Diatoms of the Mystery Lake, Taiwan (III)

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ABSTRACT: This is the last part of study about the diatom flora found in the Mystery Lake, a slightly acidic lake situated within a hardwood nature preserve in northeastern Taiwan. In this article, we reported 17 species, belonging to 4 genera, 4 families, and 2 orders, based on scanning electron microscopic observations. The species described here, 9 are newly recorded in Taiwan. They are: *Navicula cryptotenella*, *Navicula ingrata*, *Navicula subfasciata*, *Pinnularia borealis* var. *rectangularis*, *Pinnularia interrupta*, *Pinnularia maior*, *Sellaphora laevissima*, *S. vitabunda*, and *Nitzschia perminuta*. In total, we found 76 diatom species in the surface sediments of this lake. Among them, 33 (43%) are newly recorded to Taiwan. The present study indicates that this lake is characterized by high species diversity and high species richness, which are related to the oligotrophic and non-polluted environmental conditions.

KEY WORD: Diatoms, Mystery Lake, Nan-ao Nature Reserve, species diversity, species richness, Taiwan.

INTRODUCTION

Mystery Lake is slightly acidic lake situated within Nanao Nature Reserve, northeastern Taiwan. In previous two papers we reported 59 species of diatoms in this lake (Wu and Wang, 2002; Wang and Wu, 2005). In the present study, we further described 17 species, as a supplement to the diatom flora of this lake. It includes four families: Bacillariaceae, Naviculaceae, Pinnulariaceae, and Sellaphoraceae. The scanning electron microscope (SEM) was used to study the silica valve and its fine structures. To characterize the diatom assemblages in the lake sediments, both the species diversity and species richness were calculated at each sampling site.

MATERIALS AND METHODS

Six surface sediment samples collected from different localities were cleaned with a mixture of sulfuric acid and acetic acid (1:9 v/v) and then dehydrated with a series of alcohol. Subsequently, they were dried by a critical point dryer (Hitachi HCP-2). Dried diatoms were mounted on an aluminum stub and coated with gold by a sputter coater (Edwards S150A). Coated stub was viewed on a Zeiss DSM 950 SEM.

To measure the species diversity and species richness of each sample, Shannon index (Shannon and Weaver, 1949) and Margalef index (Margalef, 1958) were adopted, respectively. For this, the frequency of each species encountered in at least 500 diatom valves in each sample and the total number of diatom species occurred in each sample were calculated.

RESULTS

In this article, 17 taxa belonging to Naviculales and Bacillariales were described. In the former order, there were three families, namely Naviculaceae, Pinnulariaceae, and Sellaphoraceae, while the latter only Bacillariaceae. Their identification was based on the morphology observed under SEM. The taxonomic designations of the genera are listed in Table 1.

TAXONOMIC TREATMENTS

Order Naviculales
Family Naviculaceae
Genus ***Navicula*** Bory de Saint-Vince 1822

Valves linear, lanceolate to elliptical in shape. Axial and central areas variable. Raphe present on both valves in the axial area and extended the length of the valve. Striae uniseriately punctate, radiate, parallel, or convergent at the ends of the valve.

Key to the species of *Navicula*

1. Valves broadly linear or broadly linear-lanceolate ……..…… 2
1. Valves narrowly lanceolate to broadly lanceolate ……..…… 3
2. The striae density more than 20 in 10 μm …….. 5. *N. minima*
2. The striae density less than 20 in 10 μm ……...… 3. *N. elginensis*
3. Valves with obtuse ends ……..…… 2. *N. cryptotenella*
3. Valves with rostrate to capitate ends ……..…… 4
4. The striae density more than 20 in 10 μm ……..... 4. *N. ingrata*
4. The striae density less than 20 in 10 μm 5
5. Valves with distinctly narrowed, protracted, globose-capitate to rostrate-capitate ends ……...…… 1. *N. cryptocephala*
5. Valves with subcapitate ends ……..…… 6. *N. subfasciata*

1. *Navicula cryptocephala* Kützing. Bateman & Rushforth, 1984, p. 73, pl. 13, fig.188; Chen & Lai, 1984, p. 49, pl. 3, fig. 39; Chen & Lai, 1985, p. 81, pl. 5, fig. 8; Czarnecki & Blinn, 1977, p. 91, pl. 11, fig. 9; De

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Table 1. Summaries of the diatom genera and their taxonomic positions described in the present article.

Class Bacillariophyceae Haekel 1878
Naviculales Bessey 1907
Naviculaceae Kützing 1844
Navicula Bory de Saint-Vince 1822
Pinnulariaceae Mann 1990
Pinnularia Ehrenberg 1843
Sellaphoraceae Mereschowsky 1902
Sellaphora Mereschkowsky 1902
Bacillariales Hendey 1937
Bacillariaceae Ehrenberg 1831
Nitzschia Hassall 1845

Oliveira and Steinita-Kannan, 1992, p. 546, pl. 7, fig. 112; Foged, 1979, p. 71, pl. 24, figs. 1-4; Fungladda & Kaczmarska, 1983, p. 81, pl. 12, figs. 190 & 201; Gasse, 1986, p. 89, pl. 29, fig. 10; Güttinger, 1994, plate 2.05.31-3; Huang, 1975, p. 14, p. 2, fig. 16; Huang, 1982, p. 320, pl. 13, fig. 10; John, 1983, p. 87, pl. 38, figs. 3-4; Krammer & Lange-Bertalot, 1986, p. 503, pl. 31, figs. 8-14; Patrick & Reimer, 1966, p. 561, pl. 48, fig. 3. Figs. 1E & F

Synonym: *Navicula exilis* Kützing.

