Derek Li

Grant proposal

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Investigation of difference in ecological impact of the Late Cretaceous and the Triassic-Jurassic marine mass extinctions

Introduction:

There have been five major losses of biodiversity in Phanerozoic time (Raup and Sepkoski, 1982). Among these extinction events, the Late Triassic and the Late Cretaceous extinctions shared similar level of marine taxonomic loss, 20% and 15% familial loss respectively (Sepkoski, 1982). Despite the similarity in the marine taxonomic diversity loss, these two major extinctions resulted in different ecological effect on marine taxa. In this proposal, my objective is to investigate in what aspect did the ecological difference exist between the Late Triassic and the Late Cretaceous marine mass extinctions. Here I hypothesize that this difference in ecological effect might be present in terms of feeding strategies, resulted from habitat loss, which is commonly accompanied by extinction events (Fahrig, 2003) and have profound influence on ecology (Hoekskra, 2004).

Justification:

This study is significant in that it can potentially reveal that although taxonomically the Late Cretaceous and Triassic marine extinctions were similar in size, they could have resulted to different ecological effect in marine setting (Droser et al, 2000). This result, along with others (McKinney et al, 1998), indicates that the taxonomic evaluation alone is not enough in order to protect modern ecosystems since it only represents one of many aspects of a mass extinction.

Moreover, this study may provide a new approach for measuring the difference in ecological impact. Bush et al. (2007) states that functional morphology can usually provide a rather reliable indication of some ecologic properties of fossil taxa. As a result, the feeding strategies, as an essential variable for understanding how animals live and function in ecosystem, can also be a proper indicator that is able to provide some information regarding the ecological impact following a mass extinction event.

Lastly, this project will also be able to demonstrate how feeding strategies can be influenced by the mass extinction events via the mechanism of habitat loss. Sahney et al. (2010) supports this perspective by stating that collapse of ecosystem results in acquisition of new feeding strategies. It indicates that accompanied by extinction events, habitat loss can lead to a shift in feeding strategies. As a result, it is plausible to say that habitat loss can also be used as an indicator in estimating the difference in ecological impact of major extinction events.

Research Plan:

Data will be drawn from the Paleobiology Database (www.paelobiodb.org) for all marine taxa by utilizing R. Paleobiology Database is a rather powerful and convenient free resource for paleontological data, organized and operated by a multi-disciplinary, international group of paleobiological researchers. For the purpose of this project, we will mainly focus on three classes of marine animals, including Bivalvia, Cephalopoda, and Gastropoda. The reason that these three classes are selected is that they were all present before and after the Late Triassic and the Late Cretaceous mass extinctions. Since the data will include information that I am not particularly interested in this project, a series of extra cleaning steps will be conducted until names of animals on species level is the only thing that is remained. By utilizing the cleaned up data, I will be able to investigate the feeding strategy of each species via analyzing the trace fossil and functional morphology of each species (Mangano et al., 1998).

Moreover, I am going to group species based on their feeding strategies, such as filter-feeding, deposit-feeding, grazing, and predatory. After this, the total number of species will be calculated for each feeding strategies. This step will be done four times in terms of geological time, Late Triassic, Early Jurassic, Late Cretaceous, and Paleocene. In addition, a proportion will be calculated for each feeding strategy and a graph for each geological time will be created in order to show the overarching trends that how each strategy's proportion is influenced by the two major extinction events. If a statistically significant disparity between two trends of the same feeding strategy is observed during the analysis, we can conclude that difference in ecological effect of the Late Cretaceous and the Late Triassic marine extinctions was genuinely present in terms of feeding strategies.

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