EEA Core Set of Indicators - CSI 020

Nutrients in freshwater

May 2005 assessment

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About this service

European Environment Agency

Key policy question: Are nutrients decreasing in our freshwaters?

Key message: Concentrations of phosphorus have generally decreased in European rivers, and to a lesser extent lakes, during the 1990s reflecting the general improvement in wastewater treatment over this period. There has also been a small decrease in nitrate concentrations in some European rivers over the same period.
There is no evidence of a decrease (or increase) of nitrate concentrations in Europe's groundwaters and lakes.

The concentrations of orthophosphate have been steadily decreasing in European rivers in general over the last 10 years. In the old EU Member States this is because of the measures introduced by national and European legislation, in particular the urban waste water treatment directive which has increased levels of waste water treatment with, in many cases, increased tertiary treatment, involving the removal of nutrients. There has also been an improvement in the level of waste water treatment in the new EU Member States though not to the same levels as in the old EU Member States. In addition, the transition recession in the economies of the new EU Member States may have played a part in the decreasing (phosphorus) trends because of the closure of potentially polluting industries and a decrease in agricultural production leading to less use of nitrogen and phosphorus fertilisers. In many of the new EU Member States the economic recession had ended by the end of the 1990s. Since then many new industrial plants have been opened with better effluent treatment technologies. Furthermore, fertiliser applications also started to increase to some extent.

During the past few decades there has also been a gradual reduction in phosphorus concentrations in many European lakes. However in the 1990s the rate of decrease appears to have slowed or even stopped. As with rivers, 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 of phosphorus, both from animal manure and from diffuse pollution by erosion and leaching, are similarly important and need increased attention to obtain good status in lakes and rivers.

The improvements in some lakes 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 remain in a bad state. Particularly in shallow lakes, such problems may call for restoration measures.

Mean nitrate concentrations in groundwaters in Europe are above background levels (<10 mg/l as NO3) but do not exceed 50 mg/l as NO3. At the European level the annual mean nitrate concentrations in groundwaters have remained relatively stable since the early 1990s but show different levels of concentration regionally. Due to a very low level of mean nitrate concentrations (<2 mg/l as NO3) in the northern countries the European mean nitrate concentration shows a biased view for nitrate. Hence the presentation above is separated in the following sub-indicators into western, eastern and northern countries.

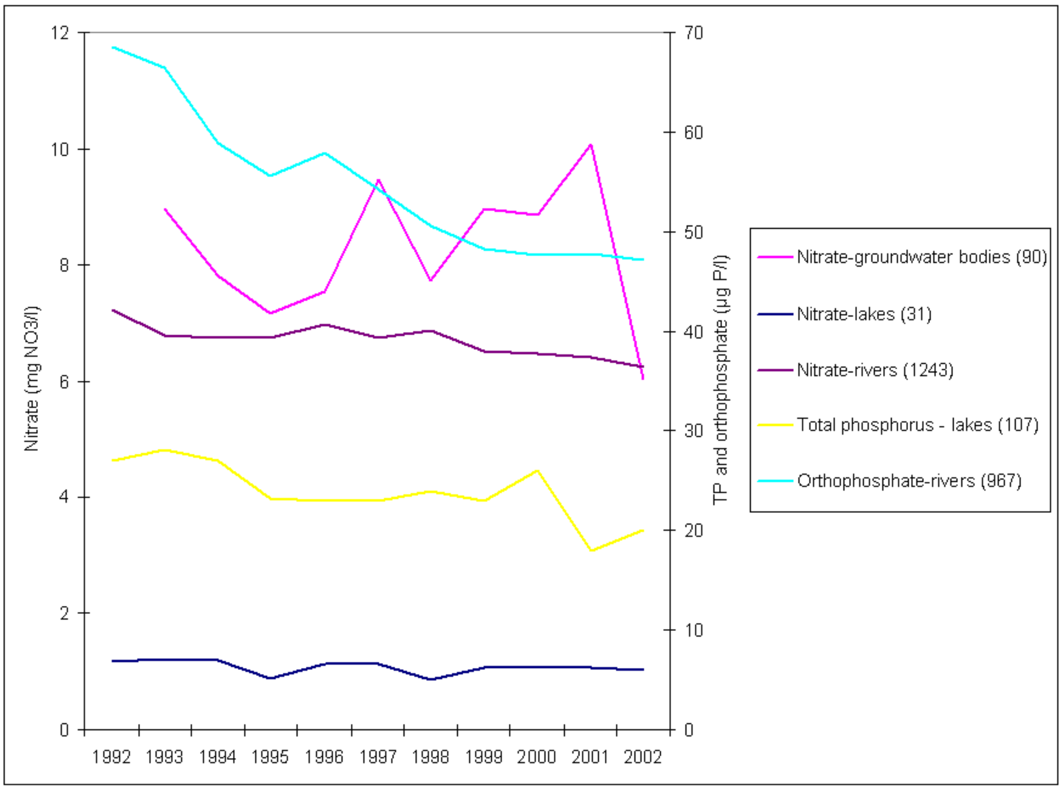
At the European level there is some evidence of a small decrease in concentrations of nitrate in rivers. The decrease has been slower than for phosphorus because measures to reduce agricultural inputs of nitrate have not been implemented in a consistent way across EU countries and because of the probable time lags between reduction of agricultural nitrogen inputs and soil surpluses, and resulting reductions in surface and ground water concentrations of nitrate.