Valves lanceolate; narrowed towards the somewhat protracted, globose-capitate to rostrate-capitate ends. Axial area narrow, slightly wider at the center of the valve. Raphe straight; proximal ends closed, rounded; distal ends hooked. Central area transversally elongated. Striae uniseriately punctate, radiate centrally, parallel or slightly convergent at the ends. Dimension: 4-7 × 28-39 μm, striae 13-17 in 10 μm.

2. *Navicula cryptotenella* Lange-Bertalot. Krammer & Lange-Bertalot, 1986, p. 507, pl. 33, figs. 9-11u, 13-17; Güttinger, 1994, plate 2.05.31-7. Figs. 1I & J

Synonym: *Navicula tenella* Brébisson ex Kützing; *Navicula radiosa* var. *tenella* (Brébisson ex Kützing) Van Heurck.

Valves broadly lanceolate; ends obtuse. Axial area narrow; slightly widened towards the center of the valve. Raphe straight; proximal ends closed. Central area small, orbicular. Striae uniseriately punctate, radiate centrally, parallel or slightly convergent at the ends. Dimension: 5-7 × 17-34 μm, striae 12-16 in 10 μm.

3. *Navicula elginensis* (Gregory) Ralfs. Chen & Lai, 1985, p. 81, pl. 5, fig. 16; Gasse, 1986, p. 94, pl. 20, figs. 28-29; Güttinger, 1994, plate 2.05.31-42; Krammer & Lange-Bertalot, 1986, p. 533, pl. 46, figs. 1-12; Patrick & Reimer, 1966, p. 565, pl. 50, fig. 3. Fig. 1K

Synonym: *Pinnularia elginensis* Gregory; *Navicula tumida* W. Smith.

Valve broadly linear or broadly linear-lanceolate; ends broadly rostrate. Axial area narrow. Raphe steaight; proximal ends closed, rounded, distal ends hooked. Central area small, circular. Striae uniseriately punctate, radiate throughout the other valve, parallel or slightly radiate at the ends. Dimension: 6-9 × 22-24 μm, striae 12-15 in 10 μm.

4. *Navicula ingrata* Krasske. Krammer & Lange-Bertalot, 1986, p. 585, pl. 72, figs. 14-16. Fig. 1G

Valves narrowly lanceolate to lanceolate, ends rostrate-wedge-shaped. Axial area narrow. Raphe straight; proximal ends closed. Central area small. Striae uniseriately punctate, radiate at the ends, slightly radiate throughout the other part of the valve. Dimension: 4-5 × 16-17 μm, striae 25-30 in 10 μm.

5. *Navicula minima* Grunow. Gasse, 1986, p. 102, pl. 20, figs. 14-15, 18; Güttinger, 1994, plate 2.05.31-30; Krammer & Lange-Bertalot, 1986, p. 593, pl. 76, figs. 39-47; Moser *et al*., 1998, p. 253, pl. 24, figs. 10-15; Patrick & Reimer, 1966, p. 557, pl. 46, figs. 17-18. Figs. 1A-D

Synonym: *Eolimna minima* (Grunow) Moser, Lange-Bertalot et Metseltin; *Navicula minutissima* Grunow; *Navicula atomoides* Grunow; *Navicula minima* var. *atomoides* (Grunow) Cleve; *Navicula tantula* Hustedt.

Valve linear to linear-elliptical; ends rounded. Axial area narrow, linear; proximal ends rounded, not extending to the central area; distal ends curved in the same directions. Central area transverse, formed by the nearly equal shortening of the central striae. Striae uniseriately punctate, radiate throughout the valve. Dimension: 2-4 × 5-12 μm, striae 25-30 in 10 μm.

6. *Navicula subfasciata* Patrick. Patrick & Reimer, 1966, p. 565, pl. 50, fig. 2. Fig. 1H

Valves narrowly lanceolate to lanceolate, ends subcapitate. Axial area narrow. Raphe straight; proximal ends closed. Central area transversely elongated, not reaching the margin of the valve. Striae uniseriately punctate, almost parallel at the center, radiate throughout the other part of the valve, parallel or slightly radiate at the ends. Dimension: 6-7 × 23-24 μm, striae 12-14 in 10 μm.

Family Pinnulariaceae

Genus ***Pinnularia*** Ehrenberg 1843

Valves linear, lanceolate or elliptical; ends rostrate, capitate or rounded. Raphe maybe appearing as a line or a filament, or twisted in various ways in some species; terminal fissures hooked at the ends; proximal ends expanded. Axial and central areas usually distinct, but variable in shape. Striae multiseriate, chambered, each chamber containing many rows of small rounded poroids.

