First record of benthic diatoms (Bacillariophyceae and Fragilariophyceae) from Isla Guadalupe, Baja California, Mexico

Primer registro de diatomeas bentónicas (Bacillariophyceae y Fragilariophyceae) de isla Guadalupe, Baja California, México

Francisco Omar López-Fuerte, David A. Siqueiros-Beltrones, Ricardo Yabur

Abstract

Guadalupe Island represents a unique ecosystem. Its volcanic origin and remoteness from the Baja California peninsula have allowed for the successful establishment of its distinctive flora and fauna. However, the difficulty in accessing the island has precluded the study of its biotic communities, mainly the marine ones. Consequently, no studies on benthic or planktonic diatoms have been hitherto published. Thus, the first records of marine benthic diatom species (epiphytic, epilithic, epizoic) from Guadalupe Island in the NW Mexican Pacific are here provided. One hundred and nineteen diatom taxa belonging to the Bacillariophyceae and Fragilariophyceae were identified, including species and varieties. The former with 87 taxa was the most diverse. Thirteen taxa are new records for Mexico; photographic images of these are provided. Because this is the first study for the benthic diatoms of Isla Guadalupe, a particular bio-geographical affinity is not proposed. However, the best represented genus was Mastogloia which has tropical affinity, and Cocconeis thalassiana was also identified, a new species recently recorded for the Mexican Caribbean.

Keywords: Insular; Bacillariophyta; Epiphytic; Epilithic; Epizoic; Eastern Pacific

Resumen

Isla Guadalupe es única como ecosistema; su origen volcánico y lejanía de la península de Baja California han permitido que el desarrollo evolutivo de sus distintivas flora y fauna haya sido exitoso. La dificultad para acceder a la isla es causa de que algunas comunidades, principalmente marinas, no hayan sido estudiadas aún. Consecuentemente, a la fecha no existía algún estudio publicado sobre diatomeas. Así, se presenta el primer registro de diatomeas bentónicas (epífitas, epílitas y epizoicas) de isla Guadalupe en el noroeste de México. Se identificaron 119 taxa (incluyendo especies y variedades) de diatomeas pertenecientes a las clases Bacillariophyceae y Fragilariophyceae. Las primeras fueron más diversas con 87 taxa. Del total, 13 taxa son nuevos registros para México y se proveen imágenes fotográficas de ellos. Dado que se trata apenas del primer estudio para la flora de diatomeas bentónicas de isla Guadalupe, no se propone una afinidad biogeográfica. Sin embargo, uno de los géneros con mayor número de especies es de afinidad tropical, i.e., Mastogloia y se identificó Cocconeis thalassiana, una especie nueva recientemente registrada para el Caribe mexicano.

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Keywords: Insular; Bacillariophyta; Epiphytic; Epilithic; Epizoic; Eastern Pacific

Palabras clave: Insular; Bacillariophyta; Epífitas; Epíliticas; Epizoicas; Pacífico oriental

* Corresponding author.
E-mail address: dsquei@gmail.com (D.A. Siqueiros-Beltrones).
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Introduction

Isla Guadalupe is a natural reserve that represents a unique ecosystem as other Mexican islands. Its volcanic origin and distance from the Baja California peninsula have allowed for a successful evolutionary development of both its particular land and marine flora and fauna, as can be inferred by the high number of cases of endemism recorded (Aguirre-Muñoz et al., 2003; García-Gutiérrez et al., 2005). However, studies on biodiversity, particularly of marine life, are lacking for Isla Guadalupe, mainly because of the difficulty to access the island. The available studies on marine flora of Isla Guadalupe date back to the late 1800s and were published by Setchell and Gardner (1930) in a list that included 90 species of macroalgae. The last review of the macroalgae of Isla Guadalupe was carried out by Stewart and Stewart (1984) and included 212 species, with 24 new records. Both studies recorded a large number of genera of subtropical affinity, indicating that the marine flora in the island is more characteristic of a subtropical than a temperate environment.

