleve	-	-	-	-	-	-	-	x		x	-	-	-	-	-	-	-	-	-
Chaetoceros brevis Schütt	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† § *Chaetoceros* cf. *constrictus* Gran	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Chaetoceros* cf. *karianus* Grunow	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chaetoceros coarctatus Lauder	x	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-
§ *Chaetoceros concavicorne* Mangin	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chaetoceros confertus Müller Melchers	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chaetoceros contortus Schütt (= *Chaetoceros compressus*)	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-
Chaetoceros convolutus Castracane	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Chaetoceros costatus* Pavillard	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
* *Chaetoceros curvisetus* Cleve	x	-	x	x	-	x	x			x			-	-	-	x	-	-	-
§ *Chaetoceros dadayi* Pavillard	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Chaetoceros danicus* Cleve	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chaetoceros debilis Cleve	x	-	-	x	-	-		-	-	-	-	-	-	-	-	-	-	-	-
Chaetoceros decipiens Cleve	x	-	-		-	-	x	-	-	-	-	x	-	-	-	-	-	-	-
Chaetoceros didymus Ehrenberg	x	-	-	x	-	-	-	x				x	-	-	x	-	-	-	-
Chaetoceros diversus Cleve	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chaetoceros furcellatus Bailey	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Chaetoceros* cf. *gracilis* Schütt	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		x	-
§ *Chaetoceros laciniosus* Schütt	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
* *Chaetoceros laevis* Leuduger-Fortmorel	x	-	-	-		x	x	x	-	x	-	x	-	-	-	-	-	-	-
§ *Chaetoceros lauderi* Ralfs	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
* *Chaetoceros lorenzianus* Grunow	x	-	-	x		x	x		-		-	x	-	-	-	-	-	x	-
§ *Chaetoceros pelagicus* Cleve	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chaetoceros pendulus Karsten	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Chaetoceros peruvianus Brightwell	x	-	-	x		x	-	-	-	x	-	x	-	-	-	-	-	-	-
Chaetoceros pseudocurvisetus Mangin	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Chaetoceros rostratus* Lauder	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Chaetoceros similis* Cleve	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chaetoceros simplex Ostenfeld	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Chaetoceros socialis Lauder	x					x			-	-	-	-	-	-	-	-	-	-	-
Chaetoceros subtilis Cleve	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-
Chaetoceros subtilis var. *abnormis* Prosckina-Lavrenko	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
Chaetoceros tenuissimus Meunier	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	x
§ *Chaetoceros tetrastichon* Cleve	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Chaetoceros tortissimus* Gran	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Climacodium frauenfeldianum Grunow	x	-	-	-	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-
Climacosphenia elongata Mereschkowsky	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Climacosphenia moniligera Ehrenberg	x	x	-	x	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Cocconeis costata var. *kerguelensis* (Petit) Cleve	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cocconeis dirupta Gregory	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cocconeis dirupta var. *flexella* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cocconeis heteroidea Hantzsch	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cocconeis pseudomarginata Gregory	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cocconeis scutellum Ehrenberg	-	x	-	x	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-

Appendix. Continued...

