**Table S1 Sampling station of *Chaetoceros* strains**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Species** | **Strains** | **Expedition dates** | **Location** | **Longitude** | **Latitude** |
| *C. muelleri* | CNS00047 | - | - | - | - |
| *C. costatus* | CNS00386 | July 2019 | The Changjiang Estuary, China | 122.865 | 30.363 |
| *C. socialis* | CNS00389 | August 2019 | The Jiaozhou Bay, China | 120.233 | 36.067 |
| *C. pseudo-curvisetus* | CNS00390 | August 2019 | The Jiaozhou Bay, China | 120.179 | 36.104 |
| *C. tenuissimus* | CNS00394 | May 2019 | The East China Sea, China | 121.342 | 21.38 |
| *C. laevisporus* | CNS00396 | July 2019 | The Changjiang Estuary, China | 122.865 | 30.363 |
| *C. curvisetus* | CNS00516 | July 2019 | The Jiaozhou Bay, China | 120.381 | 36.034 |

**Table S2. 95 shared protein-coding genes**

|  |  |
| --- | --- |
| **Category** | **Genes** |
| Photosystem Ⅰ | *psaA, psaB, psaD, psaF, psaJ, psaL* |
| Photosystem Ⅱ | *psbB*, *psbC*, *psbD*, *psbE*, *psbF*, *psbH*, *psbI*, *psbJ*, *psbK*, *psbL*, *psbN*, *psbT*, *psbV*, *psbX*, *psbY*, *psbZ* |
| Cytochrome b/f complex | *petA*, *petB*, *petD*, *petG*, *petL*, *petM*, *petN* |
| ATP synthase | *atpA*, *atpB*, *atpD*, *atpE*, *atpF*, *atpG*, *atpH*, *atpI* |
| RubisCO subunit | *rbcL*, *rbcS, rbcR* |
| RNA polymerase | *rpoA*, *rpoB*, *rpoC1*, *rpoC2* |
| Ribosomal proteins (SSU) | *rps2, rps3, rps4, rps5, rps7, rps9, rps10, rps11, rps12, rps13, rps14, rps16, rps17, rps18, rps20* |
| Ribosomal proteins (LSU) | *rpl1*, *rpl2*, *rpl3*, *rpl4*, *rpl5*, *rpl6*, *rpl11*, *rpl12*, *rpl13*, *rpl14*, *rpl16*, *rpl18*, *rpl19*, *rpl20*, *rpl23*, *rpl24*, *rpl29*, *rpl31*, *rpl32*, *rpl34*, *rpl35* |
| Other genes | *cbbX*, *ccs1*, *ccsA*, *chlI*, *clpC*, *dnaB*, *ftsH*, *groEL*, *secA*, *secG*, *secY*, *sufB*, *sufC*, *tatC*, *ycf3* |