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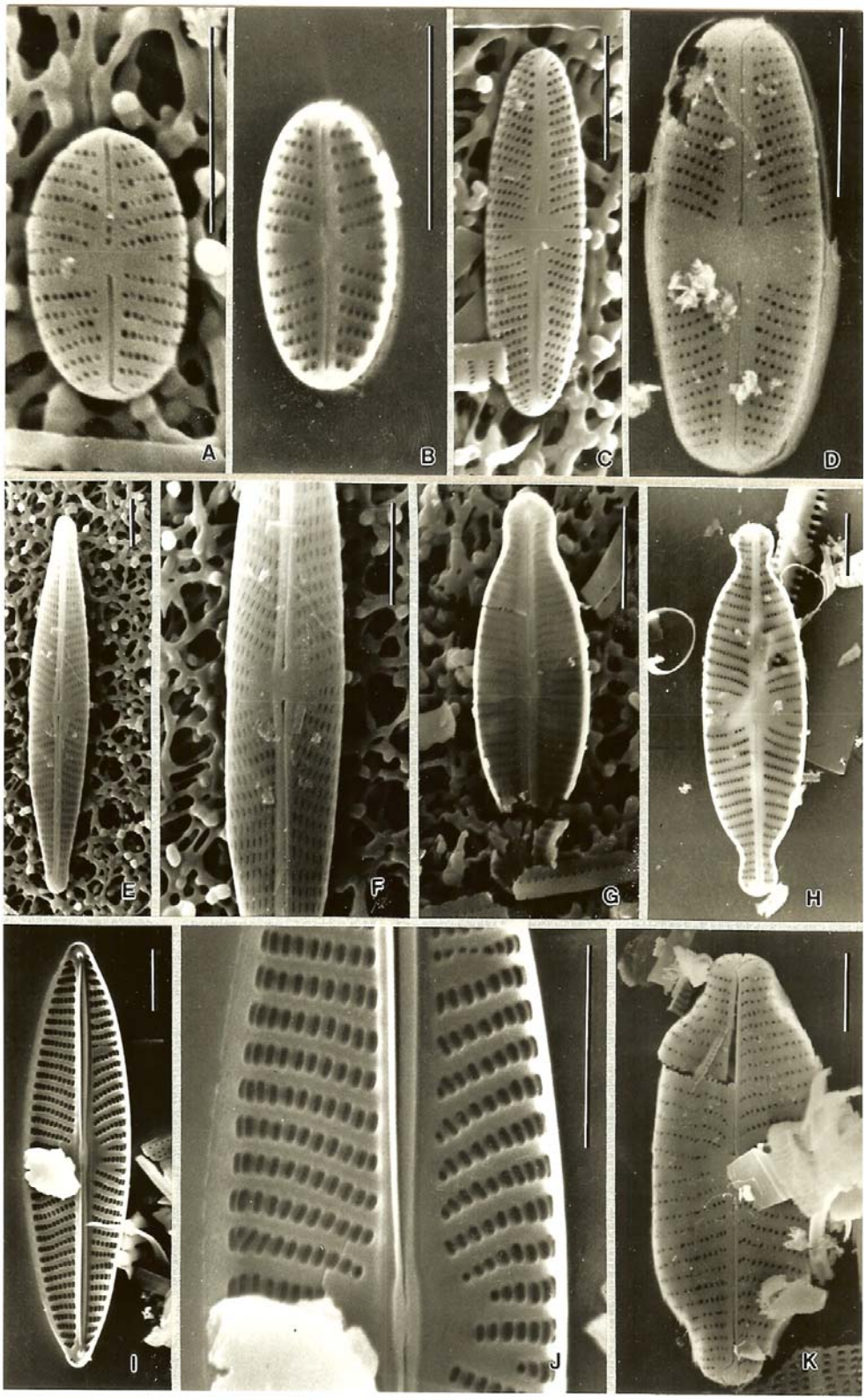


Fig. 1. A-D: *Navicula minima* Grunow. E-F: *Navicula cryptocephala* Kützing. G: *Navicula ingrata* Krasske. H: *Navicula subfasciata* Patrick. I-J: *Navicula cryptotenella* Lange-Bertalot. K: *Navicula elginensis* (Gregory) Ralfs. Bar = 4 μm.

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Key to species of *Pinnularia*

1. Valves more than 100 μm long ..... 3. *P. maior*
1. Valves less than 100 μm long 2
2. Striae density less than 7 in 10 μm . 1. *P. borealis* var. *rectangularis*
2. Striae density more than 7 in 10 μm ….…...…… 2. *P. interrupta*

1. *Pinnularia borealis* Ehrenbreg var. ***rectangularis*** Carlson. Li, 1976, p. 64, pl. 5, fig. 6; Krammer & Lange-Bertalot, 1986, p. 799, pl. 177, figs. 8-11; Moser *et al*., 1998, p. 79, pl. 9, figs. 2-6; Patrick & Reimer, 1966, p. 657, pl. 58, fig. 14. Figs. 2A & B

Synonym: *Pinnularia rectangularis* Hustedt; *Pinnularia eburnea* (Carlson) Zanon; *Pinnularia dubitabilis* Hustedt.

