Niche width impacts vertebrate diversification

Jonathan Rolland[*1] and Nicolas Salamin[1]

[1]University of Lausanne, Department of Ecology and Evolution (UNIL) – 1015 Lausanne, Switzerland

Abstract

The size of the climatic niche of a species is a major factor determining its distribution and evolution. In particular, niche width should be associated with the rate of species diversification. Here, we test whether species niche width affects the speciation and the extinction rates of three main clades of vertebrates: amphibians, mammals and birds. We obtained the time-calibrated phylogenies, IUCN conservation status, species distribution maps and climatic data for 2,340 species of amphibians, 4,563 species of mammals and 9,823 species of birds. We computed the niche width for each species as the mean annual temperatures across the species range. We estimated speciation, extinction and transition rates associated with lineages with either narrow (specialist) and wide (generalist) niches using phylogeny-based birth-death models. We also tested if current conservation status were correlated with the niche width of species. We found higher net diversification rates in specialist species than in generalist species. This result was explained by both higher speciation rates and lower extinction rates in specialist than in generalist species. In contrast, current specialist species tended to be more threatened than generalist species. Our diversification analysis shows that the width of the climatic niche is strongly associated with diversification rates and may thus be a crucial factor to understand the emergence of diversity patterns in vertebrates. The striking difference between our diversification results and current conservation status suggests that the extinction process at present may be different than extinction rates estimated from the whole history of the group.

Keywords: Niche evolution, vertebrates, diversity, diversification, speciation and extinction rate, generalist, specialist, latitudinal diversity gradient.

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[*]Speaker