Agriculture is the largest contributor of nitrogen pollution to groundwater, and also in many surface water bodies, as nitrogen fertilisers and manure are used on arable crops to increase yields and productivity. In the EU mineral fertilisers account for almost 50 % of nitrogen inputs into agricultural soils and manure for 40 % (other inputs are biological fixation and atmospheric deposition) (COM 2002). According to the indicator on the use of fertilisers, nitrogen fertiliser consumption (mineral fertilisers and animal manure) increased until the late 1980s and then started to decline but in recent years it has increased again in the EU and EFTA countries. Nitrogen fertiliser consumption per hectare of arable land is higher in the EU and EFTA countries than in the new EU and accession countries. Nitrogen from excess fertiliser percolates through the soil and is detectable as elevated nitrate levels under aerobic conditions and as elevated ammonium levels under anaerobic conditions. The rate of percolation is often slow and excess nitrogen levels may be the effects of pollution on the surface up to 40 years ago depending on the hydrogeological conditions. There are also other sources of nitrate including treated sewage effluents which may also contribute to nitrate pollution in some rivers.

Reference

COM (2002) 407 final. Implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources. Synthesis from year 2000 Member States reports. Report from the Commission. COM, Brussels.

Fig. 1: Nitrate and phosphorus concentrations in European freshwater bodies



Data source: Waterbase (Version 4)

Note: Concentrations are expressed as annual median concentrations for groundwater, and median of annual average concentrations for rivers and lakes.

Numbers of groundwater bodies, lake and river monitoring stations in brackets.

Lakes: nitrate data from: Estonia, Finland, Germany, Hungary, Latvia and UK; total phosphorus data from Austria, Denmark, Estonia, Finland, Germany, Hungary, Ireland and Latvia.

Groundwater bodies: data from Austria, Belgium, Bulgaria, Denmark, Estonia, Finland, Germany, Lithuania, Netherlands, Norway, Slovak Republic and Slovenia.

Rivers: data from Austria, Bulgaria, Denmark, Estonia, Finland, France, Germany, Hungary, Latvia, Lithuania, Poland, Slovenia, Sweden and UK.

Data are from representative river and lake stations. Stations that have no designation of type are assumed to be representative and are included in the analysis.

Specific policy question: Is nitrate concentration in groundwater decreasing?

Nitrate concentrations in different regions of Europe

Nitrate concentrations in groundwaters have remained relatively stable since the early 1990s and they vary between the different regions of Europe.

The relatively high nitrate concentration in groundwater in western European countries can be seen as consequence of the intensive agriculture and the usage of nitrogen fertilisers. The temporal development of the total nitrogen fertiliser consumption within these regions and the regional differentiation in concentration levels is very similar. Data on nitrogenous fertiliser usage for 2002 show in all of the countries for consistent time series except for Germany and Lithuania a decline with a range from 4.8 % to 57.2 % compared to 10 years before. For the Slovak Republic no data are available (2).

Not only consumption figures are high in western European countries, but also the usage per hectare of agricultural land. In 1994, the Netherlands, Denmark, Belgium and Germany were amongst the countries with the highest nitrogen fertiliser usage related to the agricultural area. In Finland (11.) and Norway (4.) the nitrogen fertiliser usage is also high but the agricultural area represents only 9 % and 3 %, respectively, of the total land area [1]. Although the agricultural area in the new EU Member States ranges between 15 % (Cyprus) and 60 % (Hungary) of the total land area the agricultural practice is of less intensity than in western Europe. The nitrate fertiliser usage per agricultural land area is about the half of that in former EU 15 [3].

Fertiliser consumption and nitrate concentrations in groundwater do not show a direct relationship on this level. However, fertiliser consumption is an indicator for agricultural use and should give an estimate of the nitrogen load of the environment [1].
In Malta analysis of nitrate values in groundwater measured at pumping stations over the 25 year period 1976-2001 indicates a steady increase. Generally the highest values are observed to occur in the north western part of Malta [6]. In Estonia quaternary aquifers used by small or individual settlements are subject to agricultural pollution (nitrates and pesticides) as well as military pollution from the Soviet period [7].
Furthermore, low nitrate concentration levels can occur due to reducing conditions. Therefore the indicator on ammonium and dissolved oxygen has been introduced to provide complementary information.

It has been shown that drinking water in excess of the nitrate limit can result in adverse health effects, especially in infants less than two months of age. 65 % of the demand for drinking water in Europe is covered by groundwater. The rate ranges up to 99 % in Austria and Denmark. In Finland approximately 60 % of the total water supply distributed by Finland's waterworks consists of groundwater [8]. In Germany, the drinking water supply is covered at more than 70 % by using groundwater and springs. Often groundwater is used untreated particularly from private wells. Decentralised drinking water supplies in some western European countries have also been linked to water-related outbreaks. Contaminated drinking-water is under the five major environmental risks perceived by citizens in the new Member States and the accession countries as affecting their own health [9]. Costs for water purification have to be compared with the costs for groundwater protecting measures.

Trends in nitrate concentrations

Between 1993 and 2002, there was a significant decreasing trend or trend reversal in 32 % of groundwater bodies for which there was available data. However, 20 % of groundwater bodies also showed increasing trends of nitrate over the same periods, reflecting that emissions of nitrate in the catchments of these groundwater bodies may not yet have been reduced or indicating that the effects of reducing emissions have not yet become evident because, for example, high nitrogen surpluses in *agricultural soils and/or long time lags before the effects of measures become apparent*.

