Year-Long Salinization of Groundwater and Surface Waters of Hudson River Watersheds due to Chronic Road Salt Application

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Salt pollution from de-icing methods threatens freshwater systems by increasing salinity in aquatic ecosystems and drinking water. However, there is limited understanding of the seasonal dynamics of salt ion persistence in the environment across varying levels of impervious surface area created by roads, sidewalks, and parking lots. This study examined the seasonal fluctuations of salt concentrations in seven streams within the Lower Hudson Valley spanning varying degrees of imperviousness of watersheds. Water samples were collected each month and major ions were measured by ion chromatography. Data loggers were deployed at the primary study site, Sing Sing Kill Lower, which continuously measured water level and conductivity and enabled us to estimate the total amount of road salt exported by Sing Sing Kill over a 10-month period. Additionally, Geographic Information System (GIS) software was employed to calculate the impervious surface area within each watershed. A strong positive association was found between watershed imperviousness and mean salt concentration, as indicated by Na+ concentrations ($r=0.890$, $p<0.05$). Streams draining watersheds that contained high percentages of impervious surfaces carried the highest Na+ and Cl- levels in both the winter and summer months ($p<0.05$). It was found that an estimated 1,662 MT (106 grams, or metric tons) of road salt were exported by Sing Sing Kill, a stream draining a highly developed watershed, over a 10- month period. In terms of seasonality, road salt contamination remained elevated in the streams year-round and salt concentrations were chronically high in the summer, the season of highest biological activity, reflecting the movement of salt into streams through groundwater pathways.

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