Fossil network analysis and the 'evolution' of marine animal communities

For decades, paleontologists have debated about the 'evolution' of communities, that is, the patterns and processes involved in the assembly, breakup, and change of communities over time. Fossils of marine animals provide a record for addressing this debate. Previous work suggests that community evolution fits a coordinated stasis-like model, wherein communities exist for long (30–40 Ma) intervals of ecologic stasis before rapidly appearing and disappearing *en masse* during relatively short (3–8 Ma) episodes of ecologic reorganization. These ecologic reorganization events are purportedly caused by environmental perturbations that drive faunal turnover (i.e. extinction and radiation). Regardless, previous efforts to test this paradigm have focused on qualitative assessments of the fossil record and case studies of regional geology, rather than analyses of global data. Hence, there is uncertainty.

In this talk, I will describe new tests of the paradigm of community evolution. These tests are based on network analyses of occurrences of marine animal fossils in Phanerozoic rocks around the world. Overall, network analysis supports an array of methods for identifying and characterizing paleoecological associations of taxa. My colleagues and I apply these methods to calculate rates and magnitudes of ecological change during various ages of Earth history. I will demonstrate that, by and large, the record of community change has been shaped by environmental perturbations. In this context, I will discuss the challenges associated with predicting the consequences of biodiversity losses over the last few hundred years (i.e. the so-called 'sixth mass extinction') as well as new paths forward.