There have been significant decreases in nitrate concentrations in some groundwater bodies in some European countries. Finland (with other Nordic countries) generally has the lowest nitrate concentrations in its groundwater. However, about 22 % of Finnish groundwater bodies showed an increasing concentration between 1993 to 2002 perhaps indicating increasing pressures from agriculture and other sectors emitting nitrate. Also the varying hydrological conditions may at least partly explain the upward trends.

There is often a significant time lag (up to 40 years) between changes in agricultural practices and changes in groundwater quality. The actual time lag for an individual groundwater body depends on its hydrogeological conditions. Therefore, some of the indicated upward trends in groundwater bodies might, for example, be caused by intensification of agricultural practice some 20 years ago. The actual cause effect relationship has to be assessed individually for each GW-body. Nevertheless, it is an indication that remediation and improvement measures have to be implemented over medium or rather long term in order to break or even reverse upward trends.

Present concentration of nitrate

Nitrate drinking water guide levels are exceeded in around one-third of the groundwater bodies for which information is currently available.

The concentrations of nitrate in groundwater in the different European countries generally reflect the relative importance and intensity of the driving forces affecting water quality. Those countries with low intensity driving forces perhaps coupled with effective measures to reduce nutrient emissions (pressures) (particularly the Nordic countries) generally have relatively low concentrations of these determinands. In contrast those countries with high intensity driving forces, perhaps coupled with ineffective measures to reduce emissions, have relatively high concentrations (for example some new EU countries).

20 of the 27 countries with available information had groundwater bodies exceeding the drinking water directive guide concentration for nitrate of 25 mg NO3/l, and 17 of these also had groundwater bodies exceeding the maximum allowable concentration of 50 mg NO3/l. Countries with the greatest agricultural land use and highest population densities (such as Denmark, Germany, Hungary and the UK), generally had higher nitrate concentrations than those with the lowest (such as Estonia, Norway, Finland and Sweden) reflecting the impact of emissions of nitrate from agriculture.

Reference

[1] EEA (2000). Groundwater quality and quantity in Europe. Environmental assessment report No 3. Copenhagen. http://reports.eea.eu.int/groundwater07012000/en

[2] EEA Dataservice. Fertiliser consumption - Raw data and trend. http://dataservice.eea.eu.int/dataservice/viewdata/viewpvt.asp?id=184

[3] EEA (2004). Agriculture and the environment in the EU accession countries. Implications of applying the EU common agricultural policy. Environmental issue report No 37. EEA, Copenhagen. http://www.eea.eu.int/

[4] German Environmental Report 2002. http://www.bmu.de/english/download/files/umweltbericht_engl_2002.pdf

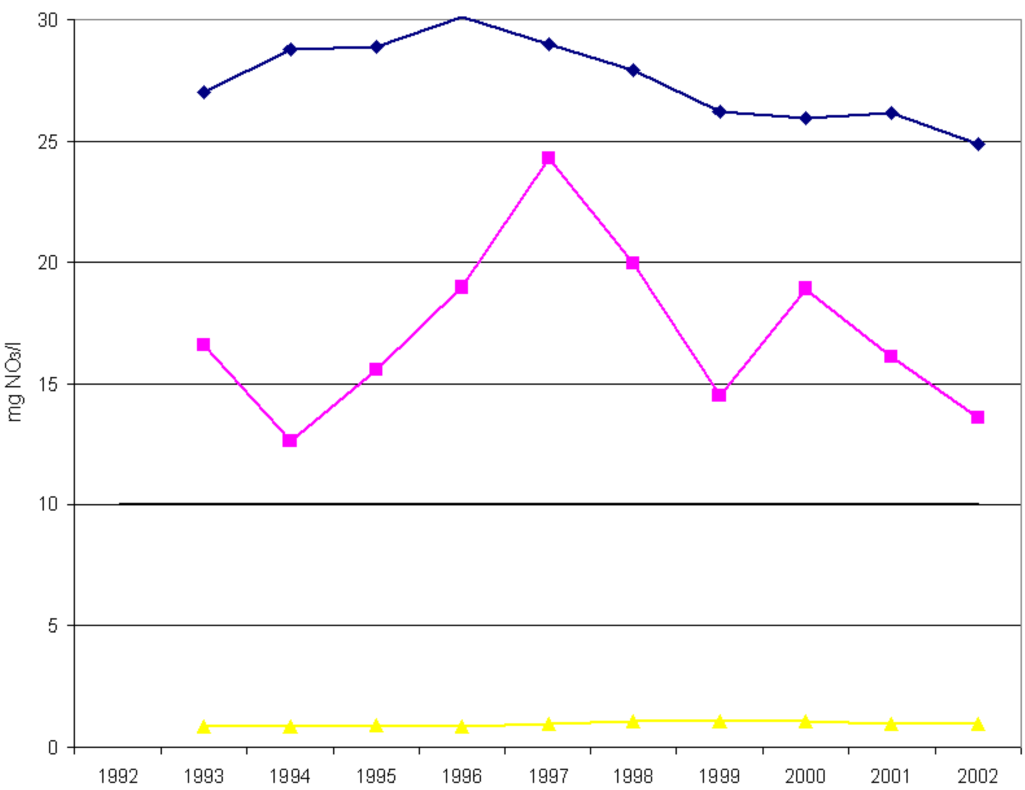
[5] COM (2002) 407 final. Implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources. Synthesis from year 2000 Member States reports. Report from the Commission. COM, Brussels.

