

# A biodiversity-inspired approach to aquatic ecosystem modeling

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ABSTRACT: Current aquatic ecosystem models accommodate increasing amounts of physiological detail, but marginalize the role of biodiversity by aggregating multitudes of different species. We propose that at present, understanding of aquatic ecosystems is likely to benefit more from improved descriptions of biodiversity and succession than from incorporation of more realistic physiology. To illustrate how biodiversity can be accounted for, we define the system of infinite diversity (SID), which characterizes ecosystems in the spirit of complex adaptive systems theory as single units adapting to environmental pressure. The SID describes an ecosystem with one generic population model and continuity in species-characterizing parameters, and acquires rich dynamics by modeling succession as evolution of the parameter value distribution. This is illustrated by a four-parameter phytoplankton model that minimizes physiological detail, but includes a sophisticated representation of community diversity and interspecific differences. This model captures several well-known aquatic ecosystem features, including formation of a deep chlorophyll maximum and nutrient-driven seasonal succession. As such, it integrates theories on changes in species composition in both time and space. We argue that despite a lack of physiological detail, SIDs may ultimately prove a valuable tool for further qualitative and quantitative understanding of ecosystems.

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