

Creating a preliminary checklist for recent freshwater Japanese endemic diatom taxa

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Abstract: A checklist of recent freshwater Japanese endemic diatom taxa was compiled. 427 recent freshwater diatom taxa have been described from Japan. 122 taxa are reported only from Japan and should be endemic. 29 taxa were reported from both Japan and other East Asian countries. 204 taxa have never been used since their first description and are regarded as ‘Practically Non-existent Species (PNS)’ and omitted from the analysis.

Key words: East Asia, diatom, endemism, Japan

Introduction

Japan is a biodiversity hotspot, and many endemic species have been reported (e.g., Kato & Ebihara 2011). Understanding endemism is a core topic of biodiversity and creating checklists of endemic species is an important task for Japanese biologists, including taxonomists. The National Museum of Nature and Science (Japan) has been making checklists of endemic species including plants, algae, animals and fungi (Kato & Ebihara 2011, National Museum of Nature and Science 2018). We have also tried to make such a list for recent freshwater diatoms.

Micro-organisms like diatoms were once thought to be cosmopolitan (e.g., Vanormelingen et al. 2007). Cosmopolitanism was an implicit assumption for many diatom studies in Japan, and as a result European monographs and flora lists (e.g., Hustedt 1930, Krammer & Lange-Bertalot 1986) were regularly used to identify Japanese diatoms (e.g., Tuji 1995). However, the assumption of cosmopolitanism was rarely discussed. For example, Watanabe et al. (2005) stated that ‘many diatoms are cosmopolitan and harvested worldwide and having the similar ecological characters as stated by Hustedt (1937).’ In Japan, endemism was noted for a limited number of waterbodies: highly acidic springs (e.g., Fukushima et al. 2002, Negoro 1944), and the ancient Lake Biwa (Tuji 2002, Tuji & Kociolek

2000). Country-level endemism has never been discussed. Though many new species have been described from Japanese oligosaprobic rivers (e.g., Kobayasi 1960), the possibility of them being endemic to Japan has never been discussed.

Furthermore, information on the diatom flora of neighboring nations is essential for understanding endemism of Japanese diatoms. However, no comparative studies between the flora of Japan and neighboring nations has been done. Since East Asian countries have strong economic exchanges, Japanese endemic taxa may exist as alien species in these nations. However, it is difficult to distinguish alien species from native species without old specimens. Unfortunately, we don’t have such old specimens in many cases (see Tuji 2011).

To provide an exhaustive and complete analysis of diatom endemism in Japan would require the examination of types and their comparison with molecular data, but this describes the requirements for Japanese diatom studies and is unrealistic as a short-term goal. The goal of this study is to create a preliminary checklist of recent freshwater Japanese ‘endemic’ diatom taxa.

Materials and Methods

For creating a preliminary checklist of recent freshwater Japanese ‘endemic’ diatom taxa, we compiled the recent freshwater diatom taxa described from Japan, using published papers, Japanese monographs (Watanabe et al.

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2005), databases, web-based databases, DiatomBase: Kociolek et al. (2017), and Index Nominum Algarum Bibliographia Phycologica Universalis (2017) to create a checklist of recent freshwater diatoms described from Japan.

Two difficult problems arise when attempting to estimate the level of endemism in Japan. One significant problem in making this checklist, was the existence of many poorly-described taxa. Boris Vassilievich Skvortsov (= Skvortzov, Skvortzkov, Skvortsow: 1890–1980) described more than half of the total number of taxa from Japan. His descriptions, however, are very brief and his figures are often too simple to be used to identify the species with any certainty. Most species described by him have never been found after his initial first descriptions, and much of the original material, including the types, have been lost, possibly during or just after World War II. Although we have examined some of the remaining original material (Ohtsuka & Tuji 2002, Tuji 2002, Tuji & Williams 2006), it is very difficult to find and specify his specimens from them. These poorly-described taxa make it extremely difficult to identify Japanese diatoms accurately. It is also difficult to assess the endemism of species for which no actual specimens exist due to a lack of detailed illustrations, less characteristic name-bearing type specimens, or specimens without citations. To identify species that have not been reported after the first description, each taxon on the checklist was examined using the Global Biodiversity Information Facility (GBIF 2017) as well as Google (2017) to search digitized journals such as DIATOM (Japanese journal of diatomology) and most bulletins published by Japanese universities, in which many Japanese diatom flora have been described. We regarded these unused taxa as ‘Practically Non-existent Species (PNS)’ in the present study.

Another problem was the limited information on the distribution of these diatoms in neighboring regions (nations or districts; China, Korea, Taiwan, Russian Far East). In the last ten years, a dozen of important monographs have been published from these regions—China: Hu & Wei (2006), Jiaying & Qi (2014), Jiaying & Yuzao (2010), Qi (1995), Qi & Li (2004), Shi (2004), Zhixin (2013); Korea: Joh (2010, 2011, 2012a, 2012b), Joh et al. (2010), Lee (2011, 2012a, 2012b); Taiwan: Wu et al. (2011a, 2011b); Russian Far East: Medvedeva & Nikulina (2014); and a comparison of these floras with the Japanese flora is now possible. We checked each taxon in the previous list using these monographs and web-based database (GBIF 2017, and AlgaeBase: Guiry & Guiry 2017). Authors of species names follow Brummitt and Powell (1992).

Results and Discussion

We found 427 recent freshwater diatom taxa that have been described from Japan. Presently known diatoms endemic to Japan should be included among these taxa. Two hundred and four taxa of the 427 taxa have not been used

after their first description. We regard these taxa as PNS and omitted these taxa from the list of endemic species. Seventeen taxa were nomenclaturally invalid taxa, and nine taxa were synonyms of other taxa. Many new species described by Hiromu Kobayasi were firstly invalid and later validated in subsequent papers. These validated nomenclatural synonyms are not counted as ‘nomenclaturally invalid taxa.’ Forty-six taxa were reported from outside of East Asia, such as North America, and should be treated as cosmopolitan taxa.

The remaining 151 taxa are possibly endemic to East Asia. Twenty-nine taxa were reported from both Japan and at least one other East Asian country. One hundred and twenty-two taxa have been reported only from Japan and can be considered endemic to Japan at the present time.

List of recent freshwater diatoms described from both Japan and other East Asian regions

Parentheses indicates the country or regions found for each taxon. ‘Russia’ means Russian far East.