The difficulty in accessing an area such as Isla Guadalupe to carry out scientific research is the main cause that many marine communities are yet to be studied, even in their most basic aspects such as species composition. Thus, no published work existed hitherto on diatoms from that area, nor planktonic or benthic forms, in spite of being the most diverse, abundant and productive algal group in marine ecosystems.

In general, studies on benthic diatoms from the Mexican NW are scarce, and these are related either with their role in the feeding habits of abalone (Haliotis spp.) and grazing intertidal molluscs (Siqueiros-Beltrones & Valenzuela-Romero, 2004), or the structure of epiphytic forms assemblages found on macroalgae and marine plants (Argumedo-Hernández & Siqueiros-Beltrones, 2008; Siqueiros-Beltrones, Serviere-Zaragoza, & Argumedo-Hernández, 2002). Another study describes assemblages of epipelic diatoms characteristic of mangrove environments (López-Fuerte, Siqueiros-Beltrones, & Navarro, 2010).

In this study we begin the construction of a taxonomic basis that serves for monitoring and assessing the environmental health of any ecosystem, and provide the first floristic account of benthic diatoms from Isla Guadalupe.

Materials and methods

Isla Guadalupe is located in the Mexican Pacific Ocean approximately 256 km off the coast of the Baja California peninsula at 29° N, 118° W, within the Guadalupe Island Biosphere Reserve (Fig. 1). It is influenced by the California Current which is characterized by low temperature and salinity (Lynn & Simpson, 1987). Surficial water temperature ranges between 15 and 20°C during winter and between 20 and 22°C in summer. Its ocean volcanic nature and its remote distance from the coast confer it an abrupt topography and a unique biodiversity. The coastal zone physiography consists of loose basalts, blocks, dikes, cliffs, and few sandy beaches (Pierson, 1987).

Sample collection

Surificial temperature, salinity and pH were measured in situ using a field multi-sensor (Horiba U10). Benthic diatoms were collected at Guadalupe Island in one sampling site on January 18, 2013. Epiphytic diatoms were scraped off from specimens of Eisenia desmarestioides Setchell and N.L. Gardner, 1930 (Ochrophyta; Laminariales), and Codium latum subsp. palmeri (E.Y. Dawson) P.C. Silva, 1962 (Chlorophyta; Bryopsidales), using a glass slide for each sampling. Epilithic and epizoic diatoms from the shell of the sea-snail Megastraea undosa
W. Wood, 1828 were brushed off from an area of 5 cm² in each substrate using a toothbrush. Afterwards, a compound sample was formed for the site and preserved in commercial ethanol (70%); concomitant observations of fresh diatom samples were made. In order to clean the diatom frustules for identification the organic matter was oxidized with a mixture of sample, commercial ethanol and nitric acid at a 1:3:5 proportion (Siqueiros-Beltrones, 2002). The samples were then rinsed with drinking water until reaching a pH >6. From each compound sample three permanent slides were mounted for each substrate using Zrax® (RI: 1.7) as mounting medium. All species names and authorities were revised, and in certain cases nomenclatural updates were made, confirming all of the currently accepted taxonomic names. In order to revise the taxonomic names and their synonymies, we consulted Round, Crawford, and Mann (1990) along with the data bases on www.algaebase.org (Guiry & Guiry, 2014) and www.marinespecies.org (WoRMS Editorial Board, 2014). Taxonomic keys used for species identification
included: Schmidt et al. (1874–1959), Peragallo and Peragallo (1897–1908), Foged (1984), Witkowski, Lange-Bertalot, and Metzeltin (2000), Siqueiros-Beltrones (2002), and López-Fuerte et al. (2010). Photographic images of newly recorded taxa and others were acquired using an electronic ocular lens.

**Results**

Surficial water temperature in the sampling site was measured at 17.7 °C; salinity was recorded at 38 psu, which renders the environment as polyhalobous. The measured pH was close to neutral at 7.4.

