

Dose Response Relationships Associated with the Acidification of Freshwater Lakes and Streams

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Secondary national ambient air quality standards (NAAQS) were established to protect public welfare (e.g. soils, water, crops, vegetation, animals, wildlife, weather, visibility, and climate). The current secondary NAAQS for oxides of nitrogen (NO_x) is an annual average of nitrogen dioxide not to exceed 0.053 ppm, and for oxides of sulfur (SO_x), a 3-hour average of sulfur dioxide not to exceed 0.5 ppm more than once per year. These standards are designed to protect against gas-phase effects and are rarely exceeded. However, damaging ecological effects of NO_x and SO_x also occur through acidifying deposition. Those deposition effects are widespread in the U.S. and include acidification of aquatic ecosystems through terrestrial deposition, which is followed by leaching of NO_3^- and SO_4^{2-} from soil to surface waters.

We have assembled an inventory of published dose-response data and relationships that can be or have been used to characterize acidification in freshwater lakes and streams. The relationships of interest are among water quality factors (biogeochemical indicators) and responses of biota to changes in those factors (biological indicators). Examples of biogeochemical indicators include NO_3^- , SO_4^{2-} , base cations, acid neutralizing capacity (ANC), inorganic aluminum, and pH. Examples of biological indicators include presence/absence of organisms, survival, growth, reproduction, and biodiversity. In the studies inventoried to date, pH and mortality were the most common indicators evaluated. This research was supported in part by an appointment to the Research Participation Program for the U.S. EPA, Office of Research and Development, administered by the Oak Ridge Institute for Science and Education through an interagency agreement between the U.S. Department of Energy and EPA. The study was reviewed by the National Center for Environmental Assessment, EPA, and approved for publication. Approval does not signify that the contents necessarily reflect the view and policies of the EPA, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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