

## New Record of Diatom Species in Korean Coastal Waters

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**Abstract** - A study on the indigenous diatoms was carried out at 103 sites during August 2008 to April 2011 from the marine and the brackish waters in Korea. A fine structure of small-sized diatoms was examined using a light and scanning electron microscopy. Sixty species of diatoms were newly identified and composed of 3 class, 6 subclass, 16 order, 21 family and 39 genus. The detailed nomenclatures, references, photographs and distributions were here reported. Of 60 species, the most frequent species was *Tryblionella coarctata* appearing 24 times, and 22 times followed by *Thalassiosira lacustris*, *Cocconeis stauroneiformis* was 20 times. In the level of genus, *Chaetoceros*, *Parlibells* and *Thalassiosira* were included 4 species, *Actinocyclus*, *Minidiscus* and *Licmophora* were included 3 species. This study will provide the knowledge of the diversity level of diatom in Korea, the knowledge is important on the diatoms for further studies.

**Key words** : Bacillariophyta, diatoms, Korea, new records

### INTRODUCTION

Diatoms have been known to the most successful group of eukaryotic phytoplankton in the ocean and bring about dominance comparatively quickly during the last 100 million years. There are more than 200 genera of living diatoms, and it is estimated that there are approximately 100,000 extant species in the world (Mann 1999).

Studies of diatom in Korean coastal waters were begun by Skvortzow (1931) in the early of 1930's, he first reported 70 planktonic diatoms in the Korea Strait. Then many diatom studies were focused on ecological investigations. The taxonomic studies of diatoms were still in the early stages till the mid-1980's in Korea. Lee and Cho (1985) first made a check-list of the marine planktonic diatoms in Korea. Lee (1990) and Choi (1990) arranged a check-list of the marine fossil diatoms and the marine tychopelagic and benthic diatoms, respectively. Lee *et al.* (1995) made a check-list of 1,457

diatom species in fresh water, brackish water, marine and fossil from 1929 to 1993 in Korea, Lee (1995) made a check-list of marine diatoms of 761 taxa in Korean coastal waters.

Since Lee and Yoo (1986, 1987) for the first time carried out the classification of *Thalassiosira* species by LM and SEM, many taxa have continued steadily (Lee and Jang 1996; Lee and Park 2008; Jung *et al.* 2009; Chung *et al.* 2010; Park and Lee 2010; Yun and Lee 2010; Lee and Lee 2011). Due to the importance of biodiversity and bio-sovereignty in recent, check-list of indigenous species became to recognize the importance. Master plan of "The Project on Survey and Excavation of Korean Indigenous Species" of the National Institute of Biological Resources (NIBR) under the Ministry of Environment of Korea was established in the year of 2006. We have been performed the survey and excavation of diatoms in brackish and marine waters of Korea during the period from 2006 to the present. In consideration of these reasons, the large numbers of new record diatom species have been discovered in Korea.

The purpose of this paper is to add new record species of diatom representing 39 genera and 60 species in the marine and the brackish waters in Korea after the previous diatom

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check-list (Lee *et al.* 1995). We presented the taxonomic information; illustration, classification, reference, synonym, basionym and distribution of the diatoms in Korea.

## MATERIALS AND METHODS

The materials were collected at 103 sites during the period from August 2008 to April 2011 from the brackish- and coastal waters of Korea, sampling stations were covered all sea areas in Korea (East Sea, Yellow Sea, South Sea and Jeju Is., Table 1). All samples were collected using a 20 $\mu$ m mesh-

sized plankton nets with vertical and/or horizontal towing. Diatoms samples were immediately fixed with 4% neutralized formalin. To examine the fine structures and specific characteristics of each diatom, cell organelles and organic matters were removed with concentrated HCl and saturated KMnO<sub>4</sub> (Hasle and Fryxell 1970). The acid-cleaned materials were made to permanent slide as the following steps: 1) The cleaned diatoms were put a drop on a cover slip which was washed with 100% ethanol. 2) Samples on the cover slip were dried in slight heat or leave over night, Pleurax was put onto a cover slip. 3) The cover slip was put face down on a slide glass and slightly heated on a alcohol lamp for the sol-

**Table 1.** A showing the sampling sites in the coastal waters of Korea

Date	Station	Locality	Latitude (N)	Longitude (E)
23 Jan. 2009	ES <sup>1</sup> -01	Geojin-ri, Geojin-eup, Goseong-gun, Gangwon-do	38° 26'54.66"	128° 27'34.08"
30 Aug. 2010	ES-02	Geojin-ri, Geojin-eup, Goseong-gun, Gangwon-do	38° 26'23.64"	128° 27'14.40"
30 Aug. 2010	ES-03	Gajin-ri, Jugwang-myeon, Goseong-gun, Gangwon-do	38° 22'21.96"	128° 30'33.48"
23 Jan. 2009	ES-04	Oho-ri, Jugwang-myeon, Goseong-gun, Gangwon-do	38° 19'36.42"	128° 31'42.48"
30 Aug. 2010	ES-05	Jugwang-myeon, Goseong-gun, Gangwon-do	38° 19'28.44"	128° 31'35.88"
30 Aug. 2010	ES-06	Bongpo-ri, Toseong-myeon, Goseong-gun, Gangwon-do	38° 15'03.00"	128° 34'03.30"
16 Feb. 2009	ES-07	Yangpo-ri, Janggi-myeon, Nam-gu, Pohang-si, Gyeongsangbuk-do	38° 13'12.00"	128° 35'24.36"
23 Jan. 2009	ES-08	Dongmyeong-dong, Sokcho-si, Gangwon-do	38° 12'38.40"	128° 25'46.26"
30 Aug. 2010	ES-09	Daepo-dong, Sokcho-si, Gangwon-do	38° 10'45.48"	128° 36'38.22"
23 Jan. 2009	ES-10	Jucheong-ri, Ganghyeon-myeon, Yangyang-gun, Gangwon-do	38° 07'23.46"	128° 37'57.66"
30 Aug. 2010	ES-11	Jucheong-ri, Ganghyeon-myeon, Yangyang-gun, Gangwon-do	38° 07'23.10"	128° 37'56.52"
23 Jan. 2009	ES-12	Namae-ri, Hyeonnam-myeon, Yangyang-gun, Gangwon-do	37° 56'40.07"	128° 47'14.72"
29 Aug. 2010	ES-13	Aninjin-ri, Gangdong-myeon, Gangneung-si, Gangwon-do	37° 44'04.68"	128° 59'13.44"
23 Jan. 2009	ES-14	Jeongdongjin-ri, Gangdong-myeon, Gangneung-si, Gangwon-do	37° 41'09.78"	129° 02'34.14"
23 Jan. 2009	ES-15	Sacheonjin-ri, Sacheon-myeon, Gangneung-si, Gangwon-do	37° 41'09.72"	129° 02'34.14"
29 Aug. 2010	ES-16	Geumjin-ri, Okgye-myeon, Gangneung-si, Gangwon-do	37° 39'09.06"	129° 03'06.42"
23 Jan. 2009	ES-17	Daejin-dong, Donghae-si, Gangwon-do	37° 34'48.24"	129° 06'49.50"
29 Aug. 2010	ES-18	Jeongha-dong, Samcheok-si, Gangwon-do	37° 26'18.90"	129° 11'15.66"
29 Aug. 2010	ES-19	Deoksan-ri, Geundeok-myeon, Samcheok-si, Gangwon-do	37° 22'40.74"	129° 15'12.06"
23 Jan. 2009	ES-20	Jeongha-dong, Samcheok-si, Gangwon-do	37° 19'37.80"	129° 16'06.96"
29 Aug. 2010	ES-21	Chogok-ri, Geundeok-myeon, Samcheok-si, Gangwon-do	37° 18'35.04"	129° 17'38.70"
22 Jan. 2009	ES-22	Imwon-ri, Wondeok-eup, Samcheok-si, Gangwon-do	37° 13'31.38"	129° 20'28.86"
29 Aug. 2010	ES-23	Wolcheon-ri, Wondeok-eup, Samcheok-si, Gangwon-do	37° 09'16.74"	129° 21'31.62"
29 Aug. 2010	ES-24	Jukbyeon-ri, Jukbyeon-myeon, Uljin-gun, Gyeongsangbuk-do	37° 03'29.22"	129° 25'18.18"
22 Jan. 2009	ES-25	Jukbyeon-myeon, Uljin-gun, Gyeongsangbuk-do	37° 01'57.66"	129° 24'56.16"
29 Aug. 2010	ES-26	Eumnam-ri, Uljin-eup, Uljin-gun, Gyeongsangbuk-do	36° 59'04.56"	129° 24'37.80"
22 Jan. 2009	ES-27	Sanpo-ri, Geunnam-myeon, Uljin-gun, Gyeongsangbuk-do	36° 57'54.42"	129° 24'53.34"
29 Aug. 2010	ES-28	Sanpo-ri, Geunnam-myeon, Uljin-gun, Gyeongsangbuk-do	36° 51'09.06"	129° 25'38.64"
22 Jan. 2009	ES-29	Mangyang-ri, Giseong-myeon, Uljin-gun, Gyeongsangbuk-do	36° 51'08.82"	129° 25'40.38"
29 Aug. 2010	ES-30	Gusan-ri, Giseong-myeon, Uljin-gun, Gyeongsangbuk-do	36° 45'22.14"	129° 28'10.08"
22 Jan. 2009	ES-31	Hupo-ri, Hupo-myeon, Uljin-gun, Gyeongsangbuk-do	36° 40'36.36"	129° 27'13.80"
29 Aug. 2010	ES-32	Byeonggok-ri, Byeonggok-myeon, Yeongdeok-gun, Gyeongsangbuk-do	36° 35'56.94"	129° 24'54.42"
22 Jan. 2009	ES-33	Byeonggok-myeon, Yeongdeok-gun, Gyeongsangbuk-do	36° 35'54.42"	129° 24'54.30"
22 Jan. 2009	ES-34	Chuksan-ri, Chuksan-myeon, Yeongdeok-gun, Gyeongsangbuk-do	36° 30'27.84"	129° 26'58.50"
29 Aug. 2010	ES-35	Daetan-ri, Yeongdeok-eup, Yeongdeok-gun, Gyeongsangbuk-do	36° 26'30.30"	129° 26'00.36"
29 Aug. 2010	ES-36	Ganggu-ri, Ganggu-myeon, Yeongdeok-gun, Gyeongsangbuk-do	36° 21'33.60"	129° 23'08.46"
22 Jan. 2009	ES-37	Samsa-ri, Ganggu-myeon, Yeongdeok-gun, Gyeongsangbuk-do	36° 21'25.80"	129° 23'03.48"
22 Jan. 2009	ES-38	Jangsa-ri, Namjeong-myeon, Yeongdeok-gun, Gyeongsangbuk-do	36° 15'40.38"	129° 22'29.58"
29 Aug. 2010	ES-39	Cheongha-myeon, Buk-gu, Pohang-si, Gyeongsangbuk-do	36° 12'29.46"	129° 22'33.18"
22 Jan. 2009	ES-40	Wolpo-ri, Cheongha-myeon, Buk-gu, Pohang-si, Gyeongsangbuk-do	36° 12'29.10"	129° 22'29.76"
21 Jan. 2009	ES-41	Daebo-ri, Homigot-myeon, Nam-gu, Pohang-si, Gyeongsangbuk-do	36° 04'47.58"	129° 33'35.76"
28 Aug. 2010	ES-42	Duho-dong, Buk-gu, Pohang-si, Gyeongsangbuk-do	36° 03'42.18"	129° 23'18.00"
21 Jan. 2009	ES-43	Dogu-ri, Donghae-myeon, Nam-gu, Pohang-si, Gyeongsangbuk-do	35° 59'48.06"	129° 27'28.20"

Table 1. Continued.

