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Perspective

Phytoplankton and Zooplankton Ecological Networks in Coastal Marine Ecosystems

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ABOUT THE STUDY

The marine autotrophic phytoplankton is responsible for approximately half of global primary production on Earth, and as the planktonic consumers, the heterotrophic zooplankton could link the phytoplankton and higher trophic level to complete the aquatic Food Web. Despite the interaction between phytoplankton and zooplankton has played important roles in speciation and ecosystem function, little is known about the spatial patterns of their interactions at the continental scale.

According to trophic strategy, grouping organisms that interact with environmental factors in similar ways, the marine planktonic protist has been classified into two major groups: photosynthetic phytoplankton and heterotrophic zooplankton [1-3]. As the primary producers in the pelagic food web, marine phytoplankton accounts for almost 50% of global primary production, meanwhile zooplankton acts as the important linker between primary producers and oceanic macro fauna.

Most phytoplankton and zooplankton species are sensitive to changes in the marine environment and their responses may directly influence oceanic ecosystem functions. For example, rising temperature can reduce phytoplankton relative cell-size and increased salinity will dramatically reduce the planktonic richness [4]. Phytoplankton organisms are able to fix atmospheric CO_2 by photosynthesis which might promote the oceanic carbon cycle. The plankton study by Falkowski and Oliver was largely focused on the effects of global climate change on phytoplankton community structure, however, there was a clear knowledge gap about the interactions between phytoplankton and zooplankton over geographic distances and variations in environment factors.

The spatial distribution of phytoplanktonic and zooplanktonic species could reveal their adaptations to many different environmental properties. Due to variations of plankton richness and community structure in space reflecting the multiple mechanisms of species loss and maintenance, the biogeography of plankton has become one of the central concerns in marine ecology [5]. The Distance-Decay Relationship (DDR) can exam spatial changes in biodiversity and describe the dissimilarity of taxonomic composition with increasing geographic distances.

Coastal marine ecosystems are among the most ecologically and socio-economically vital zones on the planet, and there are increasing concerns regarding the impacts of anthropogenic pollution and climate change. Previous studies have suggested that many planktonic species are sensitive to even slight climatic change [6,7]. Though researchers have long recognized that planktonic interactions are crucial for oceanic and coastal ecosystems, our knowledge about how they change over geographic distance is still lacking. In this study, we performed a large-scale systematic survey of both phytoplankton and zooplankton in 251 seawater samples along 13,000 km of coastline, we aimed to reveal the spatial patterns for both phytoplanktonic and zooplanktonic community composition, geographic distribution, and their interactions.

Zooplanktonic and phytoplanktonic communities were significantly divergent from north to south, in terms of both α- and β-diversities. Significant Distance-Decay Relationships (DDR) could be observed in both phytoplankton and zooplankton, but the zooplanktonic community had a steeper turnover rate than phytoplankton, indicating heterotrophic zooplankton had more divergent compositions over large distances. Furthermore, the interactions between zooplankton and phytoplankton also exhibited a clear latitudinal pattern, which became more complex from north to south. The particular associations between zooplanktonic and phytoplanktonic species were found in different regions, indicating the latitudinal gradient could restructure the relationships between these two trophically dependent planktons.

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