Life history traits impact the nuclear rate of substitution but not the mitochondrial rate in isopods.

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Abstract

Life history traits are expected to be a major driver of substitution rate variation among species. However, the relative contribution of each trait to this variation is poorly understood. Here, we intend to disentangle the relative influence of life history traits using a group of isopod species that have made multiple independent transitions from surface to subterranean environments. Species having undergone this ecological transition have evolved a lower metabolic rate, a longer lifespan and a longer generation time. We assembled the nuclear transcriptomes and the mitochondrial genomes of 13 pairs of closely related isopods, each pair being composed of one surface and one subterranean species. Based on a total of 382 nuclear and 12 mitochondrial orthologous genes, we found that subterranean species have a lower rate of nuclear synonymous substitution while the mitochondrial rate did not show any consistent trend in rate variation. This unexpected result suggests that the rate of molecular evolution of these two genomes is influenced by different factors. We propose that this decoupling between nuclear and mitochondrial rates comes from different DNA replication processes in these two compartments. In isopods, the nuclear rate is probably tightly controlled by generation time alone. In contrast, mitochondrial genomes would replicate and mutate at a rate independent of life history traits. These results are incongruent with previous studies, which were for the most part devoted to vertebrates. We suggest that this incongruence can be explained by developmental differences between animal clades, with a blockage during female gametogenesis in mammals and birds, as opposed to a continuous gametogenesis in most arthropods.

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