Date	Station	Locality	Latitude (N)	Longitude (E)
21 Jan. 2009	ES-44	Guryongpo-eup, Nam-gu, Pohang-si, Gyeongsangbuk-do	35° 59'04.98"	129° 33'11.16"
16 Feb. 2009	ES-45	Oryu-ri, Gampo-eup, Gyeongju-si, Gyeongsangbuk-do	35° 52'40.74"	129° 31'08.16"
16 Feb. 2009	ES-46	Jeongja-dong, Buk-gu, Ulsan	35° 41'35.10"	129° 28'31.32"
16 Feb. 2009	ES-47	Yangnam-myeon, Gyeongju-si, Gyeongsangbuk-do	35° 41'28.98"	129° 31'16.14"
16 Feb. 2009	ES-48	Hwangseong-dong, Nam-gu, Ulsan	35° 37'06.78"	129° 27'00.54"
28 Jul. 2007	ES-49	Hwangseong-dong, Nam-gu, Ulsan	35° 27'19.19"	129° 21'29.96"
16 Feb. 2009	ES-50	Seosaeng-myeon, Ulju-gun, Ulsan	35° 21'18.90"	129° 21'15.36"
21 Jan. 2009	ES-51	Ilgwang-myeon, Gijang-gun, Busan	35° 21'18.78"	129° 21'15.30"
29 Jan. 2010	SS <sup>1</sup> -01	Sora-myeon, Yeosu-si, Jeollanam-do	34° 34'34.08"	126° 09'02.82"
9 Aug. 2005	SS-02	Sanyang-eup, Tongyeong-si, Gyeongsangnam-do	34° 47'15.53"	128° 22'54.98"
17 Oct. 2007	SS-03	Haengam-dong, Jinhae-gu, Changwon-si, Gyeongsangnam-do	35° 06'56.60"	128° 42'01.00"
16 Feb. 2009	SS-04	Gwangan-dong, Suyeong-gu, Busan	35° 08'19.02"	129° 06'52.02"
6 Dec. 2007	SS-05	Jangcheon-dong, Jinhae-gu, Changwon-si, Gyeongsangnam-do	35° 08'32.59"	128° 40'20.21"
16 Nov. 2008	YS <sup>3</sup> -01	Changhu-ri, Hajeom-myeon, Ganghwa-gun, Incheon	37° 46'11.10"	126° 21'14.76"
2 Apr. 2010	YS-02	Choji-ri, Gilsang-myeon, Ganghwa-gun, Incheon	37° 38'07.98"	126° 31'54.48"
16 Nov. 2008	YS-03	Sagi-ri, Hwado-myeon, Ganghwa-gun, Incheon	37° 35'46.62"	126° 27'43.80"
14 Oct. 2010	YS-04	Wolgot-dong, Siheung-si, Gyeonggi-do	37° 23'14.82"	126° 44'24.78"
17 Feb. 2010	YS-05	Songdo-dong, Yeonsu-gu, Incheon	37° 23'02.46"	126° 31'59.48"
14 Oct. 2010	YS-06	Jeongwang-dong, Siheung-si, Gyeonggi-do	37° 20'43.50"	126° 41'15.90"
22 Jul. 2010	YS-07	Jeongwang-dong, Siheung-si, Gyeonggi-do	37° 19'34.32"	126° 39'16.92"
14 Oct. 2010	YS-08	Sangrok-gu, Ansan-si, Gyeonggi-do	37° 17'30.54"	126° 49'17.34"
22 Jul. 2010	YS-09	Jeon-gok-ri, Seosin-myeon, Hwaseong-si, Gyeonggi-do	37° 11'12.54"	126° 39'06.54"
22 Jul. 2010	YS-10	Gungpyeong-ri, Seosin-myeon, Hwaseong-si, Gyeonggi-do	37° 06'57.06"	126° 40'37.08"
22 Jul. 2010	YS-11	Hwangok-ri, Daesan-eup, Seosan-si, Chungcheongnam-do	37° 00'11.10"	126° 27'12.06"
22 Jul. 2010	YS-12	Hanjin-ri, Songak-eup, Dangjin-gun, Chungcheongnam-do	36° 58'14.88"	126° 46'59.58"
14 Oct. 2010	YS-13	Manho-ri, Poseung-eup, Pyeongtaek-si, Gyeonggi-do	36° 57'39.96"	126° 49'60.00"
14 Oct. 2010	YS-14	Hyeondeok-myeon, Pyeongtaek-si, Gyeonggi-do	36° 55'01.86"	126° 54'23.64"
16 Apr. 2011	YS-15	Banggal-ri, Wonbuk-myeon, Taean-gun, Chungcheongnam-do	36° 53'50.40"	126° 12'10.30"
14 Oct. 2010	YS-16	Sinpyeong-myeon, Dangjin-gun, Chungcheongnam-do	36° 53'23.10"	126° 49'34.38"
14 Oct. 2010	YS-17	Inju-myeon, Asan-si, Chungcheongnam-do	36° 51'09.42"	126° 51'16.68"
23 Jul. 2010	YS-18	Buseok-myeon, Seosan-si, Chungcheongnam-do	36° 37'27.90"	126° 22'00.18"
23 Jul. 2010	YS-19	Gung-ri, Seobu-myeon, Hongseong-gun, Chungcheongnam-do	36° 35'34.32"	126° 27'12.54"
16 Apr. 2011	YS-20	Pado-ri, Sowon-myeon, Taean-gun, Chungcheongnam-do	36° 34'33.00"	126° 18'38.30"
5 Aug. 2007	YS-21	Anmyeon-eup, Taean-gun, Chungcheongnam-do	36° 28'55.19"	126° 19'47.07"
23 Jul. 2010	YS-22	Yeongbo-ri, Ocheon-myeon, Boryeong-si, Chungcheongnam-do	36° 19'41.34"	126° 30'36.18"
3 May. 2009	YS-23	Sinheuk-dong, Boryeong-si, Chungcheongnam-do	36° 19'38.74"	126° 30'35.67"
23 Jul. 2010	YS-24	Dodun-ri, Seo-myeon, Seocheon-gun, Chungcheongnam-do	36° 09'28.86"	126° 30'01.38"
23 Jul. 2010	YS-25	Dasa-ri, Biin-myeon, Seocheon-gun, Chungcheongnam-do	36° 05'52.02"	126° 36'52.14"
14 Oct. 2010	YS-26	Napo-myeon, Gunsan-si, Jeollabuk-do	36° 02'09.90"	126° 47'25.80"
23 Jul. 2010	YS-27	Sinchang-ri, Janghang-eup, Seocheon-gun, Chungcheongnam-do	36° 00'24.18"	126° 41'52.44"
29 Aug. 2009	YS-28	Janghang-eup, Seocheon-gun, Chungcheongnam-do	35° 58'41.33"	126° 37'35.31"
15 Oct. 2010	YS-29	Soryong-dong, Gunsan-si, Jeollabuk-do	35° 58'11.40"	126° 37'01.92"
24 Jul. 2010	YS-30	Byeonsan-myeon, Buan-gun, Jeollabuk-do	35° 56'08.76"	126° 31'40.32"
15 Oct. 2010	YS-31	Hoehyeon-myeon, Gunsan-si, Jeollabuk-do	35° 53'10.80"	126° 43'39.18"
14 Oct. 2010	YS-32	Okseo-myeon, Gunsan-si, Jeollabuk-do	35° 53'09.48"	126° 37'44.22"
23 Jul. 2010	YS-33	Simpo-ri, Jimbong-myeon, Gimje-si, Jeollabuk-do	35° 51'24.36"	126° 41'56.40"
24 Jul. 2010	YS-34	Sinsido-ri, Okdo-myeon, Gunsan-si, Jeollabuk-do	35° 49'23.22"	126° 28'21.12"
15 Oct. 2010	YS-35	Gyehwa-myeon, Buan-gun, Jeollabuk-do	35° 47'38.04"	126° 38'37.74"
23 Jul. 2010	YS-36	Anseong-ri, Dongjin-myeon, Buan-gun, Jeollabuk-do	35° 47'15.00"	126° 44'53.82"
15 Oct. 2010	YS-37	Dongjin-myeon, Buan-gun, Jeollabuk-do	35° 47'14.28"	126° 44'49.32"
24 Jul. 2010	YS-38	Sinsido-ri, Okdo-myeon, Gunsan-si, Jeollabuk-do	35° 43'43.92"	126° 31'54.96"
24 Jul. 2010	YS-39	Byeonsan-myeon, Buan-gun, Jeollabuk-do	35° 43'40.20"	126° 31'45.54"
24 Jul. 2010	YS-40	Daehang-ri, Byeonsan-myeon, Buan-gun, Jeollabuk-do	35° 41'16.98"	126° 31'55.32"
23 Jul. 2010	YS-41	Sutong-ri, Buri-myeon, Geumsan-gun, Chungcheongnam-do	35° 38'17.22"	126° 27'46.26"
27 Dec. 2008	YS-42	Gopyeongsado-ri, Sinui-myeon, Sinan-gun, Jeollanam-do	34° 34'34.08"	126° 09'02.82"
27 Dec. 2008	YS-43	Obyeongdo-ri, Jodo-myeon, Jindo-gun, Jeollanam-do	34° 22'12.84"	125° 56'47.88"
27 Dec. 2008	YS-44	Nurokdo-ri, Jodo-myeon, Jindo-gun, Jeollanam-do	34° 20'52.56"	125° 57'33.96"
8 Jan. 2011	JI <sup>4</sup> -01	Mara-ri, Daejeong-eup, Seogwipo-si, Jeju-do	33° 07'18.66"	126° 16'10.14"
25 Nov. 2007	JI-02	Bomok-dong, Seogwipo-si, Jeju-do	33° 13'57.18"	126° 36'00.85"
16 Nov. 2007	JI-03	Geonip-dong, Jeju-si, Jeju-do	33° 31'05.53"	126° 31'48.52"

<sup>1</sup>ES: East Sea, <sup>2</sup>SS: South Sea, <sup>3</sup>YS: Yellow Sea, <sup>4</sup>JI: Jeju Island

vent has evaporated (Hasle and Fryxell 1970). The permanent slides were observed at  $\times 400/\times 1000$  magnification using a light microscopy (LM) (Zeiss, Axioskop 40, Germany; Nikon, Eclipse 80i, Japan) with a digital camera (Zeiss, AxioCam MRc 5, Germany; Nikon, DS-Fi1, Japan). The others cleaned samples were attached to aluminum stubs and coated with gold-palladium, which were examined using a scanning electron microscopy (SEM) (Jeol, JSM-5600LV, Japan).

Diatom identifications were mainly based on Hustedt (1930), Hendey (1964), Round *et al.* (1990), Hasle and Syvertsen (1996), and a number of references including the original description which are listed at the each taxon.

## RESULTS

Sixty species of diatoms are newly recorded in Korean coastal waters. As shown in the followings, diatom taxa were composed of 3 class, 6 subclass, 16 order, 21 family and 39 genus based on Round *et al.* system (1990). We described the taxonomic information of diatom, illustration, classification, reference, basionym, synonym and distribution.

### Division Bacillariophyta

#### Class Bacillariophyceae Haeckel 1878

##### Subclass Bacillariophycidae D.G. Mann 1990

##### Order Achnanthes Silva 1962

##### Family Achnanthesiaceae D.G. Mann 1990

*Cocconeis notata* Petit 1877

*Cocconeis stauroneiformis* (Smith) Okuno 1957

*Planothidium septentrionalis* (Østrup) Round & Bukhtiyarova 1996

##### Order Bacillariales Hendey 1937

##### Family Bacillariaceae Ehrenberg 1831

*Giffenia cocconeiformis* (Grunow) Round & Basson 1997

*Nitzschia bilobata* Smith 1853

*Nitzschia fasciculata* Grunow (Grunow) 1881

*Tryblionella coarctata* (Grunow) D.G. Mann 1990

##### Order Cymbellales D.G. Mann 1990

##### Family Rhoicospheniaceae Chen & Zhu 1983

*Gomphoseptatum aestuarii* (Cleve) Medlin 1986

##### Order Lyrellales D.G. Mann 1990

##### Family Lyrellaceae D.G. Mann 1990

*Lyrella lyroides* (Hendey) D.G. Mann 1990

*Petroneis humerosa* (Brebisson ex Smith) Stickle & D.G.

