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DIATOMS OF THE INDIAN RIVER LAGOON, FLORIDA: AN ANNOTATED ACCOUNT

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ABSTRACT: *The Indian River Lagoon, Florida has been touted as the most diverse estuary in North America, yet the biodiversity of most biota is virtually unknown. Diatoms are abundant microalgae in this estuary, in planktonic, benthic, and epiphytic habitats. This account utilizes published records supplemented with personal observations to provide the first comprehensive summary of the diatom flora in this unusual estuary system. Apart from novel and cryptic species, 436 taxa are recorded, in 129 genera. The most diverse benthic genera were* Mastogloia *(36 taxa) and* Nitzschia *(24 taxa). Among planktonic genera were 38 taxa in* Chaetoceros *and 19 taxa in* Thalassiosira. *Sixty-two genera were represented by one species.*

Key Words: Indian River Lagoon, diatom, microalgae, flora

THE Indian River Lagoon (IRL) is an elongate subtropical body of water, formed within a barrier island complex, and extending for approximately one-third the length of Florida's east coast. Its exact length varies according to the varying definitions of its geographic limit: the range is 193km to 250km (120mi-155mi). Most commonly, the northern limit is considered to be the Ponce de Leon Inlet at New Smyrna Beach (29° 04.5′N, 80° 55′W), and the southern limit is the Jupiter Inlet in Palm Beach County (26° 56.5′N, 80° 04.2′W). These inlets, plus the Sebastian, Ft. Pierce and St. Lucie inlets, provide the only continuous exchange with the adjacent Atlantic Ocean. The major portions of the IRL are the Mosquito Lagoon, Banana River Lagoon, and the Indian River (including the St. Lucie River). The temperature and salinity structure throughout the length of the lagoon is highly variable on various time scales (e.g., Liu and co-workers, 1998; Niedoroda and co-workers, 1995; Smith, 1987, 1993; Virnstein, 1990). Water temperatures vary from 5–35C and salinities range from 0–38 ppt. The transitional climatic zone coupled with high variability in physical-chemical characteristics of the water masses that make up the lagoon allow for a diverse (yet poorly characterized) biota.

This region of Florida represents a significant biogeographic transition zone for both plants and animals, marine and terrestrial (Myers and Ewel, 1990;

Richards, 1995). Biota in the northern portion is more characteristic of the temperate zone (Carolinian province), while the biota of the southern portion have many features and constituents of the sub-tropical and tropical zone (Caribbean province). Recent developmental pressures have been great in the IRL (De Freese, 1995; Larson, 1995) and will likely continue so into the foreseeable future. In addition, the multiple stressors associated with consequences of anthropogenically driven global change (rising sea level, warming, invasive species, etc.) may add to the adaptive demands on IRL biota in future (De Freese, 1991). The IRL has frequently been called the most diverse estuary in North America (e.g., Hart, 1993; Adams, 1995; Herman, 1998). While this may eventually prove to be true, at present it is a specious appellation. Biodiversity is well known only for a very few groups of organisms, leaving most groups in states of partial or complete ignorance. The most recent summary of IRL biodiversity is found in Richards (1995).

Primary productivity in the IRL is a joint function of the seagrasses, marsh plants, and microalgae. Studies are sparse, but seagrass and marsh productivity appears typical for warm temperate areas (Myers and Ewel, 1990; Dawes and coworkers, 1995). Substantial spatial and temporal variability in productivity is a feature of the IRL (Heffernan and Gibson, 1984). In one study, over 70% of the primary productivity was shown to be due to planktonic microalgae (Jensen and Gibson, 1986), with a 5% contribution by benthic microalgae. The diatoms of this lagoon system are presumably one of the main contributors to microalgal primary productivity, by virtue of their abundance and ubiquity, but comprehensive productivity studies are lacking. Moreover, the contribution to primary productivity by phototrophic and mixotrophic microflagellates (which are often abundant; pers. obs.) is unknown. Plankton chlorophyll ranges exceed two orders of magnitude throughout the lagoon, (<0.1 to >20 μg/l: Youngbluth and co-workers, 1976; Mahoney and Gibson, 1983b; and pers. obs.) of which 40–70% may be diatoms, yet their diversity has been examined only sporadically and incompletely over the last several decades. This is surprising, given the local, regional, and national economic importance and biological significance of the IRL. Several unpublished theses, some preliminary surveys, and studies restricted to single or a few genera constitute most of the available literature. There are also parts of the IRL, such as the Banana River and St Lucie River system, which have never been examined in any detail. Nevertheless, the number of recorded diatom taxa from the IRL is substantial. A series of seasonal samples collected in 1997–2001, an extended sampling series in winter 2000, and an extensive literature search resulted in a significant expansion of the diatom flora from the earlier list of Mahoney and Gibson (1983a).

METHODS—*Sample collection*—In each season of 1998, 1999, and 2000, and winter/spring of 2001 plankton samples were collected with a 20μm mesh net in the IRL at Vero Beach and at the Sebastian and Ft Pierce inlets; IRL sediment surface samples at Memorial Park, Vero Beach, and at Ft Pierce inlet; and seagrass (*Halodule* and *Syringodium*), *Rhizophora mangle* and *Spartina* samples (for epiphytes) in the IRL at Oslo Rd. and Memorial Park, Vero Beach. During winter 2000, similar plankton, sediment, and epiphyte samples were collected in the IRL at Eau Gallie Causeway, St Sebastian River, Sebastian Inlet, Vero Beach at Memorial Park and Oslo Rd., ship channel at Harbor Branch Oceanographic Institute, Ft Pierce Inlet, Stuart Causeway, and St Lucie Inlet.

Sample processing—Aliquots of preserved samples were washed free of salt with sequential centrifugation and dilution with deionized water. For light microscopy, samples were processed in two ways: duplicate sub-aliquots were evaporated on hot plates, then heated to oxidize all organic material, then mounted in a high refractive index mounting medium (Hyrax or Naphrax); other duplicate sub-aliquots were boiled for 1hr in 30% hydrogen peroxide, sequentially centrifuged and washed in deionized water, and mounted in Hyrax or Naphrax. For scanning and transmission electron microscopy, preparation was similar, except sub-aliquots were mounted on copper boats (SEM) or formvar/carbon coated grids (TEM) and coated with Au/Pt or carbon (SEM only).

Sample analysis—For light microscopy, a Zeiss Photomicroscope-II or Nikon LKe with brightfield, phase contrast and interference contrast were used; for electron microscopy, a Zeiss EM9S (TEM), and (for SEM) JEOL 1200EX or JSM6400 were used.

