

Indicator Fact Sheet

(WEU3) Phosphorus in lakes

(WEU12) Eutrophication indicators in lakes

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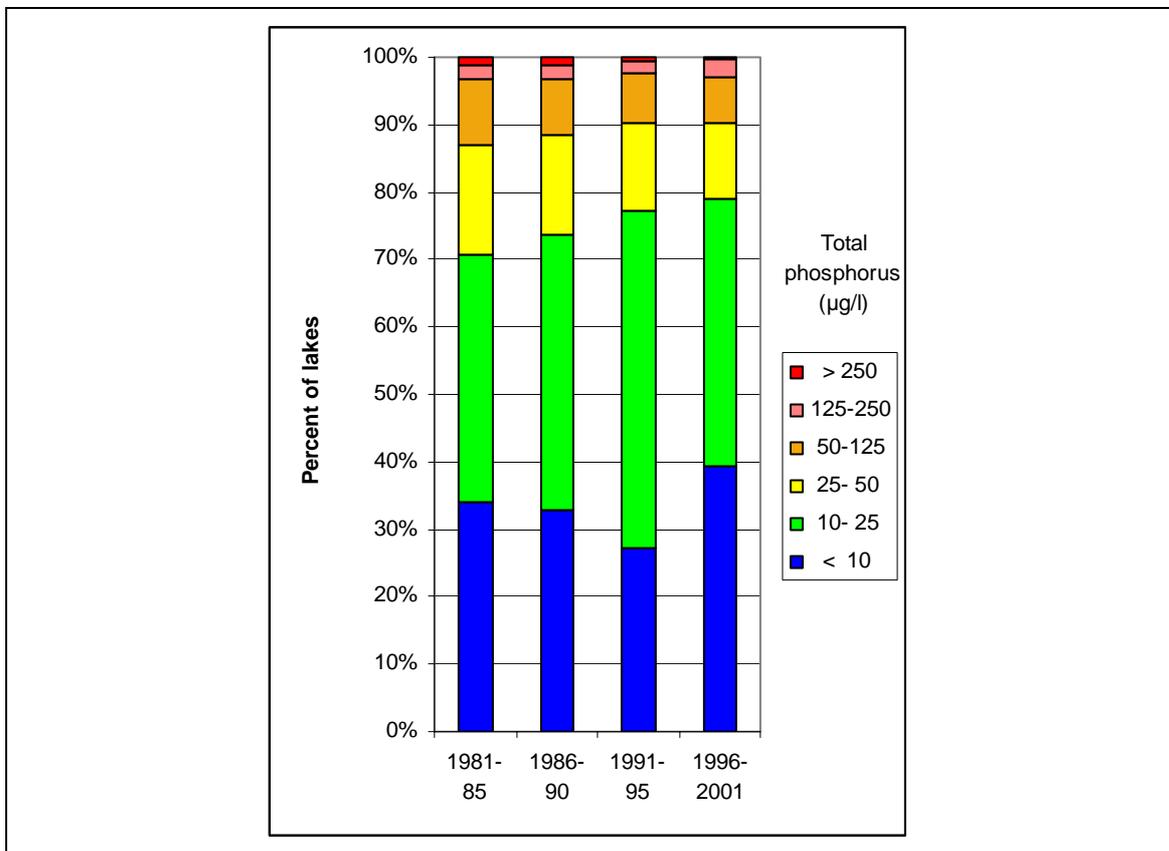
Indicator code / ID	WEU3, WEU12
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Key message

☺ Eutrophication of European lakes is decreasing. Phosphorus concentrations are decreasing, and the proportion of lakes and reservoirs with high phosphorus concentration has reduced since 1980.

⊖ However, there are still many lakes and reservoirs with high concentrations of phosphorus due to human influence.

Figure 1: Change in average summer or annual concentration of phosphorus ($\mu\text{g P/l}$).



Notes: Based on all lakes with data for all four periods, 386 in total. Most of the lakes are located in the Nordic countries, fewer are located in western and central Europe.

Sources: EUROWATERNET data collection

Results and assessment

Policy relevance and context

The indicator is not directly related to a specific policy target. The environmental quality of surface waters with respect to eutrophication and nutrient concentrations is an objective of several directives: Water Framework Directive, Nitrate Directive, Urban Wastewater Treatment Directive, Surface Water Directive, Freshwater Fish Directive.

