

Network Analysis to Reveal Microbial Community Dynamics in the Coral Reef Ocean

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Abstract : Understanding environmental system is one of the important tasks. In recent years, conservation of coral environments has been focused for biodiversity issues. The damage of coral reef under environmental impacts has been observed worldwide. However, the casual relationship between damage of coral and environmental impacts has not been clearly understood. On the other hand, structure/diversity of marine bacterial community may be relatively robust under the certain strength of environmental impact. To evaluate the coral environment conditions, it is necessary to investigate relationship between marine bacterial composition in coral reef and environmental factors. In this study, the Time Scale Network Analysis was developed and applied to analyze the marine environmental data for investigating the relationship among coral, bacterial community compositions and environmental factors. Seawater samples were collected fifteen times from November 2014 to May 2016 at two locations, Ishikawabaru and South of Sesoko in Sesoko Island, Okinawa. The physicochemical factors such as temperature, photosynthetic active radiation, dissolved oxygen, turbidity, pH, salinity, chlorophyll, dissolved organic matter and depth were measured at the coral reef area. Metagenome and metatranscriptome in seawater of coral reef were analyzed as the biological factors. Metagenome data was used to clarify marine bacterial community composition. In addition, functional gene composition was estimated from metatranscriptome. For speculating the relationships between physicochemical and biological factors, cross-correlation analysis was applied to time scale data. Even though cross-correlation coefficients usually include the time precedence information, it also included indirect interactions between the variables. To elucidate the direct regulations between both factors, partial correlation coefficients were combined with cross correlation. This analysis was performed against all parameters such as the bacterial composition, the functional gene composition and the physicochemical factors. As the results, time scale network analysis revealed the direct regulation of seawater temperature by photosynthetic active radiation. In addition, concentration of dissolved oxygen regulated the value of chlorophyll. Some reasonable regulatory relationships between environmental factors indicate some part of mechanisms in coral reef area.

Keywords : coral environment, marine microbiology, network analysis, omics data analysis

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