[6] State of the Environment Report for Malta. 2002. http://www.mepa.org.mt/environment/publications/soer2002/SOER02.PDF

[7] State of Environment in Estonia. 2002. http://nfp-ee.eionet.eu.int/SoE/index_en.htm

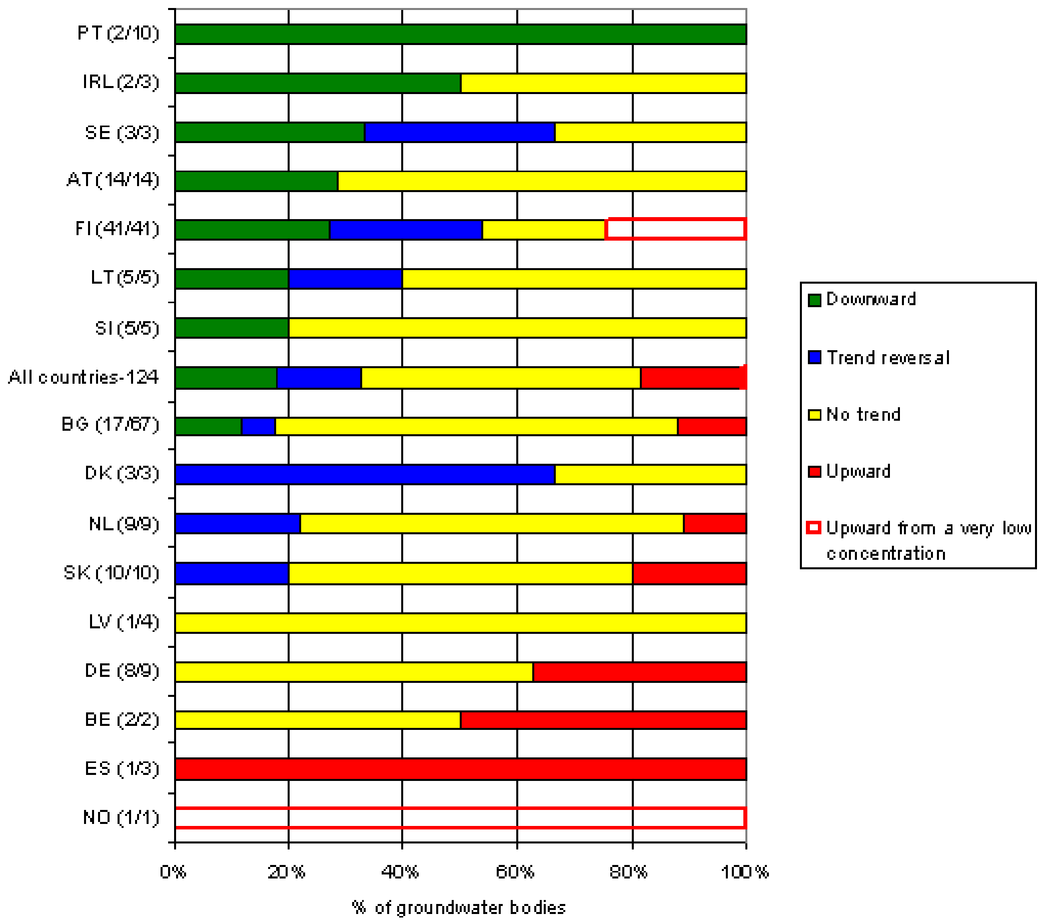
[8] Finnish State of the Environment. Environmental administration. http://www.environment.fi/default.asp?node=6085 &lan=en
[9] WHO (2004). Health and the Environment in the WHO European Region: Situation and policy at the beginning of the 21st century. Part I. The environment health situation in the WHO European region. Executive summary. Fourth Intergovernmental Preparatory Meeting. WHO, Copenhagen. http://www.euro.who.int/EEHC
[10] Working database groundwater: Umweltbundesamt Vienna. No online access.
[11] Waterbase - Groundwater quality - Information and pressures on groundwater bodies. http://dataservice.eea.eu.int/dataservice/viewdata/viewpvt.asp?id=265
[12] Indicator fact sheet 05 - Nitrogen balance in agricultural soils
[13] Indicator fact sheet 02 - Numbers of livestock
IEEP (2002): Background study on the link between agriculture and environment in accession countries. National reports. IEEP, London. http://www.ieep.org.uk