Floristic analysis yielded 119 taxa including species and varieties of benthic diatoms, including epiphytic, epilithic and epizoic forms (Appendix). All diatoms appear alive in the fresh mountings (Fig. 2). The class Bacillariophyceae with 87 taxa was much more diverse than the Fragilariophyceae which yielded 32 taxa. Out of the 45 identified genera, those with higher number of species were *Mastogloia* (13), *Diploneis* (11 species), *Nitzschia* (10), *Cocconeis* (9), *Grammatophora* (6) and *Lemicophora* (5). These represent 46% of the species recorded in this study. In contrast, 25 genera were represented by a single species. Thirteen taxa are new records for Mexico: *Achnanthes citronella* (A. Mann) Hustedt (Fig. 40), *Amphiprora conspicua* Greville (Fig. 18), *Amphora proteus* var. *oculata* H. Peragallo (Fig. 41), *Campylodiscus ambiguus* Greville (Fig. 3), *Diploneis coffaeiformis* (Schmidt Cleve (Fig. 34), *D. suborbicularis* var. *constricta* Hustedt (Fig. 33), *Donkinia reticulata* Norm. (Fig. 35), *Lyrella perplexoides* (Hustedt) D.G. Mann (Fig. 39), *Mastogloia asperuloides* Husttedt (Fig. 43), *M. tiskeiensis* Giffen (Figs. 38 and 42), *M. punctatissima* (Greville) Ricard (Fig. 44), *Parlibellus delognei* (van Heurck) E. Cox (Fig. 37) and *Psammodiscus calceatus* T. Watanabe, T. Nagumo and J. Tanaka (Fig. 31). Only 11 taxa occurred in all three surveyed substrates. The higher number of taxa was observed on the rocky substrate (57), and the lowest on the shell of *Megastraea undosa*. On the other hand, the higher number of exclusive taxa occurred on macroagal substrate, particularly on *Eisenia desmarestioides* with 29 taxa, which renders it as a proper substrate for diatoms, while *M. undosa* had the lowest (6) number of taxa.

**Discussion**

Research on benthic marine diatoms in Mexico dates barely to the 1980s, and most studies have been carried out for the NW region. Recently, however, some have been carried out in the Mexican Caribbean area (Hernández-Almeida, Herrera-Silveira, & Merino-Virgilio, 2013; López-Fuerte, Siqueiros-Beltrones, & Hernández-Almeida, 2013; Siqueiros-Beltrones, Argumedo-Hernández, & Hernández-Almeida, 2013). Nonetheless, there are still extensive areas in the country where the most basic floristic studies on benthic diatoms are lacking and are badly needed.

Our present work falls within this category, inasmuch no research on diatoms, whether scientific or of any sort, existed for Mexican islands, in spite the fact that 1365 islands are distributed within the Mexican territory (Comité Asesor Nacional sobre el Territorio Insular Mexicano, 2012). Thus, this constitutes the first list of benthic diatoms for any oceanic island located in the exclusive economic zone of Mexico, and it targets the Guadalupe Island Biosphere Reserve.

Although only three substrates were examined, the number of identified taxa is high, and over 11% are new records for the whole country. Some of the genera with a higher number of species are of tropical affinity, e.g., *Mastogloia*. Others such as *Cocconeis thalassiana*, primarily described for the Mexican Caribbean (Romero & López-Fuerte, 2013), leads us to suggest that, as with the terrestrial flora, Isla Guadalupe does not have a diatom flora with a particular biogeographical affinity, i.e., temperate, subtropical, or tropical. Moreover, due to the distance of the island with the continent it is likely that further observations based on a more exhaustive sampling may render new records of diatom species or varieties. This, and on the basis that Isla Guadalupe is not influenced by coastal upwelling, shows a biogeographically mixed macroalgal flora that includes species from California, the Mexican tropics, and the insular Indo-Pacific, plus a conspicuous group of endemic taxa derived from the California flora. All of these are evidence of their effective isolation and the ecological divergence in a process of speciation (Dawson, 1960).