Mann 1990

##### Order Naviculales Bessey 1907

##### Family Berkeleyaceae D.G. Mann 1990

*Parlibellus berkeleyi* (Kützing) Cox 1988

*Parlibellus delognei* (Van Heurck) Cox 1988

*Parlibellus rhombiformis* (Hustedt) Cox 1988

*Parlibellus schuettii* (Van Heurck) Cox 1988

##### Family Naviculaceae Kützing 1844

*Caloneis permagna* (Bailey) Cleve 1894

*Pseudogomphonema kamtschaticum* (Grunow) Medlin 1986

*Seminavis arranensis* Danielidis & D.G. Mann 2002

*Seminavis robusta* Danielidis & D.G. Mann 2002

##### Family Neidiaceae Mereschkowsky 1903

*Neidium productum* (Smith) Cleve 1894

##### Family Sellaphoraceae Mereschkowsky 1902

*Fallacia pseudosemilyrata* (Simonsen) D.G. Mann 1990

##### Family Stauroneidaceae D.G. Mann 1990

*Stauroneis constricta* Cleve 1894

##### Order Surirellales D.G. Mann 1990

##### Family Surirellaceae Kützing 1844

*Campylodiscus prentissi* Hanna & Grant 1926

*Petrodictyon gemmoides* (Østrup) D.G. Mann 1990

*Surirella linearis* var. *elliptica* Müller 1903

*Surirella lorenziana* f. *hybrid* (Grunow) Deby ex Mills 1935

##### Order Thalassiophysales D.G. Mann 1990

##### Family Catenulaceae Mereschkowsky 1902

*Amphora binodis* var. *bigibba* (Grunow) Peragallo & Peragallo 1899

*Amphora spectabilis* Gregory 1857

##### Subclass Fragilariophycidae Round 1990

##### Order Fragilariales Silva 1962

##### Family Fragilariaceae Greville 1833

*Distrionella asterionelloides* Williams 1990

*Podocystis adriatica* (Kützing) Ralfs 1861

*Synedra brockmanii* Hustedt 1959

*Tabularia fasciculata* (Agardh) Williams & Round 1986

*Tabularia parva* (Kützing) Williams & Round 1986

*Ulnaria pseudogaillonii* (Kobayasi & Idei) Idei 2006

##### Order Licmophorales Round 1990

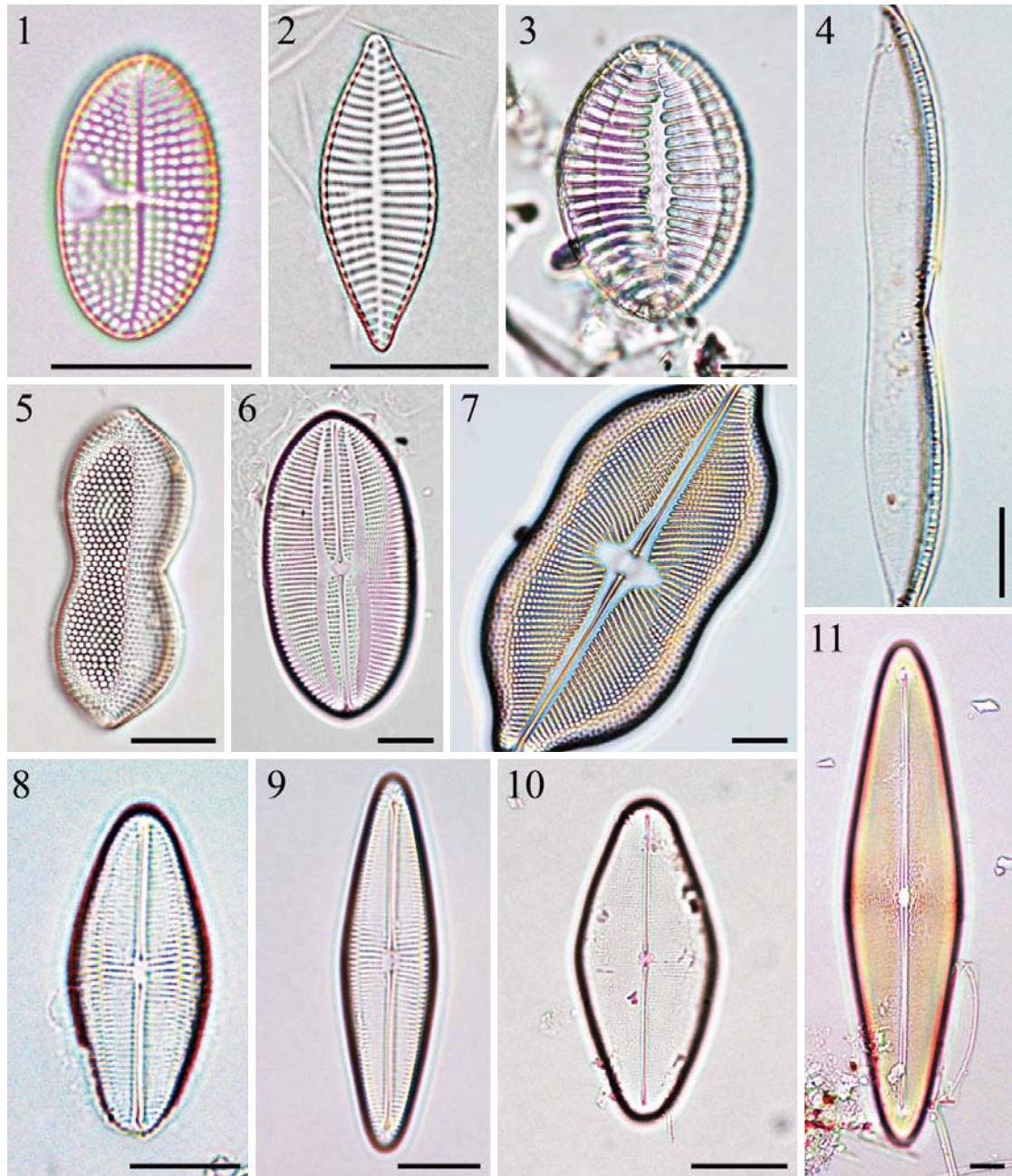
##### Family Licmophoraceae Kützing 1844

*Licmophora communis* (Heiberg) Grunow 1881

*Licmophora debilis* (Kützing) Grunow in Van Heurck 1881

*Licmophora grandis* (Kützing) Grunow 1881

**Order Rhaponeidales Round 1990****Family Rhaphoneidaceae Forti 1912***Delphineis minutissima* (Hustedt) Simonsen 1987**Order Striatellales Round 1990****Family Striatellaceae Kützing 1844***Grammatophora oceancia* var. *subtilissima* (Bailey) De Toni 1894**Class Coscinodiscophyceae Round & Crawford 1990****Subclass Coscinodiscophycidae Round & Crawford 1990****Order Coscinodiscales Round & Crawford 1990****Family Hemidiscaceae Hendey 1937***Actinocyclus circellus* Watkins 1986*Actinocyclus subtilis* (Gregory) Ralfs 1861*Actinocyclus vestigulus* Watkins 1986**Class Mediophyceae (Jousé & Proshkina-Lavrenko)****Medlin & Kaczmarek 2004****Subclass Biddulphiophycidae Round & Crawford 1990****Order Hemiaulales Round & Crawford 1990****Family Hemiaulaceae Heiberg 1863***Cerataulina dentata* Hasle 1980*Eucampia zodiacus* var. *cornigera* Grunow in Van Heurck 1883**Order Triceratiales Round & Crawford 1990****Family Triceratiaceae (Schütt) Lemmermann 1899***Triceratium pentacrinus* (Ehrenberg) Wallich 1858**Subclass Chaetocerotophycidae Round & Crawford 1990****Order Chaetocerotales Round & Crawford 1990****Family Chaetocerotaceae Ralfs 1861***Chaetoceros baculites* Meunier 1910*Chaetoceros coronatus* Gran 1897*Chaetoceros orientalis* Schiller in Hustedt 1930*Chaetoceros subtilis* var. *abnormis* (Proshkina-Lavrenko) Proshkina-Lavrenko 1961**Subclass Thalassiosirophycidae Round & Crawford 1990****Order Thalassiosirales Glezer & Makarova 1986****Family Stephanodiscaceae Glezer & Makarova 1986***Puncticulata praetermissa* (Lund) Håkansson 2002**Family Thalassiosiraceae Lebour 1930***Cymatotheca weissflogii* (Grunow) Hendey 1958*Minidiscus chilensis* Rivera 1984*Minidiscus comicus* Takano 1981*Minidiscus trioculatus* (Taylor) Hasle 1973*Planktoniella blanda* (Schmidt) Syvertsen & Hasle 1993*Porosira pentaportula* Syvertsen & Lange 1990*Thalassiosira diporocyclus* Hasle 1972*Thalassiosira lacustris* (Grunow) Hasle 1977*Thalassiosira tealata* Takano 1980*Thalassiosira wongii* Mahood 1986*Tryblioptychus cocconeiformis* (Grunow) Hendey 1958***Cocconeis notata* Petit 1877 (Fig. 1)****Synonym:** *Eucoconeis notata* (Petit) Cleve 1895.**References:** Petit 1877, p. 10, pl. 4, fig. 1; Cleve 1895, p. 176; Hustedt 1933, p. 352, fig. 806; Poulin *et al.* 1984, p. 54, figs 22-25; De Stefano and Marino 2001, p. 297, figs 1-14, 44-46; Sar *et al.* 2003, p. 91, fig. 32.**Specimen examined:** slide LJH2010001 in Sangmyung University, Seoul.**Korea distribution:** 23 Jan. 2009 (ES-04), 29 Aug. 2010 (ES-23), 29 Aug. 2010 (ES-28), 22 Jan. 2009 (ES-27).***Cocconeis stauroneiformis* (Smith) Okuno 1957 (Fig. 37)****Basionym:** *Cocconeis scutellum* var. *stauroneiformis* Rabenhorst 1864.**Synonym:** *Cocconeis scutellum* var. *stauroneiformis* Rabenhorst 1864.**References:** Rabenhorst 1864, p. 101; Okuno 1957, p. 217, fig. 2, pl. 6/2; Romero 1996, p. 373, figs 25-54; De Stefano and Marino 2000, p. 237, figs 87-92; Sar *et al.* 2003, p. 95, figs 51-57.**Specimen examined:** slide LJH2011004 in Sangmyung University, Seoul.**Korea distribution:** 23 Jan. 2009 (ES-04), 23 Jan. 2009 (ES-17), 29 Aug. 2010 (ES-21), 22 Jan. 2009 (ES-22), 29 Aug. 2010 (ES-18), 30 Aug. 2010 (ES-09), 30 Aug. 2010 (ES-11), 16 Feb. 2009 (ES-45), 22 Jan. 2009 (ES-34), 22 Jan. 2009 (ES-27), 22 Jan. 2009 (ES-29), 29 Aug. 2010 (ES-26), 21 Jan. 2009 (ES-43), 16 Feb. 2009 (ES-07), 28 Aug. 2010 (ES-42), 21 Jan. 2009 (ES-51), 23 Jul. 2010 (YS-41), 23 Jul. 2010 (YS-22), 15 Oct. 2010 (YS-29).***Planothidium septentrionalis* (Østrup) Round & Bukhtiyarova 1996 (Fig. 2)****Basionym:** *Achnanthes septentrionalis* Østrup 1910.**Synonyms:** *Achnanthes septentrionalis* Østrup 1910; *Achnanthes delicatula* subsp. *septentrionalis* (Østrup) Lange-Bertalot 1989; *Achnantheiopsis septentrionalis* (Østrup) Lange-Bertalot 1997.**References:** Østrup 1910, p. 215; pl. 13, fig. 21; Round and Bukhtiyarova 1996, p. 353; Lange-Bertalot 1997, p. 208;



**Figs 1-11.** (LM) Fig. 1. *Cocconeis notata*, valve view. Fig. 2. *Planothidium septentrionalis*, valve view. Fig. 3. *Giffenia cocconeiformis*, valve view. Fig. 4. *Nitzschia bilobata*, valve view. Fig. 5. *Tryblionella coarctata*, valve view. Fig. 6. *Lyrella lyroides*, valve view. Fig. 7. *Petroneis humerosa*, valve view. Fig. 8. *Parlibellus berkeleyi*, valve view. Fig. 9. *Parlibellus delognei*, valve view. Fig. 10. *Parlibellus rhombiformis*, valve view. Fig. 11. *Parlibellus schuettii*, valve view. Scale bars: 10  $\mu$ m.

