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The growing genomic information on non-model organisms eases exploring the evolutionary history of biodiversity. This is particularly true for Drosophila flies, in which the number of sequenced species doubled recently. Because of its outstanding diversity of species, Drosophila has become one of the most important systems to study adaptive radiation. In this study, we performed a genome-wide analysis of positive diversifying selection on more than 2000 single-copy orthologous groups in 25 species using a recent method of increased accuracy for detecting positive diversifying selection. Adopting this novel approach enabled us to find a consistent selection signal throughout the genus Drosophila, and a total of 1342 single-copy orthologous groups were identified with a putative signal of positive diversifying selection, corresponding to 1.9% of all loci. Specifically, in lineages leading to D. grimshawi, a strong putative signal of positive diversifying selection was found related to cell, morphological, neuronal, and sensorial development and function. A recurrent signal of positive diversifying selection was found on genes related to aging and lifespan, suggesting that selection had shaped lifespan diversity in Drosophila, including extreme longevity. Our study, one of the largest and most comprehensive ones on genome-wide positive diversifying selection to date, shows that positive diversifying selection has promoted species-specific differentiation among evolutionary lineages throughout the Drosophila radiation. Acting on the same biological processes via different routes, positive diversifying selection has promoted diversity of functions and adaptive divergence.

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