Valve linear; ends rounded. Axial area broad. Raphe somewhat curved, with "comma" shaped terminal fissures; proximal ends expanded, rounded; distal ends curved in the opposite direction. Central are transversely elongated. Striae multiseriate, chambered, each chamber containing many rows of small rounded poroids, striae parallel, distantly placed from each other, widely spaced, more or less alternating on opposite sides of the valve. Dimension: 7-8 × 33-34 μm, striae 5-6 in 10 μm.

2. *Pinnularia interrupta* W. Smith. De Oliveira and Steinita-Kannan, 1992, p. 548, pl. 9, fig. 151; Foged, 1979, p. 95, pl. 33, figs. 7, 9; Güttinger, 1994, plate 2.05.35-4; Huang, 1982, p. 322, pl. 15, fig. 17; Krammer & Lange-Bertalot, 1986, p. 825, pl. 190, figs. 1-11. Figs. 2E & F

Synonym: *Pinnularia mesolepta* (Ehrenberg) W. Smith; *Pinnularia biceps* Gregory; *Pinnularia bicapitata* (Lagerstedt) Cleve.

Valve linear to slightly narrowly lanceolate, ends subcapitate. Axial area broad, less than one third of the width of the valve, narrowing abruptly before reaching the ends and widening to central area. Raphe central, filamentous, with the terminal fissures like"question marks"; proximal ends closely arranged and slightly curved; distal ends curved in the same direction. Central area extending to the margin as a transverse fascia on both sides. Striae multiseriately, chambered, each chamber containing many rows of small rounded poroids, striae strongly radiate at the center of the valve, convergent towards the ends, lacking in central area. Dimension: 9-14 × 55-69 μm, striae 9-11 in 10 μm.

3. *Pinnularia maior* (Kützing) Rabenhorst. Bateman & Rushforth, 1984, p. 89, pl. 21, fig.311; Foged, 1984, p. 107, pl. 10, fig. 1; Huang, 1976, p. 12, pl. 2, fig. 1; Krammer & Lange-Bertalot, 1986, p. 837, pl. 196, figs. 1-4; Patrick & Reimer, 1966, p. 663, pl. 61, fig. 5; Tschen & Li, 1974, p. 16, pl. 5, fig. 6. Figs. 2C & D

Synonym: *Frustulia maior* Kützing.

Valve linear, ends broadly rounded. Axial area distinct, one-fourth to one-fifth the breadth of the valve, widening at the central area. Raphe somewhat undulate, proximal ends rounded, distal ends hooking in the same direction. Central area elliptical, somewhat asymmetrical. Striae multiseriate, chambered, each chamber containing many rows of small rounded poroids, striae radiate in the middle portion of the valve and convergent at the ends; crossed by a distinct band. Dimension: 26-29 × 196-234 μm, striae 6-7 in 10 μm.

Family Sellaphoraceae

Genus ***Sellaphora*** Mereschkowsky 1902

Valves linear to lanceolate or elliptical, usually with bluntly rounded ends. Raphe central, straight, often lied between two thickened ribs; distal edns curving in the same direction; proximal ends rounded; central area maybe small or transversely widened; raphe endings surrounded by a circular, rectangular or "bow-tie" spaced hyaline area. Striae uniseriately punctate, often radiate, more widely spaced at the center.

Key to species of *Sellaphora*

1. Valves linear ..... 1. *S. laevissima*
1. Valves lanceolate or elliptical lanceolate 2
2. Valves more than 20 μm long ..... 2. *S. pupula*
2. Valves less than 20 μm long ..... 3. *S. vitabunda*

1. *Sellaphora laevissima* (Kützing) Mereschkowsky. Gasse, 1986, p. 101, pl. 17, fig. 2; Güttinger, 1994, plate 2.05.31-38; Krammer & Lange-Bertalot, 1986, p. 575, pl. 67, figs. 6-10; Mann, 1989, p. 3, fig.3; Patrick & Reimer, 1966, p. 559, pl. 47, fig. 13; Podzorski, 1985, p. 165, pl. 38, fig. 1; p. 91, pl. 1, figs. 4-5; Tschen & Li, 1974, p. 17, pl. 6, fig. 2. Figs. 2A & B

Synonym: *Navicula wittrockii* (Lagerstedt) Tempère & Peragallo; *Navicula bacilliformis* Grunow; *Navicula fusticulus* Østrup, *Navicula laevissima* Kützing.

Valve linear, ends bluntly rounded. External raphe central, slightly sinuous, lied between two thickened ribs; distal ends curving in the same direction; proximal ends funnel-shaped. Internal raphe without two thickened ribs; proximal ends hooked toward the primary side; distal ends surrounded by a "bow-tie" spaced hyaline area. Central area more or less elliptical. Striae uniseriately punctate, somewhat radiate. Dimension: 8-14 × 37-48 μm, striae 17-22 in 10 μm.