Kobayasi *et al.* 2006, p. 133, pl. 168, figs 1-12.

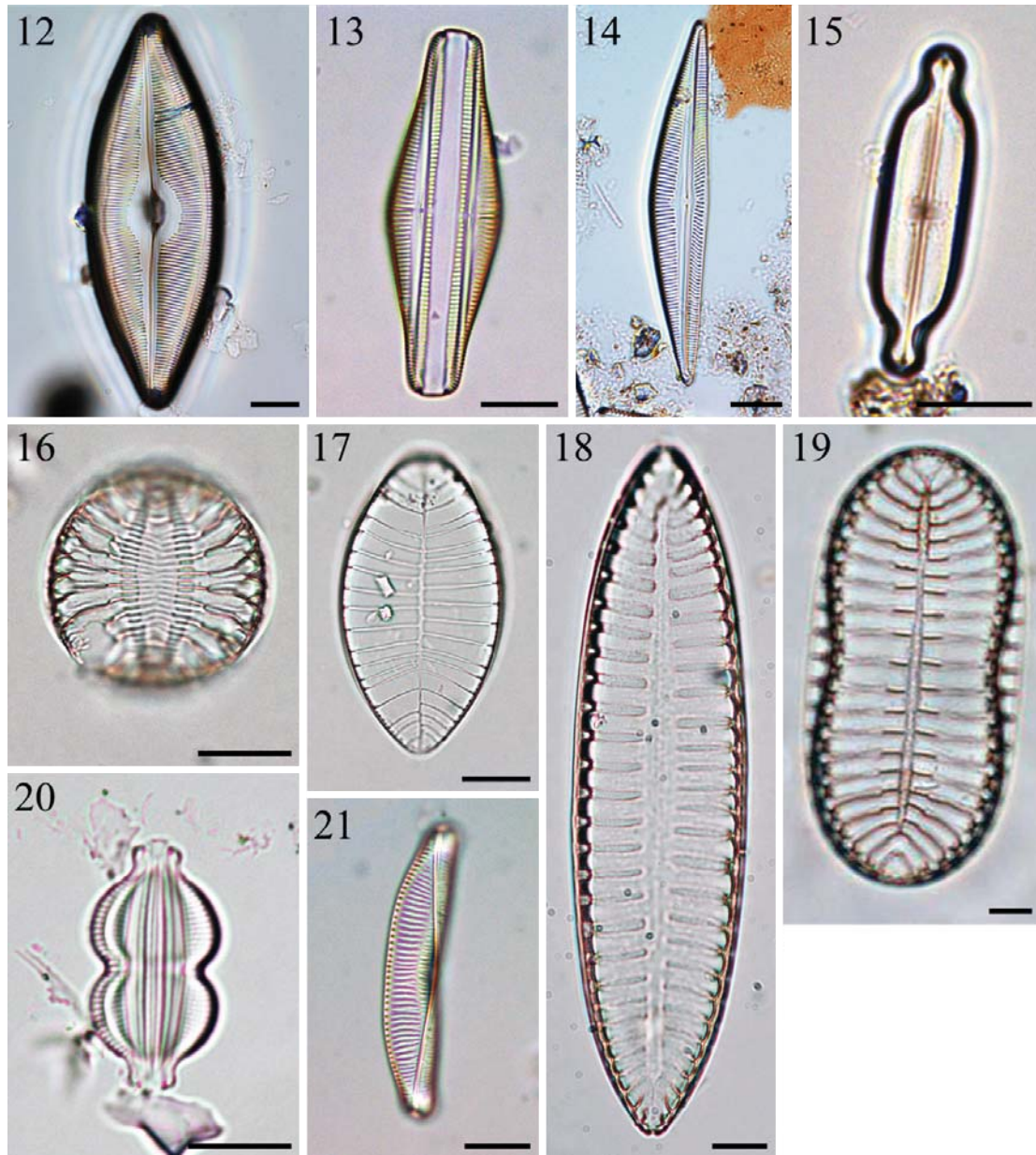
**Specimen examined:** slide LJH2010033 in Sangmyung University, Seoul.

**Korea distribution:** 30 Aug. 2010 (ES-02), 30 Aug. 2010 (ES-05), 30 Aug. 2010 (ES-11), 29 Aug. 2010 (ES-36), 29 Aug. 2010 (ES-32), 29 Aug. 2010 (ES-35), 29 Aug. 2010

(ES-30), 22 Jan. 2009 (ES-29), 29 Aug. 2010 (ES-24), 15 Oct. 2010 (YS-31).

***Giffenia cocconeiformis* (Grunow) Round & Basson 1997 (Fig. 3)**

**Basionym:** *Nitzschia cocconeiformis* Grunow 1879.



**Figs 12-21.** (LM) Fig. 12. *Caloneis permagna*, valve view. Fig. 13. *Seminavis arranensis*, valve view. Fig. 14. *Seminavis robusta*, valve view. Fig. 15. *Neidium productum*, valve view. Fig. 16. *Campylodiscus prentissi*, valve view. Fig. 17. *Petrodictyon gemmoides*, valve view. Fig. 18. *Surirella linearis* var. *elliptica*. Fig. 19. *Surirella lorenziana* f. *hybrida*, valve view. Fig. 20. *Amphora binodis* var. *bigibba*, valve view. Fig. 21. *Amphora spectabilis*, valve view. Scale bars: 10  $\mu$ m.

**Synonyms:** *Nitzschia cocconeiformis* Grunow 1879; *Homoecocladia cocconeiformis* (Grunow) Kuntze 1898; *Tryblionella cocconeiformis* (Grunow) D.G. Mann 1990.

**References:** Cleve and Möller 1879; Kuntze 1898, p. 408; Round *et al.* 1990, p. 678; Round and Basson 1997, p. 348, figs 1-12.

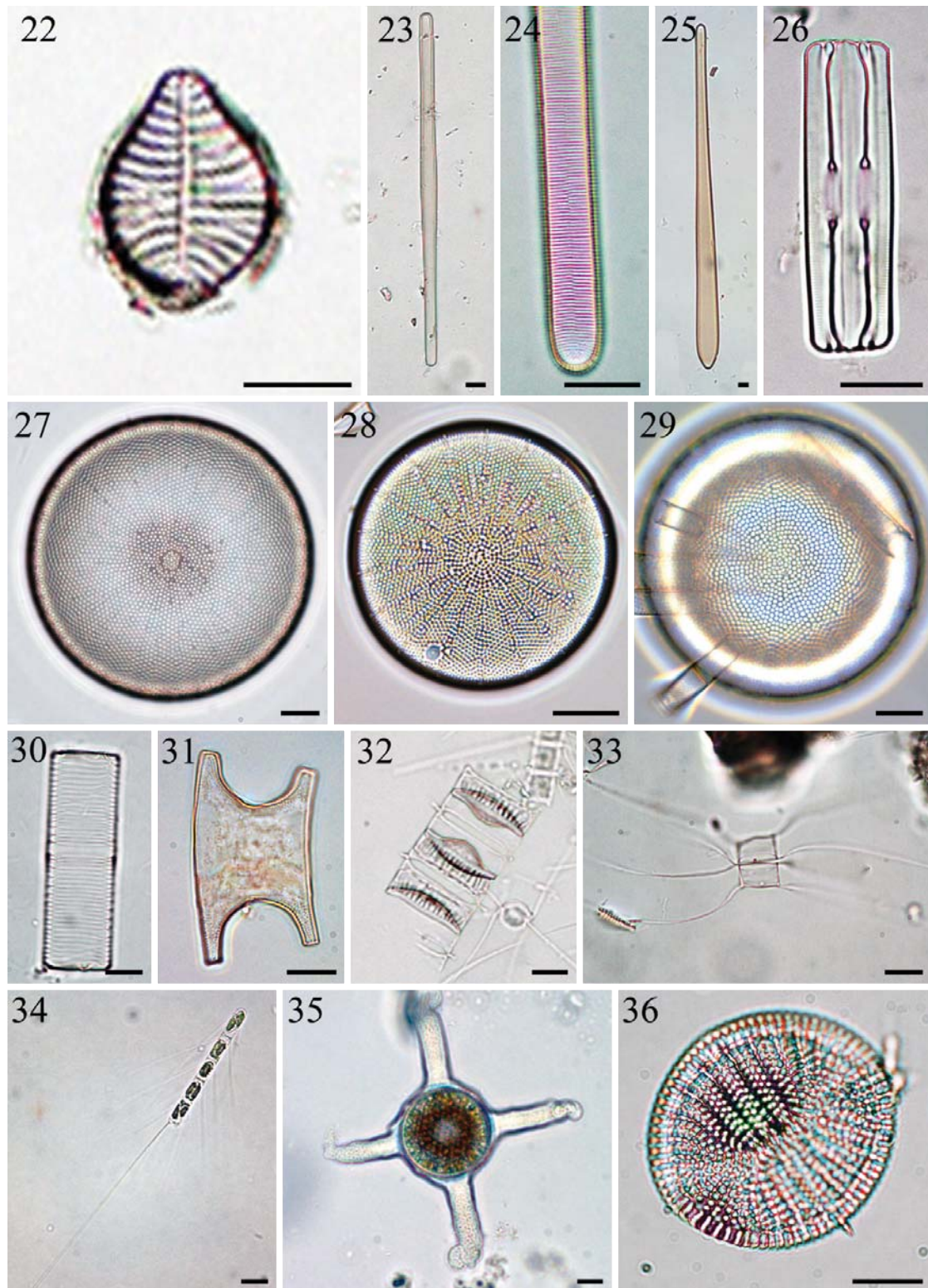
**Specimen examined:** slides NIBRDI0000127639-NIBRDI

0000127641 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 14 Oct. 2010 (YS-08), 23 Jul. 2010 (YS-25).

***Nitzschia bilobata* Smith 1853 (Fig. 4)**

**Synonyms:** *Amphiprora latestriata* Brébisson in Kützing



**Figs 22-36.** (LM) Fig. 22. *Podocystis adriatica*, valve view. Fig. 23. *Synedra brockmanii*, valve view. Fig. 24. *Synedra brockmanii*, terminal end. Fig. 25. *Ulnaria pseudogaillonii*, valve view. Fig. 26. *Grammatophora oceanica* var. *subtilissima*, girdle view. Fig. 27. *Actinocyclus circellus*, valve view. Fig. 28. *Actinocyclus subtilis*, valve view. Fig. 29. *Actinocyclus vestigulus*, valve view. Fig. 30. *Cerataulina dentata*, girdle view. Fig. 31. *Eucampia zodiacus* var. *cornigera*, girdle view. Fig. 32. *Chaetoceros coronatus*, resting spore. Fig. 33. *Chaetoceros orientalis*, girdle view. Fig. 34. *Chaetoceros subtilis* var. *abnormis*, girdle view. Fig. 35. *Planktoniella blanda*, valve view. Fig. 36. *Tryblioptychus cocconeiformis*, valve view. Scale bars: 10  $\mu$ m.



1849; *Nitzschia latestriata* (Brébisson in Kützing) Ralfs in Pritchard 1861; *Scolioleptura latestriata* (Brébisson in Kützing) Grunow 1878; *Scoliotropis latestriata* (Brébisson in Kützing) Cleve 1894; *Homoeocladia bilobata* (W. Smith) Kuntze 1898.

**References:** Kützing 1849, p. 93; Smith 1853, p. 42, pl. 15, fig. 113; Pritchard 1861, p. 780; Grunow 1878, p. 114; Cleve 1894, p. 72; Kuntze 1898, p. 408.

**Specimen examined:** slides NIBRDI0000125360-NIBRDI 0000125361 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 23 Jan. 2009 (ES-20).

***Nitzschia fasciculata* Grunow (Grunow) 1881 (Fig. 38)**

**Basionym:** *Nitzschia sigma* var. *fasciculata* Grunow 1878.

**Synonyms:** *Nitzschia sigma* var. *fasciculata* Grunow 1878; *Homoeocladia fasciculata* (Grunow; Grunow in Van Heurck) Kuntze 1898.