	Present	Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
† *Cocconeis scutellum* var. *adjuncta* Schmidt	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Cocconeis scutellum* var. *distans* (Gregory) Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Cocconeis scutellum* var. *riparia* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
* *Corethron pennatum* (Grunow) Ostenfeld (= *C. criophilum*)	x	-	x	x	-	x	x	x	-	x	x	x	-	-	-	-	-	-	-
Coscinodiscus apiculatus var. *ambigua* A. Grunow	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus asteromphalus Ehrenberg	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus brasiliensis Müller Melchers	-	-	-	x	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
† *Coscinodiscus californicus* var. *ecostatus* Schmidt	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus concinnus W. Smith	-	-	-	x	-		x	-	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus devius Schmidt	-	-	-	x	-	-	-	-	-	-	-	-	-	-		-	-	-	-
Coscinodiscus gigas Ehrenberg	-	-	-	x	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-
Coscinodiscus granii Gough	x	-	x	x	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-
† *Coscinodiscus hanckii* Grunow	-	x			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus heteroporus Ehrenberg	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus jonesianus (Greville) Ostenfeld	x	-	-	x	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-
Coscinodiscus kurzii Grunow	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus marginatus Ehrenberg	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
Coscinodiscus nitidus Gregory	-	-	-	x	-	x	-	x	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus obscurus Schmidt	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
* *Coscinodiscus oculus-iridis* (Ehrenberg) Ehrenberg	-	x	x	x	-	-	x	x	-	x	-	-	-	-	-	-	-	-	-
Coscinodiscus pavillardi Forti	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus perforatus Ehrenberg	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus punctiger (Castracane degli Antelminelli) Müller Melchers	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus radiatus Ehrenberg	-	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus radiatus var. *minor* (Schmidt) Rattray	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus robustus var. *kittoniana* Rattray	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus subconcavus Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus symmetricus Greville	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus variabilis Frenguelli	-	-	-	x		-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Coscinodiscus wailesii* Gran & Angst	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cosmioneis pusilla (W. Smith) Mann & Stickle (= *Navicula pusilla*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Craticula perrotettii Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ctenophora pulchella (Ralfs ex Kützing) Williams & Round (= *Synedra pulchella*)	-	-	-	-		x	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyclotella baltica (Grunow) Håkansson (= *Cyclotella striata* var. *baltica*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Cyclotella litoralis* Lange & Syvertsen	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyclotella meneghiniana Kützing	-	x		x		x	-	-	-		-	-	-	-	-	-	-	-	-
Cyclotella striata (Kützing) Grunow	-	x	-	-			x	-	-	x	-	-	-	-	-	-	-	-	-
Cyclotella striata var. *mesoleia* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
* *Cyclotella stylorum* Brightwell	x	x	-	x		x	x	x	-	x	-	-	-	-	-	-	-	-	-
* *Cylindrotheca closterium* (Ehrenberg) Lewin & Reimann	x	-	-	-		x	-	x	-	x	-	-	x	-	-	-	-	-	-
Cymatosira adaroi Azpeitia Moros	-	-	-	x		x	-	-	-	x	-	-	-	-	-	-	-	-	-
Cymatosira lorenziana Grunow	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix. Continued...

	Present	Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Cymbella aspera (Ehrenberg) Cleve (= *Cymbella gastroides*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cymbella lanceolata (Ehrenberg) Kirchner	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cystopleura gibba (Ehrenberg) Kuntze	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cystopleura gibberula (Ehrenberg) Kuntze	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Cystopleura musculus* (Kuetz.) Kunze	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cystopleura turgida (Ehrenberg) Kuntze	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Cystopleura turgida* var. *granulata* (Ehrenberg) Brun	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cystopleura zebra (Ehrenberg) Kuntze	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
* *Dactyliosolen fragilissimus* (Bergon) Hasle (= *Rhizosolenia fragilissima*)	x	-	-	-	-	x	-	-	-	-	x	x	-	x	-	x	-	x	x
Dactyliosolen phuketensis (Sundström) Hasle (= *Rhizosolenia huketensis*)	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-
Delphineis surirella (Ehrenberg) Andrews (= *Raphoneis surirella*)	-	-	-	x	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
† *Denticella seticulosa* (Greville) Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Denticula antillarum* Cleve et Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Denticula dusenii Cleve	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Detonula pumila* (Castracane) Gran	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dicladia capreola Ehrenberg	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dimeregramma marinum (Gregory) Ralfs ex Pritchard	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diploneis bomboides (Schmidt) Cleve	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diploneis bombus (Ehrenberg) Cleve	-	-	-	-		x	-	-	-	-	-	-	-	-	-	-	-	-	-
Diploneis chersonensis (Grunow) Cleve	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diploneis coffaeiformis (Schmidt) Cleve	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Diploneis crabro Ehrenberg (= *Navicula crabro*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diploneis fusca (Gregory) Cleve (= *Navicula fusca*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diploneis gruendleri (Schmidt) Cleve	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diploneis interrupta (Kützing) Cleve (= *Navicula interrupta*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diploneis litoralis (Donkin) Cleve	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diploneis nitescens (Gregory) Cleve	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diploneis ovalis (Hilse) Cleve	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Diploneis smithii (Brébisson) Cleve	-	-	-	-	x	-	-		-	-	-	-	-	-	-	-	-	-	-
Diploneis splendida (Gregory) Cleve (= *Navicula splendida*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diploneis weissflogii (Schmidt) Cleve	x	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-
* *Ditylum brightwellii* (T. West) Grunow	x	-	x	x		x	x			x		x	-	-	x	-	-	-	-
Encyonema prostratum (Berkeley) Kützing	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endictya oceanica Ehrenberg	-	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eucampia cornuta (Cleve) Grunow	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eucampia zoodiacus Ehrenberg	x	-	-	-	-	-	-	x	-	-	-	x	-	-	-	-	-	-	-
Eunotia serpentina var. *transilvanica* (Pantocsek) Hustedt	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eunotogramma variabile Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eupodiscus antiquus Cox	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eupodiscus radiatus Bailey	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fragilariopsis doliolus (Wallich) Medlin & Sims (= *Pseudoeunotia doliolus*)	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-

Appendix. Continued...