Literature—Few published papers give details on the IRL diatom flora. Several that were used in compiling this list are: Stephens and Gibson (1976, 1979); Tester and Steidinger (1979); Navarro (1982); Mahoney and Gibson (1983a); and Lu (1987). There are pitfalls in accepting such published lists at face value. The skill levels in accurate identification vary among authors, particularly when availability of pertinent monographs is uncertain. Spelling and orthographic errors, and changes in taxon limits and nomenclature all lead to disjuncts and inconsistencies in compiling accurate records. Some of these published records cite species authorities, others do not. I have dealt with these problems by accepting the identifications as stated, but making nomenclatural changes as necessary and including species authorities, deleting species only when egregious mistakes are suspected (e.g., an Antarctic species recorded from the IRL in mid-summer). For common or abundant taxa, synonymous names are included when the previously published name differs from the currently accepted name. Strictly speaking the Tester and Steidinger (1979) paper includes diatom occurrences outside the IRL (about 10km S of the Ft Pierce Inlet), but I have found nearly all their included species through tidal cycles at the Ft. Pierce inlet, so have included their records.

Taxonomic scheme—Diatom taxonomy is in a state of controversy and ferment: opinions on grouping of species into genera, genera to families, etc. are changing constantly. In general this uncertainty and controversy is avoided by listing taxa alphabetically within defined orders without separation into families, and by briefly comparing the contrasting ordinal scheme as delimited in Round and coworkers (1990) vs. that of Hasle and Syvertsen (1997). This is not a wholly satisfactory arrangement, since an unjustified relationship may be implied, but avoids making decisions that may prove untenable in future. Accordingly, the diatoms are grouped in five orders.

RESULTS—Four hundred thirty-six diatom taxa in 129 genera are designated as present in the IRL. A number of species require explanatory notes, and these are ordered below. In the annotated list, presented as an appendix, the habitus and distribution are briefly indicated for each taxon as two letter codes, as gleaned from other global records.

Habitus:

B = primarily benthic, including epipelic, epilithic, and epipsammic microhabitats;

E = primarily epiphytic on seaweeds and marine higher plants (or, for *Protoraphis* and *Pseudohimantidium*, epizoic);

P = primarily planktonic in dominant life form (resting spores may be benthic)

Distribution:

T = primarily a warm-water or tropical taxon;

C = primarily a warm or cold temperate taxon;

W = widespread or cosmopolitan in temperate and tropical waters;
F = primarily confined to oligohaline (<5 ppt) or fresh water.

DISCUSSION—The reported presence of 436 diatoms from the IRL seems remarkable, but in reality this number does not represent the entire diversity. Although a substantial portion of the planktonic taxa has probably been identified, many of the benthic forms are almost certainly underrepresented. In part this is a result of incomplete and sporadic sampling. The majority of published works on diatoms in the IRL have been based on samples collected at or near the Harbor Branch Oceanographic Institute in Ft. Pierce (e.g., Mahoney and Gibson, 1983a; Navarro, 1982). Likewise, many of the additional new records recorded by me were ancillary to other experiments undertaken in the same general area. The result is that regions of the IRL with major hydrographic and ecological differences from the central IRL have yet to be examined. The Mosquito Lagoon, for example, is clearly differentiated from adjacent areas on the basis of fish and invertebrate biodiversity (Paperno and co-workers, 2001) and the microalgal community surely has unique features as well. Likewise, to the south, the St Lucie River, with its eutrophication stress is likely to harbor species amenable to nutrient-rich areas that are not found farther north. Certainly the chlorophyll levels here (up to 120μg/liter; Doering 1996) indicate a substantial microalgal population whose constituents are unknown. Moreover, there are several novel species from the plankton not included in his account, yet to be described formally. Close examination of diatom communities elsewhere in Florida also has resulted in the discovery of new species (Prasad and co-workers, 1989; 2000): an expected result when the communities are examined in depth.

Several diatom taxa are potentially harmful to humans or marine life. All the *Pseudo-nitzschia* species reported from the IRL (*P. delicatissima*, *P. pseudodelicatissima*, *P. pungens*, *P. seriata*) have been reported to produce domoic acid under some circumstances elsewhere (Hargraves and Maranda, 2002). Domoic acid is a neurotoxin, the cause of amnesic shellfish poisoning (ASP), so far unknown from the east coast of Florida (for domoic acid and *Pseudo-nitzschia* references, see Bates, 2002 or NIEHS, 2002). Domoic acid was responsible for human poisoning events on the Atlantic coast of Canada and the northwest coast of the U.S. At present it is unknown whether IRL strains of these species produce domoic acid, but in most areas these species appear to be benign.

Some of these diatoms are known to produce excreted metabolites that interfere with normal functioning or life cycle events in marine animals. These include *Coscinodiscus centralis*, *Coscinodiscus wailesii*, *Cerataulina pelagica*, and *Chaetoceros debilis* (Hargraves and Maranda, 2002). Others, such as the epizoic diatoms *Protoraphis atlantica* and *Pseudohimantidium pacificum*, mechanically reduce the motility of their hosts, thus interfering with reproduction and perhaps increasing their vulnerability to predators.

There are likely invasive species of diatoms in the IRL, although insufficient prior records make an accurate assessment speculative. The intense rates of transit by recreational and commercial boats, with ballast water discharge and fouling communities, as well as migratory waterfowl, with residual attached biota, provide ample vectors for the introduction of nonindigenous species. Their eventual survival and success is less certain, however, and depends on a number of interacting parameters (Carlton and Geller, 1993; Carlton, 1996). *Coscinodiscus wailesii* is surely an invasive species in the IRL, having appeared on the U.S. east coast in the late 1970's. Many others may be termed "cryptogenic": they may be recent introductions, but there is insufficient background information to confirm this at present. Examples of cryptogenic species include *Thalassiosira proschkinae*, previously known from European coastal waters and recently discovered in Narragansett Bay, Rhode Island (pers. obs.), and *Minidiscus comicus*, a tiny species that is apparently widespread but mostly overlooked because of its size (2–5 μm).

The IRL faces increasing anthropogenic pressure, on local, regional and global scales. Recent management initiatives have focused attention on more visually obvious members of the ecosystem: manatees, fish, seagrasses, etc. The stressors for these biota are not always the same as stressors for the microalgae, which form the base of the food web. In order to evaluate the efficacy of management plans for the entire ecosystem, biodiversity at all trophic levels must be examined. The more difficult task for the future is separating local and regional anthropogenic influences on biodiversity, from those associated with broader global climate change.

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APPENDIX

Diatoms from the Indian River Lagoon. See text for notes and abbreviations

COSCINODISCALES

As considered here, the characteristics defining this order are: valve symmetry primarily with no polarities (i.e., oriented around a point rather than a line), and mostly with a marginal ring of various structural processes. In the taxonomic scheme proposed by Round, Crawford and Mann (1990), the species included here in the Coscinodiscales encompass four different orders. In the scheme followed by Hasle and Syvertsen (1997), this order corresponds to their suborder Coscinodiscineae.

