

**GENERA *THALASSIOSIRA* AND *SHIONODISCUS* (BACILLARIOPHYTA)
FROM THE SEA OF JAPAN**

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Based on original research and literature review, an annotated list of planktonic diatom species of the genera *Thalassiosira* and *Shionodiscus* from the Sea of Japan has been compiled for the first time. The list includes data on ecology and distribution of 36 *Thalassiosira* taxa and 4 *Shionodiscus* taxa. This kind of information is provided for the first time for the genus *Shionodiscus* from the Sea of Japan. The morphology of four species rare in the northwestern Sea of Japan – *Thalassiosira aestivalis*, *T. hyalina*, *T. pseudonana* and *T. tenera* – is described using electron microscopy.

Keywords: diatoms, *Thalassiosira*, *Shionodiscus*, annotated list, rare species, Sea of Japan.

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References

- Aké-Castillo J.A., Hernández-Becerril D.U., Meave del Castillo M.E. 1999. Species of the genus *Thalassiosira* (Bacillariophyceae) from the Gulf of Tehuantepec. – Bot. Mar. 42: 487–503.
- Alverson A.J., Kang S.H., Theriot E.C. 2006. Cell wall morphology and systematic importance of *Thalassiosira ritscheri* (Hustedt) Hasle, with a description of *Shionodiscus* gen. nov. – Diatom Res. 21: 251–262.
<https://doi.org/10.1080/0269249X.2006.9705667>

- Avaria S.P. 1965. Diatomeas y silicoflagelados de la Bahía de Valparaíso. – Rev. Biol. Mar. Valparaíso. 12: 61–119.
- Beklemishev K.V., Parin N.V., Semina I.V. 1977. Pelagial' [Pelagial]. – In: Okeanologia. Biologiya okeana. Biologicheskaya struktura okeana. T. 1. Moscow. P. 219–262 (In Russ.).
- Cheng Z.D., Gao Y.H., Liu S.C. 1993. Nano-phytoplanktonic diatoms in Fujian coast. Beijing: ~~Ocean Press~~. 91 p.
- Cleve P.T. 1873. On diatoms from the Arctic Sea. – Bih. Svensk. Vetensk Akad. Handl. 1(13): 1–28.
- Ferrario M.E., Almandoz G.O., Cefarelli A.O., Beszteri B., Akselman R., Fabro E., Cembella A. 2018. *Shionodiscus gaarderae* sp. nov. (Thalassiosirales, Thalassiosiraceae), a bloom-producing diatom from the southwestern Atlantic Ocean, and emendation of *Shionodiscus bioculatus* var. *bioculatus*. – Diatom Res. 33: 25–37. <https://doi.org/10.1080/0269249X.2017.1423112>
- Fryxell G.A., Hasle G.R. 1972. *Thalassiosira eccentrica* (Ehrenb.) Cleve, *T. symmetrica* sp. nov., and some related centric diatoms. – J. Phycol. 8: 297–317.
- Fryxell G.A. 1975. Three new species of *Thalassiosira*, with observations on the occluded process, a newly observed structure of diatom valves. – Nov-~~a~~ Hedwig-~~ia~~ Beih. 53: 57–75.
- Fryxell G.A., Hasle G.R. 1977. The genus *Thalassiosira*: some species with a modified ring of central strutted processes. – Nov-~~a~~ Hedwig-~~ia~~ Beih. 54: 67–98.
- Fryxell G.A., Hasle G.R. 1979. The genus *Thalassiosira*: species with internal extensions of the strutted processes. — J. Phycol. 18(4): 378–393.
- Fryxell G.A., Hasle G.R. 2004. Taxonomy of harmful diatoms. – In: Manual on Harmful Marine Microalgae. UNESCO. P. 465–510.
- Gogorev R.M., Chudaev D.A., Stepanova V.A., Kulikovskiy M.S. 2018. ~~Russkiy i angliyskiy terminologicheskii slovar' po morfologii diatomovykh vodorosley~~ [Russian and English terminological glossary on morphology of diatoms]. – Novosti Sist. Nizsh. Rast. 52(2): 265–309 (In Russ.). <https://doi.org/10.31111/nsnr/2018.52.2.265>
- Gran H.H., Angst E.C. 1931. Plankton diatoms of Puget sound. – Pub. Puget Sound Biol. Sta. 7: 417–519.
- Gran H.H. 1897. Bacillariaceae von Kleinen Karajaakfjord. – Stuttgart. Bibl. Bot. 42: 13–24.

