Insights into global diatom distribution and diversity in the world’s ocean

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Diatoms (Bacillariophyta) constitute one of the most diverse and ecologically important groups of phytoplankton. They are considered to be particularly important in nutrient-rich coastal ecosystems and at high latitudes, but considerably less so in the oligotrophic open ocean. The Tara Oceans circumnavigation collected samples from a wide range of oceanic regions using a standardized sampling procedure. Here, a total of ~12 million diatom V9-185 ribosomal DNA (rDNA) ribotypes, derived from 293 size-fractionated plankton communities collected at 46 sampling sites across the global ocean euphotic zone, have been analyzed to explore diatom global diversity and community composition. We provide a new estimate of diversity of marine planktonic diatoms at 4,748 operational taxonomic units (OTUs). Based on the total assigned ribotypes, Chaetoceros was the most abundant and diverse genus, followed by Fragilariopsis, Thalassiosira Chaetoceros, and Corethron. We found only a few cosmopolitan ribotypes displaying an even distribution across stations and high abundance, many of which could not be assigned with confidence to any known genus. Three distinct communities from South Pacific, Mediterranean, and Southern Ocean waters were identified that share a substantial percentage of ribotypes within them. Sudden drops in diversity were observed at Cape Agulhas, which separates the Indian and Atlantic Oceans, and across the Drake Passage between the Atlantic and Southern Oceans, indicating the importance of these ocean circulation choke points in constraining diatom distribution and diversity. We also observed high diatom diversity in the open ocean, suggesting that diatoms may be more relevant in these oceanic systems than generally considered.

Significance

Diatoms, considered one of the most diverse and ecologically important phytoplanktonic groups, contribute around 20% of global primary productivity. They are particularly abundant in nutrient-rich coastal ecosystems and at high latitudes. Here, we have explored the dataset generated by Tara Oceans from a wide range of oceanic regions to characterize diatom diversity patterns on a global scale. We confirm the dominance of diatoms as a major photosynthetic group and identify the most widespread and diverse genera. We also provide a new estimate of marine planktonic diatom diversity and a global view of their distribution in the world’s ocean.

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