Actinocyclus normanii (Gregory) Hustedt	(P, W)
Actinocyclus octonarius Ehrenberg	(P, W)
Actinocyclus octonarius var. crassus (W. Smith) Hendey	(P, C)
Actinocyclus octonarius var. tenellus (Brébisson) Hendey	(P, C)
Actinoptychus senarius Ehrenberg	(B, W)
Actinoptychus splendens (Shadbolt) Ralfs	(B, W)
Aulacodiscus argus (Ehrenberg) A. Schmidt	(B, W)
Aulacoseira islandica (O. Müller) Simonsen	(P, F)
synonym: *Melosira islandica* O. Müller	
Corethron hystrix Cleve	(P, W)
Coscinodiscus centralis Ehrenberg	(P, W)
Coscinodiscus granii Gough	(P, W)
Coscinodiscus oculus-iridis Ehrenberg	(P, W)
Coscinodiscus perforatus Ehrenberg	(P, W)
Coscinodiscus radiatus Ehrenberg *emend.* Hasle et Sims	(P, W)
Coscinodiscus wailesii Gran et Angst	(P, C)
Cyclotella atomus Hustedt	(P, C)
Cyclotella choctawhatcheeana Prasad	(P, W)
Cyclotella meneghiniana Kützing	(B, W)
Cyclotella stelligera Cleve et Grunow	(B, F)
Cyclotella striata (Kützing) Grunow)	(P, W) [*note 1*]
Cyclotella stylorum Brightwell	(P, T)
Detonula pumila (Castracane) Schütt	(P, W)
synonym: *Schroederella delicatula* Pavillard	
Hyalodiscus scoticus (Kützing) Grunow	(E, C)
Hyalodiscus subtilis Bailey	(E, C)
Lauderia annulata Cleve	(P, C)
synonym: *Lauderia borealis* Gran	
Leptocylindrus danicus Cleve	(P, C)
Leptocylindrus minimus Gran	(P, C)
Melosira lineata (Dillwyn) Agardh	(E, C)
synonym: *M. juergensii* Agardh	
Melosira moniliformis (O. Müller) Agardh	(E, C)
Melosira nummuloides (Dillwyn) Agardh	(E, C)
Minidiscus comicus Takano	(P, W)
Palmeria hardmanniana Greville	(P, T)
Paralia sulcata (Ehrenberg) Cleve	(P, W)
Planktoniella sol (Wallich) Schütt	(P, W)
Podosira hormoides (Montagne) Kützing	(E, T)
Podosira montagnei Kützing	(E, T)
Podosira stelliger (Bailey) A. Mann	(E, T) [*note 2*]

Skeletonema costatum (Greville) Cleve	(P, W)
Skeletonema menzelii Guillard, Carpenter et Reimann	(P,C)
Skeletonema tropicum Cleve	(P, T)
Stephanopyxis palmeriana (Greville) Grunow	(P,C)
Stephanopyxis turris (Greville et Arnott) Ralfs	(P, W)
Thalassiosira aestivalis Gran	(P, C)
Thalassiosira anguste-lineata (Schmidt) Fryxell	(P, W)
Thalassiosira binata Fryxell	(P, C)
Thalassiosira decipiens (Grunow) Jörgensen	(B, W) [*note 3*]
Thalassiosira diporocyclus Hasle	(P, W)
Thalassiosira eccentrica (Ehrenberg) Cleve)	(P, W)
synonym: *Coscinodiscus eccentricus* Ehrenberg	
Thalassiosira exigua Fryxell et Hasle	(P, W)
Thalassiosira gravida Cleve	(P, C)
Thalassiosira hyalina (Grunow) Gran	(P, C)
Thalassiosira lineata Jousé	(P, T)
Thalassiosira lundiana Fryxell	(P, C)
Thalassiosira minima Gaarder emend. Hasle	(P, W)
synonym: *T. floridana* (Cooper) Hasle	
Thalassiosira minuscula Krasske	(P, C)
Thalassiosira nanolineata (Mann) Fryxell et Hasle	(P, T)
Thalassiosira oestrupii (Ostenfeld) Proschkina-Lavrenko	
var. venrickae Fryxel*l* et Hasle	(P, W)
Thalassiosira proschkinae Makarova	(P, W)
Thalassiosira rotula Meunier	(P, W) [*note 4*]
Thalassiosira subtilis (Ostenfeld) Gran	(P, C)
Thalassiosira weissflogii (Grunow) Fryxell et Hasle	(P, F)
synonym: *T. fluviatilis* Hustedt	

RHIZOSOLENIALES

As considered here, the characteristics defining this order are: valves symmetry organized around a point or annulus, primarily unipolar, and lacking a ring of various structural processes. In the taxonomic scheme proposed by Round and coworkers (1990), the species included here in the Rhizosoleniales encompass two different orders. In the scheme followed by Hasle and Syvertsen (1997), this order corresponds to their families Rhizosoleniaceae and Lithodesmiaceae.

Dactyliosolen fragilissimus (Bergon) Hasle	(P, W)
synonym: *Rhizosolenia fragilissima* Bergon	
Guinardia delicatula (Cleve) Hasle	(P, W)
synonym: *Rhizosolenia delicatula* Cleve	
Guinardia flaccida (Castracane) Peragallo	(P, W)
Guinardia striata (Stolterfoth) Hasle	(P, W)
synonym: *Rhizosolenia stolterfothii* Peragallo	
Lithodesmium intricatum (West) Peragallo	(P, C)
Lithodesmium undulatum Ehrenberg	(P, C)
Proboscia alata (Brightwell) Sundström	(P, W)
synonym: *Rhizosolenia alata* Brightwell	
Proboscia indica (Peragallo) Hernández-Becerril	(P, T)

synonym: *Rhizosolenia alata forma indica* (Peragallo) Ostenfeld

Pseudosolenia calcar-avis (Schultze) Sundström (P, W)

Rhizosolenia bergonii Peragallo (P, T)
Rhizosolenia castracanei Peragallo (P, T)
Rhizosolenia hebetata Bailey *forma semispina* (Hensen) Gran (P, C)
Rhizosolenia imbricata Brightwell (P,W)
Rhizosolenia robusta Norman (P, W) [*note 5*]
Rhizosolenia setigera Brightwell (P, W)
Rhizosolenia styliformis Brightwell (P, C)

BIDDULPHIALES

As considered here, the characteristics defining this order are: valves symmetry organized around a point or annulus, primarily bipolar (but sometimes multipolar), and lacking a ring of various structural processes. In the taxonomic scheme proposed by Round and co-workers (1990), the species included here in the Biddulphiales encompass eight different orders. In the scheme followed by Hasle and Syvertsen (1997), this order corresponds to the suborder Biddulphiineae.