2. *Sellaphora pupula* (Kützing) Mereschkowsky**.** Bateman & Rushforth, 1984, p. 75, pl. 14, fig. 231; Chen & Lai, 1985, p. 81, pl. 5, fig. 12; Czarnecki & Blinn, 1977, p. 93, pl. 12, fig. 8; De Oliveira and Steinita-Kannan, 1992, p. 546, pl. 7, fig. 114; Foged, 1979, p. 79, pl. 25, figs. 6-7; Foged, 1981, p. 122, pl. 38,

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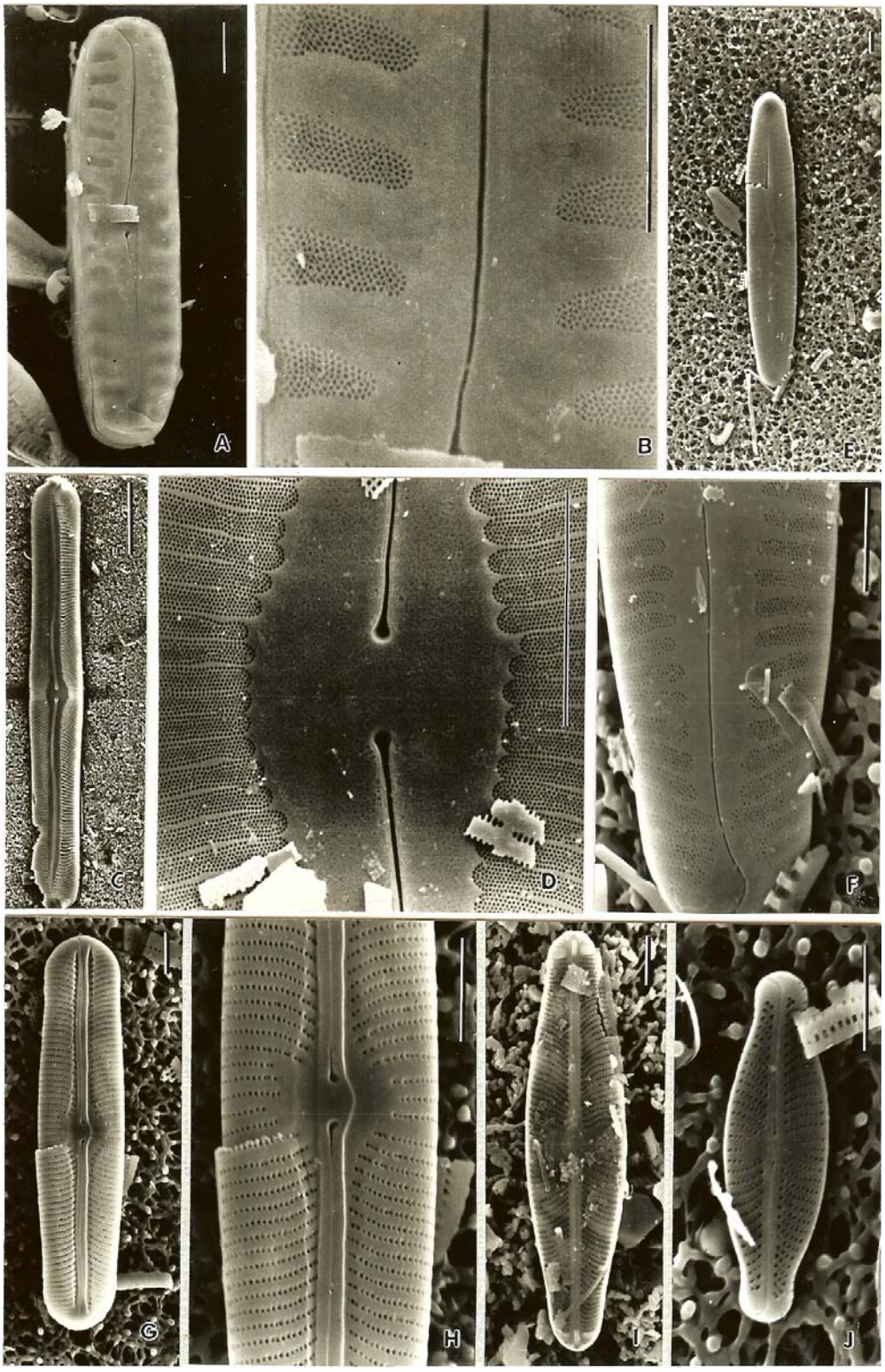


Fig. 2. A-B: *Pinnularia borealis* Ehrenbreg var. *rectangularis* Carlson. C-D: *Pinnularia maior* (Kützing) Rabenhorst. E-F: *Pinnularia interrupta* W. Smith. G-H: *Sellaphora laevissima* (Kützing) Mereschkowsky. I: *Sellaphora pupula* (Kützing) Mereschkowsky. J: *Sellaphora vitabunda* Grunow. Bar = 4 μm.