**References:** Grunow 1878, p. 119; Van Heurck 1881, p. 179, pl. 66, fig 11-13; Kuntze, 1898, p. 409.

**Specimen examined:** slides NIBRDI0000125358-NIBRDI 0000125359 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 15 Oct. 2010 (YS-29).

***Tryblionella coarctata* (Grunow) D.G. Mann 1990 (Fig. 5)**

**Basionym:** *Nitzschia coarctata* Grunow 1878.

**Synonym:** *Nitzschia coarctata* Grunow 1878; *Tryblionella punctata* var. *coarctata* (Grunow) Pelletan 1889; *Zothecca coarctata* (Grunow) Pantocsek 1902; *Nitzschia punctata* f. *coarctata* (Grunow) Hustedt 1957.

**References:** Cleve and Möller 1878, No. 154-155; Pelletan 1889, p. 28; fig. 282, 1; Pantocsek 1902, p. 84 (107); Hustedt 1957, p. 340; Round *et al.* 1990, p. 678.

**Specimen examined:** slide LJH2010050 in Sangmyung University, Seoul.

**Korea distribution:** 29 Aug. 2010 (ES-15), 30 Aug. 2010 (ES-05), 23 Jan. 2009 (ES-04), 23 Jan. 2009 (ES-17), 23 Jan. 2009 (ES-08), 22 Jan. 2009 (ES-37), 22 Jan. 2009 (ES-38), 22 Jan. 2009 (ES-34), 29 Aug. 2010 (ES-30), 22 Jan. 2009 (ES-29), 22 Jan. 2009 (ES-25), 22 Jan. 2009 (ES-31), 21 Jan. 2009 (ES-44), 28 Aug. 2010 (ES-42), 16 Feb. 2009 (SS-04), 24 Jul. 2010 (YS-34), 24 Jul. 2010 (YS-40), 23 Jul. 2010 (YS-41), 22 Jul. 2010 (YS-12), 23 Jul. 2010 (YS-22), 23 Jul. 2010 (YS-11), 23 Jul. 2010 (YS-18), 23 Jul. 2010 (YS-19).

***Gomphoseptatum aestuarii* (Cleve) Medlin 1986 (Fig. 39)**

**Basionym:** *Gomphonema aestuarii* Cleve 1893.

**Synonym:** *Gomphonema aestuarii* Cleve 1893; *Gomphonema valentinica* Nikolajev 1970.

**References:** Nikolaev 1970, p. 33, pls 1, 2, figs 1-4, 9-11; Medlin and Round 1986, p. 212, figs 16-18.

**Specimen examined:** slides NIBRDI0000125382-NIBRDI 0000125383 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 23 Jan. 2009 (ES-14), 23 Jul. 2010 (YS-41).

***Lyrella lyroides* (Hendey) D.G. Mann 1990 (Fig. 6)**

**Basionym:** *Navicula lyroides* Hendey 1958.

**Synonym:** *Navicula lyroides* Hendey 1958.

**References:** Hendey 1958, p. 60; pl. 5, fig. 3; Round *et al.* 1990, p. 672.

**Specimen examined:** slides NIBRDI0000125271-NIBRDI 0000125272 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 29 Aug. 2010 (ES-13), 30 Aug. 2010 (ES-02), 30 Aug. 2010 (ES-05), 29 Aug. 2010 (ES-17), 29 Aug. 2010 (ES-21), 29 Aug. 2010 (ES-23), 30 Aug. 2010 (ES-11), 29 Aug. 2010 (ES-30).

***Petronis humerosa* (Brébisson ex Smith) Stickle &**

**D.G. Mann 1990 (Fig. 7)**

**Basionym:** *Navicula humerosa* Brébisson ex Smith 1856.

**Synonyms:** *Navicula humerosa* Brébisson ex Smith 1856; *Navicula granulata* var. *humerosa* (Brébisson) Carruthers 1864; *Schizonema humerosum* (Brébisson ex Smith) Kuntze 1898; *Clevia humerosa* (Brébisson ex Smith) Mereschkowsky 1902.

**References:** Smith 1856, p. 93; Carruthers 1864, p. 105; Kuntze 1898, p. 553; Mereschkowsky 1902, p. 125; Round *et al.*, 1990, p. 674-675.

**Specimen examined:** slide LJH2010031 in Sangmyung University, Seoul.

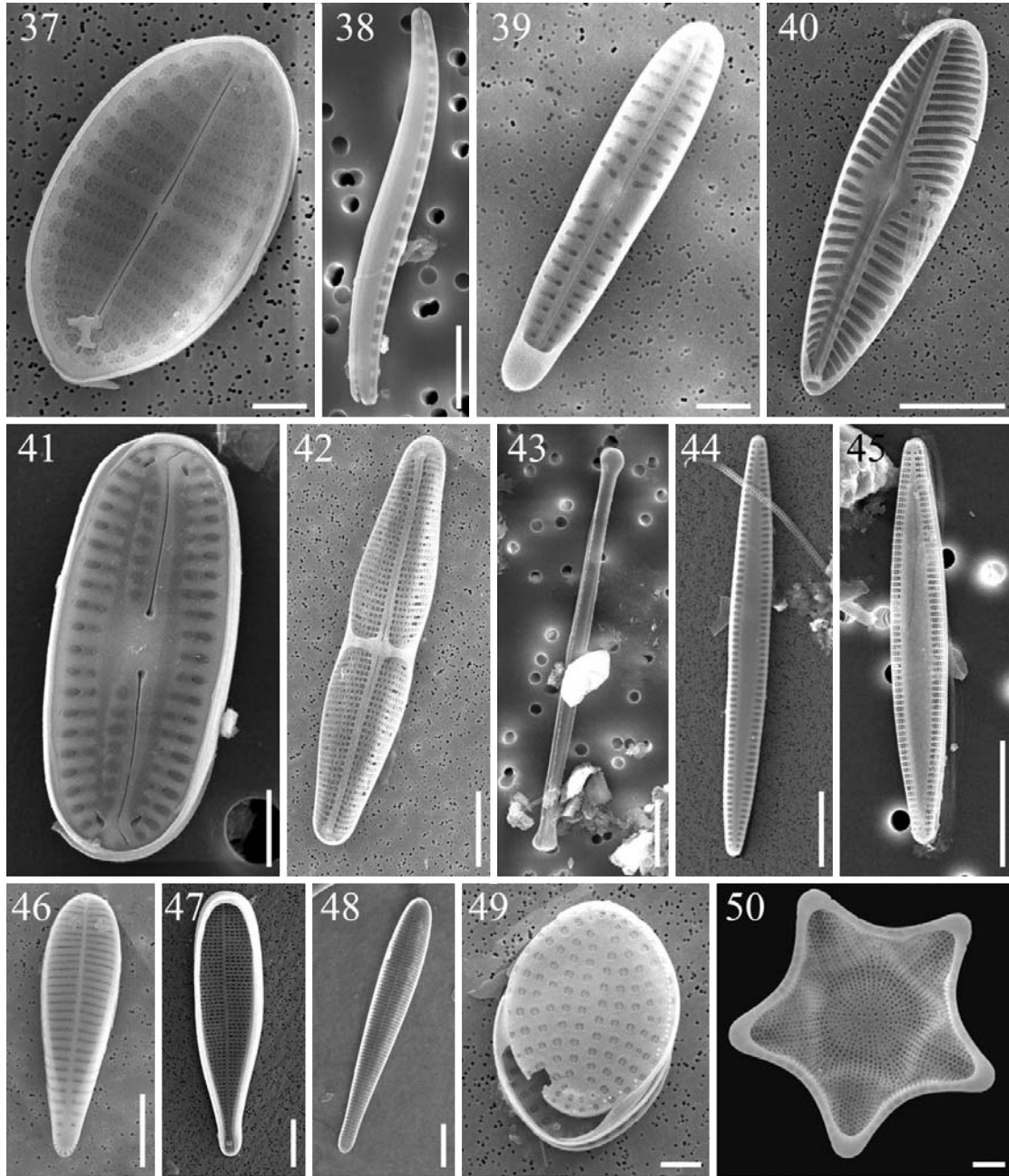
**Korea distribution:** 23 Jul. 2010 (YS-19).

***Parlibellus berkeleyi* (Kützing) Cox 1988 (Fig. 8)**

**Basionym:** *Micromega berkeleyi* Kützing 1849.

**Synonyms:** *Micromega berkeleyi* Kützing 1849; *Schizonema berkeleyi* (Kützing) Rabenhorst 1864.

**References:** Cox 1988, p. 21, figs 6-10, 16; Kützing 1849,



**Figs 37-50.** (SEM) Fig. 37. *Cocconeis stauroneiformis*, valve view. Fig. 38. *Nitzschia fasciculata*, girdle view. Fig. 39. *Gomphoseptatum aestuarii*, internal valve view. Fig. 40. *Pseudogomphonema kamtschaticum*, internal valve view. Fig. 41. *Fallacia pseudosemilyrata*, valve view. Fig. 42. *Stauroneis constricta*, internal valve view. Fig. 43. *Distrionella asterionelloides*, valve view. Fig. 44. *Tabularia fasciculata*, valve view. Fig. 45. *Tabularia parva*, valve view. Fig. 46. *Licmophora communis*, valve view. Fig. 47. *Licmophora debilis*, internal valve view. Fig. 48. *Licmophora grandis*, valve view. Fig. 49. *Delphineis minutissima*, valve view. Fig. 50. *Triceratium pentacrinus*, internal valve view. Scale bars: 37, 39, 41, 49, 2  $\mu\text{m}$ ; 38, 43-45, 10  $\mu\text{m}$ ; 40, 42, 46-48, 50, 5  $\mu\text{m}$ .

p. 106; Rabenhorst 1864, p. 279.

**Specimen examined:** slides NIBRDI0000125279-NIBRDI0000125280 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 29 Aug. 2010 (ES-30).

***Parlibellus delognei* (Van Heurck) Cox 1988 (Fig. 9)**

**Basionym:** *Navicula delognei* Van Heurck 1880.

**Synonym:** *Navicula delognei* Van Heurck 1880.

**References:** Van Heurck 1880, pl. 11, fig. 13; Cox 1988, p. 19, figs 1, 2, 11, 15.

**Specimen examined:** slides NIBRDI0000125281-NIBRDI 0000125282 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 23 Jan. 2009 (ES-14), 23 Jan. 2009 (ES-04), 23 Jan. 2009 (ES-17), 23 Jan. 2009 (ES-17), 22 Jan. 2009 (ES-22), 22 Jan. 2009 (ES-37), 22 Jan. 2009 (ES-33), 22 Jan. 2009 (ES-29), 22 Jan. 2009 (ES-25), 21 Jan. 2009 (ES-43), 28 Aug. 2010 (ES-42).

***Parlibellus rhombiformis* (Hustedt) Cox 1988 (Fig. 10)**

**Basionym:** *Navicula rhombiformis* Hustedt 1944.

**Synonym:** *Navicula rhombiformis* Hustedt 1944.

**References:** Hustedt 1944, p. 273; fig. 6; Cox 1988, p. 25.

**Specimen examined:** slides NIBRDI0000125283-NIBRDI 0000125284 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 22 Jan. 2009 (ES-38), 21 Jan. 2009 (ES-44).

***Parlibellus schuettii* (Van Heurck) Cox 1988 (Fig. 11)**

**Basionym:** *Navicula schuettii* Van Heurck 1909.

**Synonym:** *Navicula schuettii* Van Heurck 1909.

**References:** Van Heurck 1909, p. 13; pl. 1, fig. 10; Cox, 1988, p. 27.

**Specimen examined:** slides NIBRDI0000125285-NIBRDI 0000125286 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 21 Jan. 2009 (ES-43).

***Caloneis permagna* (Bailey) Cleve 1894 (Fig. 12)**

**Basionym:** *Pinnularia permagna* Bailey 1851.

**Synonyms:** *Pinnularia permagna* Bailey 1851; *Navicula permanga* (Bailey) Edwards 1859; *Navicula permagna* (Bailey) Edwards 1860; *Schizonema permagnum* (Bailey) Kuntze 1898.

**References:** Bailey 1851, p. 40; pl. 2, figs 28, 38; Edwards 1859, p. 90, 91; Edwards 1860, p. 128; Cleve 1894, p. 59; Kuntze 1898, p. 554.