Amphitetras antediluviana Ehrenberg (E, W)
synonym: *Triceratium antediluvianum* (Ehrenberg) Grunow

Auliscus caelatus Bailey *var. rhipis* (A. Schmidt) Peragallo (B, W) [*note 6*]
Auliscus caelatus var. strigillata A. Schmidt (B, W)
Auliscus pruinosus Bailey (B, W) [*note 7*]
Auliscus punctatus Bailey (B, W) [*note 7*]
Auliscus radiatus Bailey (B, W)
Auliscus reticulatus Greville (B, W)
Auliscus sculptus (W. Smith) Ralfs (B, W)

Bacteriastrum delicatulum Cleve (P, W)
Bacteriastrum hyalinum Lauder (P, W)

Bellerochea horologicalis von Stosch (P, T)

Biddulphia alternans (Bailey) Van Heurck (E, W) [*note 8*]
Biddulphia biddulphiana (J. Smith) Boyer (E, W)
synonym: *B. pulchella* Gray
Biddulphia reticulata Roper (E, W)
Biddulphia tuomeyi (Bailey) Roper (E, T)

Cerataulina pelagica (Cleve) Hendey (P, W)

Cerataulus smithii Ralfs (B, W)

Chaetoceros affinis Lauder (P, W)
Chaetoceros affinis var. willei (Gran) Hustedt (P, W)
Chaetoceros anastomosans Grunow (P, W)
Chaetoceros brevis Schütt (P, W) [*note 9*]
Chaetoceros cinctus Gran (P, W)
Chaetoceros coarctatus Lauder (P, T)
Chaetoceros compressus Lauder (P, W)
Chaetoceros constrictus Gran (P, C)
Chaetoceros curvisetus Cleve (P, W)
Chaetoceros danicus Cleve (P, W)

Chaetoceros debilis Cleve	(P, W)
Chaetoceros decipiens Cleve	(P, W) [*note 10*]
Chaetoceros diadema (Ehrenberg) Gran	(P, C)
Chaetoceros didymus Ehrenberg	(P, W)
Chaetoceros didymus var. anglicus (Grunow) Gran	(P, W)
Chaetoceros diversus Cleve	(P, T)
Chaetoceros eibenii Grunow emend. Meunier	(P, C)
Chaetoceros gracilis Schütt	(P, W) [*note 11*]
Chaetoceros laciniosus Schütt	(P, C)
Chaetoceros lauderi Ralfs	(P, W)
Chaetoceros lorenzianus Grunow	(P, T) [*note 10*]
Chaetoceros lorenzianus var. forceps Meunier	(P, W)
Chaetoceros messanensis Castracane	(P, T)
Chaetoceros minimus (Levander) Marini, Giuffre, Montressor et Zingone	(P, F)
Chaetoceros muelleri Lemmerman	(P, F)
Chaetoceros neogracilis Van Landingham	(P, W) [*note 11, 12*]
Chaetoceros pelagicus Cleve	(P, C)
Chaetoceros pendulus Karsten	(P, T) [*note 13*]
Chaetoceros peruvianus Brightwell	(P, W) [*note 13*]
Chaetoceros protuberans Lauder	(P, W)
Chaetoceros pseudocurvisetus Mangin	(P, T)
Chaetoceros simplex Ostenfeld	(P, W) [*note 11*]
Chaetoceros socialis Lauder	(P, C)
Chaetoceros subtilis Cleve	(P, F)
Chaetoceros teres Cleve	(P, C)
Chaetoceros tortissimus Gran	(P, W)
Chaetoceros vistulae Apstein	(P, F)
Chaetoceros wighami Brightwell	(P, F)
Climacodium frauenfeldianum Grunow	(P, T)
Cymatosira belgica Grunow	(B, C)
Cymatosira lorenziana Grunow	(B,W)
Ditylum brightwellii (West) Grunow	(P, W)
Eucampia cornuta (Cleve) Grunow	(P, T)
Eucampia zodiacus Ehrenberg	(P, W)
Eunotogramma laevis Grunow	(B, W)
Eunotogramma marinum (W. Smith) Peragallo	(B, W)
Eunotogramma rostratum Hustedt	(B, C)
Eupodiscus radiatus Bailey	(B, W) [*note 14*]
Helicotheca tamesis (Shrubsole) Ricard	(P, W)
Hemiaulus hauckii Grunow	(P, W)
Hemiaulus membranaceus Cleve	(P, T)
Hemiaulus sinensis Greville synonym: *H. heibergii* Cleve	(P, W)
Isthmia enervis Ehrenberg	(E, T)
Lampriscus shadboltianus (Greville) Peragallo synonym: *Triceratium shadboltianum* Greville	(E, T) [*note 15*]
Lithodesmium undulatum Ehrenberg	(P, C)

Minutocellus polymorphus (Hargraves et Guillard) Hasle, v. Stosch et Syvertsen	(P, W)
Odontella aurita Agardh	(E, W)
Odontella aurita var. minuscula Grunow	(E, W)
Odontella aurita var. obtusa (Kützing) Hustedt	(E, W)
Odontella longicruris (Greville) Hoban	(P, W)
Odontella mobiliensis Grunow	(P, W)
Odontella regia (Schultze) Hoban	(P, W)
Odontella rhombus (Ehrenberg) Kützing	(P, W)
Odontella sinensis (Greville) Grunow	(P, W)
Pleurosira laevis (Ehrenberg) Compére	(E,T)
Terpsinöe americana (Bailey) Ralfs	(E, F)
Terpsinöe musica Ehrenberg	(E, F)
Triceratium antediluvianum (Ehrenberg) Grunow	(B, C) [*note 16*]
Triceratium balearicum Cleve *forma biquadrata* (Janisch) Hustedt synonym: *T. biquadratum* Janisch	(B, C) [*note 16, 17*]
Triceratium dubium Brightwell	(B, C)
Triceratium favus Ehrenberg	(B, W)
Triceratium favus var. quadrata Grunow	(B, W)
Triceratium pentacrinus (Ehrenberg) Wallich	(B, W) [*note 16, 17, 18*]
Triceratium pentacrinus forma quadrata Hustedt	(B, W)
Trigonium reticulum (Ehrenberg) Simonsen	(E, W) [*note 16, 19*]

FRAGILARIALES

As considered here, the characteristics defining this order are: bilaterally symmetrical valves, lacking a raphe on either valve, but often with a hyaline sternum (equivalent to the pseudoraphe or axial area of other texts). The areolae are arranged more or less linear fashion in relation to the sternum. The species contained here encompass nine orders in Round and co-workers (1990). This order is subsumed in Bacillariales in the scheme adopted by Hasle and Syvertsen (1997).