- Hallegraeff G.M. 1984. Species of the diatom genus *Thalassiosira* in Australian waters. – Bot. Mar. 27: 495–513.
- Harris A.S.D., Medlin L.K., Lewis J., Jones K.J. 1995. *Thalassiosira* species (Bacillariophyceae) from a Scottish sea-loch. – Eur. J. Phycol. 30: 117–131. <https://doi.org/10.1080/09670269500650881>
- Hasle G.R. 1972. *Thalassiosira subtilis* (Bacillariophyceae) and two allied species. – Norweg. J. Bot. 19: 111–137.
- Hasle G.R. 1973a. Thalassiosiraceae, a new diatom family. – Norweg. J. Bot. 20: 67–69.
- Hasle G.R. 1973b. Some marine plankton genera of the diatom family Thalassiosiraceae. – Nov-a Hedwig-ia Beih. 45: 1–49.
- Hasle G.R. 1976. The biogeography of some marine planktonic diatoms. – Deep-Sea Res. 23: 319–338.
- Hasle G.R. 1978. Some *Thalassiosira* species with one central process (Bacillariophyceae). – Norweg. J. Bot. 25: 77–110.
- Hasle G.R., Heimdal B.R. 1968. Morphology and distribution of the marine centric diatom *Thalassiosira antarctica* Comber. – J. R. Microsc. Soc. 88(3): 357–369.
- Hasle G.R., Heimdal B.R. 1970. Some species of the centric diatom genus *Thalassiosira* studied in the light and electron microscopes. – Nov-a Hedwig-ia Beih. 31: 559–581.
- Hasle G.R., Fryxell G.A. 1977. The genus *Thalassiosira*: Some species with a linear areola array. – Nov-a Hedwig-ia Beih. 54: 15–66.
- Hasle G.R., Syvertsen E.E. 1997. Marine diatoms. – In: Identifying marine phytoplankton. San Diego. P. 5–385.
- Hendey N.I. 1964. An introductory account of the smaller algae of British coastal waters. Part V. Bacillariophyceae (Diatoms). – Ministry of Agriculture, fisheries and Food Fisheries Investig. 4: 1–317.
- Hernández-Becerril D.U., Tapia Peña M.I. 1995. Planktonic diatoms from the Gulf of California and coasts off Baja California: species of the genus *Thalassiosira*. – Bot. Mar. 38: 543–555. <https://doi.org/10.1515/botm.1995.38.1-6.543>
- Herzig W., Fryxell G. 1986. The diatom genus *Thalassiosira* Cleve in Gulf Stream warm core rings: taxonomy with *T. intrannula* and *T. lineoides*, spp. nov. – Bot. Mar. 29: 11–25.
- Hoppenrath M., Beszteri B., Drebes G., Halliger H., Van Beusekom J.E.E., Janisch S., Wiltshire K.H. 2007. *Thalassiosira* species (Bacillariophyceae, Thalassiosirales) in the North Sea at Helgoland (German Bight) and Sylt (North Frisian Wadden Sea) – a first

