

AQUATOX AS A TOOL TO UNDERSTAND WATER QUALITY STRESSORS

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ABSTRACT

AQUATOX is a mechanistic aquatic ecosystem simulation model that predicts the fate and effects of nutrients, sediments, and organic toxicants on multiple species of periphyton, phytoplankton, macrophytes, invertebrates, and fish. It can be applied to multiple waterbody types, including streams and rivers, ponds, lakes, reservoirs, and estuaries.

A mechanistic model such as AQUATOX provides several benefits over purely statistical models in terms of understanding ecosystem functioning and the role of different stressors. AQUATOX explicitly simulates ecological processes such as photosynthesis, consumption, predation, and nutrient dynamics, thereby providing a more explicit causal linkage between aquatic stressors and biological responses. A model user can analyze effects of various stressors relative to one another, and assess how different levels of stressor reduction might affect the biota, over the short or long term. Because it is an ecosystem model with multiple food web interactions, AQUATOX can predict indirect effects that would not be predicted by a purely statistical approach. The time-variable nature enables one to project what happens between monitoring periods, and possibly help explain variability in the observed data.

AQUATOX has a very flexible structure and provides multiple analytical tools, including a user friendly graphical interface, powerful output graphics and statistics, and easy export to external programs such as EXCEL. Because ecological processes are explicitly simulated, the user can graph time-varying biological rates and limitations on production in order to analyze ecological responses. Automated uncertainty and sensitivity routines can help identify the most important stressor, or combination of stressors and, therefore, the most effective stressor to reduce. Sensitivity analytical tools can also identify the most important model inputs, which in turn can be used to tailor data collection efforts to obtain more accurate or comprehensive site data, in order to decrease uncertainty of model output. Integrated linkage to the HSPF or other watershed models in BASINS can help evaluate whether proposed pollution reduction alternatives will be able to meet water quality goals.

Examples will be given from applications to a reservoir and rivers in the Midwestern and Southern US.

KEYWORDS

AQUATOX, ecosystem simulation, food webs, aquatic stressors