Ardissonea fulgens (Greville) Grunow	(E, W) [*note 20, 21*]
Ardissonea pulcherrima (Hantzsch) Grunow	(E, T)
Ardissonea robusta (Ralfs) DeNotaris	(E, W)
Asterionellopsis glacialis (Castracane) Round	(P, W)
Bleakeleya notata (Grunow) Round	(P, T)
Catacombas gaillonii (Bory) Williams et Round	(E, W) [*note 20*]
Climacosphenia elongata Bailey	(E, T)
Delphineis surirella (Ehrenberg) Andrews	(B, W)
Delphineis surirella var. australis (Petit) Navarro	(B, T)
Dimeregramma minor (Gregory) Ralfs	(B, W)
Dimeregramma minor var. nana (Gregory) Van Heurck	(B, W)
Falcula media Voigt	(E, W) [*note 22*]
Fragilaria capucina Desmazières *var. mesolepta* Rabenhorst	(P, F)
Fragilaria virescens Ralfs *var. mesolepta* Rabenhorst	(P, F)

Glyphodesmis williamsonii (W. Smith) Grunow	(B, T)
Grammatophora gibberula Kützing	(E, C)
Grammatophora marina (Lyngbye) Kützing	(E, W)
Grammatophora marina var. tropica (Kützing) Grunow	(E, T)
Grammatophora oceanica (Ehrenberg) Grunow	(E, W)
Grammatophora oceanica var. macilenta (W. Smith) Grunow	(E, W)
Grammatophora serpentina (Ralfs) Ehrenberg	(E, W)
Hyalosynedra laevigata (Grunow) Williams et Round	(E, T) [*note 23*]
Hyalosira interrupta (Ehrenberg) Navarro	(E, T) [*note 24*]
synonym: *Striatella interrupta* (Ehrenberg) Heiberg	
Licmophora abbreviata Agardh	(E, W)
Licmophora abbreviata forma grunowii (Mereschkowsky) Hustedt	(E, W)
Licmophora ehrenbergii (Kützing) Grunow	(E, C)
Licmophora flabellata (Carmichael) Agardh	(E, W)
Licmophora paradoxa (Lyngbye) Agardh	(E, W)
Licmophora remulus Grunow	(E, T)
Lioloma pacificum (Cupp) Hasle	(P, C)
Martyana martyi (Héribaud) Round	(B, F)
synonym: *Opephora martyi* Héribaud	
Nanofrustulum shiloi (Lee, Reimer et McEnery) Round, Hallsteinsen et Paasche	(P, W) [*note 37*]
Opephora marina (Gregory) Petit	(B, W)
Opephora mutabilis (Grunow) Sabbe et Vyverman	(B, W) [*note 25*]
synonym: *Opephora olsenii* Möller	
Opephora pacifica (Grunow) Petit	(B, W)
Opephora schwartzii (Grunow) Petit	(B, C)
Plagiograma interruptum (Gregory) Ralfs	(B, T)
Plagiogramma pulchellum Greville var. *pygmaea* (Greville) Peragallo	(B, T)
synonym: *Plagiogramma pygmaeum* Greville	
Plagiogramma rhombicum Hustedt	(B, C)
Plagiogrammopsis vanheurckii (Grunow) Hasle, v.Stosch et Syvertsen	(B, W)
Plagiogrammopsis wallichianum Greville	(B, C)
Podocystis adriatica Kützing	(E, C)
Protoraphis atlantica Gibson	(E, P)
Psammodiscus nitidus (Gregory) Round et Mann	(B, W)
synonym: *Coscinodiscus nitidus* Gregory	
Pseudohimantidium pacificum Hustedt et Krasske	(E, P)
Pteroncola inane (Giffen) Round	(E, W) [*note 26*]
synonym: *Fragilaria hyalina* (Kützing) Grunow	
Rhabdonema adriaticum Kützing	(E, W)
Rhabdonema arcuatum (Lyngbye) Kützing	(E, W)

Rhaphoneis amphiceros Ehrenberg	(B, W)
Rhaphoneis amphiceros var. gemmifera (Ehrenberg) Peragallo	(B, W)
Rhaphoneis castracanei Grunow	(B, T)
Rhaphoneis superba Grunow	(B, T)
Striatella unipunctata (Lyngbye) Agardh	(E, C)
Tabularia fasciculata (Agardh) Williams et Round	(E, W)
synonym: *Synedra tabulata* (Agardh) Kützing *var. fasciculata* (Agardh) Hustedt	
Tabularia parva (Kützing) Williams et Round	(E, W)
synonym: *S. tabulata var. parva* (Kützing) Hustedt	
Tabularia tabulata (Agardh) Snoeijs	(E, W)
synonym: *Synedra tabulata* (Agardh) Kützing	
Thalassionema frauenfeldii (Grunow) Hallegraeff	(P, W)
Thalassionema nitzschioides (Grunow) Mereschkowsky	(P, W)
Toxarium hennedyanum Grunow	(E, C) [*note 27*]
Trachysphenia acuminata Peragallo	(B, C)

BACILLARIALES

As considered here, the characteristics defining this order are: bilaterally symmetrical valves, and the presence of a raphe on one or both valves. In the taxonomic scheme proposed by Round and co-workers (1990), the species included here in the Bacillariales encompass nine different orders. The order Bacillariales in the sense of Hasle and Syvertsen (1997) would include the order Fragilariales as considered in this work.

Achnanthes brevipes Agardh	(E, C)
Achnanthes brevipes var. angustata (Greville) Cleve	(E, C)
Achnanthes brevipes var. parvula (Kützing) Cleve	(E, C)
Achnanthes citronella (Mann) Hustedt	(E, C)
Achnanthes curvirostrum Brun	(E, C)
Achnanthes kuwaitensis Hendey	(E, T)
Achnanthes longipes Agardh	(E, W)
Achnanthes manifera Brun	(E, C)
Amphora angusta Gregory	(B, F)
Amphora angusta var. ventricosa (Gregory) Cleve	(B, F)
Amphora arenaria Donkin	(B, F)
Amphora bigibba Grunow	(B, T)
Amphora caroliniana Giffen	(B, C)
Amphora coffaeformis Agardh	(B, W) [*note 28*]
Amphora costata W. Smith	(B, W)
Amphora decussata Grunow	(B, T)
Amphora exigua Gregory	(B, W)
Amphora marina (W. Smith) Van Heurck	(B, C)
Amphora obtusa Gregory	(B, C)
Amphora ocellata Donkin	(B, C)
Amphora ostrearia Brébisson) var. lineata Cleve	(B, C)
Amphora proteoides Hustedt	(B, C)
Amphora proteus Gregory	(B, C)

