Graph theory at the service of assessing the ecological status of lake ecosystems based on phytoplankton communities

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Résumé

Lake ecosystems play an essential role in climate, through the exchange of heat and water with the atmosphere, and in the global carbon cycle, being both a source and a sink of carbon. Lakes are also essential to human, providing numerous ecosystem services. The functioning of lakes, as well as their stability, resistance and resilience in the face of environmental disturbances, is mainly underpinned by the biodiversity they harbour, notably phytoplankton community. However, human activities are causing an unprecedented loss of biodiversity, particularly in inland water bodies. In this context, assessing the ecological status of lakes is an important task in order to evaluate their state of degradation as well as to determine the origin of degradation. Approaches based on environmental DNA (eDNA) have shown their relevance in addressing such questions. Based on this type of data, statistical modeling approaches can be used to construct ecological networks (co-occurrence), and graph theory to understand their structure (topology). Recent studies have shown that network topology can be influenced by anthropogenic pressures, and can therefore be used as an indicator of these pressures. In this context, we propose to develop an indicator of the ecological state of lake ecosystems based on the measurement of graph topology metrics from eDNA data targeting phytoplankton. More precisely, our work is focused on centrality metrics that characterize the topological role of each node (or ASV) at the scale of networks. This purpose was possible by using a dataset from around 100 lakes across France.

Mots-Clés: biomonitoring, phytoplankton, eDNA, co occurrence network, graph theory

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