European Environment Agency

Indicator Fact Sheet

(WEU02) Nitrogen and phosphorus in rivers

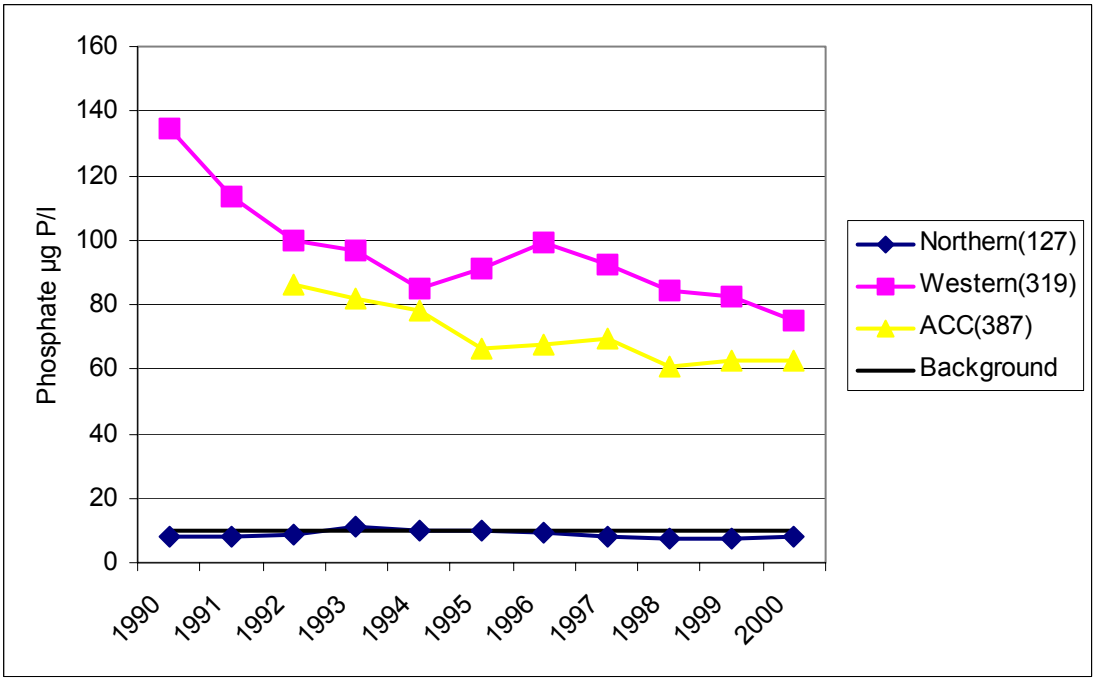
Key message

☺ The concentration of orthophosphate decreased in the rivers of the EU countries and Accession countries in the 1990's reflecting the general improvement in waste water treatment over this period.

☹ Nitrate or total oxidised nitrogen concentrations have not changed throughout the 1990's in the Accession countries but there has been a slight decrease in the EU countries.

☹ Current concentrations of orthophosphate and nitrate are still above what might be considered to be 'background' or natural levels except for in the Northern European Countries. There is no information on what the impacts are of these elevated concentrations in terms of changes in trophic and ecological status of the affected rivers.

Figure 1a: Trends in the median of the stations annual average orthophosphate concentrations.



Notes: Total number of stations in brackets. Number of stations from each country shown below.