Fig. 2: Nitrate concentrations in groundwater in different regions of Europe



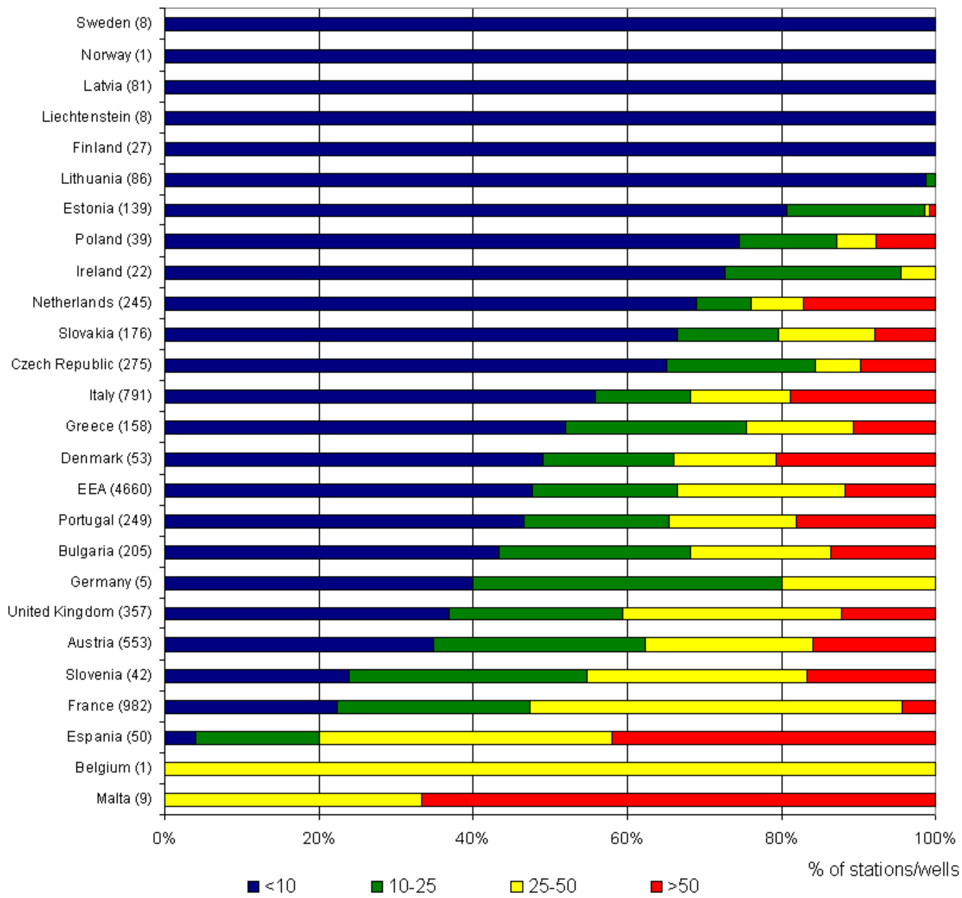
Data source: Waterbase (Version 4)
Note: Western Europe: Austria, Belgium, Denmark, Germany, Netherlands; 27 GW-bodies.
Eastern Europe: Bulgaria, Estonia, Lithuania, Slovak Republic, Slovenia; 38 GW-bodies.
Nordic countries: Finland, Norway; 25 GW-bodies; Swedish data are not included due to a data gap.
The drinking water maximum admissible concentration (MAC) for nitrate of 50 mg NO3/l is laid down in Council Directive 98/83/EC on the quality of water intended for human consumption.
Background concentrations of nitrate in groundwater (<10 mg NO3/l) are shown to aid the assessment of the significance of the nitrate concentrations (in association with the drinking water MAC).

Fig. 3: Trends in nitrate concentrations in groundwater bodies in European countries



Data source: Waterbase (Version 4)
Note: Number of groundwater bodies for each country given in brackets following the country abbreviation.
Consistent variable time series ranging from 1980 to 2002

Fig. 4: Present concentration of nitrate in groundwater bodies in European countries



Data source: Waterbase

Note: The number of groundwater monitoring stations in each country is given in brackets. Figures are based on the most recent year for which data are available (annual average concentrations): this is 2002 except for France (2000), Greece (1998), Liechtenstein (2001) and Spain (1999).

Specific policy question: Are nutrient concentrations in surface waters decreasing?

Nitrate concentrations in different regions of Europe

Nitrate concentrations in lakes have remained relatively stable since the early 1990s. There is some evidence that nitrate concentrations are decreasing in some rivers. Nitrate concentrations vary between the different regions of Europe particularly in rivers.

The relatively high nitrate concentration in rivers in western European countries can be seen as consequence of the intensive agriculture and the usage of nitrogen fertilisers. The temporal development of the total nitrogen fertiliser consumption within these regions and the regional differentiation in levels is very similar. Data on nitrogenous fertiliser usage for 2002 show in all of the countries for consistent time series except for Germany and Lithuania a decline with a range from 4.8 % to 57.2 % compared to 10 years before. For the Slovak Republicno data are available (2).

Not only consumption figures are high in western European countries, but also the usage per hectare of agricultural land. In 1994, the Netherlands, Denmark, Belgium and Germany were amongst the countries with the highest nitrogen fertiliser usage related to the agricultural area. In Finland (11.) and Norway (4.) the nitrogen fertiliser usage is also high but the agricultural area represents only 9 % and 3 %, respectively, of the total land area [1]. Although the agricultural area in the new EU Member States ranges between 15 % (Cyprus) and 60 % (Hungary) of the total land area the agricultural practice is of less intensity than in western Europe. The nitrate fertiliser usage per agricultural land area is about the half of that in former EU 15 [3].

