LESSONS LEARNED FROM ASSESSING MULTIPLE ECOSYSTEM STRESSORS OF THE GREAT LAKES

The Great Lakes are subject to multiple stressors, and assessing their impacts is challenging when these stressors have different spatial distributions and their impacts may vary across habitats. The ability to map the presence or intensity of individual stressors across the Great Lakes, weight individual stressors for their impact, and combine multiple stressors into an integrated total impact map would significantly enhance our ability to manage and restore the Great Lakes ecosystem. Here, we outline the Great Lakes Environmental Assessment and Mapping Project (GLEAM), which seeks to merge GIS layers representing every major category of threat to the Great Lakes, ranging from climate change to land-based pollution to exotic species. By synthesizing this information into a single map of cumulative threat levels across the basin, we will provide a new tool to guide management efforts. Additional comparisons between the spatial distribution of cumulative threats and priority habitats, species of concern, and ecosystem services are proceeding concurrently. This effort, modeled upon recent global threat analyses for marine waters and rivers, will facilitate prioritizing restoration and conservation actions throughout the Great Lakes region.

CENTURY-SCALE CHANGES IN CATCHMENT NUTRIENT INPUTS AND OUTPUTS

Nutrient budgets allow us to estimate the difference between catchment inputs (including fertilizer, atmospheric deposition, and trade in human food and animal feed) and outputs (primarily crops) of N and P. This difference can serve as a predictor of river export of nutrients as well as indicate whether nutrient inputs are in balance with or exceed nutrient removal via crop harvest. A further opportunity lies with historical analysis, because it may be possible to construct nutrient budgets over long time periods. Using nitrogen (N) budgets from 1880 to 2002 for Lake Michigan watersheds that have undergone urbanization, intensive agricultural specialization or experienced minimal change, we document an uneven timeline of increase in anthropogenic N inputs. N loading to 25 watersheds grew six-fold from 1880 to 2002, but has changed little since about 1980, showing a modest decline due to a leveling out of fertilizer use and greater export of animal feed and products. A similar analysis of net anthropogenic phosphorus inputs for 18 Lake Erie watersheds from 1935 to 2007 found peak values in the 1970s, and a subsequent declined in 2007 to a level last experienced in 1935. Riverine N export is predicted well from N budgets, allowing reconstruction of historical river export, but we find this approach to be much less successful for riverine P loads.