Western Europe	no of stations
DE	73
DK	30
FR	163
UK	53
Total	319

Northern Europe	no of stations
FI	48
SE	79
Total	127

ACC	no of stations
BG	33
EE	39
HU	88
LT	56
LV	54
PL	89
SI	21
SK	7
Total	387

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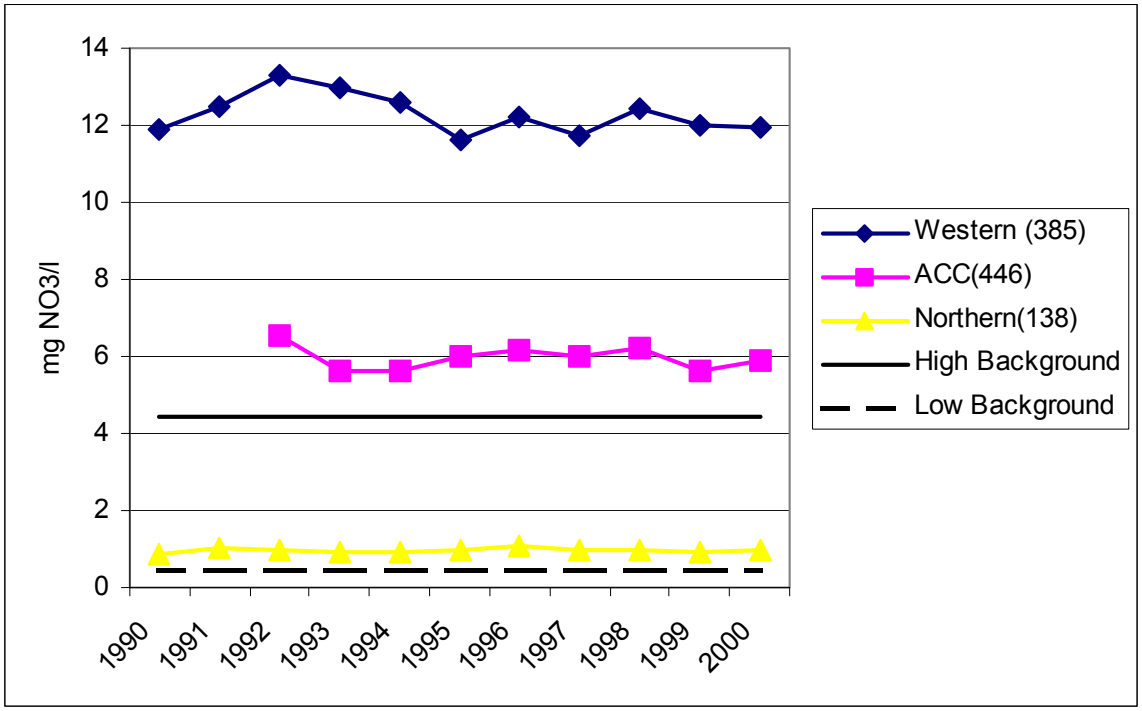
Sources: Based on EUROWATERNET data collection

Figure 1b: Trends in the median of the stations annual average nitrate concentrations.



Notes: Total number of stations in brackets. Number of stations from each country shown below.

Western Europe	no of stations
DE	105
DK	32
FR	188
UK	60
Total	385

Northern Europe	no of stations
FI	59
SE	79
Total	138

Accession countries	no of stations
BG	50
EE	43
HU	88
LT	56
LV	54
PL	93
SI	21
SK	41
Total	446

Sources: Based on EUROWATERNET data collection

Results and assessment

Policy context:

The Nitrate Directive (91/676/EEC *Nitrates from agricultural sources*) aims to reduce water pollution caused by nitrates by reducing the nitrogen input to agricultural land. The Directive sets limits for the amount of manure that can be applied to land every year. This will decrease the nitrogen run-off from agricultural land to surface and ground waters.

The Urban Waste Water Treatment Directive (91/71/EEC) requires waste water to be treated to the secondary level for all agglomerations of more than 2000 population equivalents (p.e.) discharging to freshwaters and estuaries and for all agglomerations of more than 10000 p.e.

discharging to coastal waters. Collecting systems must be provided for all agglomerations larger than 2000 p.e. Sensitive water bodies must be identified according to the criteria in the Directive and in these areas and the catchment of sensitive areas, more advanced treatment with nutrient removal must be provided. This Directive will lead to a reduction in nutrient discharges from point sources.

The IPPC Directive (96/61/EC *Integrated Pollution Prevention and Control*) aims to control and prevent pollution to water by reducing or eliminating emissions from industry. Industrial emissions can result in high phosphorus loads which cause eutrophication in water bodies.

The Water Framework Directive requires the achievement of good ecological status and good ecological potential of rivers across the EU by 2015. This includes all sizes and types of river (and other water types).