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fig. 20; Fungladda & Kaczmarska, 1983, p. 83, pl. 13, figs. 211-213; Güttinger, 1994, plate 2.05.31-17; Huang, 1982, p. 319, pl. 12, figs. 7-8; Krammer & Lange-Bertalot, 1986, p. 577, pl. 68, figs. 1-11; Mann, 1989, p. 3, figs. 1 & 4-6; Patrick & Reimer, 1966, p. 559, pl. 47, fig. 7; Podzorski, 1985, p. 91, pl. 1, figs. 4-5; p. 165, pl. 38, figs. 2-3; Tschen & Li, 1974, p. 17, pl. 6, fig. 5. Fig. 2I

Synonym: *Navicula pupula* Kützing

Valves lanceolate, ends broadly, obtusely rostrate. Raphe central, straight, lied between two thickened ribs; distal edns curving in the same direction; proximal ends rounded; central area transversely widened, almost reaching the margins of the valve; raphe endings surrounded by a "bow-tie" spaced hyaline area. Axial area narrow. Terminal nodules transversely widened, clearly marked by the end. Striae uniseriately punctate, distinctly radiate towards the center of the valve, slightly radiate at the ends, short and irregular in length about the central area. Dimension: 6-10 × 23-35 μm, striae 18-26 in 10 μm.

3. *Sellaphora vitabunda* Grunow. Krammer & Lange-Bertalot, 1986, p. 583, pl. 71, figs. 25-31. Fig. 2J

Synonym: *Navicula verecunda* Hustedt; *Navicula vitabunda* Hustedt

Valves elliptical lanceolate; ends rostrate. Raphe central, straight, lied between two thickened ribs; distal ends curving in the same direction; proximal ends rounded; central area transversely elongated, not reaching to the margins of the valve. Striae uniseriately punctate, somewhat radiate, more widely spaced at the center. Dimension: 4-5 × 14-15 μm, striae 25-30 in 10 μm.

Order Bacillariales

Family Bacillariaceae

Genus ***Nitzschia*** Hassall 1845

Valves linear, lanceolate, narrowly elliptical or sigmoid; ends various, often rostrate or capitate. Raphe not evident, concealed in keel; keel punctate, marginal to nearly median. Striae uniseriately punctate, parallel throughout the valve length.

Key to species of *Nitzschia*

1. Valve linear ….....……..... 3. *N. linearis*
1. Valve linear-lanceolate or lanceolate ……..…… 2
2. Valves slightly constricted in the center …… 5. *N. perminuta*
2. Valves not constricted in the center ……..……...… 3
3. The keel puncta density less than 10 in 10 μm …… 1. *N. amphibia*
3. The keel puncta density more than 10 in 10 μm ……..…….....… 4
4. Valves with acute ends, the striae density less than 25 in 10 μm ……. …….. 2. *N. frustulum*
4. Valves with subrostrate ends, the striae density more than 25 in 10 μm ……..... 4. *N. palea*

1. *Nitzschia amphibia* Grunow. Bateman & Rushforth, 1984, p. 81, pl. 17, fig.263; Foged, 1979, p. 85, pl. 43, figs. 10-11; Foged, 1981, p. 137, pl. 59, fig. 3; Fungladda & Kaczmarska, 1983, p. 85, pl. 14, figs. 234-236; Gasse, 1986, p. 126, pl. 32, figs. 7-8; Hadi *et al*., 1984, p.555, pl. 13, fig. 235; Huang, 1976, p. 11, pl. 1, fig. 11; Huang, 1977, p. 13, pl. 2, fig. 9; Huang, 1982, p. 313, pl. 8, fig. 9; John, 1983, p. 165, pl. 72, fig. 14; Krammer & Lange-Bertalot, 1988, p. 373, pl. 78, figs. 13-21; Lai & Chen, 1984, p. 51, fig. 11; Tschen & Li, 1974, p. 21, pl. 10, fig. 4. Figs. 3A & B

Synonym: *Nitzschia amphiba* var. *acutiuscula* Grunow.

Valves linear-lanceolate or lanceolate, narrowed towards the ends; ends somewhat cuneate or subrostrate. Keel marginal, distinct, keel puncta short. Valve surface striate. Striae uniseriately punctate, parallel. Dimension: 4-5 × 21-22 μm, striae 18 in 10 μm, keel puncta 7 in 10 μm.

2. *Nitzschia frustulum* (Kützing) Grunow. Güttinger, 1994, plate 2.08.09-3, fig.1-4; Krammer & Lange-Bertalot, 1988, p. 353, pl. 68, figs. 1-19. Figs. 3C & D

Synonym: *Synedra frustulum* Kützing; *Synedra minutissima* Kützing; *Synedra perpusilla* Kützing; *Synedra quadrangula* Kützing; *Synedra minutissima ß pelliculosa* Kützing; *Nitzschia minutissima* W. Smith; *Nitzschia frustulum* var. *perminuta* Grunow; *Nitzschia liebetruthii* var. *siamensis* Hustedt.; *Nitzschia frustulum* var. *subsalina* Hustedt.

Valves linear-lanceolate, tapering to acute or cuneate ends. Keel puncta distinct. Striate uniseriately punctate, parallel. Dimension: 3-5 × 16-24 μm, striae 16-18 in 10 μm, keel puncta 10 in 10 μm.