Amphora robusta Gregory	(B, C)
Amphora spectabilis Gregory	(B, C)
Amphora terroris Ehrenberg	(B, T)
synonym: *A. cymbifera* Gregory	
Anomoeoneis sphaerophora (Kützing) Pfitzer *var. sculpta* (Ehrenberg) O. Möller	(B, F)
Anorthoneis eurystoma Cleve	(B, T)
Anorthoneis excentrica(Donkin) Grunow	(B, C)
Anorthoneis hyalina Hustedt	(B, C)
Auricula complexa (Gregory) Cleve	(B, C)
Bacillaria paxillifer (O. Müller) Hendey	(B, W) [*note 29*]
Berkeleya micans (Lyngbye) Gran	(B, C) [*note 30*]
Berkeleya rutilans (Trentepohl) Grunow	(B, C) [*note 30*]
Caloneis elongata (Grunow) Boyer	(B, F) [*note 31*]
Caloneis excentrica (Grunow) Boyer	(B, F) [*note 31*]
Campylodiscus daemelianus Grunow	(B, T)
Campylodiscus innominatus Ross et Abdin	(B, C)
Capartogramma crucicula (Grunow) Ross	(B, C)
Climaconeis lorenzii Grunow	(B, T) [*note 32*]
Cocconeis brittanica Naegeli	(E, W)
Cocconeis convexa Giffen	(E, C)
Cocconeis disculoides Hustedt	(E, C)
Cocconeis heteroidea Hantsch	(E, T)
Cocconeis pellucida Grunow	(E, W)
Cocconeis placentula Ehrenberg	(E, F)
Cocconeis placentula var. euglypta (Ehrenberg) Cleve	(E, F)
Cocconeis pseudomarginata Gregory	(E, C)
Cocconeis scutellum Ehrenberg	(E, W)
Cocconeis scutellum var. stauroneiformis W. Smith	(E, W)
Cocconeis woodii Reyes-Vasquez	(E, T)
Cylindrotheca closterium (Ehrenberg) Reimann et Lewin	(B, W)
Cymbella pusilla Grunow	(B, F)
Denticula subtilis Grunow	(B, F)
Denticula thermalis Kützing	(B, F)
Diadesmis contenta (Grunow) Mann	(B, F)
synonym: *Navicula contenta* Grunow	
Dictyoneis marginata (Lewis) Cleve	(B, T)
Diploneis bombus Ehrenberg	(B, W)
Diploneis crabro Ehrenberg	(B, W)
Diploneis gravelleana Hagelstein	(B, T)
Diploneis gruendleri (Schmidt) Cleve	(B, C)
Diploneis interrupta (Kützing) Cleve *var. caffra* Giffen	(B, C)
Diploneis obliqua (Brun) Hustedt	(B, C)

Diploneis smithii (Brèbisson) Cleve	(B, W)
Diploneis suborbicularis (Gregory) Cleve *var. constricta* Hustedt	(B, C)
Diploneis vacillans (Schmidt) Cleve *var. renitens* Schmidt	(B, T)
Diploneis weissflogii (Schmidt) Cleve	(B, W)
Entomoneis alata (Ehrenberg) Ehrenberg	(B, W)
Entomoneis pulchra (Bailey) Reimer	(B, T)
synonym: *Amphiprora conspicua* Greville	
Epithemia sorex Kützing	(B, F)
Fallacia amphipleuroides (Hustedt) Mann	(B, C) [*note 33*]
Fallacia forcipata (Greville) Stickle et Mann	(B, C)
Fallacia hyalinula (DeToni) Stickle et Mann	(B, C)
Fallacia litoricola (Hustedt) Mann	(B, C)
Fallacia nummularia (Greville) Mann	(B, C)
Frustulia asymmetrica (Cleve) Hustedt	(B, T)
Gomphonema acuminatum Ehrenberg	(E, F)
Gomphonemopsis littoralis (Hendey) Medlin	(E, T)
Gyrosigma baileyi (Grunow) Cleve	(B, C)
Gyrosigma balticum (Ehrenberg) Rabenhorst	(B, W)
Gyrosigma fasciola (Ehrenberg) Griffith et Henfrey	(B, W)
Gyrosigma hummii Hustedt	(B, C)
Gyrosigma macrum (W. Smith) Griffith et Henfrey	(B, C)
Gyrosigma peisonis (Grunow) Hustedt	(B, W)
Gyrosigma variistriatum Hagelstein	(B, T)
Hantzschia virgata (Roper) Grunow	(B, W)
Haslea wawrickae (Hustedt) Simonsen	(P, W)
Lyrella abruptoides (Hustedt) Mann	(B, W)
Lyrella approximata (Greville) Mann	(B, W) [*note 34*]
Lyrella atlantica (Schmidt) Mann	(B, C)
synonym: *Navicula lyra* Ehrenberg *var. atlantica* Schmidt	
Lyrella clavata (Gregory) Mann	(B, C)
Lyrella clavata var. distenta Hustedt	(B, T)
Lyrella clavata var. indica (Greville) Cleve	(B, W)
Lyrella hennedyi (W. Smith) Stickle et Mann	(B, W)
Lyrella irroratoides (Hustedt) Mann	(B, T)
Lyrella lyra (Ehrenberg) Karayeva	(B, W)
Lyrella praetexta (Ehrenberg) Mann	(B, C)
Mastogloia acutiuscula Grunow *var. elliptica* Hustedt	(E, T) [*note 35*]
Mastogloia angulata Lewis	(E, W)
Mastogloia apiculata W. Smith	(E, W)
Mastogloia baldjikiana Grunow	(E, T)
Mastogloia binotata (Grunow) Cleve	(E, W)
Mastogloia braunii Grunow	(E, C)
Mastogloia citrus (Cleve) DeToni	(E, T)
Mastogloia cribrosa Grunow	(E, T)
Mastogloia crucicula (Grunow) Cleve	(E, T)
Mastogloia decipiens Hustedt	(E, C)
Mastogloia dicephala Voigt	(E, T)