Environmental context:

Large inputs of nitrogen and phosphorus to water bodies can lead to eutrophication causing ecological changes that result in a loss of plant and animal species, and have negative impacts on the use of water for human consumption and other purposes.

In many catchments the main source of nitrogen pollution is run-off from agricultural land, though discharges from waste water treatment works can also be significant. For phosphorus, industry and households are often the most important sources. Control of these nutrient discharges is needed to reduce pollution levels in water bodies. These indicators illustrate the current situation and trends regarding nitrogen and phosphorus in rivers.

Assessment:

Natural concentrations of orthophosphate vary from catchment to catchment depending upon factors such as geology and soil type. Natural ranges are considered to be approximately 0 to 10 µg P/l.

Concentrations of nitrate below 0.3 mg N/l are considered to be natural or background levels for most European rivers though for some rivers levels of up to 1 mg N/l are reported. Concentrations of nitrate above 7.5 mg N/l are considered to be of relatively poor quality and exceed the guideline concentration for nitrate of 5.6 mg N/l as given in the Surface Water for Drinking Directive (75/440/EEC).

The figures indicate that orthophosphate has been generally decreasing in EU and Accession rivers in the 1990s (Figure 1a). Orthophosphate levels, however, are generally higher in the EU countries than in the Accession countries.

The corresponding data for nitrate or total oxidised nitrogen show a different pattern with no trend over time for this period for the Accession countries and a slight decrease in the Western EU countries (Figure 1b).

EU Countries

The decrease in orthophosphate and nitrate levels in the Western EU countries is likely to be due to the implementation of the Urban Waste Water Treatment Directive which has increased levels of waste water treatment in many cases with increased tertiary treatment which often involves nutrient stripping. In addition farming practices may have improved to reduce nutrient inputs from agriculture. The higher nitrate levels in the Western EU countries reflects higher agricultural intensity and greater nitrogenous fertiliser use than in Northern EU countries or the accession countries.

Accession countries

Profound socio-economic changes have occurred in the EU Accession Countries during the 1990s and these have been coupled with major changes (decentralisation) in the way water is managed. Elevated levels of nutrients in the rivers of the Accession countries is consistent with low levels of treatment of wastewater discharges and overdeveloped input intensive industries (including agriculture). The transition recession will have played a part in providing stable (nitrate) and decreasing (phosphorus) trends over the period for which data is available. The recession affected the three main sectors (agriculture, industry and households) in different ways.

As the economies were restructured, heavy industries were closed down and there was a move towards a better balance between the service and manufacturing sectors. Economic recovery will tend to increase emissions but not to the levels seen pre-transition.

Agriculture was heavily affected with a very rapid decline in output due to the necessary reorganisation of the sector away from large scale collectivised and input intensive farming. The economic situation of farmers may have forced them to cut back significantly on P use (which affects farm productivity only in the long term) with less of a reduction in N fertilisation (because of its immediate consequences for output).

Domestic wastewater discharges have not been affected in the same way. Discharges from household tend to be relatively insensitive to changing economic circumstances. Although the raising of water prices has reduced the volume of wastewater discharged it has not reduced, to the same extent, its strength.

There has been some increase in levels of wastewater treatment in Accession countries in general and for tertiary treatment (where the removal of nutrients is significant). However, further investment is needed to improve the level of wastewater treatment.

The high cost of investments in wastewater coupled with the generally low level of affordability mean that it is essential to find cost-effective, locally appropriate solutions to treat wastewater.