	Present	Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Frickea lewisiana (Greville) Heiden	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Frustulia rhomboides (Ehrenberg) De Toni	-		-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Glyphodesmis eximia Greville	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gomphonema brasiliense var. *demerarae* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gomphonema exiguum var. *arctica* (Grunow) Cleve	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Gomphonema subclavatum* var. *sparsistriata* f. *minor* Schmidt	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Goniothecium gastridium* Ehrenberg	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Goniothecium hispidum* Ehrenberg	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grammatophora angulosa Ehrenberg	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grammatophora gibberula Kützing	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grammatophora marina (Lyngbye) Kützing	x	x	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Grammatophora oceanica Ehrenberg	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grammatophora serpentina Ehrenberg	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
* *Guinardia delicatula* (Cleve) Hasle (= *Rhizosolenia delicatula*)	x	-	-	-	-	x	-	x	-	-	-	-	x	-	-	-	-	x	x
* *Guinardia flaccida* (Castracane) H. Peragallo	x	-	-	x	-	-	x	x	-	x	-	x	-	-	x	x	-	-	x
** *Guinardia striata* (Stolterfoth) Hasle (= *Rhizosolenia stolterfothii*)	x	-	x	-	-	x	x	x	-	x	x	x	x	-	-	x	-	x	-
* *Gyrosigma balticum* (Ehrenberg) Rabenhorst	x	-	-	x	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Gyrosigma balticum* var. *wansbeckii* Donk	-	-	-		x		-	-	-	-	-	-	-	-	-	-	-	-	-
Gyrosigma fasciola (Ehrenberg) Griffith & Henfrey	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gyrosigma fasciola var. *arcuatum* (Donkin) Cleve	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Gyrosigma itaparicanum* Zimmermann	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gyrosigma strigile (W. Smith) Cleve	-		x	x		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hantzschia amphioxys (Ehrenberg) Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hantzschia amphioxys var. *capitata* Müller	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hantzschia virgata (Roper) Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Haslea wawrikae* (Husedt) Simonsen	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helicotheca tamesis (Shrubsole) Ricard (= *Streptotheca tamesis*)	x	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
Hemiaulus hauckii Grunow ex Van Heurck	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Hemiaulus membranaceus Cleve	x	-	-	-	-	-	x	x	-	x	-	x	-	-	-	-	-	-	-
* *Hemiaulus sinensis* Greville	x	-	-	x	-	-	x	-	-	x	x	x	-	-	-	x	-	-	-
Hemidiscus cuneiformis Wallich	-	-	-	x	-	-		-	-	-	-	-	-	-	-	-	-	-	-
Hemidiscus ovalis (Gersonde) Harwood & Maruyama	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Hyalodiscus scoticus (Kützing) Grunow	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hyalodiscus stelliger Bailey	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hyalosynedra laevigata (Grunow) Williams & Round (= *Synedra laevigata*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Hydrosera brasiliensis* Zimmermann	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Isthmia enervis Ehrenberg (= *Isthmiella enervis*)	x	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Isthmia minima* Harvey & Bailey	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Isthmia nervosa Kützing	x	x	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lauderia annulata Cleve (= *Lauderia borealis*)	x	-	-	x	-	x	-	-	-	x	-	-	-	-	-	x	-	-	-
** *Leptocylindrus danicus* Cleve	x	-	-	x	-	-	x	x	-	x	x	x	-	x	-	x	-	-	x

Appendix. Continued...

