

Development of an Ecosystem Model for Integrated Management of Nutrients and PCBs in Lake Erie.

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Historically, mathematical modeling of aquatic resources within the Great Lakes has focused on assessment and evaluation of management strategies for individual management issues (e.g., eutrophication, fisheries, toxic chemical exposure). With the advent of the "Ecosystem Approach" for governing and managing the Great Lakes, we have begun to observe and recognize that actions directed toward one management area can impact other problem areas. This realization has led us to a vision for the next generation of aquatic resource models, which incorporates these ecosystem linkages by coupling models of heretofore separate issues. In this paper we will present the conceptual framework for this ecosystem model. The conceptual model contains biotic and abiotic components that are necessary to investigate some of the important ecosystem linkages between nutrient dynamics, phytoplankton functional groups, zooplankton, benthic populations (including zebra mussels), forage fish, sport fish, and bioaccumulative chemicals of concern (such as PCBs). Progress toward this vision is exemplified by results of three ongoing aquatic ecosystem modeling projects: investigation of the effect of nutrient loadings and zebra mussel functioning on phytoplankton dynamics in Saginaw Bay; application of a screening-level model of the potential impact of zebra mussels in Lake Erie on cycling and potential bioaccumulation of PCBs; and conceptualization of a Lake Michigan Ecosystem Model as part of the Lake Michigan Mass Balance Study. Additional model development, process research and field data acquisition is needed in many areas. Some broad areas for research include: fish bioenergetics and population dynamics and coupling with lower food web; benthic production and coupling with pelagic food web; dynamic effects of trophic structure and function on contaminant bioaccumulation; and zebra mussel population dynamics and processing of nutrients and contaminants. Also, a large integrated field program that includes measurement of nutrient and contaminant loads, all important state variables, and process rates where possible is necessary to calibrate our ecosystem model.