**Specimen examined:** slides NIBRDI0000125374-NIBRDI 0000125375 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 14 Oct. 2010 (YS-08).

***Pseudogomphonema kamtschaticum* (Grunow) Medlin 1986 (Fig. 40)**

**Basionym:** *Gomphonema kamtschaticum* Grunow 1878.

**Synonym:** *Gomphonema kamtschaticum* Grunow 1878.

**References:** Grunow 1878, p. 109; pl. 3, fig. 4; Medlin and Round 1986, p. 216, figs 23-26, 64-70.

**Specimen examined:** slide NIBRDI0000125291 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 23 Jan. 2009 (ES-15), 23 Jan. 2009 (ES-04), 22 Jan. 2009 (ES-38), 21 Jan. 2009 (ES-41).

***Seminavis arranensis* Danielidis & D.G. Mann 2002**

**(Fig. 13)**

**References:** Danielidis and D.G. Mann 2002, p. 439, figs. 22-38.

**Specimen examined:** slide LJH2010039 in Sangmyung University, Seoul.

**Korea distribution:** 29 Aug. 2010 (ES-23), 22 Jan. 2009 (ES-22), 30 Aug. 2010 (ES-09), 23 Jan. 2009 (ES-10), 30 Aug. 2010 (ES-11), 23 Jan. 2009 (ES-12), 29 Aug. 2010 (ES-30), 21 Jan. 2009 (ES-43), 28 Aug. 2010 (ES-42), 14 Oct. 2010 (YS-32), 15 Oct. 2010 (YS-35).

***Seminavis robusta* Danielidis & D.G. Mann 2002**

**(Fig. 14)**

**References:** Danielidis and D.G. Mann 2002, p. 440, figs. 39-53.

**Specimen examined:** slides NIBRDI0000125296-NIBRDI 0000125297 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 23 Jan. 2009 (ES-14), 23 Jan. 2009 (ES-17), 30 Aug. 2010 (ES-09), 23 Jan. 2009 (ES-08), 22 Jan. 2009 (ES-38), 22 Jan. 2009 (ES-34), 29 Aug. 2010 (ES-26), 21 Jan. 2009 (ES-44), 21 Jan. 2009 (ES-41), 21 Jan. 2009 (ES-43), 28 Aug. 2010 (ES-42), 29 Aug. 2010 (ES-39), 21 Jan. 2009 (ES-51), 16 Feb. 2009 (ES-50), 14 Oct. 2010 (YS-32), 15 Oct. 2010 (YS-35).

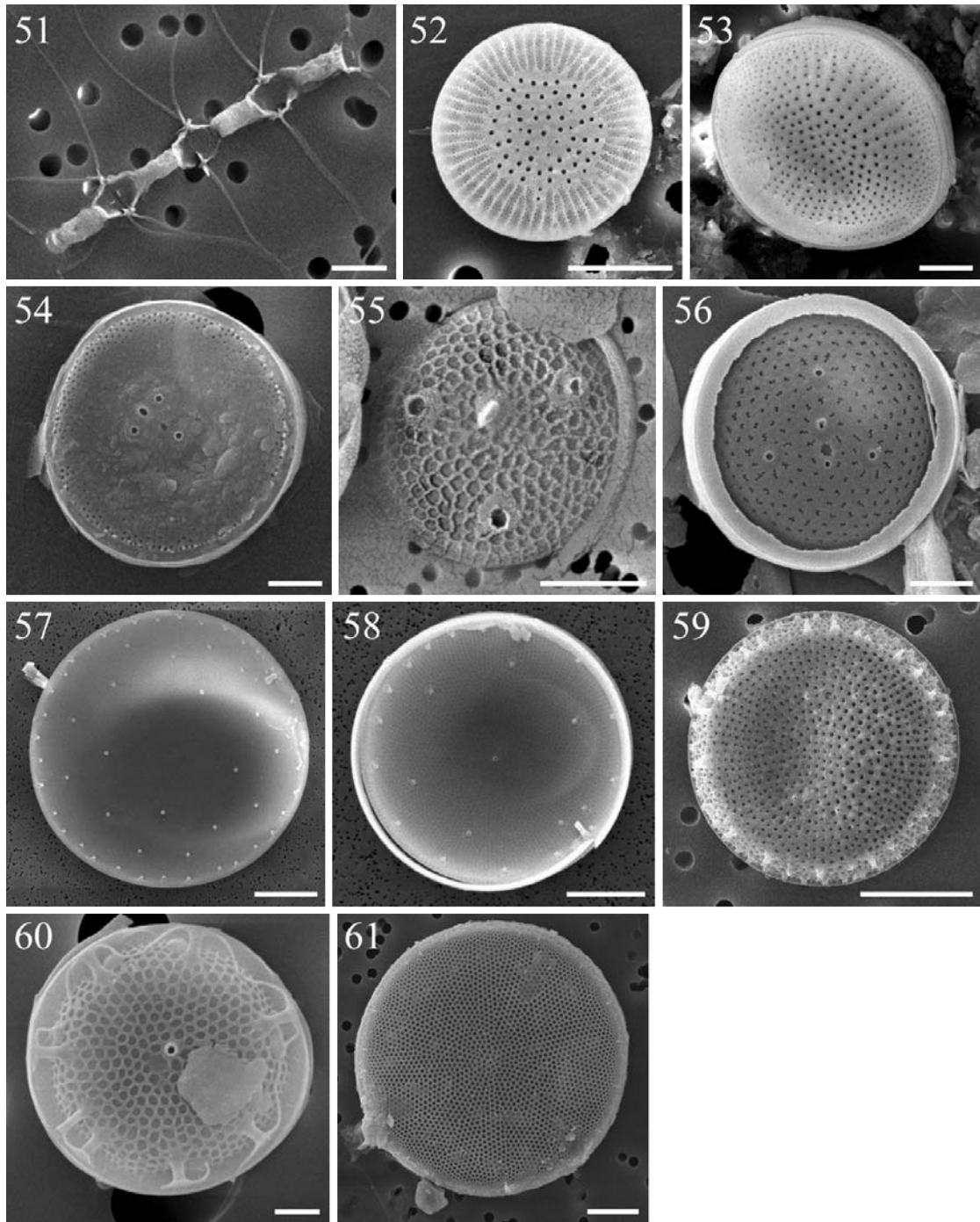
***Neidium productum* (Smith) Cleve 1894 (Fig. 15)**

**Basionym:** *Navicula producta* Smith 1853.

**Synonyms:** *Navicula producta* Smith 1853; *Navicula affinis* var. *producta* (Smith) Rabenhorst 1864; *Navicula iridis* var. *producta* (Smith) Van Heurck 1885; *Schizonema productum* (Smith) Kuntze 1898.

**References:** Smith 1853, p. 51; pl. 17, fig. 144; Rabenhorst 1864, p. 197; Van Heurck 1885, p. 104; Cleve 1894, p. 69; Kuntze 1898, p. 554.

**Specimen examined:** slides NIBRDI0000125376-NIBRDI



**Figs 51-61.** (SEM) Fig. 51. *Chaetoceros baculites*, girdle view. Fig. 52. *Puncticulata praetermissa*, valve view. Fig. 53. *Cymatotheca weissflogii*, valve view. Fig. 54. *Minidiscus chilensis*, valve view. Fig. 55. *Minidiscus comicus*, valve view. Fig. 56. *Minidiscus trioculatus*, valve view. Fig. 57. *Porosira pentaportula*, internal valve view. Fig. 58. *Thalassiosira diporocyclus*, internal valve view. Fig. 59. *Thalassiosira lacustris*, valve view. Fig. 60. *Thalassiosira tealata*, valve view. Fig. 61. *Thalassiosira wongii*, valve view. Scale bars: 51, 52, 57 & 58, 5  $\mu$ m; 53-56 & 60, 1  $\mu$ m; 59 & 61, 10  $\mu$ m.

0000125377 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 14 Oct. 2010 (YS-08).

*Fallacia pseudosemilyrata* (Simonsen) D.G. Mann 1990  
(Fig. 41)

**Basionym:** *Navicula pseudosemilyrata* Simonsen 1959.

**Synonym:** *Navicula pseudosemilyrata* Simonsen 1959.

**References:** Simonsen 1959, p. 78; pl. 11, fig. 15; Round *et al.* 1990, p. 669.

**Specimen examined:** slides NIBRDI0000125384-NIBRDI 0000125385 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 14 Oct. 2010 (YS-08).

***Stauroneis constricta* Cleve 1894 (Fig. 42)**

**References:** Cleve 1894, p. 145.

**Specimen examined:** slide NIBRDI0000127638 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 23 Jan. 2009 (ES-15), 23 Jan. 2009 (ES-04), 22 Jan. 2009 (ES-37), 22 Jan. 2009 (ES-38), 22 Jan. 2009 (ES-33), 22 Jan. 2009 (ES-27), 21 Jan. 2009 (ES-44), 21 Jan. 2009 (ES-43).

***Campylodiscus prentissi* Hanna & Grant 1926 (Fig. 16)**

**References:** Hanna and Grant 1926, p. 134, pl. 14, fig. 8.

**Specimen examined:** slides NIBRDI0000125259-NIBRDI 0000125260 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 21 Jan. 2009 (ES-51).

***Petrodictyon gemmoides* (Østrup) D.G. Mann 1990 (Fig. 17)**

**Basionym:** *Surirella gemmoides* Østrup 1897.

**Synonym:** *Surirella gemmoides* Østrup 1897.

**References:** Østrup 1897, p. 277; pl. 1, fig. 14; Round *et al.* 1990, p. 674.

**Specimen examined:** slides NIBRDI0000125287-NIBRDI 0000125288 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 23 Jan. 2009 (ES-15), 22 Jan. 2009 (ES-22), 23 Jan. 2009 (ES-20), 16 Feb. 2009 (ES-45), 16 Feb. 2009 (ES-47), 22 Jan. 2009 (ES-38), 21 Jan. 2009 (ES-44), 21 Jan. 2009 (ES-43), 16 Feb. 2009 (ES-07), 16 Feb. 2009 (ES-48), 24 Jul. 2010 (YS-34), 23 Jul. 2010 (YS-41), 22 Jul. 2010 (YS-12), 23 Jul. 2010 (YS-25), 23 Jul. 2010 (YS-24), 23 Jul. 2010 (YS-19).

***Surirella linearis* var. *elliptica* Müller 1903 (Fig. 18)**

**References:** Müller 1903, p. 30, pl. 1, fig. 10.

**Specimen examined:** slide LJH2010043 in Sangmyung University, Seoul.

**Korea distribution:** 30 Aug. 2010 (ES-05), 14 Oct. 2010 (YS-17).

***Surirella lorenziana* f. *hybrida* (Grunow) Deby ex Mills 1935 (Fig. 19)**

**Basionym:** *Surirella hybrida* Grunow 1881.

**Synonym:** *Surirella hybrida* Grunow 1881.

**References:** Van Heurck 1881, pl. 73, fig. 17; Mills, 1935, p. 1692.

**Specimen examined:** slide LJH2010042 in Sangmyung University, Seoul.

**Korea distribution:** 17 Feb. 2010 (YS-05).

***Amphora binodis* var. *bigibba* (Grunow) Peragallo & Peragallo 1899 (Fig. 20)**

**Basionym:** *Amphora bigibba* Grunow in Schmidt *et al.* 1875.

**Synonym:** *Amphora bigibba* Grunow in Schmidt *et al.* 1875.

**References:** Schmidt *et al.* 1875, pl. 25, figs 69-75; Peragallo and Peragallo 1899, p. 227, pl. 50, fig. 36; Hustedt 1955, p. 40, pl. 14, figs 19-25.

**Specimen examined:** slide NIBRDI0000127637 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 29 Aug. 2010 (ES-15), 23 Jan. 2009 (ES-17), 30 Aug. 2010 (ES-11), 22 Jan. 2009 (ES-38), 29 Aug. 2010 (ES-30), 22 Jan. 2009 (ES-31).

***Amphora spectabilis* Gregory 1857 (Fig. 21)**

**References:** Gregory, 1857, p. 516, pl. 13, fig. 80; Hendey, 1964, p. 268, pl. 38, figs 8, 9; Navarro, 1982, p. 323, fig. 33.