	Present	Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Leptocylindrus mediterraneus (Peragallo) Hasle (= *Dactyliosolen mediterraneus*)	-	-	-	x	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-
Leptocylindrus minimus Gran	x	-	-	-	-	-	-	-	-	-	-	x	-	x	-	x	-	-	x
Licmophora lyngbyei (Kützing) Grunow ex Van Heurck (= *Licmophora abbreviata*)	x	x	x	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-
† *Licmophora tincta* (Agardh) Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lioloma pacificum (Cupp) Hasle (= *Thalassiothrix mediterranea* var. *pacifica*)	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lithodesmium undulatum Ehrenberg	x	-	-	x		x	x	-	-	x	-	-	-	-	-	-	-	-	-
Lyrella hennedyi (W. Smith) Stickle & Mann (= *Navicula hennedyi*)	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lyrella lyra (Ehrenberg) Karajeva (= *Navicula lyra*; = *Navicula lyra* var. *ehrenbergi*)	-	-	-	x	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Martyana martyi (Héribaud) Round (= *Opephora martyi*)	-	-	-	x		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mastogloia apiculata W. Smith	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mastogloia binotata (Grunow) Cleve	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mastogloia brauni Grunow	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mastogloia decussata Grunow	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mastogloia fimbriata (Brightwell) Cleve	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Mastogloia smithii* var. *pusilla* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mastogloia splendida (Gregory) Cleve	-		-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Melosira borreri Greville	-		x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Melosira granulata var. *angustissima* Müller	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Melosira moniliformis (Müller) Agardh	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-
Melosira setosa Greville	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Melosira varians Agardh	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meuniera membranacea (Cleve) Silva	x	-	-	-	-	-	-	x	-	x	x	x	-	-	-	-	-	-	-
† *Navicula aspera* var. *vulgaris* Cleve	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula bacilliformis Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula bottnica Grunow (= *Navicula smithii*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula braunii Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula bullata Norman	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula clavata var. *caribaea* (Cleve) Peragallo	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Navicula crabro* var. *multicostata* (Grunow) Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula crucicula (W. Smith) Donkin	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula dariana Schmidt	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula didyma (Ehrenberg) Kützing	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula elliptica Kützing	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula eximia (Grunow) Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Navicula floridae* Brun	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula forcipata var. *versicolor* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula gentilis Donkin	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Navicula guarujana* Zimmermann	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Navicula hennedyi* var. *campechiana* Peragallo	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Navicula hennedyi* var. *clavata* Cleve	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula iridis var. *affinis* (Ehrenberg) Van Heurck	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula latiuscula Kützing	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Navicula liber* var. *umbilicata* Peragallo	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix. Continued...

	Present	Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Navicula longa Ralfs ex Pritchard	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula lyra var. *gibba* Peragallo	-	x	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
Navicula marina Ralfs ex Pritchard (= *Navicula punctulata* var. *marina*)	-	-	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula mesolepta Ehrenberg	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula mesolepta var. *stauroneiformis* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula minima Grunow	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula nobilis var. *dactylus* (Ehrenberg) Van Heurck	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula nodosa Ehrenberg	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula palpebralis Brébisson	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula pennata Schmidt	-	-	-	-	x		-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula rostellata Kützing (= *Navicula rhyncocephala* var. *rostellata*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula serians var. *brachysira* (Brébisson) Van Heurck	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula serians Brébisson ex Kützing	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula singularis Maillard	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula stauroptera var. *parva* (Ehrenberg) Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula subcarinata (Grunow ex Schmidt) Hendey (= *Navicula lyra* var. *subcarinata*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula tabellaria (Ehrenberg) Kützing	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula trigonocephala (Ehrenberg) Ralfs	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula tubulosa Brun	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula viridula (Kützing) Kützing	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Navicula viridula* f. *subsalina* Zimmermann	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Neocalyptrella robusta (Norman ex Ralfs) Hernández-Becerril & Meave del Castillo (= *Rhizosolenia robusta*)	x	-	-	x	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia angularis W. Smith	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia bilobata W. Smith	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia circumsuta (Bailey) Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia granulata Grunow	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia littoralis Grunow	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia longissima (Brébisson in Kützing) Ralfs	-	-	-	-	-	x	x	x	-	-	-	-	-	-	-	-	-	-	-
Nitzschia lorenziana Grunow	-	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-
Nitzschia obtusa var. *nana* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia obtusa W. Smith	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia obtusa W. Smith	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Nitzschia panduriformis* var. *minor* Gregory	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Nitzschia rigida* var. *rigidula* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia sigma (Kützing) W. Smith	-	-	-	-	-	-		x	-	-	-	-	-	-	-	-	-	-	-
Nitzschia sigma var. *sigmatella* (Gregory) Grunow	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia tryblionella Hantzsch	-	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia tryblionella var. *levidensis* (W. Smith) Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia ventricosa Kitton	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia vermicularis (Kützing) Hantzsch	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia vidovichii Grunow	-	-	-	-	-	-	x		-	-	-	-	-	-	-	-	-	-	-

Appendix. Continued...

