The differences of microbial network characteristics and N cycle-related microbial interaction pattern in sediments of shallow freshwater lake with different eutrophic status

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The study on interaction pattern differences of nitrogen cycle-related microbes in lakes have a great scientific significance on exploring the bigeochemical cycling characteristics of N and the mechanism of eutrophication. In the present study, sediment samples were collected from different eutrophic lake areas, Western Taihu Lake (medium eutrophication) and Xukou Bay (mesotrophication), of the Taihu Lake in the four seasons from 2015 to 2017. High-throughput sequencing technology was used to recognize the taxonomic features of microbes in sediments. Based on molecular ecological network analysis, the characteristics of microbial molecular ecological network, diversity of N cycle-related microbes and their ecological interaction pattern of lake sediment with different eutrophic status were identified. In order to highlight the influence of microbial interaction pattern on the mechanism of eutrophication, we put emphasis on discussing the ecological impacts of denitrifiers in the networks.

The results show that with the increase of eutrophication, the average degree of molecular ecological networks increased from 3.833 to 5.136, the average path distance decreased from 6.370 to 5.136, but the average clustering coefficient has no significant change, indicated that sediment microbes of higher eutrophication interacted more complexed with each other and the network was more clustered.

After taxonomic and functional annotation of OTUs in the network, the link number and average degree of denitrifier in Western Taihu Lake was lower and higher than Xukou Bay respectively, indicationg that less denitrifiers intensely interact in Western Taihu Lake but a larger number of denitrifiers weakly interact in Xukou Bay. Links of denitrifier key nodes in Western Taihu Lake and Xukou Bay networks were all positive, but Xukou Bay network has a higher positive link percentage of denitirifier key nodes, which revealed that microbial interaction pattern of Xukou Bay sediments favored the occurrence of denitrifiers, and leading to the N removal process.