- approach to assessing diversity. – Eur. J. Phycol. 42(3): 271–288.
<https://doi.org/10.1080/09670260701352288>
- Ianora A., Miralto A., Poulet S.A., Carotenuto Y., Buttino I., Romano G., Casotti R., Pohnert G., Wichard T., Colucci-D'amato L., Terrazzano G., Smetacek V. 2004. Aldehyde suppression of copepod recruitment in blooms of a ubiquitous planktonic diatom. – Nature. 429: 403–407.
- Kiselev I.A. 1969. Plankton morey i kontinental'nykh vodoyemov [Plankton of seas and continental reservoirs]. T. 1. Leningrad. 658 p. (In Russ.).
- Konovalova G.V. 1979. Vidovoy sostav i chislennost' fitoplanktona zaliva Pos'eta (Yaponskoe more) [Species composition and abundance of phytoplankton in Posyet Bay (Sea of Japan)]. – In: Issledovaniya pelagicheskikh i donniykh organizmov dal'nevostochnykh morey. Vladivostok. DVNC AN SSSR. P. 6–16 (In Russ.).
- Konovalova G.V. 1984. Vidovoy sostav fitoplanktona zaliva Vostok [Species composition of the Vostok Bay phytoplankton]. – In: Gidrobiologicheskiye issledovaniya zalivov i bukht Primorskogo kraya. Vladivostok. P. 93–98 (In Russ.).
- Konovalova G.V. 1987. Morphology and ecology of the plankton diatome algae *Thalassiosira nordenskioldii* Cl. dominant in the Japan sea. – Trudy ZIN AN SSSR. 172: 39–45 (In Russ.).
- Konovalova G.V., Orlova T.Yu., Pautova L.A. 1989. Atlas fitoplanktona Yaponskogo moryay [Atlas of phytoplankton in the Sea of Japan]. Leningrad. 160 p. (In Russ.).
- Konovalova G.V., Orlova T.Yu. 1991. Spisok vidov fitoplanktona bukhty Melkovodnaya (Yaponskoe more) [List of phytoplankton species in Melkovodnaya Bay (Sea of Japan)]. – In: Ekosistemniye issledovaniya pribrezhnykh soobshchestv zaliva Petra Velikogo. Vladivostok. P. 146–152 (In Russ.).
- Kulikovskiy M.S., Kuznetsova I.V. 2014. Biogeography of Bacillariophyta. Main concepts and approaches. Algologia. 24(2): 125–146 (In Russ.).
<https://doi.org/10.15407/alg24.02.125>
- Lee J.H., Park J.S. 2008. A study on the fine structure of the marine diatoms of Korean coastal waters – genus *Thalassiosira* 3. – Algae. 23(3): 187–199.
<https://doi.org/10.4490/ALGAE.2008.23.3.187>
- Li Y., Zhao Q., Lü S. 2013. The genus *Thalassiosira* off the Guangdong coast, South China Sea. – Bot. Mar. 56(1): 83–110. <https://doi.org/10.1515/bot-2011-0045>

- Mahood A.D., Fryxell G.A., McMillan M. 1986. The diatom genus *Thalassiosira*: species from the San Francisco Bay system. – Proceedings of the California Academy of Sciences. 44: 127–156.
- Makarova I.V. 1988. Diatomov*iy*e vodorosli morey SSSR: rod *Thalassiosira* Cl. [Diatoms of the seas of the USSR: genus *Thalassiosira* Cl.]. Leningrad. 117 p. (In Russ.).
- Muylaert K., Sabbe K. 1996. The diatom genus *Thalassiosira* (Bacillariophyta) in the estuaries of the Schelde (Belgium/The Netherlands) and the Elbe (Germany). – Bot. Mar. 39: 103–115. <https://doi.org/10.1515/botm.1996.39.1-6.103>
- Orlova T.Yu. 1990. Diatomovye vodorosli planktona neriticheskikh vod Yuzhnogo Primorya [Diatoms of plankton in the neritic waters of southern Primorye]: Diss. ...Kand. Sci. Vladivostok. 26 p. (In Russ.).
- Orlova T.Yu., Stonik I.V., Shevchenko O.G. 2009. Flora of planktonic microalgae of Amursky Bay, Sea of Japan. – Rus. J. Mar. Bio. 35(1): 60–78. <https://doi.org/10.1134/S106307400901009X>
- Park J.S., Jung S.W., Lee J.H. 2009. A study on the fine structure of the marine diatoms of Korean coastal waters – genus *Thalassiosira* 4. – Algae. 24: 67–77. <https://doi.org/10.4490/algae.2009.24.2.067>
- Park J.S., Jung S.W., Lee S.D., Yun S.M., Lee J.H. 2016. Species diversity of the genus *Thalassiosira* (Thalassiosirales, Bacillariophyta) in South Korea and its biogeographical distribution in the world. – J. Phycol. 55(4): 403–423. <https://doi.org/10.2216/15-66.1>
- Park J.S. 2019. The taxonomic status of *Thalassiosira concaviuscula* I.V. Makarova and *Thalassiosira ordinaria* I.V. Makarova (Thalassiosiraceae, Bacillariophyta). – Notulae algarum. 90.
- Ponomareva L.A. 1954. Zimniy zooplankton severnoy chasti Yaponskogo*i* mor*yay* zimoy [Winter zooplankton of the northern part of the sea of Japan in winter]. – Trudy IO AN SSSR. 9: 159–172 (In Russ.).
- Proshkina-Lavrenko A.I. 1961. Novye diatomovye vodorosli*iy* iz Chernogo i Azovskogo morey [New diatoms from the Black and Azov seas]. – Botan. mater. Otd. spor. Rasteniy BIN AN SSSR. 14: 33–39 (In Russ.).
- Quillfeldt von C.H. 2001. Identification of some easily confused common diatom species in Arctic spring blooms. – Bot. Mar. 44: 375–389. <https://doi.org/10.1515/BOT.2001.048>
- Rivera P.R. 1981. Beiträge zur Taxonomie und Verbreitung der Gattung *Thalassiosira* Cleve (Bacillariophyceae) in den Küstengewässern Chiles. – Bibl. Phycol. 56: 1–220.

