Shape matters: the relationship between cell geometry and diversity in phytoplankton

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Abstract

Organisms' size and shape profoundly influence their ecophysiological performance and evolutionary fitness, suggesting a link between morphology and diversity. We analyse global datasets of unicellular phytoplankton, major group of photosynthetic microbes with an astounding diversity of cell sizes and shapes, and explore the distribution of taxonomic diversity across different cell shapes and sizes. We find that cells of intermediate volume have the greatest shape variation, from oblate to extremely elongated forms, while small and large cells are mostly compact (e.g., spherical or cubic). Taxonomic diversity varies across cell elongation and cell volume, with both traits explaining up to 92% of its variance. It decays exponentially with cell elongation and displays a log-normal dependence on cell volume, peaking for compact, intermediate-volume cells. Our findings point to the presence of different selective pressures and constraints on the geometry of phytoplankton cells and, thus, improve our understanding of the evolutionary rules of life.

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