

The Devastating Effects of Acid Rain on Our Ecosystems

Belay Yadeta Negera*

Department of Ecology, University of Innsbruck, Innsbruck, Austria

Commentary

Received: 01-Aug-2022,
Manuscript No. JEAES-22-
60701; **Editor assigned:** 03- Aug
-2022, PreQC No. JEAES-22-
60701 (PQ); **Reviewed:** 17- Aug -
2022, QC No. JEAES-22- 60701;
Revised: 24-Aug -2022,
Manuscript No. JEAES-22-
60701 (R); **Published:** 31- Aug -
2022, DOI: 10.4172/ 2347-
7830.2022.10.S3.001
***For Correspondence:**
Belay Yadeta Negera,
Department of Ecology,
University of Innsbruck,
Innsbruck, Austria
E-mail: belayad@gmail.com

DESCRIPTION

Acid rain is rain or any other form of precipitation that is unusually acidic, meaning that it has elevated levels of hydrogen ions (low pH). Most water, including drinking water, has a neutral pH that exists between 6.5 and 8.5, but acid rain has a pH level lower than this and ranges from 4–5 on average. The more acidic the acid rain is, the lower its pH is. Acid rain can have harmful effects on plants, aquatic animals, and infrastructure. Acid rain is caused by emissions of sulfur dioxide and nitrogen oxide, which react with the water molecules in the atmosphere to produce acids.

Acid rain has been shown to have adverse impacts on forests, freshwaters, soils, microbes, insects and aquatic life-forms. In ecosystems, persistent acid rain reduces tree bark durability, leaving flora more susceptible to environmental stressors such as drought, heat/cold and pest infestation. Acid rain is also capable of detriming soil composition by stripping it of nutrients such as calcium and magnesium which play a role in plant growth and maintaining healthy soil. In terms of human infrastructure, acid rain also causes paint to peel, corrosion of steel structures such as bridges, and weathering of stone buildings and statues as well as having impacts on human health.

Some governments, including those in Europe and North America, have made efforts since the 1970s to reduce the release of sulfur dioxide and nitrogen oxide into the atmosphere through air pollution regulations. These efforts have had positive results due to the widespread research on acid rain starting in the 1960s and the publicized information on its harmful effects. The main source of sulfur and nitrogen compounds that result in acid rain are anthropogenic, but nitrogen oxides can also be produced naturally by lightning strikes and sulphur dioxide is produced by volcanic eruptions.

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Both the lower pH and higher aluminium concentrations in surface water that occur as a result of acid rain can cause damage to fish and other aquatic animals. At pH lower than 5 most fish eggs will not hatch and lower pH can kill adult fish. As lakes and rivers become more acidic biodiversity is reduced. Acid rain has eliminated insect life and some fish species, including the brook trout in some lakes, streams, and creeks in geographically sensitive areas, such as the Adirondack Mountains of the United States. However, the extent to which acid rain contributes directly or indirectly via runoff from the catchment to lake and river acidity (i.e., depending on characteristics of the surrounding watershed) is variable. The United States Environmental Protection Agency's (EPA) website states: Of the lakes and streams surveyed, acid rain caused acidity in 75% of the acidic lakes and about 50% of the acidic streams. Lakes hosted by silicate basement rocks are more acidic than lakes within limestone or other basement rocks with a carbonate composition due to buffering effects by carbonate minerals, even with the same amount of acid rain.

Soil biology and chemistry can be seriously damaged by acid rain. Some microbes are unable to tolerate changes to low pH and are killed. The enzymes of these microbes are denatured (changed in shape so they no longer function) by the acid. The hydronium ions of acid rain also mobilize toxins, such as aluminium, and leach away essential nutrients and minerals such as magnesium

Adverse effects may be indirectly related to acid rain, like the acid's effects on soil (see above) or high concentration of gaseous precursors to acid rain. High altitude forests are especially vulnerable as they are often surrounded by clouds and fog which are more acidic than rain.

Other plants can also be damaged by acid rain, but the effect on food crops is minimized by the application of lime and fertilizers to replace lost nutrients. In cultivated areas, limestone may also be added to increase the ability of the soil to keep the pH stable, but this tactic is largely unusable in the case of wilderness lands. When calcium is leached from the needles of red spruce, these trees become less cold tolerant and exhibit winter injury and even death