- Round F.E., Crawford R.M., Mann D.G. 1990. The diatoms:— Biology and morphology of the genera. Cambridge. 747 p.
- Sar E.A., Sunesen J., Lavigne A.S. 2002. The diatom genus *Thalassiosira*: species from the northern San Matias Gulf (Rio Negro, Argentina). – *Nov-a Hedwig-ia* Beih. 74: 373–386. <https://doi.org/10.1127/0029-5035/2002/0074-0373>
- Semina G.I. 1981. Kachestvennyy sostav fitoplanktona zapadnoy chasti Beringova morya I prilozheniye k chasti Tikhogo okeana. Chast' II. Diatomovye vododrosli [Qualitative composition of phytoplankton in the western part of the Bering sea and the adjacent part of the Pacific ocean. Part II. Diatoms]. – In: *Ekologiya morskogo fitoplanktona*. Institut okeanologii AN SSSR. Moscow. P. 6–32 (In Russ.).
- Shevchenko O.G., Orlova Y.Yu., Stonik I.V. 2003. Species of the genus *Thalassiosira* (Bacillariophyta) new for the Far Eastern seas of Russia. – *Botanicheskii zhurnal*. 88(5): 152–156 (In Russ.).
- Shevchenko O.G., Orlova T.Yu. Hernández-Becerril D.U. 2006. The genus *Chaetoceros* (Bacillariophyta) from Peter the Great Bay, Sea of Japan. – *Bot. Mar.* 49: 236–258. <https://doi.org/10.1515/BOT.2006.028>
- Smayda T.J. 1966. A quantitative analysis of the phytoplankton of the Gulf of Panama. – III *Bull. Inter-Am. Trop. Tuna Commn.* 11: 355–612.
- Somers D. 1972. Scanning electron microscope studies on some species of the centric diatom genera *Thalassiosira* and *Coscinodiscus*. – *Biol. Jb. Dodonaea*. 40: 304–315.
- Stonik I.V., Orlova T.Yu., Shevchenko O.G. 2009. Summer phytoplankton in the area of the Razdolnaya river mouth and adjacent waters of Amursky Bay (Sea of Japan). – In: *Ecological studies and the state of the ecosystem of Amursky Bay and the estuarine zone of the Razdolnaya River (Sea of Japan)*. Vladivostok. 2: 247–262.
- Strickland J.D.H., Eppley R.W., de Mendiola B.R. 1968. Phytoplankton populations, nutrients and photosynthesis in Peruvian coastal waters. – *Bol. Ins. Mar. Perú-Callao*. 2: 4–45.
- Takano H. 1980. New and rare diatoms from Japanese marine waters V. *Thalassiosira tealata* sp. nov. – *Bull. Tokai Reg. fish. Res. Lab.* 103:55–63.
- Takano H. 1981. New and rare diatoms from Japanese marine waters VII. Ten species from Neritic water. – *Bull. Tokai Reg. Fish. Res. Lab.* 105: 45–57.
- Takano H. 1990. Diatoms. – In: *Red tide organisms in Japan – an illustrated taxonomic guide*. Japan. 407 p.

Wilks J.V., Armand L.K. 2017. Diversity and taxonomic identification of *Shionodiscus* spp. in the Australian sector of the Subantarctic Zone. – *Diatom Res.* 32: 295–307. <https://doi.org/10.1080/0269249X.2017.1365015>

Zernova V.V. 1980. Nekotorye zakonomernosti raspredeleniya fitoplanktona v Yaponskom more i prilegayushchikh rayonakh Tikhogo okeana [Some patterns of phytoplankton distribution in the Sea of Japan and adjacent areas of the Pacific Ocean]. – In: *Issledovaniya planktona Yaponskogo morya*. Moscow. P. 15–29 (In Russ.).