**Table S5**. Nucleotide substitution rates and plastome features included in correlation analyses.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Species | *dN* | *dS* | Size | Indel | LSC | SSC | IR | Clade |
| *Leptocylindrus danicus* | 0.132 | 3.0563 | 125213 | 128 | 66724 | 40981 | 8754 | radial1 |
| *Proboscia* sp. | 0.1784 | 5.9626 | 138249 | 196 | 57631 | 39450 | 20584 | radial2 |
| *Actinocyclus subtilis* | 0.1431 | 3.9087 | 119120 | 155 | 59040 | 38042 | 11019 | radial3 |
| *Coscinodiscus radiatus* | 0.1392 | 4.0845 | 122213 | 145 | 60402 | 36643 | 12584 | radial3 |
| *Rhizosolenia setigera* | 0.1341 | 3.4955 | 121011 | 145 | 58541 | 38332 | 12069 | radial3 |
| *Guinardia striata* | 0.1275 | 3.0861 | 122145 | 143 | 59711 | 38870 | 11782 | radial3 |
| *Rhizosolenia fallax* | 0.1392 | 3.8077 | 125283 | 158 | 59165 | 28184 | 18967 | radial3 |
| *Rhizosolenia imbricata* | 0.1401 | 4.0877 | 120956 | 158 | 61244 | 27482 | 16115 | radial3 |
| *Lithodesmium undulatum* | 0.1334 | 3.2036 | 122660 | 158 | 61086 | 37854 | 11860 | polar1 |
| *Eunotogramma sp.* | 0.1318 | 3.3076 | 172317 | 160 | 84201 | 39912 | 24102 | polar1 |
| *Roundia cardiophora* | 0.1436 | 3.889 | 126871 | 168 | 64387 | 26274 | 18105 | polar1 |
| *Thalassiosira weissflogii* | 0.1436 | 3.3167 | 127601 | 178 | 64555 | 26494 | 18276 | polar1 |
| *Discostella pseudostelligera* | 0.1433 | 3.6842 | 129261 | 170 | 64734 | 26735 | 18896 | polar1 |
| *Thalassiosira oceanica* | 0.1458 | 3.5168 | 141790 | 179 | 70298 | 24106 | 23693 | polar1 |
| *Cyclotella nana* | 0.1426 | 3.4036 | 128814 | 181 | 65292 | 27684 | 18261 | polar1 |
| *Cyclotella* sp. L04\_2 | 0.1472 | 3.6482 | 129400 | 195 | 65250 | 26889 | 18338 | polar1 |
| *Cyclotella* sp. WC03\_2 | 0.1469 | 3.6491 | 129498 | 193 | 65268 | 27620 | 18256 | polar1 |
| *Plagiogrammopsis van heurckii* | 0.1345 | 3.4051 | 139305 | 152 | 74042 | 41125 | 12069 | polar1 |
| *Trieres sinensis* | 0.1375 | 3.5028 | 119704 | 159 | 65346 | 38908 | 7725 | polar1 |
| *Triceratium dubium* | 0.136 | 3.5093 | 120381 | 156 | 65233 | 38936 | 8106 | polar1 |
| *Cerataulina daemon* | 0.1348 | 3.2203 | 120144 | 155 | 65546 | 40590 | 7004 | polar2 |
| *Acanthoceras zachariasii* | 0.1428 | 3.5508 | 120392 | 168 | 63924 | 39368 | 8550 | polar2 |
| *Chaetoceros simplex* | 0.1362 | 2.8153 | 116459 | 159 | 62136 | 39517 | 7403 | polar2 |
| *Attheya longicornis* | 0.1391 | 3.6231 | 129565 | 154 | 65290 | 44231 | 10022 | polar3 |
| *Biddulphia tridens* | 0.143 | 3.6062 | 126295 | 168 | 66995 | 39752 | 9774 | polar3 |
| *Biddulphia biddulphiana* | 0.1517 | 4.5121 | 122128 | 159 | 63612 | 40024 | 9246 | polar3 |
| *Asterionellopsis glacialis* | 0.1415 | 3.6106 | 146024 | 168 | 72585 | 51181 | 11129 | araphid1 |
| *Plagiogramma staurophorum* | 0.1457 | 4.2639 | 201816 | 173 | 77767 | 54273 | 34888 | araphid1 |
| *Psammoneis obaidii* | 0.144 | 3.9499 | 168922 | 169 | 73911 | 51965 | 21523 | araphid1 |
| *Asterionella formosa* | 0.1491 | 4.0496 | 121238 | 170 | 62681 | 40193 | 9182 | araphid2 |
| *Astrosyne radiata* | 0.2786 | 18.4078 | 131032 | 287 | 50213 | 37953 | 21433 | araphid2 |
| *Synedra acus* | 0.1541 | 3.9532 | 116251 | 183 | 61724 | 40937 | 6795 | araphid2 |
| *Licmophora sp.* | 0.1577 | 3.73 | 121184 | 170 | 64999 | 40389 | 7898 | araphid2 |
| *Eunotia naegelii* | 0.1464 | 4.1596 | 152906 | 166 | 73679 | 24857 | 27185 | raphid |
| *Cylindrotheca closterium* | 0.1551 | 4.0927 | 165809 | 174 | 86398 | 49671 | 14870 | raphid |
| *Seminavis robusta* | 0.1499 | 3.1636 | 150905 | 174 | 70540 | 61497 | 9434 | raphid |
| *Entomoneis sp.* | 0.1519 | 3.4616 | 122056 | 178 | 64114 | 43246 | 7348 | raphid |
| *Fistulifera* sp. JPCC DA0580 | 0.1542 | 3.5073 | 134918 | 176 | 62994 | 45264 | 13330 | raphid |
| *Didymosphenia germinata* | 0.1514 | 3.7183 | 117972 | 168 | 63610 | 40370 | 6996 | raphid |
| *Phaeodactylum tricornutum* | 0.1488 | 4.1613 | 117369 | 163 | 63674 | 39871 | 6912 | raphid |

*dN*: nonsynonymous substitution rate

*dS*: synonymous substation rate

Size: total plastome size in nucleotides (nt)

Indel: in-frame (coding region) insertions and deletions

LSC: large single copy region of the plastome monomer (nt)

SSC: small single copy region of the plastome monomer (nt)

IR: a single copy of the IR (nt)