3. *Nitzschia linearis* (Agardh) W. Smith. Huang, 1977, p. 13, pl. 2, fig. 10; John, 1983, p. 170, pl. 70, figs. 3-4; Krammer & Lange-Bertalot, 1988, p. 327, pl. 55, figs. 1-4. Figs. 3H-K

Synonym: *Frustulia linearis* C. Agardh fide W. Smith; *Surirella multifasciata* Kützing.

Valves linear; ends acutely rounded. Keel marginal, keel puncta distinct. Striae uniseriately punctate, parallel. Dimension: 2-4 × 36-52 μm, striae 40-45 in 10 μm, keel puncta 12-15 in 10 μm.

4. *Nitzschia palea* (Kützing) W. Smith. Bateman & Rushforth, 1984, p. 83, pl. 18, fig.279-281; Fan & Cheng, 1981, p. 81, pl. 4, fig. 10; Foged, 1979, p. 88, pl. 43, fig. 7; Fungladda & Kaczmarska, 1983, p. 87, pl. 15, figs. 260-262; Gasse, 1986, p. 138, pl. 35, figs.

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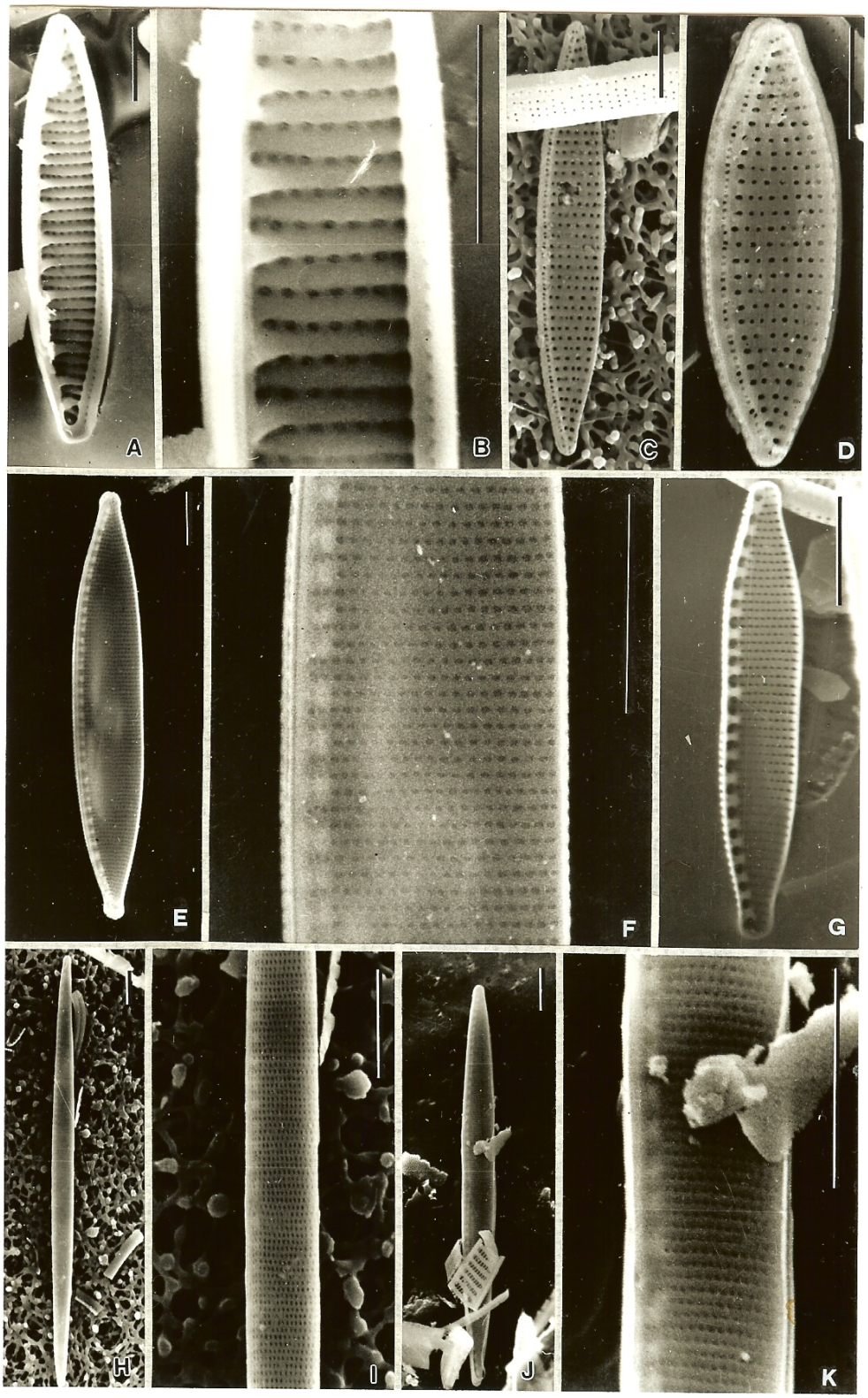


Fig. 3. A-B: *Nitzschia amphibia* Grunow. C-D: *Nitzschia frustulum* (Kützing) Grunow. E-F: *Nitzschia palea* (Kützing) W. Smith. G: *Nitzschia perminuta* (Grunow) Peragalla. H-K: *Nitzschia linearis* (Agardh) W. Smith. Bar = 4 μm.

