Rapid evolution allows coexistence of highly divergent lineages within the same niche

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Abstract

Marine microbial ecosystems underpin global biogeochemical cycles and play a central role in the regulation of Earth's climate. These communities are extremely diverse, and their taxonomic composition varies considerably across ocean basins. It has however been difficult to establish links between taxonomic diversity and ecosystem function, and the ecological and evolutionary mechanisms underpinning taxonomic variation are not well understood. Here we use an individual-based eco-evolutionary model in which taxonomic diversity emerges as a consequence of evolutionary history. Using this model we are able to show that virtually unlimited genetic divergence can be supported in highly abundant and rapidly evolving assemblages, even in the absence of niche separation. With a steady stream of genetic, epigenetic and plastic heritable changes to phenotype, competitive exclusion may be weakened, allowing sustained coexistence of nearly neutral phenotypes with highly divergent lineages. This response may help to explain observed patterns of taxonomic diversity and functional redundancy - without recourse to hidden dimensions of niche partitioning. In light of these results we suggest that individual-level variability is a key driver of species coexistence and the maintenance of microbial biodiversity.

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