Trends in nitrate concentrations

Around 40 % and 9 % of monitoring stations on Europe's rivers and lakes, respectively, showed a decreasing trend of nitrate concentrations between 1992 and 2002 reflecting the success of legislative measures to reduce nitrate pollution.
However, 14 % of the river stations and 15 % of lake stations also showed increasing trends of nitrate over the same periods, reflecting that emissions of nitrate in the catchments of these rivers and lakes may have not yet been reduced or indicating that the effects of reducing emissions have not yet become evident because, for example, high nitrogen surpluses in agricultural soils.

There have been significant decreases in nitrate concentrations at some river and lake stations in some European countries. In the old EU countries assessed, Denmark had the highest proportion of river stations with decreasing trends indicating that national and EU measures introduced to reduce nitrate pollution, such as those in the nitrates directive, are having some effect. Finland (with other Nordic countries) generally has the lowest nitrate concentrations in its rivers and lakes. However, about 20% of Finnish river stations and 28 % (2 out of 7) of lake stations showed an increasing concentration between 1992 to 2002, perhaps indicating increasing pressures from agriculture and other sectors emitting nitrate. Also the varying hydrological conditions may at least partly explain the upward trends. The other EU countries had different proportions of river stations with decreasing, no and increasing trends. In the new EU countries, the Czech Republic had the highest proportion of river stations (74 %) with decreasing nitrate concentrations and no stations with increasing trends. The eight other new EU countries with available data had varying proportions of river stations with decreasing, no and increasing trends. Poland had the highest proportion of river stations (34 %) with increasing concentrations. The decreasing trends are probably because of the decrease in agricultural productivity and activity in these countries during the transition of their economies to become more market orientated. This has led to, for example, decreases in nitrogenous fertiliser use and in numbers of livestock (and hence manure production), both potential sources of nitrate pollution.

Present concentration of nitrate

Nitrate drinking water guide levels are exceeded at around 10 % of river stations and at around 1 % of *lake stations for which information is currently available.*

The concentrations of nitrate in rivers and lakes in the different European countries generally reflect the relative importance and intensity of the driving forces affecting water quality. Those countries with low intensity driving forces perhaps coupled with effective measures to reduce nutrient emissions (pressures) (particularly the Nordic countries) generally have relatively low concentrations of these determinands. In contrast those countries with high intensity driving forces, perhaps coupled with ineffective measures to reduce emissions, have relatively high concentrations (for example some new EU countries).

In terms of nitrate, 15 of the 25 countries with available information had a number of river stations where the drinking water directive guide concentration for nitrate of 25 mg NO3/l was exceeded, and three of these countries had stations where the maximum allowable concentration of 50 mg NO3/l was also exceeded. Countries with the greatest agricultural land use and highest population densities (such as Denmark, Germany, Hungary and the UK), generally had higher nitrate concentrations than those with the lowest (such as Estonia, Norway, Finland, and Sweden) reflecting the impact of emissions of nitrate from agriculture and waste water treatment works, respectively.

Phosphorus concentrations in different regions of Europe

Total phosphorus concentrations in lakes have remained relatively stable since the early 1990s. There have been significant decreases in orthophosphate concentrations in eastern and western European rivers during the 1990s. In both rivers and lakes, however, phosphorus concentrations remain above background levels potentially increasing the risk of eutrophication in some water bodies. The Nordic countries have relatively low concentrations reflecting the high level of wastewater treatment in those countries.

Concentrations of phosphorus in Nordic rivers and lakes are much lower than in other parts of Europe and are around what are considered to be background concentrations. This reflects the relatively low population densities in these countries and the high level of treatment of sewage effluents including the removal of phosphorus.

The concentration of total phosphorus in lakes in eastern and western Europe are similar and show no clear trends between 1992 and 2002. Concentrations are however still above what is considered to be the general background levels: the ecological significance of these elevated levels are not known.

Concentrations of orthophosphate have steadily decreased over the last 10 years in western European rivers reflecting the improvement in wastewater treatment including increasing proportions of sewage effluent subject to phosphorus removal. There were also relatively large decreases in orthophosphate concentrations in eastern European rivers during the 1990's but since 2000 there is some evidence of increases in concentrations again. The extent and levels of sewage treatment have generally been lower in eastern than in western European countries. The more recent increases could reflect that more sewage treatment is being introduced in eastern European countries as socio-economic conditions improved in preparation of accession to the EU. However, without nutrient removal, increased levels of sewage treatment may increase the emissions/loads of orthophosphate entering eastern European rivers. In 2002 concentrations of orthophosphate in eastern European rivers were much higher than in western. In both cases the concentrations are many times background concentrations: the ecological significance of these elevated concentrations are not known but it is probable that they contribute to the eutrophication of these rivers.

Trends in phosphorus concentrations

Around 40 % and 20 % of monitoring stations on Europe's rivers and lakes, respectively, showed a decreasing trend of orthophosphate and total phosphorus concentrations between 1992 and 2002 reflecting the success of legislative measures to reduce emissions of phosphorus such as those

required by the urban waste water treatment directive.
However, 12 % of river stations and 9 % of lake stations also showed increasing trends of orthophosphate and total phosphorus, respectively, over the same period, reflecting that emissions of phosphate in the catchments of these rivers and lakes may not yet have been reduced or indicating that in some catchments there might be increasing phosphorus surpluses in agricultural soils.

