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Global shapes of evolutionary trees in trait spaces can be described by the Price equation

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Diversification and extinction are ubiquitously repeated in the evolutionary histories of biological communities. A minimal mechanism for driving the repeated diversification and extinction is a combination of resource competition in one trait and a weak directional selection in another trait; resource competition induces diversification in the first trait, but inevitably nonuniform innovations in the second trait among the diversified lineages induce further diversification of the most innovated lineage, excluding the other outdated ones. In this dynamics, the evolutionary speed of community average of the second trait can be partitioned into the contribution by directional evolution of each lineage consisting the community, i.e., within-lineage evolution, and the contribution by changes of those lineages' frequencies, i.e., between-lineage selection. This study generalizes such a partitioning by the Price equation for an arbitrary bivariate trait space, by which the global shapes of evolutionary trees in the trait spaces can be understood in terms of within-lineage evolution and between-lineage selection.

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