Eunotiaceae

1. *Eunotia monodon* var. *asiatica* Skvortsov, 1936, Philipp. J. Sci. **61**: 18. *pl. 1, f. 25, 35. pl. 2, f. 7, 3/1.* (China)

2. *Eunotia monodon* var. *koreana* Skvortsov, 1936, Philipp. J. Sci. **61**: 18. *pl. 1, f. 13, 14, 19, 20, 30, 33.* (Russia)

3. *Eunotia veneris* var. *nipponica* Skvortsov, 1936, Philipp. J. Sci. **61**: 22. *pl. 1, f. 31.* (Russia)

Fragilariaceae

4. *Hannaea arcus* var. *hattoriana* (F.Meister) T.Ohtsuka, 2002, Diatom **18**: 35.

≡ *Ceratoneis arcus* var. *hattoriana* F.Meister, 1914, Arch. Hydrobiol. Planktonk. **9**: 226. *pl. 8, f. 1–3.* (China)

5. *Hannaea arcus* var. *subarcus* (Iwah.) J.H.Lee in Lee et al. 1992, Diatom **7**: 50.

≡ *Ceratoneis recta* f. *subarcus* Iwah., 1936, J. Jpn. Bot. **12**: 391. *f. 1, d–f.* (Korea)

6. *Ulnaria inaequalis* (H.Kobayasi) M.Idei in Kobayasi et al. 2006, H. Kobayasi’s Atlas Jpn. Diat. p. 12.

≡ *Synedra inaequalis* H.Kobayasi, 1987, Diatom **3**: 9–10. (Russia)

7. *Ulnaria pseudogaillonii* (H.Kobayasi & M.Idei) M.Idei in Kobayasi et al. 2006, H. Kobayasi’s Atlas Jpn. Diat. p. 12.

≡ *Fragilaria pseudogaillonii* H.Kobayasi & M.Idei, 1979, Jpn. J. Phycol. **27**: 196, 198. *f. 1–13.* (Taiwan)

Achnanthisiaceae

8. *Achnanthisidium convergens* (H.Kobayasi) H.Kobayasi, 1997, Nova Hedwigia **65**: 159.

≡ *Achnanthes convergens* H.Kobayasi ex H.Kobayasi et

al. 1986, *Diatom* 2: 84–85. *pl. 1, f. 1–7, 11–18, pl. 3, f. 37–43, pl. 5, f. 51–54.*

(Korea, Taiwan, Russia)

9. *Achnantheidium japonicum* (H.Kobayasi) H.Kobayasi, 1997, *Nova Hedwigia* 65: 156.
 ≡ *Achnanthes japonica* H.Kobayasi ex H.Kobayasi et al., 1986, *Diatom* 2: 85–86. *pl. 2, f. 19–21, 27–36, pl. 4, f. 44–50, pl. 5, f. 55–58.*

(Korea, Taiwan)

Cymbellaceae

10. *Cymbella turgidula* var. *nipponica* Skvortsov, 1936, *Philipp. J. Sci.* 61: 283. *pl. 2, f. 8, pl. 4, f. 4.*
 Lectotype (LT): Slide 30000136 in Lake Biwa Museum (LBM) (Ohtsuka & Tuji 2002, Tuji 2006).
 ≡ *Cymbella rheophila* Ohtsuka in Ohtsuka & Tuji 2002, *Phycol. Res.* 50: 245.

(Korea)

Gomphonemataceae

11. *Gomphonema vastum* Hust., 1927, *Arch. Hydrobiol.* 18: 166. *pl. 5, f. 4.*
 (Russia)
 12. *Gomphonema pseudosphaerophorum* H.Kobayasi in Ueyama & Kobayasi 1988, *Proc. Ninth Int. Diat. Symp.* p. 452. *f. 10–12, 25–37.*

(Taiwan)

Diploneidaceae

13. *Diploneis marginestriata* var. *nipponica* Skvortsov, 1936, *Philipp. J. Sci.* 61: 269. *pl. 4, f. 3.*
 (China, Russia)
 14. *Diploneis oculata* var. *nipponica* Skvortsov, 1936, *Philipp. J. Sci.* 61: 31. *pl. 14, f. 2.*

(Russia)

Naviculaceae

15. *Caloneis nipponica* Skvortsov, 1936, *Philipp. J. Sci.* 61: 267. *pl. 2, f. 7, pl. 3, f. 9, pl. 4, f. 15.*
 (Korea)
 16. *Navicula globulifera* var. *nipponica* Skvortsov, 1936, *Philipp. J. Sci.* 61: 37. *pl. 3, f. 10.*
 (Russia)
 17. *Navicula senjoensis* H.Kobayasi in Kobayasi & Ando 1977, *Bull. Tokyo Gakugei Univ.*, ser. 4. 29: 241–242. *pl. 4, f. 23–26.*
 (Korea)
 18. *Navicula yuraensis* Negoro et Gotoh ex Gotoh in Lee et al. 1994, *Diatom* 9: 33. *pl. 2, f. 7, 8.*

(Korea, Taiwan)

Pleurosigmataceae

19. *Gyrosigma pseudokuetszingii* H.Kobayasi in Kobayasi & Ando 1977, *Bull. Tokyo Gakugei Univ.* ser. 4. 29: 239. *pl. 8, f. 62, 63.*

(Korea)

Pinnulariaceae

20. *Pinnularia acidojaponica* M.Idei & H.Kobayasi in Idei & Mayama 2001, *Lange-Bert. -Festschr.* p. 266. *f. 1–29.*

(Russia)

21. *Pinnularia appendiculata* var. *paeninsulaekoreana* Skvortsov, 1936, *Philipp. J. Sci.* 61: 22. *pl. 3, f. 12.*

(China)

22. *Pinnularia balfouriana* var. *stauroptera* Skvortsov, 1936, *Philipp. J. Sci.* 61: 43. *pl. 16, f. 15.*

(China)

23. *Pinnularia hilseana* var. *japonica* H.Kobayasi in Kobayasi & Ando 1977, *Bull. Tokyo Gakugei Univ.*, ser. 4. 29: 246–247. *pl. 6, f. 44–46.*

(Korea)

24. *Pinnularia nobilis* var. *parallela* Skvortsov, 1936, *Philipp. J. Sci.* 61: 27. *pl. 4, f. 5.*

