

Evolution of Phanerozoic radiolaria and marine eco-system

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Living radiolarian research provides us with a key to reconstructing the past marine eco-system. Detailed observations of a variety in feeding behavior of cultured radiolarian specimens make it possible to understand the relationship between skeletal morphology and feeding behavior. Four types of feeding strategy well correspond to skeletal morphology in extant radiolarian taxa. Multi-segmented nassellarians, other nassellarians, spumellarians, and colonial radiolarians have their own feeding strategies. The wide variation in feeding behavior means that radiolarians occupy several kinds of ecological niches in marine environments. We can infer feeding behavior of extinct radiolarian group based on their skeletal morphology. Once we recognize the role of radiolarians in food web in the modern ocean environments, we can apply it to reconstruct marine eco-system in the past. Fluctuation in morphological diversity of radiolarian skeletons is well documented in fossil records. This fluctuation can be interpreted as change in the number of ecological niches in the marine eco-system through time.

Paleozoic radiolarians are characterized mostly by spherical, discoidal and cone-shaped shells. Most forms of early Paleozoic radiolarians possess a spherical skeleton including the earliest family Echidniniidae which appeared in the Cambrian time. One of unique shell morphology in Paleozoic radiolarians is a curved conical skeleton typical in albaillellarians that appeared in the Silurian time. They might adopt a feeding strategy which is different from and is not found in recent radiolarians. After the Permian/Triassic mass extinction, curved conical skeletons have never been found not only in fossil records but also extant taxa. This might suggest that the ecological niche once occupied by Albaillellaria has never been utilized by any radiolarians but occupied by other organism.

Mesozoic radiolarians include most types of basic skeletal morphology of extant radiolarians except for colonial radiolaria. Assuming that skeletal morphology indicates their feeding strategy then at least three types of feeding behavior were developed in the Mesozoic time. The presence of radiolarian skeletal morphology suggests that prey of radiolarians also existed in a water column where radiolarians dwelled. The resemblance between modern and Mesozoic radiolarian skeletons indicates that the marine eco-system in the present and Mesozoic times is probably similar to each other in terms of the nature (size and mobility) of prey.

Cenozoic radiolarians are the same as recent ones in terms of feeding behavior. Colonial radiolaria appeared early Cenozoic time and became popular in the Neogene time. The marine eco-system inferred from Cenozoic radiolarian skeletons is similar to the modern eco-system. Skeleton-less radiolarians live in the modern ocean.

Mass extinctions and the following recoveries seem the crush of eco-system and its gradual restoration judging from fossil records. Similar processes in crush-restoration of marine ecosystem are repeatedly recognized in the Phanerozoic time, including the Permian/Triassic and Triassic/Jurassic mass extinctions. Radiolarians have not been severely damaged at the Cretaceous/Tertiary mass extinction event unlike planktonic foraminifers.