In comparison with *E. desmarestioides* that stands out as a proper substrate for diatoms with 29 exclusive taxa and the second most number of taxa overall, Siqueiros-Beltrones et al. (2002) did not find diatom epiphytes on *Eisenia arborea* Areschoug, although recent research has shown that older blades may harbor monospecific proliferations of diatoms. Along the West coast of the Baja California Peninsula, *Macrocytis pyrifera* (Linnaeus) C. Agardh is considered the main food source of abalone (*Haliotis* spp.), together with its numerous epiphytic diatom species (Argumedo-Hernández & Siqueiros-Beltrones, 2008). However, in Isla Guadalupe *M. pyrifera* is absent, thus its ecological role may be replaced by *E. desmarestioides*, which is the largest macroalgae in the area and, according to the local fishermen, its abundance relate to the that of abalone.

Aside from this being the first publication on the diatom flora of Isla Guadalupe or any other Mexican island, the high number of new records either for the region or the whole country gives an insight to a highly diverse flora hitherto unknown as an assemblage. Thus, the generated information is relevant both in bio-geographical as well as in environmental health terms. We are confident that further exhaustive research will provide much valuable information that is hard to come by, given the remoteness of the studied area. The differential distribution of exclusive diatom taxa on distinct substrates strongly supports the expectation of increasing the species richness for the island as more substrates are examined.

**Acknowledgements**

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Appendix.

List of benthic diatoms recorded for the Biosphere Reserve Isla Guadalupe, Mexico. Symbols indicate the type of substrate from which it was sampled. Epiphytic (*Eisenia desmarestioides*; *Codium latum* subsp. *palmeri* ■); epilithic ●; epizoic ▲ (*Megastraea undosa*); ♦ new records for Mexico.