(China)

25. *Pinnularia legumen* var. *capitata* H.Kobayasi in Kobayasi & Ando 1977, *Bull. Tokyo Gakugei Univ.* ser. 4. 29: 247. *pl. 6, f. 47, 48.*

(Korea)

26. *Pinnularia platycephala* var. *hattoriana* F.Meister, 1914, *Arch. Hydrobiol. Planktonk.* 9: 228. *pl. 8, f. 6, 7.*

(China)

Sellaphoraceae

27. *Stauroneis staurolineata* var. *japonica* H.Kobayasi & Kaz.Ando, 1978, *Jpn. J. Phycol.* 26: 15–16. *pl. 2, f. 18–20.*

(Korea)

Surirellaceae

28. *Surirella capronii* var. *obtusa* Hust., 1927, *Arch. Hydrobiol.* 18: 170. *f. 2.*
 (Russia)
 29. *Surirella pantocsekii* F.Meister, 1914, *Arch. Hydrobiol. Planktonk.* 9: 230, 231. *pl. 8, f. 14, 15.*

(Russia)

List of recent freshwater diatoms endemic to Japan

Aulacoseiraceae

1. *Aulacoseira subarctica* var. *longispina* (Hust.) Tuji & Houki, 2004, *Bull. Natl. Sci. Mus.*, Ser. B. 30: 38–39.
 ≡ *Melosira longispina* Hust. in Huber-Pestalozzi 1942, *Binnengew. Einzeld. Limn. Nachb.* 16(2 : 2): 388. *pl. 115, f. 469a.*
 ≡ *Aulacoseira longispina* (Hust.) Simonsen, 1979, *Bacill.* 2: 61.
 2. *Aulacoseira subarctica* var. *tenuis* (Hust.) Tuji & Houki, 2004, *Bull. Natl. Sci. Mus.*, Ser. B. 30: 39.
 ≡ *Melosira longispina* var. *tenuis* Hust. in Huber-Pestalozzi 1942, *Binnengew. Einzeld. Limn. Nachb.* 16(2 : 2): 389. *pl. 115, f. 469b.*
 ≡ *Aulacoseira longispina* var. *tenuis* (Hust.) Simonsen, 1979, *Bacill.* 2: 61.
 3. *Aulacoseira nipponica* (Skvortsov) Tuji, 2002, *Phycol. Res.* 50: 315.
 ≡ *Melosira solida* var. *nipponica* Skvortsov, 1936, *Philipp. J. Sci.* 61: 255. *pl. 1, f. 1, 2, 21.*
 LT: TNS-AL-53965 in TNS (Department of Botany, National Museum of Nature and Science) (Tuji 2002, 2006).

Biddulphiaceae

4. *Terpsinoe muninensis* Tuji, 2018, Mem. Natl. Mus. Nat. Sci. **52**: 6–10. f. 1–29.

Stephanodiscaceae

5. *Cyclostephanos costatilimbus* (H.Kobayasi & Kobayashi) Stoermer et al., 1987, Brit. Phycol. J. **22**: 357.
 ≡ *Stephanodiscus costatilimbus* H.Kobayasi & Kobayashi, 1986, Jpn. J. Phycol. **34**: 8–9. f. 1–13.
6. *Discostella nipponica* (Skvortsov) Tuji & D.M.Williams, 2006, Bull. Natl. Sci. Mus., Ser. B. **32**: 11.
 ≡ *Cyclotella glomerata* f. *nipponica* Skvortsov, 1936, Philipp. J. Sci. **61**: 13. pl. 1, f. 12.
 LT: An individual in slide TNS-AL-55512sl in TNS (Tuji & Williams 2006).
7. *Stephanodiscus akanensis* Tuji et al., 2003, Bull. Natl. Sci. Mus., Ser. B. **29**: 2. f. 1–5.
8. *Praestephanos sukuzii* (Tuji & Kociolek) Tuji in Tuji et al. 2014, Plankt. Benthos Res. **9**: 134.
 ≡ *Stephanodiscus sukuzii* Tuji & Kociolek, 2000, Phycol. Res. **48**: 238. f. 17–26.

Thalassiosiraceae

9. *Puncticulata ozensis* H.Tanaka & Nagumo, 2005, Diatom **21**: 48. f. 2–7, 11–22.

Eunotiaceae

10. *Eunotia biareofera* f. *linearis* H.Kobayasi, 1975, Bull. Tokyo Gakugei Univ., ser. 4. **27**: 184. pl. 1, f. 13–15.
11. *Eunotia biseriatoidea* H.Kobayasi et al., 1981, Proc. Sixth Symp. Rec. Foss. Diat. p. 98–99. pl. 4, f. 27–34.
12. *Eunotia daisetsuensis* Hirano & Iwaki, 1970, Bull. Fuji Women's Coll. **2**: 68. pl. 11, f. 28–30.
 ≡ *Eunotia nipponica* var. *daisetsuensis* (Hirano & Iwaki) H.Kobayasi et al., 1981, Proc. Sixth Symp. Rec. Foss. Diat. p. 95.
13. *Eunotia duplicoraphis* H.Kobayasi et al., 1981, Proc. Sixth Symp. Rec. Foss. Diat. p. 101–102. pl. 7, f. 48–57.
14. *Eunotia hyperborea* var. *undulata* Hirano, 1976, Study Reps. Baika Jr. Coll. **25**: 77–78. pl. 5, f. 3.
15. *Eunotia kocheliensis* var. *alpina* Hirano, 1972, Cont. Biol. Lab. Kyoto Univ. **24**: 16. pl. 1, f. 23.
16. *Eunotia latitaenia* H.Kobayasi et al., 1981, Proc. Sixth Symp. Rec. Foss. Diat. p. 100–101. pl. 5, f. 41–42, pl. 6, f. 43–47.
17. *Eunotia multiplastidica* Mayama, 1992, Kor. J. Phycol. **7**: 46. f. 1–30.
18. *Eunotia nipponica* Skvortsov, 1938, J. Jpn. Bot. **14**: 209. f. 47.
19. *Eunotia osoresanensis* Negoro, 1944, Sci. Rep. Tokyo Bunr. Daig., sec. B. **6**: 320. f. 4.
20. *Eunotia osoresanensis* var. *cuneata* Tosh.Watan., 2004, Diatom **20**: 167. f. 1–7.
21. *Eunotia pseudoserrata* H.Kobayasi et al., 1981, Proc. Sixth Symp. Rec. Foss. Diat. p. 96–97. pl. 2, f. 11–15, pl. 3, f. 16.
22. *Eunotia pseudosoresanensis* Tosh.Watan., 2004,

Diatom **20**: 168. f. 14–19.

