Recovery of Lakes and Coastal Marine Ecosystems from Eutrophication: A Global Meta-Analysis

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Abstract

In order to inform policies aimed at reducing nutrient emissions to surface waters, it is essential to understand how aquatic ecosystems respond to eutrophication management. Using data from 89 studies worldwide, we examined responses to the reduction or cessation of anthropogenic nutrient inputs relative to baseline conditions. Baseline conditions were pre-disturbance conditions, undisturbed reference sites, restoration targets, or experimental controls. We estimated recovery completeness (% baseline conditions reached) and recovery rate (annual % change relative to baseline conditions) for plant and animal abundance and diversity and for ecosystem functions. Categories were considered fully recovered if the 95% confidence interval (CI) of recovery completeness overlapped 100% and partially recovered if the CI did not overlap either 100% or zero. Cessation of nutrient inputs did not result in more complete or faster recovery than partial nutrient reductions, due likely to insufficient passage of time, nutrients from other sources, or shifting baselines. Together, lakes and coastal marine areas achieved 34% (±16% CI) and 24% (±15% CI) of baseline conditions decades after the cessation or partial reduction of nutrients, respectively. One third of individual response variables showed no change or worsened conditions, suggesting that achieving baseline conditions may not be possible in all cases. Implied recovery times after cessation of nutrient inputs varied widely, from < 1 yr to nearly a century, depending on response. Our results suggest that long-term monitoring is needed to better understand recovery timescales and trajectories and that policy measures must consider the potential for slow and partial recovery.


Associated Project: A Restoration Synthesis [1]

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[1] https://www.sesync.org/project/restoration-synthesis