	Present	Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Nitzschia vivax W. Smith	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Nitzshia insignis* Gregory	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Nitzshia punctata* (W. Smith) Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Odontella aurita (Lyngbye) Agardh	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Odontella longicruris (Greville) Hoban (= *Biddulphia longicruris*)	x	-	-	-	-	x	x	x	-	x	-	-	-	-	-	-	-	-	-
* *Odontella mobiliensis* (Bailey) Grunow (= *Biddulphia mobiliensis*)	x	x	x	x	-	x	x	x	-	x	-	x	-	-	x	-	-	-	-
§ *Odontella obtusa* Kützing	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Odontella regia (Schultze) Simonsen (= *Biddulphia regia*)	-	-	-	x	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-
Odontella rhombus (Ehrenberg) Kützing (= *Biddulphia rombus*)	x	-	-	x	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-
Odontella sinensis (Greville) Grunow (= *Biddulphia sinensis*)	x	-	-	x	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-
Odontella turgida (Ehrenberg) De Toni	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Palmerina hardmaniana (Greville) Hasle (= *Palmeria hardmaniana* ; = *Hemidiscus hardmanianus*)	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
** *Paralia sulcata* (Ehrenberg) Cleve (= *Melosira sulcata*)	x	x	x	x	-	x	x	x	-	x	-	x	-	-	x	x	-	-	-
Paralia sulcata f. *coronata* (Ehrenberg) Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paralia sulcata f. *radiata* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petrodictyon gemma (Ehrenberg) Mann (= *Surirella gemma*)	-	x	x	x	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-
Petroneis plagiostoma (Grunow) Mann (= *Navicula plagiostoma*)	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
* *Phaeodactylum tricornutum* Bohlin	-	-	-	-	-	-	-	x	-	x	-	x	-	-	-	-	-	x	x
Pinnularia cardinalis (Ehrenberg) W. Smith (= *Navicula cardinalis*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pinnularia latevittata Cleve	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-
Pinnularia stauroptera (Grunow) Rabenhorst (= *Navicula stauroptera*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pinnularia viridis (Nitzsch) Ehrenberg (= *Navicula viridis*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Plagiogramma obesum* Greville	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Plagiogramma staurophorum* var. *robustum* Brun in Tempère	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Plagiotropis zebra* Cleve	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pleurosigma acutum f. *brasiliana* Müller Melchers	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pleurosigma acutum Norman ex Ralfs	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pleurosigma angulatum (Queckett) W. Smith	-	-	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	-
† *Pleurosigma angulatum* var. *densestriata* Andrade & Teixeira	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pleurosigma angulatum W.Smith	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pleurosigma elongatum W. Smith	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
Pleurosigma formosum W. Smith	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Pleurosigma hippocampus (Ehrenberg) W. Smith	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Pleurosigma intermedium* var. *mauritiana* Grunow	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pleurosigma naviculaceum Brébisson	-	-	-	x	x	x	-	-	-	x	-	-	-	-	-	-	-	-	-

Appendix. Continued...