23. *Eunotia pseudovalida* Mayama, 1997, Nova Hedwigia Beih. **65**: 168. f. 17–31.
24. *Eunotia raphidioides* Tosh.Watan., 2004, Diatom **20**: 168. f. 8–13.
25. *Eunotia septentrionalis* var. *intermedia* Negoro, 1944, Sci. Rep. Tokyo Bunr. Daig. sec. B. **6**: 319.
26. *Eunotia sparsistriata* Mayama, 1993, Nova Hedwigia Beih. **106**: 144. f. 1–3, 6–19.
27. *Eunotia subalpina* Hirano et Iwaki, 1973, Bull. Fuji Women's Coll. ser. II **11**: 99. pl. 8, f. 4–5.
28. *Eunotia tenelloides* H.Kobayasi, Kaz.Ando & Nagumo, 1981, Proc. Sixth Symp. Rec. Foss. Diat. p. 97–98. pl. 3, f. 18–26.

Fragilariaceae

29. *Fragilaria asterionelloides* Tuji & D.M.Williams, 2017, Bull. Natl. Mus. Nat. Sci., ser. B **43**: 46–47. f. 1, 2, 5–18.
30. *Fragilaria parasitica* var. *asterionelloides* F.Meister, 1914, Arch. Hydrobiol. Planktonk. **9**: 227. pl. 8, f. 4.
31. *Opephora okadae* Skvortsov, 1936, Philipp. J. Sci. **61**: 15. pl. 12, f. 6.
 ≡ *Opephora martyi* var. *okadae* (Skvortsov) Okuno, 1952, Atlas Diat. Jpn. Diat. Dep. p. 39.

Tabellariaceae

32. *Tabellaria pseudoflocculosa* H.Kobayasi ex Mayama in Kobayasi et al. 2006, H. Kobayasi's Atlas. Jpn. Diat. p. 9. pl. 112.

Bacillariaceae

33. *Nitzschia heideni* (F.Meister) Hust. in Schmidt et al. 1924, Atlas Diat.-kunde. pl. 351, f. 9–13.
 ≡ *Nitzschia moissacensis* var. *heidenii* F.Meister, 1914, Arch. Hydrobiol. Planktonk. **9**: 229. pl. 8, f. 10.
34. *Nitzschia obtusa* f. *nipponica* Negoro, 1944, Sci. Rep. Tokyo Bunr. Daig., sec. B. **6**: 321. f. 5.
35. *Nitzschia okamurae* Skvortsov, 1937, Philipp. J. Sci. **62**: 213. pl. 3, f. 9.

Achnanthidiaceae

36. *Achnanthidium ovatum* Tosh.Watan. & Tuji in Watanabe et al. 2008, Diatom **24**: 34. f. 2–25.

Cocconeidaceae

37. *Cocconeis disculus* var. *nipponica* Skvortsov, 1936, Philipp. J. Sci. **61**: 262. pl. 4, f. 16.
 LT: Slide 30000142 in Lake Biwa Museum (LBM) (Ohtsuka & Tuji 2002).

Cymbellaceae

38. *Cymbella amphioxys* var. *delicatissima* Hirano, 1978, Study Reps. Baika Jr. Coll. **27**: 111. pl. 1, f. 15.
39. *Cymbella lata* var. *nipponica* Skvortsov, 1936, Philipp. J. Sci. **61**: 283. pl. 3, f. 6.
40. *Cymbella nipponica* Skvortsov, 1936, Philipp. J. Sci. **61**: 283. pl. 5, f. 20, 23.
41. *Cymbella perpusilla* var. *lanceolata* Hirano, 1972, Cont. Biol. Lab. Kyoto Univ. **24**: 29.

Gomphonemataceae

42. *Gomphoneis okunoi* Tuji, 2005, Bull. Natl. Sci. Mus.,

Ser. B, **31**: 92. *pl.* 12–14.

43. *Gomphonopsis tetrastigmatum* (Okuno) Ohtsuka, 2002, *Diatom* **18**: 32.
 ≡ *Gomphonema tetrastigmatum* Horikawa & Okuno in Okuno 1944, *Bot. Mag.* **58**: 10. *f.* 3e.
 LT: A photo dry plate numbered 1221 in TNS (Tuji 2004).
44. *Gomphonema curvipedatum* H.Kobayasi ex K.Osada in Kobayasi et al. 2006, H. Kobayasi's Atlas Jpn. Diat. p. 10. *pl.* 122.
45. *Gomphonema kinokawaensis* H.Kobayasi ex K.Osada in Kobayasi et al. 2006, H. Kobayasi's Atlas Jpn. Diat. p. 10–11. *pl.* 125.
46. *Gomphonema parvulum* var. *neosaprophilum* H.Kobayasi ex K.Osada in Kobayasi et al. 2006, H. Kobayasi's Atlas Jpn. Diat. p. 11. *pl.* 129–130.
47. *Gomphonema yakuensis* Tuji & Tosh.Watan. in Watanabe et al. 2008, *Diatom* **24**: 34. *f.* 113–121.
48. *Gomphonema yamatoensis* H.Kobayasi ex K.Osada in Kobayasi et al. 2006, H. Kobayasi's Atlas Jpn. Diat. p. 11–12. *pl.* 135.

Rhoicospheniaceae

49. *Gomphosphenia biwaensis* Ohtsuka & D.Nakai in Ohtsuka et al. 2018, *Diat. Res.* **33**: 108. *f.* 4–22, 27–30.
50. *Gomphosphenia ryukyuensis* Tuji & Ohtsuka in Tuji 2016, *Algae Aquae Dulcis Jpn. Exs.* **VII**: no. 121, *f.* 1–18.

Achnanthaceae

51. *Achnanthes hauckiana* var. *densistriata* Horikawa & Okuno in Okuno 1940, *J. Sci. Hiroshima Univ.*, ser. B. **2–4**: 52. *f.* 20.