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Table 2. Shannon species diversity index and Margalef species richness index of diatom assemblages in the surface sediment samples of the Mysterious Lake.

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Shannon species diversity index	4.09	4.82	4.28	4.19	4.26	4.08
Margalef species richness index	7.33	8.01	6.81	7.18	7.79	6.98

10-13;Güttinger, 1994, plate 2.08.09-5; Hadi *et al*., 1984, p.555, pl. 13, fig. 230-231; John, 1983, p. 171, pl. 70, fig. 12; Krammer & Lange-Bertalot, 1988, p. 335, pl. 59, figs. 1-10. Figs. 3E & F

Synonym: *Synedra palea* Kützing; *Nitzschia accommodata* Hustedt.

Valves linear-lanceolate or lanceolate; ends sub-rostrate. Keel marginal, keel puncta distinct. Valve surface striate. Striae uniseriately punctate, parallel. Dimension: 3-6 × 23-26 μm, striae 30-35 in 10 μm, keel puncta 12-14 in 10 μm.

5. *Nitzschia perminuta* (Grunow) Peragalla. Bateman & Rushforth, 1984, p. 83, pl. 18, fig. 286; Krammer & Lange-Bertalot, 1988, p. 359, pl. 72, figs. 1-23a. Fig. 3G

Synonym: *Nitzschia palea* var. *perminuta* Grunow; *Nitzschia frustulum* var. *tenella* Grunow; *Nitzschia tenella* Brébisson ex W. Smith; *Nitzschia frustulum* var. *minutula* Grunow; *Nitzschia frustulum* var. *asiatica* Hustedt; *Nitzschia perminuta* (Grunow) Peragalla; *Nitzschia hiemalis* Hustedt.

Valves lanceolate or linear-lanceolate, slightly constricted in the center; end rostrate or subrostrate. Keel marginal, keel puncta distinct. Valve surface striate. Striae uniseriately punctate, parallel. Dimension: 2-3 × 16-18 μm, striae 29-33 in 10 μm, keel puncta 10-15 in 10 μm.

Species diversity and species richness

The diatom assemblages of lake sediments were characterized by high species diversity and species richness. Table 2 showed that the Shannon's diversity index and Margalef's richness index at each sampling site fluctuated to certain degree. The former index ranged between 4.08 and 4.82, while the latter between 6.81 and 8.01.

DISCUSSION

In previous papers, we have reported 59 taxa of diatoms for the Mysterious Lake (Wu and Wang, 2002; Wang and Wu, 2005). Together with the present study, a total of 76 diatom species were identified in this lake. In them, there are 33 species (ca. 43%) which are new to the checklist recorded by Wang and Chen (2000).

Our study shows that numerous species in the Mysterious Lake are rare to Taiwan. In addition, the species diversity and species richness are relatively high, when compared with the water reservoirs or other Taiwanese lakes (Wu et al. 2008a, 2008b). Possibly, such characteristics are related to the oligotrophic and non-polluted environment (Wu, 2000).

The genera *Sellaphora* and *Eolimna* were formerly placed in *Navicula* (*cf.* Krammer and Lange-Bertalot, 1988). *Sellaphora* was treated as separated genus by Mann (1989), while *Eolimna* by Moser et al. (1998). Thus, in total, there are 11 taxa of *Navicula* sensu lato in the Mystery Lake. In morphology and ecological occurrence, *Eolimna minima* is quite similar to *Navicula minima*. Thus, Watanabe (2005) treated *E. minima* as a synonym of *N. minima*. In the present study, we follow the Watanabe's treatment.

Nitzschia is a difficult and large genus in the diatom world. Cleve and Grunow (1880) split *Nitzschia* into several sections. In Mystery Lake, however, there were only five species of this genus, belonging to the same section. As a whole, all of these species appeared in low abundance. Apparently, this genus should play a minor role in the aquatic ecosystem of this lake.

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摘要：本文描述位於臺灣東北部南澳闊葉林保留區內之神祕湖的矽藻，為系列報告之最後一個部份。本文主要係以掃描電子顯微鏡下觀察到的微細形態構造為鑑定依據，共描述在湖積物表層出現之 17 種，分屬於 2 目 4 科 4 屬。其中有 9 種為臺灣的新紀錄種，即 *Navicula cryptotenella*, *Navicula ingrata*, *Navicula subfasciata*, *Pinnularia borealis* var. *rectangularis*, *Pinnularia interrupta*, *Pinnularia maior*, *Sellaphora laevissima*, *S. vitabunda*, and *Nitzschia perminuta* 等。綜合各項資料，顯示此湖有豐富的矽藻資源，在總共發現之 76 種矽藻中，有 33 種 (約 43%) 為臺灣新紀錄種。此外，此湖之矽藻群落種歧異度和種豐富度都比一般水庫高，推測這些現象與此湖為未受污染之貧養湖有關。

關鍵詞：矽藻、種歧異度、種豐富度、神祕湖、南澳自然保留區、臺灣。

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