<table>
<thead>
<tr>
<th>Class Bacillariophyceae Haeckel, 1878</th>
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<tr>
<td>Subclass Bacillariophycidae D.G. Mann, 1990</td>
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<tr>
<td>Order: Achnanthales Silva, 1962</td>
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<td>Family: Achnanthaceae Kützing, 1844</td>
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<tr>
<td>1. Achnanthes Bory de Saint Vincent, 1822</td>
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<td>1. Achnanthes brevipes var. angustata (Greville) Cleve, 1894 (H17033 ▲)</td>
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<td>2. Achnanthes brevipes var. intermedia (Kützing) Cleve, 1895 (H17033)</td>
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<td>3. Achnanthes citronella (A. Mann) Hustedt, 1937 ♦ (H17033)</td>
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<td>4. Achnanthes yaquinensis McIntire et Reimer, 1974 (H17033)</td>
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<tr>
<td>Order: Bacillariales Hendey, 1937</td>
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<td>Family: Bacillariaceae Ehrenberg, 1831</td>
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<td>5. Alveus Kaczmarska et Fryxell, 1995</td>
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<td>6. Alveus marinus (Grunow) Kaczmarska et Fryxell, 1996 (Fig. 17) ■ (H17033)</td>
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<td>7. Denticula Kützing, 1844</td>
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<td>8. Denticula kuetzingii Grunow, 1862 * (Fig. 26)</td>
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<td>9. Nitzschia Hassall, 1845</td>
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<td>10. Nitzschia angularis W. Smith, 1853 ♦</td>
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<td>11. Nitzschia dissipata (Kützing) Grunow, 1862 * (H17033)</td>
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<td>12. Nitzschia macilenta W. Gregory, 1859 ♦ (H17033)</td>
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<td>13. Nitzschia marginulata var. didyma Grunow, 1880 *</td>
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<td>14. Nitzschia punctata var. coarctata (Grunow) Hustedt, 1921 ♦</td>
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<td>15. Nitzschia sigma (Kützing) W. Smith, 1853 ♦</td>
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<td>16. Nitzschia spathulata W. Smith, 1853 ■</td>
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<td>17. Tryblionella W. Smith, 1853</td>
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<td>18. Tryblionella hungarica (Grunow) Hustedt, 1933</td>
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<tr>
<td>Order: Cymbellales D.G. Mann, 1990</td>
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<tr>
<td>Family: Rhoicospheniaceae Chen et Zhu, 1983</td>
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<td>20. Campylopyxis garkeana (Grunow) L. K. Medlin, 1985 (Fig. 23) *</td>
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<td>22. Gomphonemopsis pseudexigua cf. (R. Simonsen) L.K. Medlin, 1986 *</td>
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<tr>
<td>Order: Lyrellales D.G. Mann, 1990</td>
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<td>Family: Lyrellaceae D.G. Mann, 1990</td>
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<tr>
<td>23. Lyrella approximata (Greville) D.G. Mann, 1990 (Fig. 7) *</td>
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<td>24. Lyrella perplexoides (Hustedt) D.G. Mann, 1990</td>
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<td>25. Mastogloia asperuloides Hustedt, 1933 ♦</td>
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<td>26. Mastogloia binotata (Grunow) Cleve, 1895 ♦</td>
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<td>27. Mastogloia borneensis Hustedt, 1927 ♦</td>
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<td>28. Mastogloia crucicula (Grunow) Cleve, 1895</td>
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<td>29. Mastogloia crucicula var. alternans Zanon, 1948</td>
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<td>30. Mastogloia erythraea Grunow, 1860</td>
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<td>31. Mastogloia fimbriata (T. Brightwell) Grunow, 1863 (Fig. 8)</td>
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<td>32. Mastogloia gieskessii Cholnoky, 1963</td>
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<td>33. Mastogloia mediterranea Hustedt, 1933</td>
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<td>34. Mastogloia obliqua Haglestein, 1939</td>
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<td>35. Mastogloia punctatissima (Greville) Ricard, 1975</td>
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<td>36. Mastogloia rostrata (Wallich) Hustedt, 1933</td>
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<tr>
<td>Order: Naviculales Bessey, 1907</td>
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<td>Family: Amphipleuraceae Grunow, 1862</td>
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<td>37. Amphipleura Ehrenberg, 1844</td>
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<td>38. Amphipleura conspicua Greville, 1861 (Fig. 18) ♦</td>
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<tr>
<td>Family: Brachysiraceae D. G. Mann, 1990</td>
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<td>39. Brachysira Kützing, 1836</td>
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<td>40. Brachysira aff. neoexilis Lange-Bertalot, 1994 (Fig. 25) *</td>
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Family: Pinnulariaceae D.G. Mann, 1990