Amphiplauraceae

52. *Frustulia rhomboides* var. *shiretokensis* Fukush. & Kishimoto, 1968, *J. Yokohama City Univ.*, ser. C-58. **180**: 10. *pl.* 4, *f.* M.

Diploneidaceae

53. *Diploneis aokiensis* M.Idei, 2013, *Diat. Res.* **28**: 2, *f.* 1–3, 10–17.
 ≡ *Diploneis aokiensis* M.Idei & H.Kobayasi, 1984, *Jpn. J. Phycol.* **32**: 97. (nom. nud.)
54. *Diploneis linearifera* M.Idei, 2013, *Diat. Res.* **28**: 8–10. *f.* 7–9, 42–58.
 ≡ *Diploneis linearifera* M.Idei & H.Kobayasi, 1984, *Jpn. J. Phycol.* **32**: 97. (nom. nud.)
55. *Diploneis yamanakaensis* M.Idei, 2013, *Diat. Res.* **28**: 5. *f.* 4–6, 28–41.
56. *Diploneis yatukaensis* Horikawa & Okuno in Okuno 1944, *Bot. Mag.* **58**: 8. *f.* 3a.
 LT: A photo dry plate numbered 1229 in TNS (Tuji 2004).

Anomoconeidaceae

57. *Placoneis gastrum* f. *nipponica* (Skvortsov) Ohtsuka & Fujita, 2001, *Nova Hedwigia* **73**: 107.
 ≡ *Navicula gastrum* f. *nipponica* Skvortsov, 1936, *Philipp. J. Sci.* **61**: 274. *pl.* 8, *f.* 8.
 LT: slide 30000144 in LBM (Ohtsuka & Tuji 2002, Tuji

2006).

58. *Placoneis clementis* var. *nipponica* (Skvortsov) Ohtsuka in Ohtsuka & Tuji 2002, *Phycol. Res.* **50**: 249.
 ≡ *Navicula similis* var. *nipponica* Skvortsov, 1936, *Philipp. J. Sci.* **61**: 276. *pl.* 3, *f.* 2.
 LT: Slide 30000141 in LBM (Ohtsuka & Tuji 2002, Tuji 2006).

Brachysiraceae

59. *Diadesmis confervacea* var. *nipponica* (Skvortsov) Tuji, 2003, *Bull. Natl. Sci. Mus.*, Ser. B. **29**: 66.
 ≡ *Navicula confervacea* f. *nipponica* Skvortsov, 1936, *Philipp. J. Sci.* **61**: 34. *pl.* 2, *f.* 7, *pl.* 4, *f.* 23.
60. *Luticola nipponica* (Skvortsov) Tuji, 2003, *Bull. Natl. Sci. Mus.*, Ser. B. **29**: 67.
 ≡ *Navicula mutica* var. *nipponica* Skvortsov, 1936, *Philipp. J. Sci.* **61**: 270. *pl.* 4, *f.* 10.

Naviculaceae

61. *Caloneis clevei* var. *minor* H.Kobayasi, 1975, *Bull. Tokyo Gakugei Univ.* ser. 4. **27**: 181. *pl.* 2, *f.* 23–26.
62. *Geissleria pusilla* Tuji, 2016, *Algae Aquae Dulcis Jpn. Exs.* **VII**: 7. no. 123, *f.* 1–6.
63. *Navicula biwaensis* (Skvortsov) Ohtsuka in Ohtsuka & Tuji 2002, *Phycol. Res.* **50**: 249.
 ≡ *Navicula rostellata* var. *biwensis* Skvortsov, 1936, *Philipp. J. Sci.* **61**: 272. *pl.* 3, *f.* 14.
 LT: Slide 30000136 in LBM (Ohtsuka & Tuji 2002, Tuji 2006).
64. *Navicula acidobiontica* Tosh.Watan., 2004. *Diatom* **20**: 168–170. *f.* 14–19.
65. *Navicula brehmii* Hust., 1927, *Arch. Hydrobiol.* **18**: 163. *pl.* 5, *f.* 6.
66. *Navicula clementis* var. *japonica* H.Kobayasi, 1968, *Jpn. J. Bot.* **20**: 105. *pl.* 4, *f.* 54–56.
67. *Navicula cremorne* var. *salinarum* Negoro & Gotoh, 1983, *Acta Phytot. Geobot.* **34**: 92. *f.* 1D–F.
68. *Navicula delicatilineolata* H.Kobayasi & Mayama in Mayama 2003, *Diatom* **19**: 19–21. *f.* 11–20.
69. *Navicula elevata* H.Kobayasi, 1968, *Jpn. J. Bot.* **20**: 106. *pl.* 4, *f.* 44–46.
70. *Navicula elginensis* var. *cuneata* H.Kobayasi, 1975, *Bull. Tokyo Gakugei Univ.*, ser. 4. **27**: 188–189. *pl.* 4, *f.* 54–55.
71. *Navicula exiloides* H.Kobayasi & Mayama in Mayama 2003, *Diatom* **19**: 17–19. *f.* 1–10.
72. *Navicula fushimiensis* Okuno, 1974, *Diatm. Elektroenmikr.* **9**: 21. *pl.* 875, 876.
73. *Navicula koidzumiana* (Skvortsov) Tuji, 2011, *Bull. Natl. Sci. Mus.*, Ser. B. **37**: 113.
 ≡ *Cymbella koidzumiana* Skvortsov, 1971, *Sci. Rep. Niigata Univ.*, ser. D. **8**: 20. *pl.* 3, *f.* 9.
74. *Navicula longistriata* Horikawa & Okuno in Okuno 1940, *J. Sci. Hiroshima Univ.* ser. B. **2–4** **5**: 60. *f.* 33.
75. *Navicula pseudobrasiliiana* Tuji, 2003, *Bull. Natl. Sci. Mus.*, Ser. B. **29**: 69. *pl.* 6, *f.* 6–12.
76. *Navicula pseudocrucicula* H.Kobayasi, 1975, *Bull. Tokyo Gakugei Univ.*, ser. 4. **27**: 189–190. *pl.* 4, *f.*