Mastogloia elegans	(E, C)
Mastogloia erythraea Grunow	(E, T) [*note 36*]
Mastogloia erythraea var. biocellata Grunow	(E, T)
Mastogloia exigua Lewis	(E, F)
Mastogloia euxina Cleve	(E, T)
Mastogloia exilis Hustedt	(E, T)
Mastogloia fimbriata (Brightwell) Cleve	(E, T)
Mastogloia grunowii Schmidt	(E, T)
Mastogloia hustedtii Meister	(E, T)
Mastogloia lanceolata Thwaites	(E, W)
Mastogloia minutissima Voigt	(E, C)
Mastogloia omissa Voigt	(E, T)
Mastogloia ovalis Schmidt	(E, T)
Mastogloia paradoxa Grunow	(E, T)
Mastogloia pisciculus Cleve	(E, T)
Mastogloia pumila (Grunow) Cleve	(E, C)
Mastogloia pumila var. papuarum Cholnoky	(E, C)
Mastogloia pumila var. africana Giffen	(E, C)
Mastogloia pusilla Grunow	(E, C)
Mastogloia pusilla var. subcapitata Hustedt	(E, T)
Mastogloia schmidtii Heiden	(E, T)
Mastogloia smithii Thwaites	(E, W) [*note 35*]
Mastogloia splendida (Gregory) Ralfs	(E, W)
Mastogloia subaffirmata Hustedt	(E, T)
Mastogloia varians Hustedt	(E, T)
Navicula carinifera Grunow	(B, W)
Navicula clamans Hustedt	(B, W)
Navicula directa W. Smith	(B, C)
Navicula fromenterae Cleve	(B, T)
Navicula johanrossii Giffen	(B, C)
Navicula longa (Gregory) Ralfs	(B, T)
Navicula maculosa Donkin	(B, C)
Navicula normalis Hustedt	(B, C)
Navicula pennata Schmidt	(B, C)
Navicula platyventris Meister	(B, C)
Navicula pseudocomoides Hendey	(B, C) [*note 30, 41*]
Navicula pseudocrassirostris Hustedt	(B, C)
Navicula ramosissima Agardh) Cleve	(B, C) [*note 30*]
Navicula salinarum Grunow	(B, W)
Navicula scopulorum Brébisson	(B, W)
Navicula tripunctata Müller) Bory	(B, F)
Navicula yarrensis Grunow	(B, T)
Nitzschia amphibia Grunow	(B, F) [*note 38*]
Nitzschia brittonii Hagelstein	(B, T)
Nitzschia fonticola Grunow	(B, F)
Nitzschia frustulum (Kützing) Grunow	(B, F)
Nitzschia insignis Gregory	(B, W)
Nitzschia lanceolata W. Smith	(B, W)
Nitzschia lesbia Cholnoky	(B, C)
Nitzschia linearis W. Smith	(B, F)
Nitzschia lionella Cholnoky	(B, C)
Nitzschia longissima (Brébisson) Ralfs	(B, W)
Nitzschia lorenziana Grunow *var. subtilis* Grunow	(B, C)

Nitzschia martiana (Agardh) Van Heurck	(B, W) [*note 30*]
Nitzschia obtusa W. Smith *forma parva* Hustedt	(B, W)
Nitzschia palea (Kützing) W. Smith *var. debilis* (Kützing) Grunow	(B, F)
Nitzschia parvula W. Smith	(B, C)
Nitzschia quickiana Hagelstein	(B, T)
Nitzschia reversa W. Smith	(B, C)
Nitzschia rhopalodioides Hustedt	(B, C)
Nitzschia sigma (Kützing) W. Smith	(B, W)
Nitzschia sigma var. intercedens Grunow	(B, C)
Nitzschia socialis Gregory	(B, C) [*note 39*]
Nitzschia spathulata W. Smith	(B, W)
Nitzschia ventricosa Kitton	(B, T)
Nitzschia vidovichii Grunow	(B, C)
Parlibellus berkeleyi (Kützing) Cox	(B, C) [*note 40, 41*]
Parlibellus delognei (Van Heurck) Cox	(B, C)
Parlibellus hamulifer (Grunow) Cox	(B, C)
Parlibellus tubulosus (Brun) Cox	(B, C)
Petrodictyon gemma (Ehrenberg) Mann	(B, W) [*note 42*]
synonym: *Surirella gemma* Ehrenberg	
Petroneis granulata (Bailey) Mann	(B, W) [*note 43*]
Petroneis transfuga (Grunow) Mann	(B, T)
Pinnularia gentilis (Donkin) Cleve	(B, F)
Pinnularia robusta Hustedt	(B, F)
Plagiotropis lepidoptera(Gregory) Kuntze	(B, C)
Plagiotropis lepidoptera var. proboscidea (Cleve) Reimer	(B, F)
Plagiotropis seriata (Cleve) Kuntze	(B, C)
Planothidium delicatulum (Kützing) Round et Bukhtiyarova	(E, F) [*note 44, 45*]
Planothidium hauckianum (Grunow) Round et Bukhtiyarova	(E, F)
Planothidium ellipticum (Cleve) Round et Bukhiyarova	(E, F)
synonym: *Achnanthes lanceolata* Brébisson *var. elliptica* Cleve	
Pleurosigma aestuarii (Brébisson) W. Smith	(B, C) [*note 46*]
Pleurosigma angulatum (Queckett) W. Smith	(B, W)
Pleurosigma delicatulum W. Smith	(B, C)
Pleurosigma elongatum W. Smith *var. gracilis* Grunow	(B, C)
Pleurosigma formosum W. Smith	(B, C)
Pleurosigma intermedium W. Smith	(B, C)
Pleurosigma rigidum W. Smith	(B, W)
Psammodictyon constrictum (Gregory) Mann	(B, W) [*note 47*]
Psammodictyon panduriforme (Gregory) Mann	(B, W)
Pseudo-nitzschia delicatissima (Cleve) Heiden	(P, W)
Pseudo-nitzschia pseudodelicatissima (Hasle) Hasle	(P, W)
Pseudo-nitzschia pungens (Grunow) Hasle	(P, W)
Pseudo-nitzschia seriata (Cleve) Peragallo	(P, W) [*note 48*]
Rhopalodia gibberula (Ehrenberg) Müller	(B, W)
Rhopalodia operculata (Agardh) Håkansson	(B, W)
synonym: *Rhopalodia musculus* (Kützing) Müller	
Stauroneis amphoroides Grunow	(B, T) [*note 49*]

Staurophora amphioxys (Gregory) Mann	(B, C)
synonym: *Stauroneis amphioxys* Gregory	
Staurophora amphioxys var. producta Grunow	(B, C)
Surirella fastuosa (Ehrenberg) Kützing	(B, W)
Trachyneis aspera (Ehrenberg) Cleve	(B, W)
Trachyneis brunii (Cleve) Cleve	(B, C)
Tryblionella acuminata (W. Smith) Mann	(B, W) [*note 50*]
Tryblionella acuta (Hantzsch) Mann	(B, C)
Tryblionella coarctata (Grunow) Mann	(B, W)
Tryblionella granulata Grunow) Mann	(B, C)
Tryblionella granulata var. hyalina Amosse	(B, T)
Tryblionella marginulata (Grunow) Mann	(B, C)
Tryblionella marginulata var. didyma Grunow	(B, C)

