Reduction targets for Nitrogen and Phosphorous loads to the project area Ravn Sø.

Part of task 1.1 in the EU- LIFE project AGWAPLAN

English Summary

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SUMMARY

According to the Water Frame Directive the lakes in EU must achieve as a minimum a “good ecological status” by the year 2015. Phosphorus is the main environmental stressor in Danish lakes and the primary determining factor for numerous biological variables. In the AGWAPLAN project we have determined the cricitical phosphorus load of lake Ravn in Jutland, DK.

Lake Ravn (area 182 ha) is a deep (maximum depth 33 meters) lake stratifying in the summer time. It has been included in the Danish national monitoring programme since 1989. Mean (summer) concentration of phosphorus, chlorophyll and secchidepth is 25 µg P/l (total- P), 8-10 µg/l and 3-3,5 meters respectively. In warm periods the lake is often subjected to blooms of very poisonous bluegreen algae. Since 1989 there has been a signifi cant (P<0,001) reduction of the mean P-inlet concentration mainly due to improved waste water purification. There is a substantial variation of annual P-load with high loads in years with a high precipitation like 1994 and low loads in the dry period 1996-1997 (Figure 1).

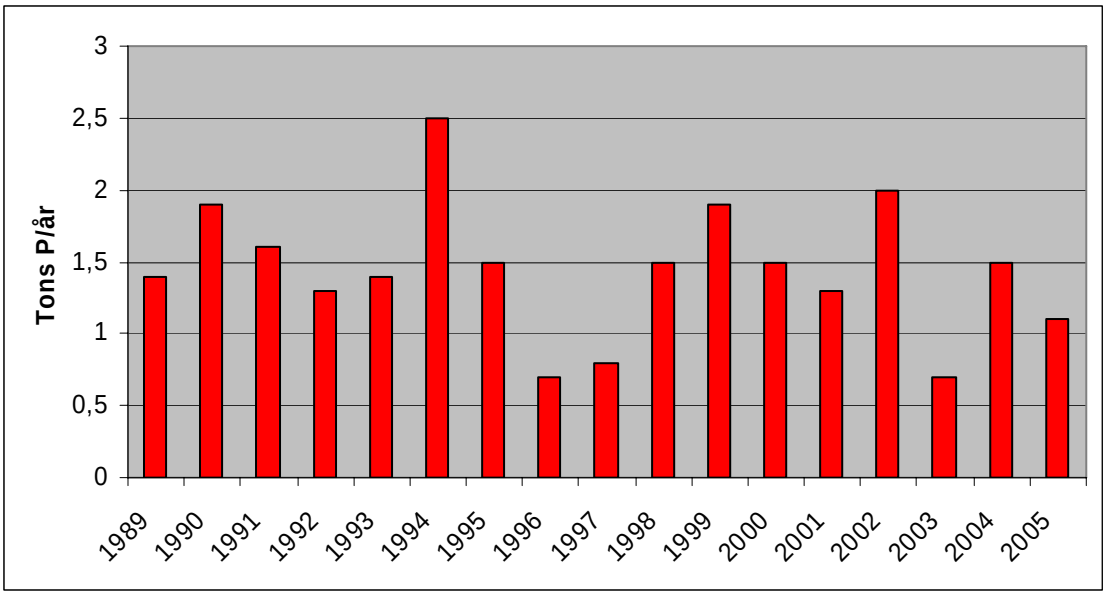

Figure 1: Annual load of phosphorus and P-inlet concentration in Lake Ravn.

Ecological model

A hydrodynamic and ecological model was established. The model was able to describe the seasonal dynamic and suitable for predictions of ecological status of the lake in various scenarios of external nutrient load. Data on phytoplankton biomass (carbon weight) were used to model a chlorophyll concentration reflecting the true phytoplankton biomass, since chlorophyll is one of the present EU-intercalibrated indicators of ecological status in lakes.

Data from the calibration period (1992-2002) indicated a need of a 40-50% reduction of the average phosphorus load at that time in order to achieve 6,5 µg chla/l (Figure 2). In this scenario the phosphorus concentration in the lake could be reduced to app.15 µg P/l and the secchi depth increased to app. 4 meters enhancing the chance of a higher distribution of submerged macrophytes.