Sub-indicators: Nitrogen and Phosphorus in river stations by country

Key message

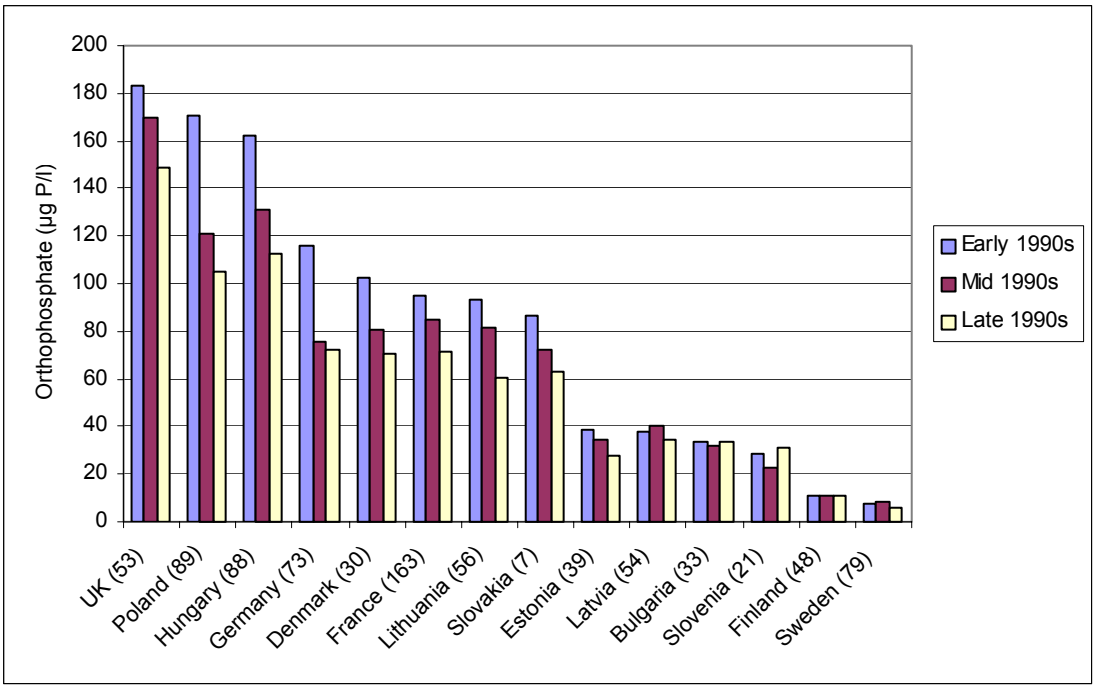
☺ Most countries show the decrease in orthophosphate levels shown by the main indicator.

😐 Phosphate levels are highest in the UK, Hungary and Poland and lowest in Estonia, Finland and Sweden.

☹ The decline in nitrate concentrations in the Western EU countries is due to declines in Denmark and Germany. Some of the Accession countries show an increasing trend e.g. Poland and some show a decreasing trend e.g. Latvia but most show no trend which is consistent with the main indicator.

😐 Nitrate levels are highest in the UK, Denmark and Germany and lowest in Sweden, Estonia and Finland.

Figure 2a: Median of the stations annual average orthophosphate concentrations (µg P/l) by country.