- 59–62.
77. *Navicula schonfeldii* var. *capitata* H.Kobayasi in Kobayasi & Ando 1977, Bull. Tokyo Gakugei Univ., ser. 4. **29**: 241. *pl. 5, f. 40–43*.
78. *Navicula subdicephala* Hust., 1927, Arch. Hydrobiol. **18**: 64. *pl. 5, f. 9*.
79. *Navicula subhastata* Ohtsuka in Ohtsuka & Tuji 2002, Phycol. Res. **50**: 246.
- ≡ *Navicula hasta* var. *gracilis* Skvortsov, 1936, Philipp. J. Sci. **61**: 275. *pl. 7, f. 9*.
80. *Navicula subtropicatrix* Tuji, 2003, Bull. Natl. Sci. Mus., Ser. B. **29**: 70. *pl. 5, f. 8–15*.
81. *Navicula tanakae* Fukush. et al., 2002, Diatom **18**: 16. *f. 1–110*.
82. *Navicula tokyoensis* H.Kobayasi, 1968, Jpn. J. Bot. **20**: 109. *pl. 5, f. 73, 74, pl. 8, f. 116*.
83. *Navicula undulata* Skvortsov, 1936, Philipp. J. Sci. **61**: 275. *pl. 4, f. 2, pl. 7, f. 6*.
- ≡ *Navicula hasta* var. *undulata* (Skvortsov) H.Kobayasi in Mayama et al. 2002, Diatom **18**: 89.
84. *Navicula watanabei* Fukush., et al., 2014, Jpn. J. Water Treat. Biol. **50**: 33. *f. 55–57*.
- Neidiaceae**
85. *Neidium minus* Tosh.Watan. et al. ex Tuji 2016, Algae Aquae Dulcis Jpn. Exs. **VII**: 9. *no. 124, f. 1–6*.
86. *Neidium nipponicum* f. *rostratum* H.Kobayasi in Kobayasi & Ando 1975, Bull. Tokyo Gakugei Univ., ser. 4. **27**: 191–192. *pl. 3, f. 34, 36*.
87. *Neidium pseudogracilis* H.Kobayasi in Kobayasi & Ando 1977, Bull. Tokyo Gakugei Univ., ser. 4. **29**: 243. *pl. 1, f. 3–4*.
88. *Neidium skvortsovii* H.Kobayasi in Kobayasi & Ando 1977, Bull. Tokyo Gakugei Univ., ser. 4. **29**: 243–244. *pl. 1, f. 5–6*.
89. *Neidium tokyoense* H.Kobayasi in Kobayasi & Ando 1977, Bull. Tokyo Gakugei Univ., ser. 4. **29**: 244. *pl. 1, f. 1–2*.
- Pinnulariaceae**
90. *Pinnularia acidobionta* Tuji & Tosh.Watan., 2003, Diatom **19**: 47–49. *f. 1–12*.
91. *Pinnularia caudata* var. *maior* Hirano, 1976, Study Rep. Baika Jr. Coll. **25**: 84. *pl. 7, f. 2–3*.
92. *Pinnularia osoresanensis* (Negoro) Fukush. et al., 2002, Diatom **18**: 8.
- ≡ *Pinnularia acoricola* var. *osoresanensis* Negoro, 1944, Sci. Rep. Tokyo Bunr. Daig., sec. B. **6**: 317. *f. 3c*.
93. *Pinnularia acrosphaeria* var. *hyalina* H.Kobayasi in Kobayasi & Ando 1977, Bull. Tokyo Gakugei Univ., ser. 4. **29**: 244–245. *pl. 4, f. 29–30*.
94. *Pinnularia bicepsoides* H.Kobayasi, 1975, Bull. Tokyo Gakugei Univ., ser. 4. **27**: 193. *pl. 4, f. 47–50*.
95. *Pinnularia negoroi* Fukush. et al., 2002, Diatom **18**: 2.
- ≡ *Pinnularia braunii* var. *undulata* Negoro, 1944, Sci. Rep. Tokyo Bunr. Daig., sec. B. **6**: 310. *f. 2*.
96. *Pinnularia gibba* var. *dissimilis* H.Kobayasi, 1975, Bull. Tokyo Gakugei Univ., ser. 4. **27**: 194. *pl. 5, f. 71–73*.
97. *Pinnularia gracivalvis* Fukush. et al. in Fukush. et al. 2002, Diatom **18**: 5. *f. 16–33*.
98. *Pinnularia hartleyana* var. *notata* H.Kobayasi, 1968, Jpn. J. Bot. **20**: 112. *pl. 7, f. 98–100*.
99. *Pinnularia japonica* H.Kobayasi in Kobayasi & Ando, 1975, Bull. Tokyo Gakugei Univ., ser. 4. **27**: 194–195. *pl. 5, f. 69–70*.
100. *Pinnularia kirisimaensis* Tuji & Tosh.Watan., 2003, Diatom **19**: 50–51. *f. 13–19*.
101. *Pinnularia lenticuloides* H.Kobayasi in Kobayasi & Ando 1975, Bull. Tokyo Gakugei Univ., ser. 4. **27**: 195. *pl. 5, f. 74–77*.
102. *Pinnularia nipponica* Skvortsov, 1936, Philipp. J. Sci. **61**: 45. *pl. 7, f. 12*.
103. *Pinnularia nodosa* var. *japonica* H.Kobayasi in Kobayasi & Ando 1977, Bull. Tokyo Gakugei Univ., ser. 4. **29**: 248. *pl. 5, f. 37–39*.
104. *Pinnularia paralange-bertalotii* Fukush. et al. in Fukush. et al. 2001, Diatom **17**: 38. *f. 1–59*.
105. *Pinnularia pseudotabellaria* H.Kobayasi in Kobayasi & Ando 1977, Bull. Tokyo Gakugei Univ., ser. 4. **29**: 248–249. *pl. 8, f. 60–61*.
106. *Pinnularia senjoensis* H.Kobayasi in Kobayasi & Ando 1977, Bull. Tokyo Gakugei Univ., ser. 4. **29**: 249. *pl. 5, f. 34–36*.
107. *Pinnularia ueno* Skvortsov, 1936, Philipp. J. Sci. **61**: 44. *pl. 7, f. 1*.
108. *Pinnularia valdetolerans* Mayama & H.Kobayasi in Idei & Mayama 2001, Lange-Bert.-Festschr. p. 270. *f. 30–53*.
- Sellaphoraceae**
109. *Sellaphora lambda* var. *nipponica* (Skvortsov) Ohtsuka in Ohtsuka & Tuji 2002, Phycol. Res. **50**: 247.
- ≡ *Navicula lambda* var. *nipponica* Skvortsov, 1936, Philipp. J. Sci. **61**: 271. *pl. 6, f. 15*.
LT: Slide 30000130 in LBM (Ohtsuka & Tuji 2002, Tuji 2006).
110. *Stauroneis agrestis* var. *inflata* H.Kobayasi & Kaz. Ando, 1978, Jpn. J. Phycol. **26**: 13. *pl. 1, f. 1–3*.
111. *Stauroneis anceps* var. *longirostris* H. Kobayasi in Kobayasi & Ando 1977, Bull. Tokyo Gakugei Univ., ser. 4. **29**: 250–251. *pl. 3, f. 14, 15*.
- ≡ *Stauroneis anceps* f. *longirostris* (H.Kobayasi) H.Kobayasi & Kaz.Ando, 1978, Bull. Tokyo Gakugei Univ., ser. 4. **30**: 283.
112. *Stauroneis incerta* var. *constricta* Hirano, 1972, Cont. Biol. Lab. Kyoto Univ. **24**: 22. *pl. 11, f. 14*.
113. *Stauroneis kriegeri* f. *lanceolata* H.Kobayasi & Kaz. Ando, 1978, Jpn. J. Phycol. **26**: 14. *pl. 1, f. 4–6*.
114. *Stauroneis legumen* var. *elliptica* H.Kobayasi & Kaz. Ando, 1978, Jpn. J. Phycol. **26**: 14. *pl. 1, f. 11–13*.
115. *Stauroneis miyakoensis* Tuji, 2016, Algae Aquae Dulcis Jpn. Exs. **VII**: 5. *no. 122, f. 1–8*. 2016.
116. *Stauroneis nobilis* f. *capitata* H.Kobayasi in Kobayasi