In the coming years, phosphorus concentrations in lakes will be highly relevant to the work under the Water Framework Directive.

Environmental context

Many European lakes have been impacted by discharges of nutrients. In most lakes phosphorus is the limiting nutrient and the state of water quality is determined by the input of phosphorus. Phosphorus concentration is therefore a good indicator of eutrophication. In severe cases of eutrophication, massive blooms of algae (sessile and planktonic) occur. Some blooms are toxic. As dead algae decompose, the oxygen in the water is used up, bottom-dwelling animals die and fish either die or leave the affected area. Dense planktonic algae populations reduce the light penetration and the aquatic vegetation may be severely reduced by shading. This in turn gives less competition for nutrients. The fish stock may also be affected. The predatory pike needs vegetation for cover and relatively clear water for spotting its prey. Both conditions are impaired by eutrophication. Therefore the predation on planktivorous fish is reduced and there is an increase in planktivorous fish stock, which in turn leads to increased predation on zooplankton and thereby less grazing on plankton algae. These relationships are self-perpetuating and may lead to a shift to a "bad" steady state. In that case recovery after pollution reduction may be very slow and possibly it is necessary to use various restoration measures, such as removing most of the planktivorous fish stock, to force the ecosystems into a better state.

The impacts of eutrophication include a reduced recreational value, both for angling and general pleasure because most people rather enjoy clear water. In addition the water becomes unsuitable for human consumption.

Assessment

During the past few decades there has been a gradual reduction in phosphorus concentrations in many European lakes. Discharges of urban wastewater have been a major source of pollution by phosphorus, but as purification has improved and many outlets have been diverted away from lakes, this source of pollution is gradually becoming less important. Agricultural sources, both from animal manure and from diffuse pollution by erosion and leaching are similarly important and need attention to obtain good water quality in the lakes.

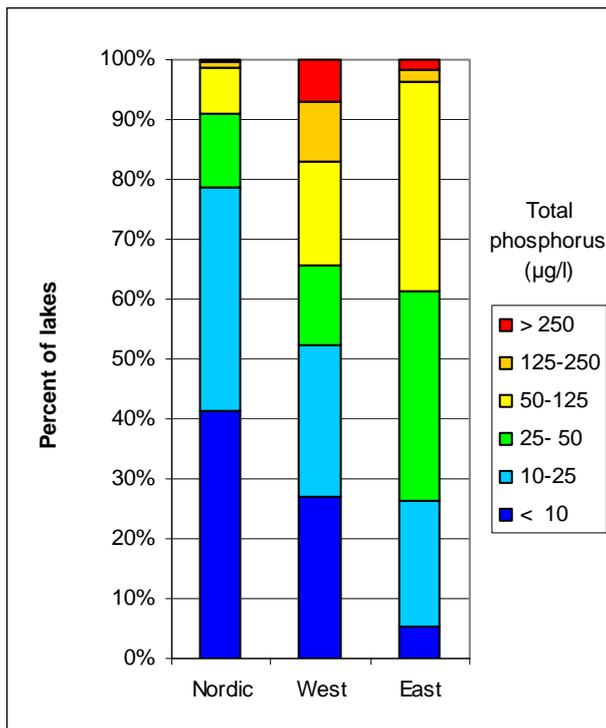
The improvements have generally been relatively slow despite the pollution abatement measures taken. This is at least partly because of the slow recovery due to internal loading and because the ecosystems can be resistant to improvement and thereby maintain a bad steady state. Particularly in shallow lakes, such problems may call for restoration measures.

Sub-indicator 1: Phosphorus in EUROWATERNET lakes

Key message

● There are significant differences in eutrophication, indicated by the concentration of phosphorus, across Europe.