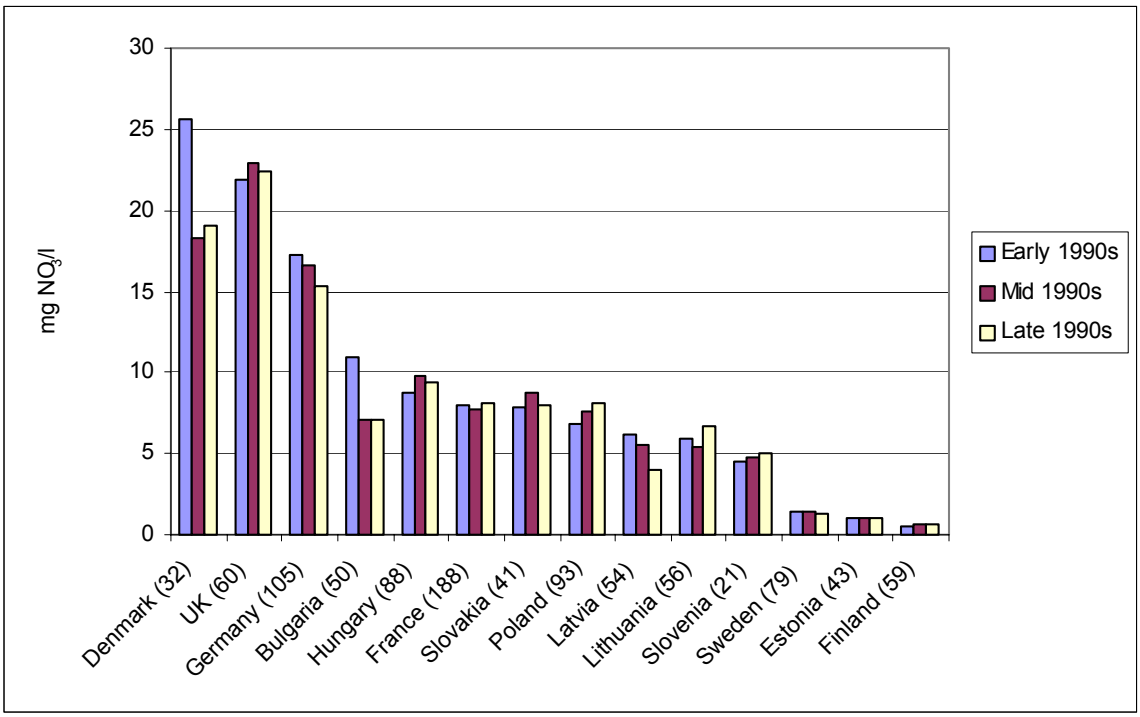


Notes: Number of stations in brackets. Early 1990s = average 1990-1993, mid 1990s = average 1994-1997, late 1990s = average 1998-2000

UK data is for England and Wales only, less South Western region, and therefore may not be fully representative

Sources: Based on EUROWATERNET data collection

Figure 2b: Median of the stations annual average nitrate concentrations (mg NO_3/l) by country.



Notes: Number of stations in brackets. Early 1990s = average 1990-1993, mid 1990s = average 1994-1997, late 1990s = average 1998-2000

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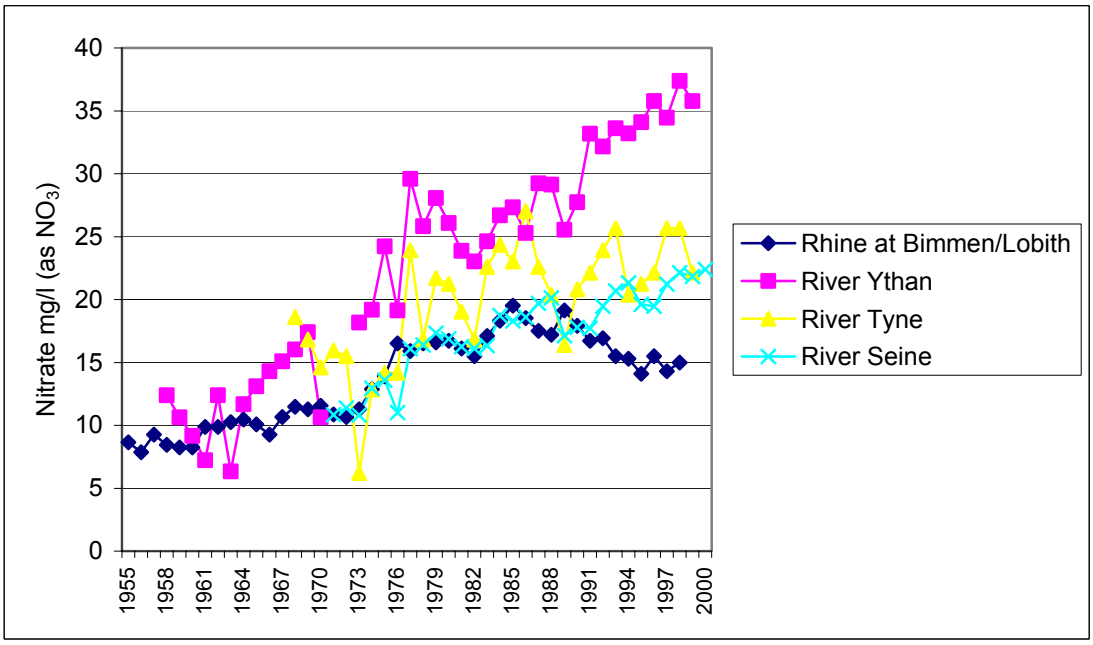
Figure 3 Trends in nitrate concentrations since the 1950s in some European rivers



Sources: UBA, 2001 (Rhine), SEPA 2002 (Tyne and Ythan) and Waterbase (Seine).