Sixteen of the 19 countries assessed had a higher proportion of river stations with decreasing orthophosphate concentration than those with increasing trends. Two (Bulgaria and Slovenia) had more river stations with increasing concentrations than decreasing. Estonia and Italy were the only countries with no river stations showing increasing trends. The total phosphorus data on lakes is limited in many cases to only a few lakes in each country (e.g. Ireland, Estonia and Latvia), and therefore information from these countries must be treated with some caution. Denmark, Finland, Hungary and the Netherlands had a higher proportion of lakes with decreasing total phosphorus concentrations than those with increasing concentrations. Austria and Germany had no lake stations showing increasing trends.

The increasing trends might be because of ineffective control of phosphorus in some river catchments, particularly those with relatively small (in terms of load) sources of phosphorus that might fall outside of legislative requirements. Dishwasher detergents containing phosphorus are also becoming increasingly important as dishwashers are increasingly used in more affluent societies. There are also cases where agricultural sources of phosphorus are becoming more important in catchments as point sources are progressively reduced. Phosphorus surpluses may also be increasing in some agricultural soils.

All the new EU countries, except Slovenia, had some river stations with decreasing phosphate concentrations. The decreasing trends reflect a general improvement of sewage treatment in these countries (though they have not yet fully implemented the urban waste water treatment directive) and/or the closure of polluting industries that has occurred during the restructuring of their economies as part of the process of transition into the EU.

Present concentration of phosphorus

The concentrations of phosphorus in rivers and lakes in the different European countries generally reflect the relative importance and intensity of the driving forces affecting water quality. Those countries with low intensity driving forces (e.g. low population density) perhaps coupled with effective measures to reduce nutrient emissions (pressures) (particularly the removal of phosphorus from waste water effluents in the Nordic countries) generally have relatively low concentrations of these determinands. In contrast those countries with high intensity driving forces, perhaps coupled with ineffective measures to reduce emissions, have relatively high concentrations (for example some new EU countries).

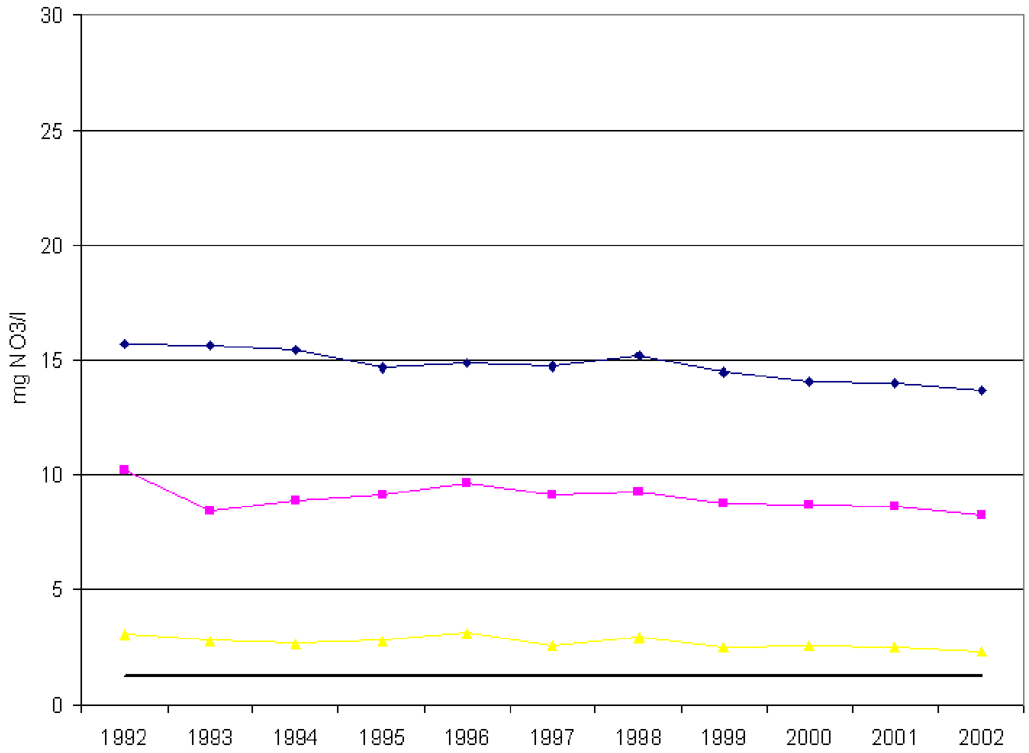
Those countries with high proportions of nutrient removal in their sewage treatment works (such as Sweden, Finland and the Netherlands) have relatively low orthophosphate concentrations whereas those countries with relatively low nutrient removal, high population densities and high phosphorus fertiliser usage (such as France, Italy and UK) tend to have relatively high orthophosphate concentrations.

As already described the ecological significance of the elevated concentrations of phosphorus in rivers and lakes is not known. The water framework directive requires the achievement of good ecological status in surface water bodies. Where nutrient emissions are identified as a pressure impacting/decreasing ecological status then target concentrations equating to good ecological status will have to be set for each type of river and lake water body. It is anticipated, therefore, that in the longer term concentrations of phosphorus in European rivers and lakes will continue to decrease and as a result eutrophication to decrease and ecological quality increase.

