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Title: Conserved Gene Order and Expanded Inverted Repeats Characterize Plastid Genomes of Thalassiosirales

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Abstract: Diatoms are mostly photosynthetic eukaryotes within the heterokont lineage. Variable plastid genome sizes and extensive genome rearrangements have been observed across the diatom phylogeny, but little is known about plastid genome evolution within order-or family-level clades. The Thalassiosirales is one of the more comprehensively studied orders in terms of both genetics and morphology. Seven complete diatom plastid genomes are reported here including four Thalassiosirales: Thalassiosira weissflogii, Roundia cardiophora, Cyclotella sp. WC03_2, Cyclotella sp. L04_2, and three additional non-Thalassiosirales species Chaetoceros simplex, Cerataulina daemon, and Rhizosolenia imbricata. The sizes of the seven genomes vary from 116,459 to 129,498 bp, and their genomes are compact and lack introns. The larger size of the plastid genomes of Thalassiosirales compared to other diatoms is due primarily to expansion of the inverted repeat. Gene content within Thalassiosirales is more conserved compared to other diatom lineages. Gene order within Thalassiosirales is highly conserved except for the extensive genome rearrangement in Thalassiosira oceanica. Cyclotella nana, Thalassiosira weissflogii and Roundia cardiophora share an identical gene order, which is inferred to be the ancestral order for the Thalassiosirales, differing from that of the other two Cyclotella species by a single inversion. The genes ilvB and ilvH are missing in all six diatom plastid genomes except for Cerataulina daemon, suggesting an independent gain of these genes in this species. The acpP1 gene is missing in all Thalassiosirales, suggesting that its loss may be a synapomorphy for the order and this gene may have been functionally transferred to the nucleus. Three genes involved in photosynthesis, psaE, psaI, psaM, are missing in Rhizosolenia imbricata, which represents the first documented instance of the loss of photosynthetic genes in diatom plastid genomes.

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