NOTES

1. According to Håkansson (1996) some identifications of this taxon, including samples from Florida, are in reality *Cyclotella litoralis* Lange et Syvertsen.
2. The distinction between *Podosira* and *Hyalodiscus* is not clear (Round and co-workers, 1990); *P. stelliger*, for example, is frequently called *H. stelliger*.
3. According to Hasle (1979) many records of this species may be suspect; it appears to be primarily a benthic species, "possibly... as an epiphyte or trapped by branched larger algae...".
4. There is evidence that at colder temperatures this diatom becomes altered in its morphology and resembles *T. gravida* (Syvertsen, 1977).
5. This species was recently transferred to a new genus, *Calyptrella*, later transferred again to *Neocalyptrella* (Hernández-Becerril and Meave de Castillo, 1997).
6. The genus *Auliscus* is primarily fossil, and rarely seen alive; some have questioned whether it is solely fossil; at least *A. caelatus* is extant.
7. *Auliscus pruinosus* and *A. punctatus* are probably synonymous; see Sullivan, 1987)
8. This species has also been called *Triceratium alternans* and *Trigonium alternans*. The correct name depends on one's interpretation of the generic limits of the three genera involved.
9. The exact identity and validity of *C. brevis* is uncertain; see Rines and Hargraves, 1988.
10. Without the presence of resting spores (in *C. lorenzianus* only) it is difficult to separate *C. decipiens* from *C. lorenzianus* since morphological intergrades are common (see Rines and Hargraves, 1988).
11. There is no consistency to the naming of unicellular *Chaetoceros* species, and several names have been applied almost indiscriminately; see Rines and Hargraves, 1988.
12. This species is often reported in the literature, but has no taxonomic validity; it is difficult to say exactly what its identity is.
13. The differences between *C. peruvianus* and *C. pendulus* are not always distinct, and some authors have combined them (see Rines and Hargraves, 1988).
14. Round and co-workers (1990) have questioned whether *E. radiatus* is extant or only fossil.
15. Proper assignment to a genus depends on whether electron microscope examination shows the presence of ocelli (as in *Triceratium*), or pseudocelli (as in *Lampriscus*. See Round and co-workers, 1990, and Navarro, 1981.
16. The generic limits amongst *Amphipentas*, *Amphitetras*, *Biddulphia*, *Triceratium* and *Trigonium* are confused and complex; see Round and co-workers, 1990.
17. The structure of this species corresponds to Ehrenberg's genus *Amphipentas* (Sims, 2001)
18. If one considers the genus *Amphipentas* as valid, then this species would be the generitype (Sims, 2001)
19. This species has pseudocelli and non-loculate areolae, unlike the type species of *Trigonium*, and might be better placed in the genus *Sheshukovia* (P. Sims, pers. com., 8/01); see Round and co-workers, 1990.
20. Species in this genus were formerly placed in *Synedra*.
21. According to Sullivan and Wear (1995) this species may be misplaced in *Ardissonea*.
22. *Falcula* is primarily epizoic on marine zooplankton. Prasad and co-workers (1989) believe this is a misidentification for *F. hyalina* Takano.
23. Some species in this genus were formerly placed in *Fragilaria*.

24. Round and co-workers (1990) place this species in *Microtabella*, an invalid name according to Navarro and Williams (1991)
25. Round and co-workers (1990) do not include this species in *Opephora*, but offer no alternative.
26. Although primarily an epiphyte on seagrasses, this species may also be abundant on the feathers of diving sea birds.
27. This species bears a resemblance to the recently described genus *Reimerothrix* (Prasad and co-workers, 2001), and may be a misidentification for that taxon. *Toxarium hennedyanum* is common in temperate coastal areas, whereas *R. floridensis* has been confirmed only from Florida Bay.
28. See Sala and co-workers (1998) for problems in identifying this species.
29. Most records throughout the world list *B. paxillifer* (or its synonym, *B. paradoxa*). It seems certain, however, that *Bacillaria* is made up of more than one species, and the one so common in the IRL is probably not *B. paxillifer*.
30. This is a diatom which forms foliose colonies, with the cells in mucilaginous tubes.
31. Round and co-workers (1990) do not distinguish between *Caloneis* and *Pinnularia*.
32. The genus *Climaconeis* appears to be more diverse in Florida than was previously evident (Prasad and co-workers, 2000).
33. Species of *Fallacia* were formerly in the genus *Navicula*.
34. Species of *Lyrella* were formerly in the genus *Navicula*, primarily in the 'Lyratae', variously called a subgenus, section, or simply, group.
35. Most species of *Mastogloia* are predominantly epiphytic, but may also exist as members of the epipelic (sediment surface) community.
36. In some species of *Mastogloia* the number of internal marginal siliceous chambers (partecta) is related to valve length. Such is the case, for example, in *M. erythraea* and *M. smithii* (Novarino and Muftah, 1992).
37. This species may be planktonic, benthic, or symbiotic, and has been reported under a variety of names; see Round and co-workers (1999).
38. This is a large genus containing many species which are probably not closely related. A number of *Nitzschia* species have been transferred to other genera, e.g., *Psammodictyon* and *Tryblionella*.
39. The relationship between *N. socialis* and *Bacillaria paxillifer* is unclear. Individual cells of both taxa are similar, and it is becoming apparent that, contrary to conventional wisdom, *Bacillaria* is made up of several undescribed species.
40. *Parlibellus* includes a number of species formerly placed in the large and unwieldy genus *Navicula* (see Cox, 1988). The species listed here all occur primarily within mucilaginous tubes, sometimes branched.
41. According to Cox (1988), *Navicula pseudocomoides* Hendey is a synonym for *Parlibellus berkeleyi* (Van Heurck) Cox.
42. It is likely that many records of this species from subtropical and tropical waters are misidentifications of *P. patrimonii* Sterrenburg (see Sterrenburg, 2001).
43. Species of *Petroneis* were formerly in the genus *Navicula* (see Round and co-workers, 1990).
44. The relationship between *P. delicatulum* and *P. hauckiana* is uncertain; see Patrick and Reimer, 1966.
45. Species of *Planothidium* were formerly in the genus *Achnanthes* (see Round and Bukhtiyarova, 1996).
46. Some authors (e.g., Patrick and Reimer, 1966) prefer to retain this species as a variety of *P. angulatum* (Queckett) W. Smith.
47. *Psammodictyon* was established by D.G. Mann (in Round and co-workers, 1990) to include the species from the Panduriformes section of *Nitzschia*.
48. *Pseudo-nitzschia seriata* is frequently a misidentified name for other species in this genus of very similar species (see Hasle and co-workers, 1996). These species potentially may produce domoic acid, a potent neurotoxin.
49. This species may be better placed in *Staurophora*, which contains marine/brackish species with one plastid (Prasad and Silva, 2000). *Stauroneis* species usually have two plastids and are freshwater inhabitants. However, the IRL contains numerous adventitious freshwater species. I have not seen living cells, and so the chloroplast number is unknown.
50. *Tryblionella* consists of species formerly in the section Tryblionellae of the genus *Nitzschia*.