Impervious surfaces driving up levels of salinity in streams

De-icers pose serious threat to freshwater ecosystems in the Northeast, and not just in the winter

By Lara Lutz *(reprinted from Bay Journal, January 2006, published by the Alliance for the Chesapeake Bay. www.bayjournal.com)*

The road salt crunching under car tires this winter will be around a lot longer than drivers might think. Once the snow has gone, the salt will likely appear in nearby streams, and possibly drinking water—a problem made worse by the growing amount of roads and parking lots that have spread throughout vulnerable watersheds.

A team of scientists who conducted a long-term study in Maryland, New York and New Hampshire say that salt from de-icers poses one of the most significant threats to freshwater ecosystems in the northeastern United States.

According to the report, recently published in the *Proceedings of the National Academy of Sciences*, the long-term presence of salt in freshwater streams and rivers has risen dramatically over the last 30 years, in both rural and urban areas. The research also demonstrates that the highest salinity occurs in watersheds with the most roads and parking lots.

Winter readings showed concentrations of chloride, an element of salt, at levels up to 25 percent of the concentration in seawater. But salinity levels don't just rise with winter weather—they are higher year round, with summertime chloride levels up to 100 times greater than unimpacted forested streams.

Increased salinity in freshwater systems can harm aquatic life and contaminate human drinking water. If salinity continues to grow at the current rate, scientists warn that much of the region's water may become toxic to freshwater life and unfit for human consumption within the next 100 to 200 years.

"Basically, we're hardening the watersheds and feeding them a high salt diet," said Sujay Kaushal, a principal researcher and professor at the University of Maryland Center for Environmental Science's Appalachian Laboratory.

According to satellite data from the U.S. Geological Survey, impervious surface in the Chesapeake Bay watershed alone increased by approximately 41 percent during the 1990s—while accommodating only an 8 percent growth in population. Nationwide, impervious surfaces cover a combined area roughly equivalent to the size of Ohio. That area has expanded rapidly in recent years, and the trend is expected to continue.

On state roads, Maryland applies approximately 236,000 tons of road salt each year, and Pennsylvania applies approximately 750,000 tons. This is in addition to quantities used by counties, local municipalities and homeowners.

With as little as 10 percent impervious cover in a watershed, the variety of stream life may begin to decline. Salinity may be one of many factors that trigger this decline, because this latest research shows that relatively small areas of paved surface can generate a notable increase in salinity. At 40 percent impervious cover, high- salinity levels can deliver chronic problems for freshwater plants and animals.

Wintertime spikes in salinity can damage more vulnerable plants and organisms, but the year-round increase is of equal concern for its effects over time. Researchers believe that one cause may be accumulations of salt in shallow ground water, which may bleed back into streams during the summer. Discharges from salt in water softeners and septic systems may also contribute to the problem.

"The ranges we see in some urban and suburban Baltimore streams are like those you would see in a tidal river. It's unclear what these levels, and the large winter fluctuations, will do to species or critical ecosystem functions in the long term.," Kaushal said. "We may be fundamentally changing these aquatic systems in ways we don't realize."

The use of salt for de-icing is not regulated, although the EPA recommends that chloride levels in water reach no higher than 250 milligrams per liter. Many urban and suburban streams, including some in Baltimore, already exceed that level in the winter.

Bill Stack, chief of water quality management for Baltimore City and co-author of the study on freshwater salinity, said the city has been tracking the increase since 1982.

"We monitor two dozen streams that drain to our three drinking reservoirs, and we've noted this trend in every stream for each of the reservoirs," Stack said. "We also see it in the reservoirs themselves and in the finished water from the treatment plant."

While many of the Baltimore streams register above the recommended chloride limit, the long-term average is approximately 25 to 30 milligrams per liter and treated water is safe to drink. But Stack said there is reason for concern. Levels continue to rise and more recent monitoring indicates that sodium, which poses greater public health risks than chloride, is also on the rise.

Baltimore is exploring options for reducing salinity in local waterways, but there is no easy or immediate answer. Some parts of the country have established "no salt zones" near reservoirs. Others work with alternatives to road salt, such as sand, calcium chloride, or corn-based de-icers. In Massachusetts, the state government has begun dealing with the consequences of increased salinity by replacing contaminated drinking wells.

Kaushal said that any effort to reduce freshwater salinity must address its connection to impervious surfaces.

"There is a direct connection between parking lots, pavement and our water supplies," he said. "Even small changes in impervious surface can lead to large changes in mean annual salinity."

Kaushal points to two streams in Baltimore County's Oregon Ridge Park that were part of the study. The watershed surrounding one stream had no impervious surface at all. The other, with light residential development, had only 1–2 percent impervious surface—yet its chloride levels were 10 times greater throughout the year.

"The point is, human development has a profound effect on salinity," Kaushal said. "In particular, we need to think about runoff from roads and where we place roads and parking lots. Do we really want them near our headwater areas or places that supply public drinking water?"

Streams in the Baltimore study area are in largely rural watersheds showing pockets of urbanization. With salinity on the rise in these less developed areas, Stack's team decided to look at more urban streams, where the amount of impervious surface is much higher. By comparing levels in urban and rural settings, they glimpsed what the future may hold for outlying areas faced with growing development pressure.

"We started asking, how bad can it get? The urban streams showed us that things can get a lot worse," Stack sad. "We really need to continue our efforts to minimize the growth of impervious areas in our reservoir areas."

A team of researchers, including Kaushal and others from the University of Maryland Center for Environmental Science, the Baltimore Ecosystem Study, and the Maryland Biological Stream Survey, plan future studies on the effects of salinity in streams across Maryland.