	Present	Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Pleurosigma normanii Ralfs	-	x	-	x	x	-	-	-	-	x	-	-	-	-	-	-	-	-	-
† *Pleurosigma rhomboides* (Ehrenberg) De Toni	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pleurosigma strigilis W. Smith	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pleurosira laevis (Ehrenberg) Compère (= *Biddulphia laevis*)	-	-	-	x		x	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Pleurostauron acutum* (W. Smith) Rabenhorst	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Podosira maxima (Kützing) Grunow	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Podosira stelliger (Bailey) Mann	-	-	-	x	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
* *Proboscia alata* (Brightwell) Sündstrom (= *Rhizosolenia alata*)	x	-	-	x	-	-	x	x	-	x	-	x	-	-	-	-	-	-	-
Psammodictyon panduriforme (Gregory) Mann (= *Nitzschia panduriformis*)	-	x	-	-	-	-	x	x	-	x	-	-	-	-	-	-	-	-	-
† *Pseudoauliscus radiatus* (Bailey) Rattraz	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Pseudo-nitzschia "delicatissima"* (= *Nitzshia delicatissima*)	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	x	x
† * *Pseudo-nitzschia* "*seriata*" (= *Nitzschia seriata*)	-	-	x	-	-	-	x	-	-	-	-	-	x	-	-	-	-	x	x
§ *Pseudo-nitzschia calliantha* Lundholm, Moestrup & Hasle	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Pseudo-nitzschia delicatissima* (Cleve) Heiden	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Pseudo-nitzschia fraudulenta* (Cleve) Hasle	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Pseudo-nitzschia multistriata* (Takano) Takano	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Pseudo-nitzschia pungens* (Grunow ex Cleve) Hasle	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudosolenia calcar-avis (Schultze) Sundström (= *Rhizosolenia calcar-avis*)	x	-	-	x	-	-	x	x	-	-	-	x	-	-	-	-	-	-	-
Raphoneis castracanei Grunow	-	-	-	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhabdonema adriaticum Kützing	-	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhabdonema arcuatum (Lyngbye) Kützing	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhaphoneis amphiceros (Ehrenberg) Ehrenberg	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Rhizosolenia acuminata* (H. Peragallo) H. Peragallo	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizosolenia bergonii H. Peragallo	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
§ *Rhizosolenia castracanei* H. Peragallo	x	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizosolenia hebetata Bailey	x	-		-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
Rhizosolenia hebetata f. *semispina* (Hensen) Gran (= *Rhizosolenia semispina*)	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizosolenia hyalina Ostenfeld	x	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-
* *Rhizosolenia imbricata* Brightwell (= *Rhizosolenia imbricata* var. *shrubsolei*)	x	-	-	x		x	x	x	-	-	-	x	-	-	-	-	-	-	-
§ *Rhizosolenia pungens* Cleve-Euler	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
* *Rhizosolenia setigera* Brightwell	x	-	-	x		x	x	x	-	x	-	x	-	-	-	-	-	-	-
Rhizosolenia styliformis Brightwell	x	-	-	-	-		x	-	-	-	-	x	-	-	-	-	-	-	-
† *Schizonema liebmannii* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Schizostauron brasiliense* Zimmermann	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Schizostauron crucicula* Grunow	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† * *Skeletonema costatum* (Greville) Cleve	-	-	-	x		x	x	x	x	x	x	x		x	x	x	x	-	x
§ *Skeletonema tropicum* Cleve	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Stauroneis acuta* var. *terryana* Tempère	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stauroneis phoenicenteron Ehrenberg	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix. Continued...

	Present	Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Stauroneis schinzii Brun	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stellarima stellaris (Roper) Hasle & Sims (= *Coscinodiscus stellaris*)	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stephanopyxis palmeriana (Greville) Grunow	x	-	-	x	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-
* *Stephanopyxis turris* (Greville) Ralfs ex Pritchard	x	-	x	x	-	-	x	-	-	x	-	x	-	-	-	-	-	-	-
Stictodiscus californicus Greville	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Streptotheca tamesis* Shrubsole	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Striatella unipunctata (Lyngbye) Agardh	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Surirella davidsonii Schmidt	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Surirella fastuosa* (Ehrenberg) Kützing	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Surirella fastuosa* var. *cuneata* (Schmidt) H. Peragallo & M. Peragallo	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surirella febigerii Lewis	-	x	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Surirella gruendleri Janisch	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surirella kittoni Schmidt	-		-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-
Surirella ovalis Brébisson	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surirella ovalis var. *ovata* (Kützing) Van Heurck	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surirella praeclare Schmidt	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surirella recedens Schmidt	-		-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Surirella robusta Ehrenberg	-	x	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-
Surirella rorata Frenguelli	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Surirella tenera var. *nervosa* Schmidt	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surirella tenera var. *splendidula* Schmidt et al.	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Synedra affinis* var. *fasciculata* (Kützing) Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Synedra affinis* var. *hybrida* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Synedra affinis* var. *intermedia* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Synedra affinis* var. *obtusa* Hustedt	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Synedra affinis* var. *parva* Van Heusen	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Synedra affinis* var. *tabulata* (Agardh) Van Heusen	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Synedra crystallina (Agardh) Kützing	-		-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Synedra fasciculata (Agardh) Kützing (= *Synedra affinis*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Synedra gallioni* var. *macilenta* Peragallo	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Synedra investiens W. Smith	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Synedra investiens W. Smith	-		-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Synedra ulna (Nitzsch) Ehrenberg	-	x	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Synedra ulna var. *amphirhynchus* (Ehrenberg) Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Synedra ulna var. *amphirhynchus* (Ehrenberg) Grunow	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Synedra ulna var. *splendens* (Kützing) Brun	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Synedra ulna var. *subaequalis* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Terpsinoe americana (Bailey) Ralfs	-	x	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thalassionema frauenfeldii (Grunow) Hallegraeff (= *Thalassiothrix frauenfeldii*)	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-
**Thalassionema nitzschioides* (Grunow) Mereschkowsky	x	-	x	x	-	x	x	x	x	x	x	x	-	-	x	x	-	-	-
Thalassiosira decipiens (Grunow) Jørgensen (= *Coscinodiscus decipiens*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix. Continued...

