

Ecological thresholds governing the fate and transport of phosphorus from watershed to lake

Daniel B.G. Collins¹, Stephen R. Carpenter², Jonathan A. Foley¹, and Monica G. Turner²

1. Center for Sustainability and the Global Environment, University of Wisconsin, Madison, WI 53726
2. Department of Zoology, University of Wisconsin, Madison, WI 53706

Background/Question/Methods

Ecological thresholds are of particular interest to lake nutrient status because they can separate desirable clear water conditions from less desirable turbid conditions. The threshold manifests itself in the switching on and off of internal phosphorus (P) loading, which supplements the external loading of point and non-point sources of P from the watershed. However, while external P loading is often considered a proximal driver of the threshold behavior, external loading is itself a response to a suite of threshold-based processes across the watershed.

Results/Conclusions

In this paper we extend the analysis of ecological thresholds from the lake to the watershed, and identify threshold phenomena governing the supply, mobilization, retention, and transport of P from land to lake. The significance of these terrestrial thresholds is then illustrated by modeling phosphorus export from an agricultural watershed in southern Wisconsin, subject to a range of climate and land use change scenarios. These analyses show that threshold-based management of eutrophic lakes need not stop at the lake shore, but can extend to the watershed boundary. Targeting the entire suite of terrestrial and aquatic thresholds in this way offers a more robust and systems-based approach for managing the nutrient status of eutrophic lakes and increasing the resilience of clear water conditions.