**Table S3. The cpDNAs in the diatoms**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Class | Species | Length | GC% | Access No. | Reference |
| Mediophyceae (22) | *Acanthoceras zachariasii* | 120,392  | 29.8 | MG755808 | (Yu et al., 2018) |
|  | *Attheya longicornis* | 129,565  | 31.1 | MG755798 | (Yu et al., 2018) |
|  | *Biddulphia biddulphiana* | 122,128  | 29.9 | MG755805 | (Yu et al., 2018) |
|  | *Biddulphia tridens* | 126,286  | 30.1 | MG755806 | (Yu et al., 2018) |
|  | *Cerataulina daemon* | 120,144  | 31.2 | KJ958484 | (Sabir et al., 2014) |
|  | *Chaetoceros muelleri* | 116,284  | 30.9 | NC\_053621 | (Li and Deng 2021) |
|  | *Chaetoceros simplex* | 116,459  | 32.1 | NC\_025310 | (Sabir et al., 2014) |
|  | *Cyclotella pseudostelligera* | 129,261  | 30.9 | MG755804 | (Yu et al., 2018) |
|  | *Cyclotella sp. L04\_2* | 129,400  | 30 | KJ958480 | (Sabir et al., 2014) |
|  | *Cyclotella sp. WC03\_2* | 129,498  | 30 | KJ958481 | (Sabir et al., 2014) |
|  | *Eunotogramma sp.* | 172,317  | 31.3 | MG755797 | (Yu et al., 2018) |
|  | *Leptocylindrus danicus* | 125,213  | 31.9 | KC509524 | (Ruck et al., 2014) |
|  | *Lithodesmium undulatum* | 122,660  | 31.1 | KC509525 | (Ruck et al., 2014) |
|  | *Odontella sinensis* | 119,704  | 31.8 | Z67753 | (Kowallik et al., 1995) |
|  | *Plagiogrammopsis vanheurckii* | 139,235  | 31.8 | MG755794 | (Yu et al., 2018) |
|  | *Roundia cardiophora* | 126,871  | 31 | KJ958483 | (Sabir et al., 2014) |
|  | *Skeletonema pseudocostatum* | 127,013  | 31.2 | MK372941 | (Hamedi et al., 2019) |
|  | *Thalassiosira oceanica* | 141,790  | 30.4 | GU323224 | (Markus et al., 2010) |
|  | *Thalassiosira pseudonana* | 128,814  | 30.7 | EF067921 | (Oudot-Le Secq et al., 2007) |
|  | *Thalassiosira weissflogii* | 127,601  | 30.8 | KJ958485 | (Sabir et al., 2014) |
|  | *Toxarium undulatum* | 141,681  | 29.8 | KX619437 | (Ruck et al., 2017) |
|  | *Pseudictyota dubia* | 120,381  | 32 | MG755801 | (Yu et al., 2018) |
|  Bacillariophyceae (26) | *Fistulifera solaris* | 134,918  | 32.2 | AP011960 | (Tanaka et al., 2011) |
|  | *Gomphoneis minuta var. cassieae* | 119,630  | 32.7 | KY499654 | \* NCBI  |
|  | *Halamphora calidilacuna* | 150,738  | 32.3 | MK045451 | (Id et al., 2019) |
|  | *Plagiogramma staurophorum* | 201,816  | 29.6 | MG755792 | (Yu et al., 2018) |
|  | *Psammoneis obaidii* | 168,922  | 29.5 | MG755803 | (Yu et al., 2018) |
|  | *Seminavis robusta* | 150,905  | 30.9 | MH356727 | (Ruck et al., 2014) |
|  | *Synedra acus* | 116,251  | 30.6 | JQ088178 | (Galachyants et al., 2011) |
|  | *Asterionella formosa* | 121,238  | 30.6 | KC509519 | (Ruck et al., 2014) |
|  | *Asterionellopsis glacialis* | 146,024  | 31.2 | KC509520 | (Ruck et al., 2014) |
|  | *Astrosyne radiata* | 131,032  | 28.8 | MG755807 | (Yu et al., 2018) |
|  | *Cylindrotheca closterium* | 165,809  | 30.4 | KC509522 | (Ruck et al., 2014) |
|  | *Didymosphenia geminata* | 117,972  | 31.6 | KC509523 | (Ruck et al., 2014) |
|  | *Entomoneis sp.* | 122,056  | 32.4 | MG755800 | (Yu et al., 2018) |
|  | *Eunotia naegelii* | 152,906  | 28.7 | KF733443 | (Ruck et al., 2014) |
|  | *Fragilariopsis cylindrus* | 123,275  | 30.7 | NC\_045244 | \* NCBI  |
|  | *Fragilariopsis kerguelensis* | 170,380  | 29.7 | LR812620 | \* NCBI  |
|  | *Halamphora americana* | 142,551  | 31.7 | MK045450 | (Id et al., 2019) |
|  | *Halamphora coffeaeformis* | 121,927  | 31.8 | MK045452 | (Id et al., 2019) |
|  | *Haslea nusantara* | 120,448  | 31.1 | MH681881 | (Prasetiya et al., 2019) |
|  | *Licmophora sp.* | 121,184  | 31.6 | MG755795 | (Yu et al., 2018) |
|  | *Nanofrustulum shiloi* | 160,994  | 31.6 | MN276191 | (Li et al., 2021) |
|  | *Nitzschia palea* | 119,116  | 32.8 | AP018511 | \* NCBI  |
|  | *Nitzschia palea* | 119,449  | 32.7 | MH113811 | (Crowell et al., 2019) |
|  | *Pseudo-nitzschia multiseries* | 111,539  | 31.4 | KR709240 | (Cao et al., 2016) |
|  | *Phaeodactylum tricornutum* | 117,369  | 32.5 | EF067920 | (Oudot-Le Secq et al., 2007) |
|  | *Phaeodactylum tricornutum* | 117,363  | 32.5 | MN937452 | \* NCBI  |
| Coscinodiscophyceae (7) | *Actinocyclus subtilis* | 119,120  | 29.4 | MG755799 | (Yu et al., 2018) |
|  | *Coscinodiscus radiatus* | 122,213  | 30.4 | NC\_024081 | (Ruck et al., 2014) |
|  | *Guinardia striata* | 122,145  | 32.2 | MG755796 | (Yu et al., 2018) |
|  | *Proboscia sp.* | 138,249  | 32.6 | MG755791 | (Yu et al., 2018) |
|  | *Rhizosolenia fallax* | 125,283  | 30.2 | MG755802 | (Yu et al., 2018) |
|  | *Rhizosolenia imbricata* | 120,956  | 31.8 | KJ958482 | (Sabir et al., 2014) |
| 　 | *Rhizosolenia setigera* | 121,011  | 32.2 | MG755793 | (Yu et al., 2018) |

Note: \*These chloroplast genomes are also publicly available in GenBank under mentioned accession numbers; NCBI, National Center for Biotechnology Information.

**Table S4. Calibration points used in the divergence time analysis by PAML**

|  |  |  |  |
| --- | --- | --- | --- |
| **Taxon1** | **Taxon2** | **Divergence time (Mya)** | **References** |
| *Ectocarpus siliculosus* | *Diatoms* | 176.0–202.0 | (Matari and Blair 2014) |
| *Rhizosolenia setigera* | *Skeletonema pseudocostatum* | 90.5-91.5 | (Damste et al., 2004) |
| *Pseudo-nitzschia multiseries* | *Fragilariopsis cylindrus* | 10.0-35.3 | (Matari and Blair 2014) |

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