SHIFTS IN TROPHIC ARCHITECTURE AND ECOSPACE STABILITY DETERMINING SURVIVORSHIP AND EXTINCTION AT THE END CRETACEOUS

Chiarenza, Alfio A.[1], García-Girón, Jorge[2], Alahuhta, Janne[3], DeMar, David G.[4], Heino, Jani[2], Mannion, Philip D.[5], Williamson, Thomas E.[6], Wilson Mantilla, Gregory P.[4], Brusatte, Stephen L.[7]

[1]Ecology and Animal Biology, Universidade de Vigo, Vigo, Galicia, Spain, [2]Freshwater Centre, Finnish Environment Institute, Oulu, Finland, [3]Geography Research Unit, University of Oulu, Oulu, Finland, [4]Burke Museum, University of Washington, Seattle, Washington, United States, [5]Earth Sciences, University College London, London, United Kingdom, [6]New Mexico Museum of Natural History and Science, Albuquerque, New Mexico, United States, [7]Grant Institute, The University of Edinburgh School of GeoSciences, Edinburgh, Scotland, United Kingdom

An explanation for why some species, such as non-avian dinosaurs, became extinct, whereas others, including mammals, survived the Cretaceous/Paleogene (K/Pg) mass extinction, 66 million years ago (Ma) is still debated. What were the mechanisms behind community restructuring and the emergence of new ecological opportunities after the K/Pg event, selectively driving extinction and survivorship patterns? Using Markov networks, ecological niche partitioning and Earth System models, we reconstructed disruptions in continental food web dynamics, simulating long-term trajectories in ecospace occupancy through the latest Cretaceous (83.6–66.0 Ma) and early Paleogene (66.0–61.6 Ma). This method uses partial correlation networks to represent how different trophic groups interact in a food web and builds on empirical spatial co-variations to explore dependencies between trophic groups. Our analyses are based on a spatiotemporally and taxonomically standardized dataset, comprising more than 1,600 fossil occurrences representing more than 470 genera of fish, salamanders, frogs, albanerpetontids, lizards, snakes, champsosaurs, turtles, crocodylians, dinosaurs (including birds), and mammals across the best sampled region for this interval, the Western Interior of North America. We explicitly tested whether: 1) shifts in food web architecture underwent major restructuring before and after the K/Pg transition, including whether some trophic guilds were more prone to these shifts than others; and 2) any of these changes were associated with fluctuations in the realized niche space, helping to explain survivorship and extinction patterns at the boundary. We find a shift in latest Cretaceous dinosaur faunas, as medium-sized species counterbalanced a loss of large herbivores, but that dinosaur niches were otherwise resilient and static until the K/Pg boundary. Smaller terrestrial vertebrates, including mammals, followed a consistent trajectory of increasing trophic impact and relaxation of ecological niche limits that began in the Cretaceous and continued after the extinction. Patterns of mammalian ecological radiation and niche restructuring indicate that these taxa did not simply proliferate after the extinction; rather, their earlier ecological diversification might have helped them survive the K/Pg event, whereas the static niche of dinosaurs might have contributed to their demise.