Oestrupia Heiden ex Hustedt, 1935

36. Oestrupia musca (Gregory) Hustedt, 1935

Suborder: Diploneidinae D.G. Mann, 1990

Family: Diploneidaceae D.G. Mann, 1990

Diploneis Ehrenb. ex Cleve, 1844

37. Diploneis aestuarii Hustedt, 1939

38. Diploneis bombus (Ehrenb.) Ehrenberg, 1853 (Fig. 14)

39. Diploneis chersonensis (Grunow) Cleve, 1894

40. Diploneis coffeiformis (Schmidt) Cleve, 1894

41. Diploneis crubro (Ehrenb.) Ehrenberg, 1854

42. Diploneis nitescens (Gregory) Cleve, 1894

43. Diploneis papula (A.W.F. Schmidt) Cleve, 1894 (Fig. 14)

44. Diploneis coffaeiformis (Schmidt) Cleve, 1894

45. Diploneis suborbicularis var. constricta Hustedt, 1937

46. Diploneis vacillans var. renitens (A. Schmidt) Cleve, 1894

Suborder: Naviculineae (Bessey) Hendey, 1937

Family: Naviculaceae Kützing, 1844

Caloneis Cleve, 1894

48. Caloneis excenctrica (Grunow) Boyer, 1927

49. Caloneis linearis (Grunow) Boyer, 1927

Navicula Bory de Saint-Vincent, 1822

50. Navicula agnita Hustedt, 1955

51. Navicula cancellata Donkin, 1872

52. Navicula longa var. irregularis Hustedt, 1935

53. Navicula zosteteri Grunow, 1860

Trachyneis Cleve, 1894

54. Trachyneis aspera (Ehrenb.) P.T. Cleve, 1894 (Fig. 24)

55. Trachyneis velata A. Schmidt, 1876

Family: Pleurosigmataceae Mereschkowsky, 1903

Pleurosigma W. Smith, 1852

56. Pleurosigma salinarum (Grunow) Grunow, 1880

Family: Sellaphoraceae Mereschkowsky, 1902

Fallacia Stickle et D.G. Mann, 1990

57. Fallacia forcipata (Greville) Stickle et Mann, 1990

Family: Berkeleyaceae D.G. Mann, 1990

Faribellus E. J. Cox, 1998

58. Faribellus delognei (Van Heurck) E. J. Cox, 1988

Family: Pleurosigmataceae Mereschkowsky, 1903

Donkinia Ralfs, 1861

59. Donkinia reticulata Norman, 1861

Order: Rhopalodiales D.G. Mann, 1990

Family: Rhopalodiaceae (G. Karst.) Topachevs’kyj et Oksiyuk, 1960

Rhopalodia Otto Müll., 1895

60. Rhopalodia pacifica Krammer, 1987

Epithemia Kützing, 1844

61. Epithemia turgida (Ehrenb.) Kützing, 1844

Order: Surirellales D.G. Mann, 1990

Family: Surirellaceae Kützing, 1844

Campylodiscus Ehrenb. ex Kützing, 1840

62. Campylodiscus ambiguus Greville, 1860

63. Campylodiscus crebrecostatus var. speciosa T. Eulenstein, 1875 (Fig. 2)

64. Campylodiscus fastuosus Ehrenberg, 1845 (Fig. 4)

65. Campylodiscus simulans Gregory, 1857

Family: Cocconeidaceae Kützing, 1844

Campyloneis Grunow, 1862

66. Campyloneis grevillei Petit, 1877 (Fig. 7)

Cocconeis Ehrenberg, 1836

67. Cocconeis costata var. hexagona Grunow, 1880

68. Cocconeis dirupta var. flexella (Janisch et Rabenhorst) Grunow, 1880

69. Cocconeis discrepans A.W.F. Schmidt, 1894

70. Cocconeis molesta var. crucifera Grunow, 1880 (Fig. 32)

71. Cocconeis molesta var. molesta Kützing, 1844

72. Cocconeis pediculas Ehrenberg, 1838

73. Cocconeis cf. pseudomarginata Gregory, 1857
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74. Cocconeis scutellum Ehrenberg, 1838  
Psammodicyton D.G. Mann, 1990  
76. Psammodicyton panduriforme (W. Gregory) D.G. Mann, 1990  
Order: Thalassiophysales D.G. Mann, 1990  
Family: Catenulaceae Mereschkowsky, 1902  
Amphora Ehrenb. ex Kützing, 1844  
77. Amphora angusta Gregory, 1857  
78. Amphora clevei Grunow, 1875  
79. Amphora immarginata Nagumo, 2003  
80. Amphora laevissima W. Gregory, 1857  
81. Amphora libyca Ehrenberg, 1840  
82. Amphora proteus Gregory, 1857  
83. Amphora proteus var. oculata H. Peragallo, 1898  
84. Amphora rhombica var. intermedia Cleve, 1895  
Halamphora (Cleve) Levkov, 2009  
85. Halamphora coffeaeformis (C. Agardh) Levkov, 2009  
86. Halamphora costata (W. Smith) Levkov, 2009  
87. Halamphora cymbifera (Gregory) Levkov, 2009  
Class Fragilariophyceae Round et R.M. Crawford, 1990  
