

# Effects of Forest Fire and Fire-fighting operations on Water Chemistry and Phytoplankton in Lake Stensjön, Sweden

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In August 1999, wildfire burned about 20% of Tyresta National Park. A scientific program was designed to study the effects of the fire. One part of the program focus on the effects in brooks and lakes. This study is important since few similar studies exist in northern Europe.

40% of the lake drainage area was burned in the fire. The lake system drains through River Åvaån, an important spawning ground for sea run Brown Trout. Water chemical data before the fire is available from a national monitoring programme including the lakes in the park.

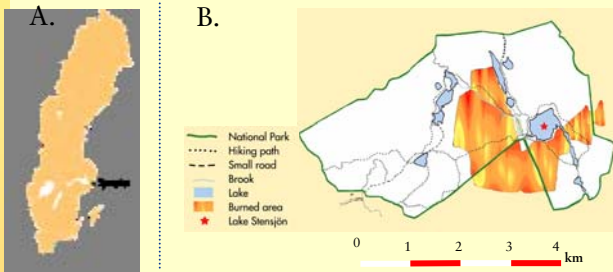


Figure 1: A. Tyresta National Park is located close to the coast about 20 km south east of Stockholm. B. Map of the National Park – Lake Stensjön marked with a red star

## Methods

Lake Stensjön is included in national monitoring programs. Sampling is done once a month April-October and once wintertime. Analysis are done using standardized methods at the Swedish University of Agricultural Sciences and at ITM, Stockholm University.

## Results

After the fire, the concentrations of sulphate, chloride, magnesium, potassium, sodium, manganese, zinc, cadmium, ammonium and nitrate increased significantly in the run-off water from the burned catchment, causing elevated levels in the lake water as well (Fig. 2). Due to repeated lime treatment of the lake since 1978, pH, alkalinity and Ca changed very little, in spite of a drastic pH-decrease in the run-off water from the catchment. An extreme phytoplankton bloom was observed during spring 2000. Combined with the surplus of organic material from the fire, the increased plankton production caused anaerobic conditions in hypolimnion (Fig. 3 & Fig. 4).



Hanna Eriksson taking water samples in the lake



Aerial photo of Lake Stensjön and the burned area

## Acknowledgements

We would like to thank The Foundation of the Tyresta forest, the Swedish Environmental Protection Agency, SLU and everyone involved in sampling and analyses.

## Links and publications

- Dept. of Applied Environmental Research (ITM): <http://www.itm.su.se>
- The Foundation of the Tyresta forest: <http://tyresta.se/english.shtml>
- Eriksson, H., F. Edberg, and H. Borg, 2003. *Effects of forest fire and fire-fighting operations on water chemistry in Tyresta National Park, Stockholm, Sweden.* Journal De Physique Iv 107: 427-430.

## Magnesium, sodium, potassium, sulphate and chloride

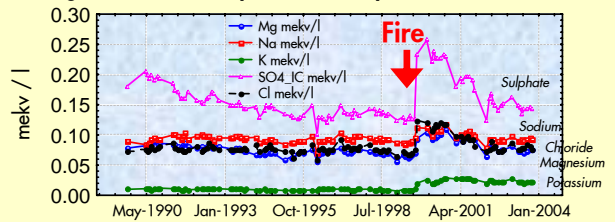


Figure 2: All an- and cations except calcium increased after the fire and are then decreasing slowly to the original concentrations.

## Oxygen (mg/l) at bottom

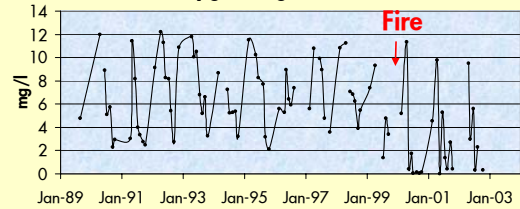


Figure 3: After the fire anaerobic conditions occurred in hypolimnion, for the first time in thirty years.

## Phytoplankton composition

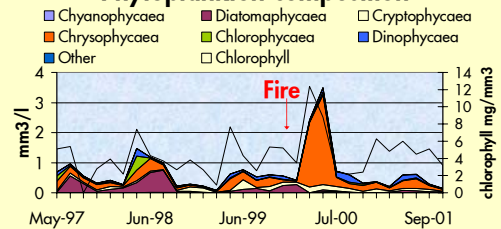


Figure 4: An extreme phytoplankton bloom was observed during spring 2000. Chrysophyceae dominated the bloom and one species Uroglena represented 85% of the biomass.

## Conclusions

- Post-fire effects in L. Stensjön were observed with changes on both water chemistry and phytoplankton community.
- The fire caused extensive changes in the land cover within the drainage area. Large areas were completely cleared of vegetation. The thin layers of soil and organic matter on the flat rocks were then mobilized and washed into the rivers and lakes with the extinguishing water and rain. Most of the trees in the burned area fell during the first storms after the fire. Effects can thereby be compared to those of clear-cutting.
- The post-fire effects in L. Stensjön were probably intensified by the use of brackish water during the fire-fighting operations.
- 4 years after, the water chemistry of the lake is still affected by the fire.