

rates. The results of those studies conducted in North America are summarized below.

There have been no reported chemical or biological effects for regions currently receiving loadings of sulphate in precipitation at rates less than about 20 kg/ha.yr.

Evidence of chemical change exists for some waters in regions currently estimated or measured to be receiving between about 20-30 kg/ha.yr sulphate in precipitation. In Nova Scotia rivers, 40 years of historical records document reductions in angling success for Atlantic salmon in nine rivers of low pH. Records over later periods for other nearby rivers document decreases in alkalinity and pH. In Maine there is evidence of pH declines over time and loss of alkalinity from some surface waters. In Muskoka-Haliburton historical evidence documents loss of alkalinity for one lake and pH depressions in a number of lakes and streams. Fish confined to the inlet of one lake died during spring melt. In the Algoma region there are elevated sulphate and aluminum levels in some headwater lakes.

Long-term chemical and/or biological effects and short-term chemical effects have been observed in some low alkalinity surface waters experiencing loadings greater than about 30 kg/ha.yr. In Quebec, sulphate concentrations in surface waters decrease towards the east and north in parallel with the deposition pattern of sulphate. Sulphate concentrations are equal to or greater than the bicarbonate concentration in some lakes in the southwest part of the province. In the Adirondack Mountains of New York comparison of data from the 1930s with recent surveys has shown that more lakes are now in low pH categories. The relative contribution of natural and anthropogenic sources to acidification of these lakes is not known. The New York Department of Environmental Conservation has concluded that at least 180 former brook trout ponds are acidic and no longer support brook trout, although a direct association with acidic deposition has not been established. In the Hubbard Brook study area in New Hampshire there are pH depressions in some streams during snowmelt of 1 to 2 units.

In the watershed studies summarized above, sulphate in precipitation was used as a surrogate for total acid loading. Sulphate in precipitation can be reliably measured. It is recognized that dry deposition of sulphate and sulphur dioxide, and the wet and dry deposition of nitrogen oxides, nitric acid, particulate nitrate and ammonia, as well as other compounds, also contribute to acidic deposition. The use of a single substance as a surrogate for acidic loadings adds unknown error owing to site-to-site variability in: (1) composition of deposition, and (2) ability of watersheds to neutralize incoming acidity. Wet and dry deposition of sulphur compounds appeared to predominate in long-term acidification.