**Specimen examined:** slide NIBRDI0000125373 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 30 Aug. 2010 (ES-05), 23 Jan. 2009 (ES-04).

***Distrionella asterionelloides* Williams 1990 (Fig. 43)**

**References:** Williams, 1990, p. 176, figs 8-17.

**Specimen examined:** slides NIBRDI0000125365-NIBRDI 0000125366 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 14 Oct. 2010 (YS-08).

***Podocystis adriatica* (Kützing) Ralfs 1861 (Fig. 22)**

**Basionym:** *Surirella* (*Suriraya*) *adriatica* Kützing 1844.

**Synonym:** *Surirella* (*Suriraya*) *adriatica* Kützing 1844.

**References:** Kützing 1844, p. 62; pl. 7, fig. 8, pl. 30, fig. 80;

Pritchard, 1861, p. 772.

**Specimen examined:** slides NIBRDI0000125289-NIBRDI 0000125290 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 22 Jan. 2009 (ES-25).

***Synedra brockmanii* Hustedt 1959 (Figs 23, 24)**

**References:** Hustedt 1959, p. 228, fig. 715.

**Specimen examined:** slide LJH2010044 in Sangmyung University, Seoul.

**Korea distribution:** 23 Jan. 2009 (ES-08), 16 Feb. 2009 (ES-47), 21 Jan. 2009 (ES-51).

***Tabularia fasciculata* (Agardh) Williams & Round 1986 (Fig. 44)**

**Basionym:** *Diatoma fasciculata* Agardh 1812.

**Synonyms:** *Diatoma fasciculata* Agardh 1812; *Echinella fasciculata* (Agardh) Jurgens 1816-1822; *Lyngbyea fasciculata* (Agardh) Sommerfelt 1826; *Exilaria fasciculata* (Agardh) Greville 1827; *Exilaria fasciculata* Kützing 1833; *Ctenophora pulchella* var. *fasciculata* (Agardh ex Kützing) Schonfeldt 1907; *Fragilaria fasciculata* (Agardh) Lange-Bertalot 1980.

**References:** Agardh 1812, p. 35; Jurgens 1816-1822, Dec. 11; Sommerfelt 1826, p. 190; Greville 1827, pl. 291; Kützing 1833, p. 561; fig. 40; Schonfeldt 1907, p. 104, 248; Lange-Bertalot 1980, p. 750; Williams and Round 1986, p. 326, figs 46-52.

**Specimen examined:** slides NIBRDI0000125300-NIBRDI 0000125301 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 22 Jan. 2009 (ES-22), 21 Jan. 2009 (ES-43).

***Tabularia parva* (Kützing) Williams & Round 1986 (Fig. 45)**

**Basionym:** *Synedra parva* Kützing 1849.

**Synonyms:** *Synedra parva* Kützing 1849; *Synedra tabulata* var. *parva* (Kützing) Hustedt 1932; *Fragilaria tabulata* var. *parva* (Kützing) Lange-Bertalot 1980; *Synedra fasciculata* var. *parva* (Kützing) Desikachary and Sridharan in Desikachary 1989.

**References:** Kützing 1849, p. 46; Hustedt 1932, p. 219, fig. 710m-n; Lange-Bertalot 1980, p. 750; Williams and Round 1986, p. 324, figs 33-38; Desikachary 1989, pl. 735, figs 6-7.

**Specimen examined:** slides NIBRDI0000125302-NIBRDI 0000125303 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 29 Aug. 2010 (ES-16), 22 Jan. 2009 (ES-22), 16 Feb. 2009 (ES-45), 16 Feb. 2009 (ES-47), 22 Jan. 2009 (ES-37), 22 Jan. 2009 (ES-38), 22 Jan. 2009 (ES-34), 21 Jan. 2009 (ES-44), 21 Jan. 2009 (ES-41), 21 Jan. 2009 (ES-43), 21 Jan. 2009 (ES-51), 16 Feb. 2009 (SS-04), 16 Feb. 2009 (ES-46).

***Ulnaria pseudogaillonii* (Kobayasi and Idei) Idei 2006 (Fig. 25)**

**Basionym:** *Fragilaria pseudogaillonii* Kobayasi and Idei.

**Synonym:** *Fragilaria pseudogaillonii* Kobayasi and Idei.

**References:** Kobayasi and Idei 1979, p. 196, figs 1-3; Kobayasi *et al.* 2006, p. 88, pl. 106, figs 1-7.

**Specimen examined:** slide LJH2010052 in Sangmyung University, Seoul.

**Korea distribution:** 14 Oct. 2010 (YS-08).

***Licmophora communis* (Heiberg) Grunow 1881 (Fig. 46)**

**Basionym:** *Podospheonia communis* Heiberg 1863.

**Synonym:** *Podospheonia communis* Heiberg 1863.

**References:** Heiberg 1863, p. 76; pl. 6, fig. 23; Van Heurck 1881, pl. 48, figs 8-9.

**Specimen examined:** slides NIBRDI0000125367-NIBRDI 0000125368 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 23 Jan. 2009 (ES-04), 21 Jan. 2009 (ES-43).

***Licmophora debilis* (Kützing) Grunow in Van Heurck 1881 (Fig. 47)**

**Basionym:** *Podospheonia debilis* Kützing 1844.

**Synonym:** *Podospheonia debilis* Kützing 1844; *Licmophora tincta* f. *debilis* (Kützing) Grunow 1867.

**References:** Kützing 1844, p. 120, 8/7, 12/1, 24/1, fig. 6; Grunow 1867, p. 35; Van Heurck, 1881, pl. 48, fig. 23.

**Specimen examined:** slides NIBRDI0000125369-NIBRDI 0000125370 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 27 Dec. 2008 (YS-42).

***Licmophora grandis* (Kützing) Grunow 1881 (Fig. 48)**

**Basionym:** *Rhipidophora grandis* Kützing 1844.

**Synonyms:** *Rhipidophora grandis* Kützing 1844; *Stylaria grandis* (Kützing) Trevisan 1848; *Styllaria grandis* (Kützing) Trevisan 1848; *Licmophora gracilis* f. *grandis* (Kützing) Grunow 1867.

**References:** Kützing 1844, p. 122; pl. 11, fig. 1; Trevisan 1848, p. 98; Van Heurck, 1881, pl. 48, figs 2, 3.

**Specimen examined:** slides NIBRDI0000125371-NIBRDI 0000125372 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 23 Jan. 2009 (ES-15), 23 Jan. 2009 (ES-20), 22 Jan. 2009 (ES-38), 22 Jan. 2009 (ES-33), 22 Jan. 2009 (ES-25), 22 Jan. 2009 (ES-31), 21 Jan. 2009 (ES-44), 21 Jan. 2009 (ES-41), 21 Jan. 2009 (ES-43), 28 Aug. 2010 (ES-42), 22 Jan. 2009 (ES-40).

***Delphineis minutissima* (Hustedt) Simonsen 1987 (Fig. 49)**

**Basionym:** *Rhaphoneis minutissima* Hustedt 1939.

**Synonym:** *Rhaphoneis minutissima* Hustedt 1939.

**References:** Hustedt 1939, p. 599, figs 14, 15; Simonsen 1987, p. 252; Sar *et al.* 2007, p. 72, fig. 5A-J.

**Specimen examined:** slides NIBRDI0000125380-NIBRDI 0000125381 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 23 Jan. 2009 (ES-14), 23 Jan. 2009 (ES-04), 23 Jan. 2009 (ES-17), 23 Jan. 2009 (ES-10), 23 Jan. 2009 (ES-12), 22 Jan. 2009 (ES-38), 29 Aug. 2010 (ES-30).

***Grammatophora oceanica* var. *subtilissima* (J.W. Bailey)**

**De Toni 1894 (Fig. 26)**

**Basionym:** *Grammatophora subtilissima* J.W. Bailey ex Ralfs.

**Synonyms:** *Grammatophora subtilissima* J.W. Bailey ex Ralfs 1861; *Grammatophora oceanica* var. *macilenta* f. *subtilissima* (J.W. Bailey) Hustedt 1931.

**References:** Pritchard 1861, p. 809; Hustedt 1931, fig. 575; Sato *et al.* 2004, p. 18, figs 9a, b, 10, 19, 20, 29, 30.

**Specimen examined:** slides NIBRDI0000125269-NIBRDI 0000125270 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 30 Aug. 2010 (ES-06), 16 Feb. 2009 (ES-45), 16 Feb. 2009 (ES-47), 29 Aug. 2010 (ES-36), 22 Jan. 2009 (ES-37), 22 Jan. 2009 (ES-38), 29 Aug. 2010 (ES-35), 22 Jan. 2009 (ES-34), 22 Jan. 2009 (ES-25), 22 Jan. 2009 (ES-31), 21 Jan. 2009 (ES-44), 21 Jan. 2009 (ES-41),

21 Jan. 2009 (ES-43), 16 Feb. 2009 (ES-07), 21 Jan. 2009 (ES-51), 16 Feb. 2009 (ES-50).

***Actinocyclus circellus* Watkins 1986 (Fig. 27)**

**References:** Watkins and Fryxell, 1986, p. 294, 308, figs 1-8; Hasle and Syvertsen, 1996, p. 119.

**Specimen examined:** slides NIBRDI0000127631-NIBRDI 0000127635 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 29 Aug. 2010 (ES-35), 24 Jul. 2010 (YS-30), 22 Jul. 2010 (YS-12), 23 Jul. 2010 (YS-22), 23 Jul. 2010 (YS-11).

***Actinocyclus subtilis* (Gregory) Ralfs 1861 (Fig. 28)**

**Basionym:** *Eupodiscus subtilis* Gregory 1857.

**Synonym:** *Eupodiscus subtilis* Gregory 1857.

**References:** Gregory 1857, p. 501, pl. 11, fig. 50; Pritchard 1861, p. 835; Hustedt 1930, p. 534, fig. 304; Anderson *et al.* 1986, p. 467, figs 1-35; Hasle and Syvertsen 1996, p. 120.

**Specimen examined:** slide NIBRDI0000127636 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 29 Aug. 2010 (ES-15), 23 Jan. 2009 (ES-12), 22 Jul. 2010 (YS-07), 14 Oct. 2010 (YS-06), 22 Jan. 2009 (ES-38), 22 Jan. 2009 (ES-34), 16 Feb. 2009 (SS-04), 16 Feb. 2009 (ES-46), 22 Jul. 2010 (YS-12).

***Actinocyclus vestigulus* Watkins 1986 (Fig. 29)**

**References:** Watkins and Fryxell 1986, p. 296, 308, 310, figs 9-16; Hasle and Syvertsen, 1996, p. 123.

**Specimen examined:** slide NIBRDI0000127688 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 14 Oct. 2010 (YS-26).

***Cerataulina dentata* Hasle 1980 (Fig. 30)**

**References:** Hasle and Syvertsen 1980, p. 87, figs 65, 72-94, 97; Hasle and Syvertsen 1996, pl. 33, figs a-c.

**Specimen examined:** slides NIBRDI0000127622-NIBRDI 0000127623 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 22 Jul. 2010 (YS-12), 23 Jul. 2010 (YS-19).

***Eucampia zodiacus* var. *cornigera* Grunow in Van Heurck 1883 (Fig. 31)**

**References:** Van Heurck, 1883, pl. 95B, figs 3, 4.

**Specimen examined:** slides NIBRDI0000127624-NIBRDI 0000127626 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 14 Oct. 2010 (YS-04), 22 Jul. 2010 (YS-10), 24 Jul. 2010 (YS-39), 24 Jul. 2010 (YS-30), 3 May 2009 (YS-23), 29 Aug. 2009 (YS-28), 15 Oct. 2010 (YS-31).