Assessment for the sub-indicators

There are differences between the countries of Europe in terms of orthophosphate concentrations with Finland, Estonia and Sweden having far lower levels than the other countries (figure 2a) and the UK, Hungary and Poland having the highest concentrations. Most countries show a decreasing trend in orthophosphate concentrations apart for Bulgaria, Slovenia and Latvia.

Estonia, Finland and Sweden also have the lowest nitrate levels and the UK, Denmark and Germany have the highest. However, there was a decline in median concentrations in Denmark and Germany during the 1990s (figure 2b).

Nitrate concentration increases are evident in four rivers for which there is a long time series available. These are the River Rhine (has shown recent decreases in levels), the River Ythan and the River Tyne in Scotland and the River Seine in France (Figure 3).

Data

Spreadsheet files:

18a_18b_18c_BOD_N_P_Amm_2.xls (figures 1a and b)

18b_Orthophosphate_country_year.xls (figure 2a)

18b_EU_EFTA_Orthophosphate.xls

18b_PHARE_ACC_Orthophosphate.xls

18b_Nitrate_country_year (figure 2b)

18b_Northern_nitrate.xls

18b_Western_Nitrate.xls

18b_PHARE_ACC_Nitrate.xls

Nitrate in rivers long time series-16Dec.xls

Meta data

Technical information

1. Data source: WATERBASE, EEA-ETC/WTR database containing EUROWATERNET data.
2. Description of data: The source data are river station annual averages of Total Oxidised Nitrogen, Nitrate, and Orthophosphate. Data are from ‘representative’ monitoring stations, i.e. those which reflect the majority of rivers in a region/area with human activities in the catchment consistent with the region’s/area’s activities.
3. Geographical coverage: EEA countries
4. Temporal coverage: Data are available from 1975-2000. Data from only 1990 to 2000 used for this assessment. This period had the most consistent dataset in terms of years, numbers of stations and countries covered.
5. Methodology and frequency of data collection: Through data exchange with NFPs collected annually.
6. Methodology of data manipulation: Data are reported as annual averages (plus other statistics) for each station included in EUROWATERNET. The data between stations are highly skewed and hence median concentrations of the stations' annual averages are used to summarise the country-aggregated, station-size and catchment type aggregated data. In contrast for the distributions of concentrations for the most recent year per country, the reported station annual average concentration is used. This is because many countries only reported station annual average concentration and not annual median concentrations.

Qualitative information

7. Strength and weakness (at data level): A very consistent and comparable time series has been obtained. This covers more stations and countries across Europe than has been

previously available. For the first time comparable information is also available on the smaller rivers of Europe. At the moment the most detailed information is from relatively few western countries, and there are less time series data for the southern countries.

8. Reliability, accuracy, robustness, uncertainty (at data level): The data are provided by official national data sources and data up to 1998 have had some initial validation although the 1999-2000 data still requires validation. The EWN stations are designed to give a representative overview of the status in each country. There is a large amount of data variability within each strata and within each year. This could perhaps be reduced by a more powerful and thorough statistical assessment.
9. Overall scoring

Relevancy: 1

Accuracy: 1

Comparability over time: 2

Comparability over space: 2

Further work required

This indicator will be improved as more countries implement EUROWATERNET. There are gaps in river characteristic information from some countries. This does not enable stratification by river size, and thus limits the current dataset for size-stratification. Also many countries did not report all the requested summary statistics such as the median. A bigger gap in the information is in terms of catchment pressures. Some countries have used Corine land cover data to provide proxy indicators of pressures. It is expected that this aspect will improve significantly during the next year as new updated Corine data will be available, and as work is undertaken by the ETC/WTR and ETC Terrestrial Environment to fill in the gaps in the pressure indicators. More times series data would improve the dataset particular from Southern countries.