Order: Clacimospheniales Round, 1990  
Climacosphenia Ehrenberg, 1843  
88. Climacosphenia moniligera Ehrenberg, 1843 (Figs. 15 and 16)  
Order: Cyclophorales Round, 1990  
Family: Entopylaceae Round, 1990  
Gephyria Arnott, 1858  
89. Gephyria media Arnott, 1860 (Fig. 19)  
Subclass Fragilariphycidae Round et R.M. Crawford, 1990  
Order: Fragilariales Silva, 1962  
Family: Fragilariaeae Greville, 1833  
Hyalosynedra D.M. Williams et F.E. Round, 1986  
90. Hyalosynedra laevigata (Grunow) D.M. Williams et Round, 1986  
Order: Licmophorales Round et R.M. Crawford, 1990  
Licmophora C. Agardh, 1827  
96. Licmophora abbreviata C. Agardh, 1831 (Fig. 20)  
97. Licmophora communis (Heiberg) Grunow, 1881 (Fig. 28)  
98. Licmophora ehrenbergii (Kützing) Grunow, 1867 (Fig. 29)  
99. Licmophora gracilis (Ehrenb.) Grunow, 1867  
100. Licmophora paradoxus (Lyngbye) C. Agardh, 1828  
Licmosoma Round & C.G. Alexander, 2002: 324  
101. Licmosoma squamosum Round & C.G. Alexander, 2002 (Fig. 30)  
Order: Rhabdionematales Round, 1990  
Family: Psammodesicaceae Round et D.G. Mann, 1990  
Psammodesiscus Round et D.G. Mann, 1980  
103. Psammodesiscus nitidus (Gregory) Round et D.G. Mann, 1980  
Order: Rhabdonematales Round et R.M. Crawford, 1990  
Family: Rhabdonemataceae Round et R.M. Crawford, 1990  
Rhabdonema Kützing 1844  
104. Rhabdonema adriaticum Kützing, 1844 (Figs. 10 and 11)  
105. Rhabdonema arcuatum (Lyngbye) Kützing, 1844 (Figs. 12 and 13)  
Order: Striatellaceae Round, 1990  
Family: Striatellaceae Kützing, 1844  
Grammatophora Ehrenberg, 1840  
106. Grammatophora angulosa Ehrenberg, 1841
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<td>107. Grammatophora hamulifera</td>
<td>Kützing, 1844</td>
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<td>108. Grammatophora marina</td>
<td>(Lyngbye) Kützing, 1844 (Fig. 21)</td>
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<td>109. Grammatophora oceanica</td>
<td>Ehrenberg, 1840</td>
<td>*</td>
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<td>110. Grammatophora var. macilentata</td>
<td>(W. Smith) Grunow, 1862</td>
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<td>111. Grammatophora undulata</td>
<td>Ehrenberg, 1840 (Fig. 22)</td>
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<tr>
<td>Striatella C. Agardh, 1832</td>
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<tr>
<td>112. Striatella interrupta</td>
<td>(Ehrenb.) Heiberg, 1863</td>
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<td>113. Striatella unipunctata</td>
<td>(Lyngbye) C. Agardh, 1832 (Fig. 36)</td>
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<td>Order: Surirellales</td>
<td>D.G. Mann, 1990</td>
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<td>Plagiodesmus</td>
<td>Grunow et Eulenstein, 1867</td>
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<td>Grunow, 1867 (Fig. 27)</td>
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<td>Surirella Turpin, 1828</td>
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<td>115. Surirella armoricana</td>
<td>Peragallo et M. Peragallo, 1899</td>
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<td>116. Surirella fastuosa</td>
<td>(Ehrenb.) Ehrenberg, 1843 (Fig. 9)</td>
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<td>(Grunow) Tempère et Peragallo, 1910</td>
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<td>118. Thalassionema nitscshoides</td>
<td>(Grunow) Meseschkowsky, 1902</td>
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<td>Toxarium</td>
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<td>119. Toxarium undulatum</td>
<td>J.W. Bailey, 1854</td>
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