***Triceratium pentacrinus* (Ehrenberg) Wallich 1858  
(Fig. 50)**

**Basionym:** *Amphipentas pentacrinus* Ehrenberg 1840.

**Synonyms:** *Amphipentas pentacrinus* Ehrenberg 1840; *Bidulphia pentacrinus* (Ehrenberg) Boyer 1900.

**References:** Wallich, 1858, p. 249, pl. 12, figs 10-14.

**Specimen examined:** slide LJH2007013 in Sangmyung University, Seoul.

**Korea distribution:** 25 Nov. 2007 (JI-02).

***Chaetoceros baculites* Meunier 1910 (Fig. 51)**

**References:** Meunier 1910, p. 251; pl. 27, fig. 30.

**Specimen examined:** slide LJH2007001 in Sangmyung University, Seoul.

**Korea distribution:** 27 Jul. 2007 (YS-05).

***Chaetoceros coronatus* Gran 1897 (Fig. 32)**

**References:** Gran 1897, p. 22, pl. 2, figs 28-31; Rines and Hargraves 1988, p. 68, figs 135-138; Ishii *et al.* 2011, p. 354, figs 12, 13.

**Specimen examined:** slide NIBRDI0000125263 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 29 Jan. 2010 (SS-01).

***Chaetoceros orientalis* Schiller in Hustedt 1930 (Fig. 33)**

**References:** Hustedt 1930, p. 721, fig. 412.

**Specimen examined:** slides NIBRDI0000127627-NIBRDI 0000127628 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 23 Jul. 2010 (YS-18), 23 Jul. 2010 (YS-19).

***Chaetoceros subtilis* var. *abnormis* (Proschkina-Lavrenko)  
Proschkina-Lavrenko 1961 (Fig. 34)**

**Basionym:** *Chaetoceros abnormis* Proschkina-Lavrenko 1953.

**Synonym:** *Chaetoceros abnormis* Proschkina-Lavrenko 1953.

**References:** Proschkina-Lavrenko 1961, p. 40; Sunesen *et al.* 2008, p. 320, fig. 14; Aké-Castillo *et al.* 2004, p. 204, figs 2, 4.

**Specimen examined:** slide NIBRDI0000125264 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 17 Aug. 2009 (YS-05).

***Puncticulata praetermissa* (Lund) Håkansson 2002  
(Fig. 52)**

**Basionym:** *Cyclotella praetermissa* Lund.

**Synonym:** *Cyclotella praetermissa* Lund.

**References:** Lund 1951, p. 98, figs 1:A-H, 2:A-L; Håkansson 2002, p. 116, figs 422-426; Tanaka 2007, p. 43, pls 56-59.

**Specimen examined:** slides NIBRDI0000125388-NIBRDI 0000125389 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 16 Feb. 2009 (ES-45).

***Cymatotheca weissflogii* (Grunow) Hendey 1958 (Fig. 53)**

**Basionym:** *Euodia weissflogii* Grunow in Van Heurck 1883.

**Synonyms:** *Euodia weissflogii* Grunow in Van Heurck 1883; *Hemidiscus weissflogii* (Grunow) Kuntze 1898; *Hemidiscus weissflogii* (Grunow in Van Heurck) Hustedt 1955.

**References:** Van Heurck 1883, pl. 126, fig. 13; Kuntze 1898, p. 408; Hustedt 1955, p. 11; pl. 1, fig. 6; Hendey 1958, p. 41, pl. 5, fig. 9; Tremarin *et al.* 2008, p. 1103, figs 3-4, 61; Lehmkuhl *et al.* 2010, p. 319, fig. 25.

**Specimen examined:** slide NIBRDI0000125391 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 14 Oct. 2010 (YS-04), 14 Oct. 2010 (YS-13), 2 Apr. 2010 (YS-02), 16 Nov. 2008 (YS-03), 15 Oct. 2010 (YS-31).

***Minidiscus chilensis* Rivera 1984 (Fig. 54)**

**References:** Rivera and Koch 1984, p. 281, figs 5-14.

**Specimen examined:** slide NIBRDI0000127689 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 16 Apr. 2011 (YS-20), 16 Apr. 2011 (YS-15).

***Minidiscus comicus* Takano 1981 (Fig. 55)**

**References:** Takano, 1981, p. 32-33, figs 1A, 2-13.

**Specimen examined:** slide NIBRDI0000125275 in NIBR (The National Institute of Biological Resources), Inchoen.



**Korea distribution:** 23 Jan. 2009 (ES-17), 23 Jan. 2009 (ES-10), 14 Oct. 2010 (YS-08), 21 Jan. 2009 (ES-43).

***Minidiscus trioculatus* (Taylor) Hasle 1973 (Fig. 56)**

**Basionym:** *Coscinodiscus trioculatus* Taylor 1967.

**Synonym:** *Coscinodiscus trioculatus* Taylor 1967.

**References:** Taylor 1967, p. 437; pl. 92, fig. 43; Hasle 1973, p. 67-68.

**Specimen examined:** slide NIBRDI0000125276 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 23 Jan. 2009 (ES-17), 22 Jan. 2009 (ES-38), 22 Jan. 2009 (ES-27), 21 Jan. 2009 (ES-51).

***Planktoniella blanda* (Schmidt) Syvertsen & Hasle 1993 (Fig. 35)**

**Basionym:** *Coscinodiscus blandus* Schmidt 1878.

**Synonyms:** *Coscinodiscus blandus* Schmidt 1878; *Thalassiosira blanda* (Schmidt) Desikachary and Gowthaman 1989.

**References:** Schmidt 1878, pl. 59, figs 35-37; Desikachary 1989, pl. 742, figs 1-7, pl. 743, figs 1-5, pl. 744, figs 1-5; Hasle 1993, p. 304, figs 19-31; Hasle and Syvertsen 1996, p. 40, pl. 2.

**Specimen examined:** slides NIBRDI0000125392-NIBRDI0000125393 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 16 Feb. 2009 (ES-45), 29 Aug. 2010 (ES-32), 21 Jan. 2009 (ES-51), 16 Feb. 2009 (ES-50), 8 Jan. 2011 (JI-01).

***Porosira pentaportula* Syvertsen & Lange 1990 (Fig. 57)**

**References:** Syvertsen and Lange, 1990, p. 144, figs 1-21.

**Specimen examined:** slides NIBRDI0000125394-NIBRDI0000125395 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 14 Oct. 2010 (YS-04), 22 Jan. 2009 (ES-29), 27 Dec. 2008 (YS-43).

***Thalassiosira diporocyclus* Hasle 1972 (Fig. 58)**

**References:** Hasle 1972, p. 134, figs 25-45.

**Specimen examined:** slide LJH2008002 in Sangmyung University, Seoul.

**Korea distribution:** 22 Jan. 2009 (ES-38), 16 Feb. 2009 (ES-46).

***Thalassiosira lacustris* (Grunow) Hasle 1977 (Fig. 59)**

**Basionym:** *Coscinodiscus lacustris* Grunow 1880.

**Synonyms:** *Coscinodiscus lacustris* Grunow 1880; *Cyclotella punctata* Smith 1856; *Stephanodiscus punctatus* (Smith) Grunow 1878.

**References:** Smith 1856, p. 87; Cleve and Grunow 1880, p. 114; Hasle, 1977, p. 40.

**Specimen examined:** NIBRDI0000125396-NIBRDI0000125397 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 29 Aug. 2010 (ES-15), 30 Aug. 2010 (ES-02), 30 Aug. 2010 (ES-05), 30 Aug. 2010 (ES-06), 29 Aug. 2010 (ES-18), 30 Aug. 2010 (ES-09), 30 Aug. 2010 (ES-11), 14 Oct. 2010 (YS-08), 14 Oct. 2010 (YS-14), 29 Aug. 2010 (ES-26), 28 Aug. 2010 (ES-42), 2 Apr. 2010 (YS-02), 16 Nov. 2008 (YS-01), 23 Jul. 2010 (YS-33), 23 Jul. 2010 (YS-18), 23 Jul. 2010 (YS-27), 14 Oct. 2010 (YS-17), 14 Oct. 2010 (YS-26), 15 Oct. 2010 (YS-29), 15 Oct. 2010 (YS-31), 15 Oct. 2010 (YS-37).

***Thalassiosira tealata* Takano 1980 (Fig. 60)**

**References:** Takano 1980, p. 55-58, fig. 17.

**Specimen examined:** slide LJH2007011 in Sangmyung University, Seoul.

**Korea distribution:** 16 Feb. 2009 (ES-48).

***Thalassiosira wongii* Mahood 1986 (Fig. 61)**

**References:** Mahood *et al.* 1986, p. 132, 137, figs 24-29, 99-101.

**Specimen examined:** slides NIBRDI0000127643-NIBRDI0000127645 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 14 Oct. 2010 (YS-04), 15 Oct. 2010 (YS-31), 15 Oct. 2010 (YS-37).

***Trybliptychus cocconeiformis* (Grunow) Hendey 1958 (Fig. 36)**

**Basionym:** *Campylodiscus cocconeiformis* Grunow in Cleve.

**Synonym:** *Campylodiscus cocconeiformis* Grunow in Cleve.

**References:** Cleve 1883: 502, pl. 38: fig. 78; Hendey 1958, p. 46, pl. 2, fig. 10; Tremarin *et al.* 2008, p. 1108, fig. 41.

**Specimen examined:** slides NIBRDI0000125308-NIBRDI0000125309 in NIBR (The National Institute of Biological Resources), Inchoen.

**Korea distribution:** 14 Oct. 2010 (YS-04), 22 Jul. 2010 (YS-









07), 14 Oct. 2010 (YS-06), 21 Jan. 2009 (ES-43), 16 Feb. 2009 (ES-50), 16 Nov. 2008 (YS-01), 22 Jul. 2010 (YS-12), 14 Oct. 2010 (YS-16), 15 Oct. 2010 (YS-29), 15 Oct. 2010 (YS-35).

## DISCUSSION

Lee and Yoo (1986, 1987) studied the fine structure of diatoms by light microscopy and scanning electron microscopy, and they reported 10 new *Thalassiosira* species to Korean diatom flora. Since then, studies on native unrecorded species have been started. The enforcement of the Convention on Biological Diversity (CBD), and the establishment of the National Institute of Biological Resources (NIBR) resulted in the beginning of research on the indigenous species in Korea.

This research was supported by National Institute of Biological Resources for 5 years, in this study, 60 diatom species representing 3 class, 6 subclass, 16 order, 21 family and 39 genus were newly recorded in Korea. Thirty-nine species were found in the East Sea, 33 species were found from the Yellow Sea, 4 species were from the South Sea and 2 species were found from Jeju Island (Table 2).

In the generic level, *Chaetoceros*, *Parlibells* and *Thalassiosira* consisted of 4 species, and *Actinocyclus*, *Minidiscus* and *Licmophora*, 3 species, respectively. *Thalassiosira* and *Chaetoceros*, the most species rich diatoms have more than 100 species (Hasle and Syvertsen 1996). Despite of their high species diversity, recorded species are insufficient in Korea. The number of recorded *Thalassiosira* species is 36 taxa (Park and Lee 2010), and *Chaetoceros* is 89 taxa (Lee 1995). These numbers indicate that the study on the high species diversity group is deficient. Taxonomic studies on the group involved rich number of species such as *Coscinodiscus*, *Cyclotella*, will help to understand the diatom diversity in Korea.

From 103 sites in the present study, the most frequent species are *Tryblionella coarctata* appearing 24 times, *Thalassiosira lacustris* appearing 22 times and *Cocconeis stauroneiformis* appearing 20 times (Table 2). *Tryblionella coarctata* and *Cocconeis stauroneiformis* have been known to the epipelagic species in the brackish and marine sediments (Round *et al.* 1990). *Thalassiosira lacustris* are common species in the brackish waters (Hasle 1977). There are lacks

of investigations concerning the habitats such as surface films at the water-sediment interface and the brackish waters, these species have not been recorded in Korea.

Of 103 sites, the sites that involved over 10 new recorded species in Korea are ES-43 (17 species), ES-38 (16 species), ES-17 (12 species), ES-51 (12 species), ES-30 (11 species), ES-04 (10 species), ES-42 (10 species), ES-44 (10 species), YS-08 (10 species) and YS-12 (10 species) (Table 2). The newest record diatoms are observed from the benthic habitats at shallow coastal environments in East Sea.

Still, there are many unidentified species in the authors' collections, which we plan to present in future papers. Although many authors have been contributed on Korean diatoms, the taxonomic study with the description, references and illustrations is poor in Korea. This study contributes to the understanding of diatom diversity in Korea.

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