	Present	Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Thalassiosira eccentrica (Ehrenberg) Cleve (= *Coscinodiscus excentricus*)	-	-	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
Thalassiosira eccentrica var. *micropora* Grunow (= *Coscinodiscus excentricus* var. *micropora*)	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thalassiosira hendeyi Hasle & Fryxell (= *Coscinodiscus hustedtii*)	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thalassiosira leptopus (Grunow ex Van Heurck) Hasle & Fryxell (= *Coscinodiscus lineatus*)	-	-	-	x	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
Thalassiosira pacifica Gran & Angst	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
§ *Thalassiosira rotula* Meunier	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thalassiosira subtilis (Ostenfeld) Gran	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxarium undulatum Bailey (= *Synedra undulata*)	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trachyneis aspera (Ehrenberg) Cleve	-		-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trachyneis aspera var. *intermedia* (Grunow) Cleve (= *Navicula aspera* var. *intermedia*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Trachysphenia australis* var. *aucklandica* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triceratium bergonii Tempère & Brun	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triceratium biquadratum Janisch	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triceratium distictum Barker & Meakin	-		x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Triceratium distinctum* Janisch	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triceratium favus Ehrenberg	x	x	-	x		x	x		-	x	-	-	-	-	-	-	-	-	-
Triceratium favus var. *quadrata* Grunow	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triceratium formosum Brightwell	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triceratium patagonicum Schmidt	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Triceratium pentacrinus (Ehrenberg) Wallich	-	x		x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triceratium scitulum f. *quadrata* Schmidt	-	x			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tryblionella littoralis (Grunow) Mann (= *Nitzschia littoralis*)	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DINOFLAGELLATES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Alexandrium fraterculus* (Balech) Balech	x	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
Amphisolenia bidentata Schröder		-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Ceratium breve (Ostenfeld & Schmidt) Schröder	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Ceratium carriense Gourret	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Ceratium contortum (Gourret) Cleve		-	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	-
Ceratium declinatum (Karsten) Jørgensen		-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
§ *Ceratium declinatum* var. *angusticornum* (Peters) Taylor	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Ceratium declinatum* var. *majus* Jørgensen	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ceratium euarcuatum Jørgensen	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Ceratium extensum (Gourret) Cleve	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
§ *Ceratium falcatum* (Kofoid) Jørgensen	x	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
Ceratium furca (Ehrenberg) Claparéde & Lachmann	x	-	x	-	-	-	-	x	-	x	-	-	-	-	x	-	-	-	-
§ *Ceratium furca* var. *eugrammum* (Ehrenberg) Jørgensen	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ceratium fusus (Ehrenberg) Dujardin	x	-	x	-	-	-	-	x	-	x	-	-	-	-	x	-	-	-	-
Ceratium gibberum Gourret	-	-	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	-
Ceratium gravidum Gourret	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Ceratium hexacanthum Gourret	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-

Appendix. Continued...

	Present	Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
§ *Ceratium hircus* Schröder	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Ceratium horridum* (Cleve) Gran	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Ceratium humile* Jørgensen	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ceratium inflatum (Kofoid) Jørgensen	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Ceratium karsteni Pavillard	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
§ *Ceratium kofoidii* Jørgensen	x	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
Ceratium longirostrum Gourret	-	-	x	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Ceratium lunula (Schimper ex Karsten) Jørgensen	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
§ *Ceratium macroceros* (Ehrenberg) Vanhöffen	x	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
Ceratium macroceros var. *gallicum* Kofoid		-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Ceratium massiliense (Gourret) Jørgensen	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Ceratium pentagonum var. *robustom* Cleve	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Ceratium pentagonum var. *tenerum* Jørgensen	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
§ *Ceratium pulchellum* Schröder	x	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
Ceratium sumatranum (Karsten) Jørgensen	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
§ *Ceratium symmetricum* Pavillard	x	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
Ceratium tenue (Ostenfeld & Schmidt) Jørgensen	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Ceratium teres Kofoid	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
§ *Ceratium deflexum* (Kofoid) Jørgensen	x	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
Ceratium trichoceros (Ehrenberg) Kofoid	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Ceratium tripos (Müller) Nitzsch	x	-	x	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
† *Ceratium tripos* var. *tripodioides* (Jørgensen) Paulsen	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
§ *Ceratium tripos* var. *atlanticum* (Ostenfeld) Paulsen	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
† *Ceratium vultur* var. *recurvum* (Jørgensen) Schiller	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
§ *Corythodinium michaelsarsi* (Gaarder) Taylor	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Corythodinium tesselatum* (Stein) Loeblich Jr. & Loeblich III	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinophysis acuminata Claparède & Lachmann	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
§ *Dinophysis argus* (Stein) Abé	x	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
Dinophysis caudata Saville-Kent	x	-	x	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	-
§ *Dinophysis hastata* Stein	x	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
Dinophysis rapa (Stein) Balech	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
§ *Dinophysis rotundata* Claparède & Lachmann	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinophysis tripos Gourret	x	-	x	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
Goniodoma polyedricum (Pouchet) Jørgensen		-	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	-
§ *Gonyaulax* cf. *verior* Sournia	x	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
Gonyaulax digitale (Pouchet) Kofoid		-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
§ *Gymnodinium catenatum* Graham	x	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
§ *Mesoporos perforatus* (Gran) Lillick (= *Porella perforata*)	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Noctiluca scintillans (Macartney) Kofoid et Swezy	x	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
§ *Ornithocercus thumii* (Schmidt) Kofoid & Skogsberg	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Oxyphysis oxytoxoides* Kofoid	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Oxytoxum milneri* Murray & Whitting	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oxytoxum scolopax Stein	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-