Figure 2: Phosphorus concentrations ($\mu\text{g/l}$) in EWN lakes in parts of Europe



Assessment of the sub-indicator

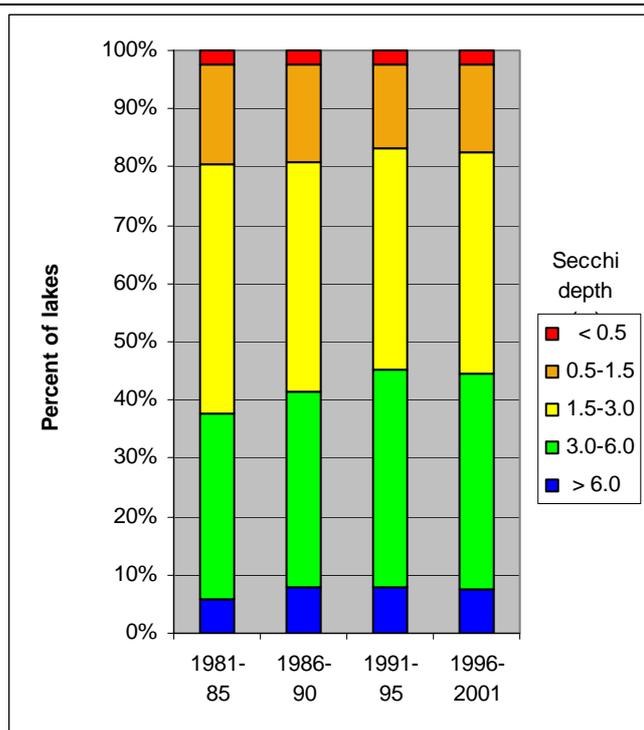
Phosphorus concentrations are high in the western European countries and low in the Nordic (Iceland, Norway, Sweden and Finland) countries. In the Nordic countries there are large areas with low population density and human activity, and many lakes in these areas are under virtually no influence from human impact regarding eutrophication. In Western Europe population density is higher and agriculture is more intensive. There is a higher proportion of eutrophicated lakes in this part of Europe.

Sub-indicator 2: Transparency in lakes

Key message

😊 The quality of water in terms of transparency has improved in European lakes since 1980 because of a reduction in concentrations of phosphorus resulting from measures to reduce discharges of phosphorus from point and other sources.

Figure 3: Change in average summer Secchi depth (m)



Assessment of the sub-indicator

High nutrient concentrations promote algal growth resulting in high turbidity. This is a nuisance to the recreational use of lakes for bathing, fishing and the immediate visual impression. Large amounts of algae also adversely affect the entire lake ecosystem. Along with improvement in phosphorus concentrations, some improvement in transparency has been achieved, but there are still many lakes with rather turbid water. However, high turbidity may also be caused by clay particles or brown water caused by humic substances.

References

EUROWATERNET Lakes

Data

Spreadsheet files:

WEU3_ptot.xls

WEU3_P_regions.xls

WEU12_secchi.xls

Meta data

Web presentation information

1. Abstract / description / teaser:

Phosphorus concentrations and Secchi depth values are presented as indicators of eutrophication in European lakes.

2. Policy issue / question:

Is the condition regarding eutrophication of Europe's lakes improving?

3. EEA dissemination themes (list one or more themes):

Water

4. DPSIR:

S

Technical information

5. Data source: Eurowaternet lakes

6. Description of data: Summer/annual averages of total phosphorus concentration

7. Geographical coverage: EEA countries

8. Temporal coverage: 1931-2001, best coverage since 1990

9. Methodology and frequency of data collection: annual update by initiative of the ETC/WTR

10. Methodology of data manipulation, including making 'early estimates': grouping of lakes in categories

Quality information

11. Strength and weakness (at data level): total phosphorus is used in most countries, which gives a good geographical coverage. There is not the same density of EUROWATERNET lakes in all countries, and the representativity may not be equally good in all countries. There is insufficient information on pressures to each lake. Longer time-series are mostly available from the Nordic countries.

12. Reliability, accuracy, robustness and uncertainty (at data level): The key messages are reliable and robust. The accuracy is not so good, but will improve as the implementation of EUROWATERNET progress. Exact statements on percentage of lakes should therefore be avoided in the assessment.

13. Overall scoring (give 1 to 3 points: 1=no major problems, 3=major reservations):

Relevancy: 1

Accuracy: 2

Comparability over time: 1

Comparability over space: 2

Further work required

Accuracy and comparability over space should be improved, mainly by continued implementation of EUROWATERNET. A closer linking to the demands of the Water Framework Directive is needed on longer term. To allow for better linking of pressure and state there is a need to improve information on the pressures on each lake or groups of lakes. Availability of such information should improve during the implementation of the Water Framework Directive.