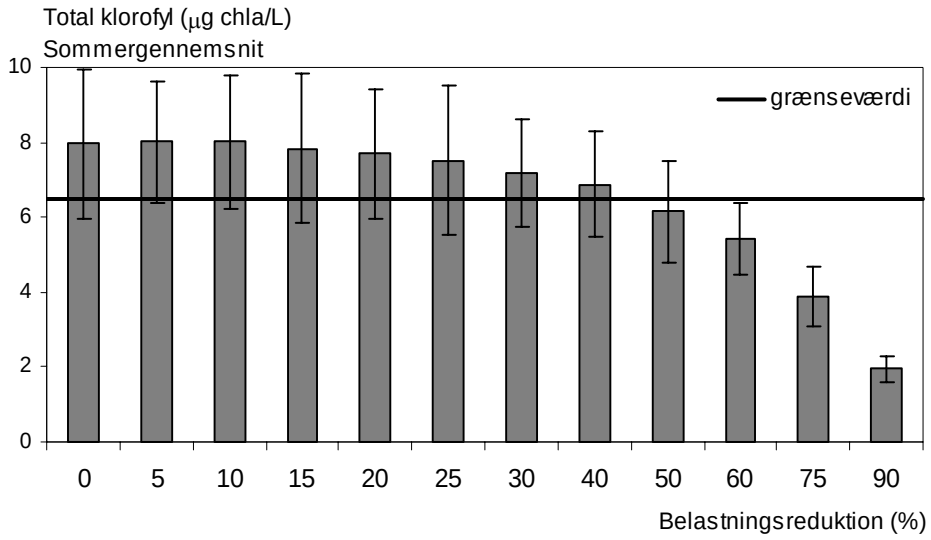

Figure 2: Calculated chlorophyll concentration (summer mean) after 0, 5, 10….90% reduction of external phosphorus load. The line represents good ecological status (6,5 µg chla/l).

Reduction target

The present phosphorus load was calculated using data from 2000-2005 (Figure 3). The main P-source now is natural washout and erosion of phosphorus in the catchment area (reference condition), waste water and diffusive washout and erosion from agricultural areas along the streams. The reduction target of phosphorus load is app. 0.1 kg P/ha in the catchment area, which may be achieved by improved waste water purification and by focusing on fields in agricultural areas with a high phosphorus concentration in the soil and high risks of erosion.

The reduction target for the phosphorus load to Lake Ravn was calculated to 850 kg P/year using a hydrodynamic and ecological model. The total amount of P to the lake at present is 1300 kg/year with approximately 350 kg from wastewater, 150 – 350 kg from agriculture and 600 – 800 kg from natural loss. It is difficult to separate contributions from agriculture and natural loss. If the natural loss is 600 kg the contribution from agriculture is 350 kg and vice versa.

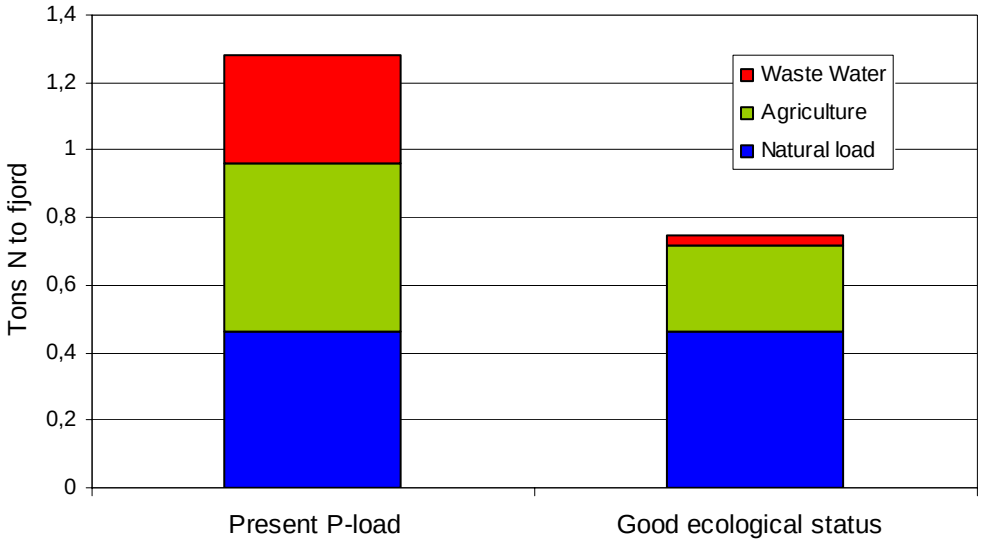

Figure 3. Present annual P-load and a calculated P-load resulting in a good ecological status. The colours of the columns indicate main P-sources.