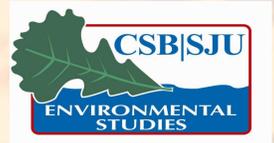


EFFECTS OF FOREST FIRES ON MERCURY CONTAMINATION OF MINNESOTA LAKES

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Abstract

Mercury (Hg) contamination is a common problem found in Minnesota lakes and it is important because of the effects it has on human health. Activities such as burning coal and processing taconite are common anthropogenic sources of Hg, and their effects on aquatic ecosystems are well documented. Less well known are the effects of natural sources of Hg contamination. This project focuses on the contribution of forest fires to Hg contamination. By calculating the amount of mercury released by coniferous forest fires in northern Minnesota and comparing it to other sources of Hg in the state, I was able to determine that forest fires are not a significant contributor to atmospheric Hg and therefore not a significant contributor of Hg contaminated deposition to a lake. However, the effect of particulate Hg and Hg from other sources resulting from forest fires (vegetation loss, soil erosion, etc.) on lakes within a particular burnt catchment may have a more significant contribution.

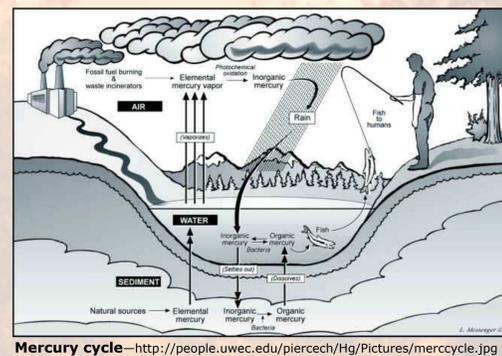
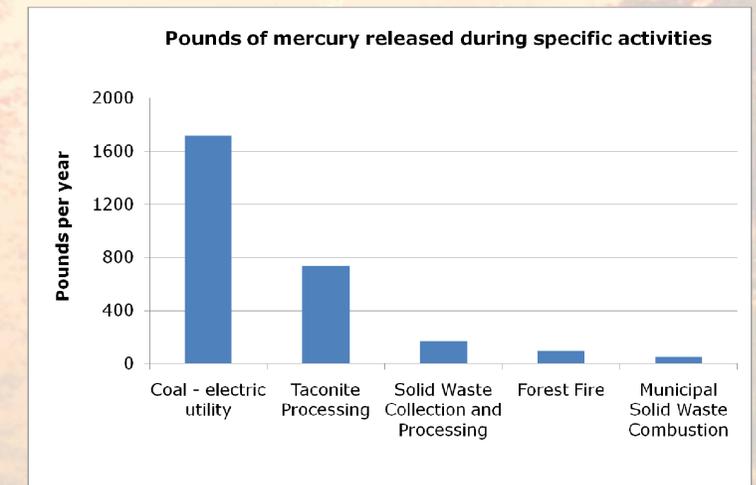
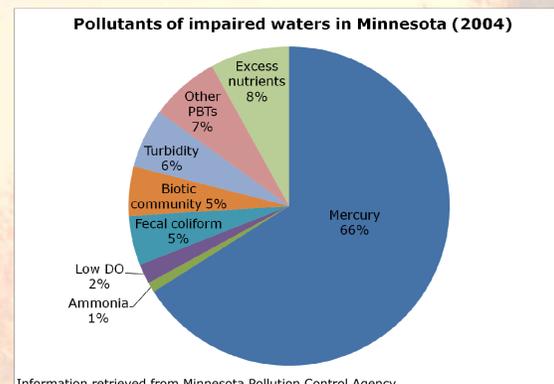
Mercury

Mercury is a neurotoxin that is the main contaminant in the majority of polluted lakes in Minnesota. It is dangerous when it enters the water because it can easily go through a process of methylation in which the inorganic Hg transforms into an organic form that is easily taken up by aquatic plants and animals. This methylmercury continues to build up within organisms higher on the food chain. Humans are exposed to methylmercury mainly through eating contaminated fish and the effects of Hg poisoning can be dangerous, especially to young children and developing fetuses.

Results

Over the ten year period, forest fires burned an average of 43,780 acres/year, resulting in an average annual release of about 96.5 pounds of Hg. Specific years experienced a much larger number of acres burned, thus resulting in more Hg release, while others much smaller. The number of acres burned per year is believed to be increasing because of an increase in both the number and severity of droughts due to climate change.

In 2005, the largest source of Hg in Minnesota was coal burning for electrical use with 1716.3 lbs/yr, while the second largest was taconite processing at 734.8 lbs/yr. Mercury from forest fires is significantly lower and consequently contributes less to pollution. Forest fires contribute almost twice as much Hg as combustion of municipal waste.



Methods

To calculate the total amount of atmospheric Hg released during a forest fire, I first gathered information on the acres burned from 1999-2008 focusing on northern Minnesota. I multiplied this information by the estimated amount of Hg released per acre to find total Hg released by a forest fire in each of the ten years. I then averaged these numbers to account for large differences in acre burned from year to year to get a final Hg value.

After I completed these calculations, I compared the final number with estimated amounts of Hg released from major anthropogenic sources to determine whether or not the amount of mercury Hg from forest fires was significant.

Conclusion

Hg released from a forest fire is found primarily as atmospheric Hg. In Minnesota the amount that is released is not significant compared to other activities such as burning coal and taconite processing. Therefore, Hg release from forest fires contributes minimally to the polluted deposition entering lakes. The amount of Hg entering a lake through other means created by a forest fire is, at the moment, not entirely known. Soil erosion and leaf litter runoff may increase lake Hg contamination by dumping Hg rich materials directly into the lake. However, it is difficult to measure the amount of Hg released from a fire due to the unpredictable nature of the event. Research is ongoing on this subject to better understand the role of forest fires on Hg contamination in lakes.