& Kaz. Ando 1977, Bull. Tokyo Gakugei Univ., ser. 4. **29**: 251. *pl. 2, f. 9, 10*.

117. *Stauroneis nobilis* f. *densestriata* H. Kobayasi & Kaz. Ando, 1978, Jpn. J. Phycol. **26**: 45–15. *pl. 1, f. 14–15*.
 118. *Stauroneis parallelistriata* H. Kobayasi in Kobayasi & Ando 1977, Bull. Tokyo Gakugei Univ., ser. 4. **29**: 251–252. *pl. 2, f. 7, 8*.
 119. *Stauroneis pseudotenera* H. Kobayasi & Ando, 1978, Jpn. J. Phycol. **26**: 15. *pl. 2, f. 26–28*.

Catenulaceae

120. *Amphora hiromuii* Nagumo, 2003, Bibl. Diat. **49**: 20–21. *pl. 33–37*.
 121. *Amphora liriopae* Nagumo, 2003, Bibl. Diat. **49**: 28–29. *pl. 61–65*.

Surirellaceae

122. *Surirella linearis* var. *heteropolis* Hirano et Iwaki, 1973, Bull. Fuji Women's Coll., ser. II. **11**: 101. *pl. 13, f. 2–3*.

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References

- Brummitt R, Powell C (1992) Authors of Plant Names. A list of authors of scientific names of plants, with recommended standard forms of their names, including abbreviations. Royal Botanic Gardens, Kew, 732pp.
- Fukushima H, Yoshitake S, Ko-Bayashi T (2002) Three new diatoms *Pinnularia* from acid waters in Japan. Diatom 18: 1–12.
- GBIF (2017) GBIF | Global Biodiversity Information Facility. Available at: <https://www.gbif.org> (accessed on Jan. 2017)
- Google (2017) Google. Available at: <https://www.google.com> (accessed on 2015–2017)
- Guiry MD, Guiry GM (2017) AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. Available at: <http://www.algaebase.org> (accessed on 2015–2017)
- Hu H, Wei Y (2006) The freshwater algae of China : systematics, taxonomy and ecology. Ke xue chu ban she, Beijing, 1023 pp.
- Hustedt F (1930) Bacillariophyta (Diatomaceae), vol 10. Gustav Fischer, Jena, 466 pp.
- Hustedt F (1937) Systematische und ökologische Untersuchungen über die Diatomeen Flora von Java, Bali und Sumatra nach dem Material der Deutschen Limnologischen Suda-Expedition. Arch Hydrob Suppl 15: 133–177, pls. 9–12.
- Index Nominum Algarum Bibliographia Phycologica Universalis (2017) Index Nominum Algarum, University Herbarium, University of California, Berkeley. Compiled by Paul Silva. Available at: <http://ucjeps.berkeley.edu/CPD/> (accessed on 2015–2017)
- Jiaying L, Qi Y (2014) Flora Algarum Sinicarum Aquae Dulcis. tomus XIX Bacillariophyta Naviculaceae (II). Science Press, Beijing, 147 pp.
- Jiaying L, Yuzao Q (2010) Flora Algarum Sinicarum Aquae Dulcis. tomus XIV Bacillariophyta Naviculaceae (I). Science Press, Beijing, 177 pp.
- Joh G (2010) Chrysophyta: Bacillariophyceae: Centrales: Freshwater Diatoms I, vol 3, Number 1b, National Institute of Biological Resources, Ministry of Environment, Incheon, 161 pp.
- Joh G (2011) Chrysophyta: Bacillariophyceae: Pennales: Raphidinae: Eunotiaceae: Freshwater Diatoms III, vol 3, Number 3, National Institute of Biological Resources, Ministry of Environment, Incheon, 92 pp.
- Joh G (2012a) Chrysophyta: Bacillariophyceae: Pennales: Raphidinae: Achnanthaceae: Freshwater Diatoms V, vol 3, Number 7, National Institute of Biological Resources, Ministry of Environment, Incheon, 134 pp.
- Joh G (2012b) Chrysophyta: Bacillariophyceae: Pennales: Raphidinae: Naviculaceae: *Biremis*, *Caloneis* I, *Pinnularia* I: Freshwater Diatoms VII, vol 3, Number 9, National Institute of Biological Resources, Ministry of Environment, Incheon, 120 pp.
- Joh G, Lee JH, Yoon S-K (2010) Chrysophyta: Bacillariophyceae: Pennales: Araphidinae: Diatomaceae: Freshwater Diatoms II, vol 3, Number 2, National Institute of Biological Resources, Ministry of Environment, Incheon, 152 pp.
- Kato M, Ebihara A (2011) Endemic plants of Japan. A book series from the National Museum of Nature and Science No. 11, Tokai University press, Kanagawa, 504 pp.
- Kobayasi H (1960) Diatoms in Nagatoro Park. Bull Chichibu Museum Natural History: 67–76.
- Kociolek JP, Balasubramanian K, Blanco S, Coste M, Ector L, Liu Y, Kulikovskiy M, Lundholm N, Ludwig T, Potapova M, Rimet F, Sabbe K, Sala S, Sar E, Taylor J, Van De Vijver B, Wetzel CE, Williams DM, Witkowski A, Witkowski J (2017) DiatomBase. Available at: <http://www.diatombase.org> (accessed on Jan. 2017)
- Krammer K, Lange-Bertalot H (1986) Bacillariophyceae. 1. Teil: Naviculaceae, vol 2. Gustav Fischer Verlag, Jena, 876 pp.
- Lee JH (2011) Chrysophyta: Bacillariophyceae: Pennales: Raphidinae: Naviculaceae: *Cymbella*, *Cymbopleura*, *Encyonema*, *Encyonopsis*, *Reimeria*, *Gomphonema*: Freshwater Diatoms IV, vol 3, Number 4 National Institute of Biological Resources, Ministry of Environment, Incheon, 70 pp.
- Lee JH (2012a) Chrysophyta: Bacillariophyceae: Pennales: Raphidinae: Naviculaceae: 20 genera including *Navicula*: Freshwater Diatoms VIII, vol 3, Number 10 National Institute of Biological Resources, Ministry of Environment, Incheon, 74 pp.
- Lee JH (2012b) Chrysophyta: Bacillariophyceae: Pennales: Raphidinae: Naviculaceae: *Navicula*: Freshwater Diatoms VI, vol 3, Number 8 National Institute of Biological Resources, Ministry of Environment, Incheon, 56 pp.
- Medvedeva LA, Nikulina TV (2014) Catalogue of freshwater al-

