

Lake browning effect on accumulation of carbon and mercury in lake sediments

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An increase in the water colour or lake browning has been observed in the northern hemisphere boreal zone during the last 30 years. It was hypothesized that the decrease of acids in precipitation is one of the primary causes of the increase in the water colour. It is also theorized that this, in turn, influences the concentration of mercury in lakes. In this study we investigated the link between the increase in the water colour and mercury along with carbon accumulation rates in two lakes: Solbergvann and S-Elvåga both located in Østmarka, Norway.

Mercury is a toxic metal and is naturally present in the environment. Mercury and acid in precipitation, which are transported to Norway from European mainland and Great Britain, decreased considerably since the 1970ies. Nevertheless, the mercury levels measured in fish in Norwegian lakes have increased in recent years.

The two studied lakes are located in the same area and therefore have received similar amounts of acid and mercury from precipitation. At the same time, the lakes are very different: Solbergvann is a small headwater lake with a small catchment where the lake itself occupies 10%. S-Elvåga is a large lake with a large catchment of which lake constitutes only 2%. S-Elvåga serves as a drinking water source for the city of Oslo.

The results of long term measurements of the water colour show up to 3 fold increase in both Solbergvann and S-Elvåga. Though of the same proportion, these changes are not on the same scale, S-Elvåga water colour being much lighter than Solbergvann's.

The results of the study show that the increase in the water colour leads to an increase in carbon and mercury accumulation in the surface sediments of Solbergvann and to an increase in mercury accumulation in the surface sediments in S-Elvåga. This is probably caused by an increased input of organic matter to the lakes. Strong negative correlation between the amount of sulphate in precipitation and the concentration of mercury in the sediments was observed. This indicates that the acid rain has an impact on the input of mercury in the sediments, which could be explained by the mobilization of organic matter in the soil caused by decreased ionic strength of the soil solution. Organic carbon mineralisation rates and burial efficiency were similar in both lakes.

This research shows that the mitigation of an important environmental problem such as acid rain caused other problems. In this case, an increase in water colour, carbon and mercury accumulation in boreal lakes.

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