Appendix. Continued...

	Present	Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
§ *Peridinium quinquecorne* Abé	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Podolampas bipes Stein	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
§ *Podolampas elegans* Schütt	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Podolampas palmipes* Stein	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prorocentrum compressum (Bailey) Abé ex Dodge	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
§ *Prorocentrum cordatum* (Ostenfeld) Dodge	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prorocentrum gracile Schütt	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-
Prorocentrum micans Ehrenberg	x	-	-	-	-	-	-	x	-	-	-	-	x	-	-	-	-	-	-
§ *Prorocentrum sigmoide* Bohm	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Protoperidinium* cf. *tenuissinum* (Kofoid) Balech	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Protoperidinium crassipes (Kofoid) Balech	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Protoperidinium depressum (Bailey) Balech	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Protoperidinium divergens (Ehrenberg) Balech	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Protoperidinium grande (Kofoid) Balech	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Protoperidinium pellucidum Bergh ex Loeblich Jr. & Loeblich III	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
§ *Protoperidinium asymmetricum* (Karsten) Balech	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ † *Protoperidinium* "type" *brochii*	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Protoperidinium conicum* (Gran) Balech	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ † *Protoperidinium* "type" *latissimum*	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ † *Protoperidinium* "type" *leonis*	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ † *Protoperidinium* "type" *oceanicum*	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ † *Protoperidinium* "type" *ovatum*	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ † *Protoperidinium* "type" *pentagonum*	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Protoperidinium steinii* (Jørgensen) Balech	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Protoperidinium tuba* (Schiller) Balech	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseliodinium vaubanii Soumia	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
Pyrocystis lunula (Schütt) Schütt	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Pyrocystis obtusa Pavillard	x	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
§ *Pyrophacus horologium* Stein	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrophacus steinii (Schiller) Wall & Dale	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
SILICOFLAGELLATES	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
§ *Dictyocha cruz* Ehrenberg	x	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
Dictyocha fibula Ehrenberg	x	-	-	-	-	-	-	x		x	x	x	-	-	-	-	-	-	-
Octactis octonaria (Ehrenberg) Hovasse	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
COCCOLITHOPHORIDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Emiliania huxleyi (Lohmann) Hay & Mohler	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-
Calciosolenia murrayi Gran	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-
Calciopappus caudatus Gaarder & Ramsfjell	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	-	-
Umbilicosphaera sibogae (Weber-van Bosse) Gaarder	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-
Ophiaster hydroideus (Lohmann) Lohmann	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	-	-
EBRIIDEANS	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-
Ebria tripartita (Schumann) Lemmermann	x	-	-	-	-	-	-	-	-	x		x	-	-	-	-	-	-	-
§ *Hermesinum adriaticum* Zacharias	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CYANOBACTERIA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
§ *Johannesbaptistia pellucida* (Dickie) W.R. Taylor & Drouet	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichodesmium erythraeum Ehrenberg ex Gomont	x	-	-	-	-	-	-	-	-	-	-	-	x				-	-	-
§ *Trichodesmium thiebautii* Gomont ex Gomont	x																-	-	-

Legend: *cited in 30-50% of publications; ** cited in 51-80% of publications; † nomenclature/taxonomy to be verified; § new record (present survey, 2004-2006).

Legenda: *citada em 30-50% das publicações; ** citada em 51-80% das publicações; † nomenclatura/taxonomia exige verificação; § novo registro (levantamento atual, 2004-2006).