- gae of the southern part of the Russian far East. Russian academy of sciences, Far Eastern branch, Institute of biology and soil sciences, Vladivostok, 271 pp.
- National Museum of Nature and Science (2018) Biological properties of biodiversity hotspots in Japan. Available at: [https://www.kahaku.go.jp/research/activities/project/hotspot_japan/endemic_list/](https://www.kahaku.go.jp/research/activities/project/hotspot_japan/ endemic_list/) (accessed on 1 January 2019).
- Negoro K (1944) Untersuchungen über die Vegetation der mineralogenazidotrophen Gewässer Japans. Sci Rep the Tokyo Bunrika Daigaku Section B 6: 231–374, Taf. 1–12, fig. 1–8.
- Ohtsuka T, Tuji A (2002) Lectotypification of some pennate diatoms described by Skvortzov in 1936 from Lake Biwa. Phycol Res 50: 243–249.
- Qi Y (1995) Flora algarum sinicarum aquae dulcis tomus IV. Bacillariophyta centricae. Science Press, Beijing, 104 pp.
- Qi Y, Li J (2004) Flora Algarum Sinicarum Aquae Dulcis. tomus X, Bacillariophyta, Pennatae. Science Press, Beijing, 161 pp.
- Shi Z (2004) Flora Algarum Sinicarum Aquae Dulcis. tomus XII, Bacillariophyta, Gomphonemaceae. Science Press, Beijing, 147 pp.
- Tuji A (1995) Attached diatom assemblages in the ecotone of Lake Biwa. (in Japanese). Diatom 11: 17–24.
- Tuji A (2002) Observations on *Aulacoseira nipponica* from Lake Biwa, Japan, and *Aulacoseira solida* from North America (Bacillariophyceae). Phycol Res 50 313–316.
- Tuji A (2004) The Diatom Type Materials of Haruo Okuno 1. Five diatom species described by Okuno (1943, 1944) from the Yatuka deposit. Bull Nat Sci Mus, Tokyo, Ser B 30: 79–88.
- Tuji A (2006) Re-designation of Seventeen Lectotypes for Diatoms (Bacillariophyceae), Originally Designated by Ohtsuka & Tuji (2002), Tuji (2002) and Tuji (2004). Bull Nat Sci Mus, Tokyo, Ser B 32: 171–173.
- Tuji A (2011) Appearance of *Didymosphenia geminata* (Lyngb.) Mart.Schmidt in Japan. Diatom 27: 65–68.
- Tuji A, Kociolek J-P (2000) Morphology and taxonomy of *Stephanodiscus suzukii* sp. nov. and *Stephanodiscus pseudosuzukii* sp. nov. (Bacillariophyceae) from Lake Biwa, Japan, and *S. carconensis* from North America. Phycol Res 48: 231–239.
- Tuji A, Williams DM (2006) The Identity of *Cyclotella glomerata* Bachmann and *Discostella nipponica* (Skvortzov) Tuji et Williams comb. et stat. nov. (Bacillariophyceae) from Lake Kizaki, Japan. Bull Nat Sci Mus, Tokyo, Ser B 32: 9–14.
- Vanormelingen P, Verleyen E, Vyverman W (2007) The diversity and distribution of diatoms: from cosmopolitanism to narrow endemism. Biodivers Conserv 17: 393–405.
- Watanabe T, Ohtsuka T, Tuji A, Houki A (2005) Picture book and ecology of the freshwater diatoms. Uchida-rokakuho, Tokyo, 666 pp.
- Wu J-T, Babu B, Chou C-L, Saraswathi SJ (2011a) Freshwater Diatom Flora of Taiwan, vol 2. Biodiversity Research Center, Academia Sinica, National Science Council, Taiwan, Taiwan, 356 pp.
- Wu J-T, Babu B, Chou C-L, Saraswathi SJ (2011b) Freshwater Diatom Flora of Taiwan, vol 1. Biodiversity Research Center, Academia Sinica, National Science Council, Taiwan, Taiwan, 392 pp.
- Zhixin S (2013) Flora Algarum Sinicarum Aquae Dulcis. tomus XVI Bacillariophyta Cymbellaceae. Science Press, Beijing, 174 pp.