Reference

[1] EEA (2000). Groundwater quality and quantity in Europe. Environmental assessment report No 3. Copenhagen. http://reports.eea.eu.int/groundwater07012000/en
[2] EEA Dataservice. Fertiliser consumption - Raw data and trend. http://dataservice.eea.eu.int/dataservice/viewdata/viewpvt.asp?id=184
[3] EEA (2004). Agriculture and the environment in the EU accession countries. Implications of applying the EU common agricultural policy. Environmental issue report No 37. EEA, Copenhagen. http://www.eea.eu.int/
[4] German Environmental Report 2002. http://www.bmu.de/english/download/files/umweltbericht_engl_2002.pdf
[5] COM (2002) 407 final. Implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources. Synthesis from year 2000 Member States reports. Report from the Commission. COM, Brussels.
[6] State of the Environment Report for Malta. 2002. http://www.mepa.org.mt/environment/publications/soer2002/SOER02.PDF
[7] State of Environment in Estonia. 2002. http://nfp-ee.eionet.eu.int/SoE/index_en.htm
[8] Finnish State of the Environment. Environmental administration. http://www.environment.fi/default.asp?node=6085 &lan=en
[9] WHO (2004). Health and the Environment in the WHO European Region: Situation and policy at the beginning of the 21st century. Part I. The environment health situation in the WHO European region. Executive summary. Fourth Intergovernmental Preparatory Meeting. WHO, Copenhagen. http://www.euro.who.int/EEHC
[10] Working database groundwater: Umweltbundesamt Vienna. No online access.
[11] Waterbase - Groundwater quality - Information and pressures on groundwater bodies. http://dataservice.eea.eu.int/dataservice/viewdata/viewpvt.asp?id=265
[12] Indicator fact sheet 05 - Nitrogen balance in agricultural soils
[13] Indicator fact sheet 02 - Numbers of livestock
IEEP (2002): Background study on the link between agriculture and environment in accession countries. National reports. IEEP, London. http://www.ieep.org.uk

Fig. 5: Nitrate concentrations in rivers in different regions of Europe



Data source: Waterbase (Version 4)

Note: Western Europe: Austria (152), Denmark (32), France (235), Germany (121), Luxembourg (3), UK (113). Number of stations in brackets.

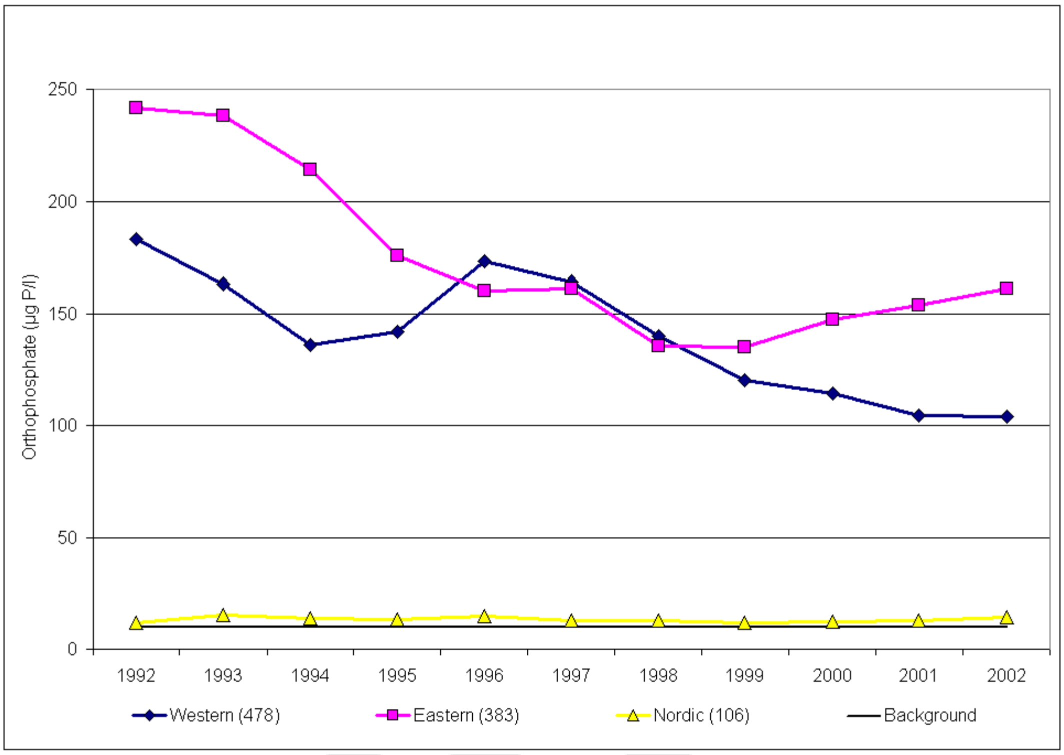
Eastern Europe: Bulgaria (50), Czech Rep. (58), Estonia (43), Hungary (89), Lithuania (57), Latvia (51), Poland (93), Slovak Rep. (9), Slovenia (21).

Nordic countries: Finland (26), Sweden (90).

Background concentrations of nitrate in rivers (about 1.3 mg NO3/l) are shown to aid the assessment of the significance of the nitrate concentrations (in association with the drinking water MAC).

The time series comprise consistent data sets with no data gaps. For each time series the arithmetic mean of the station annual average concentrations was used in the regional aggregations.

Fig. 6: Phosphorus concentrations in rivers (orthophosphate) in different regions of Europe



Data source : Waterbase (Version 4)

Note: Number of monitoring stations in brackets

Western Europe: Austria (103), Denmark (32), France (204), Germany (109), UK (30).

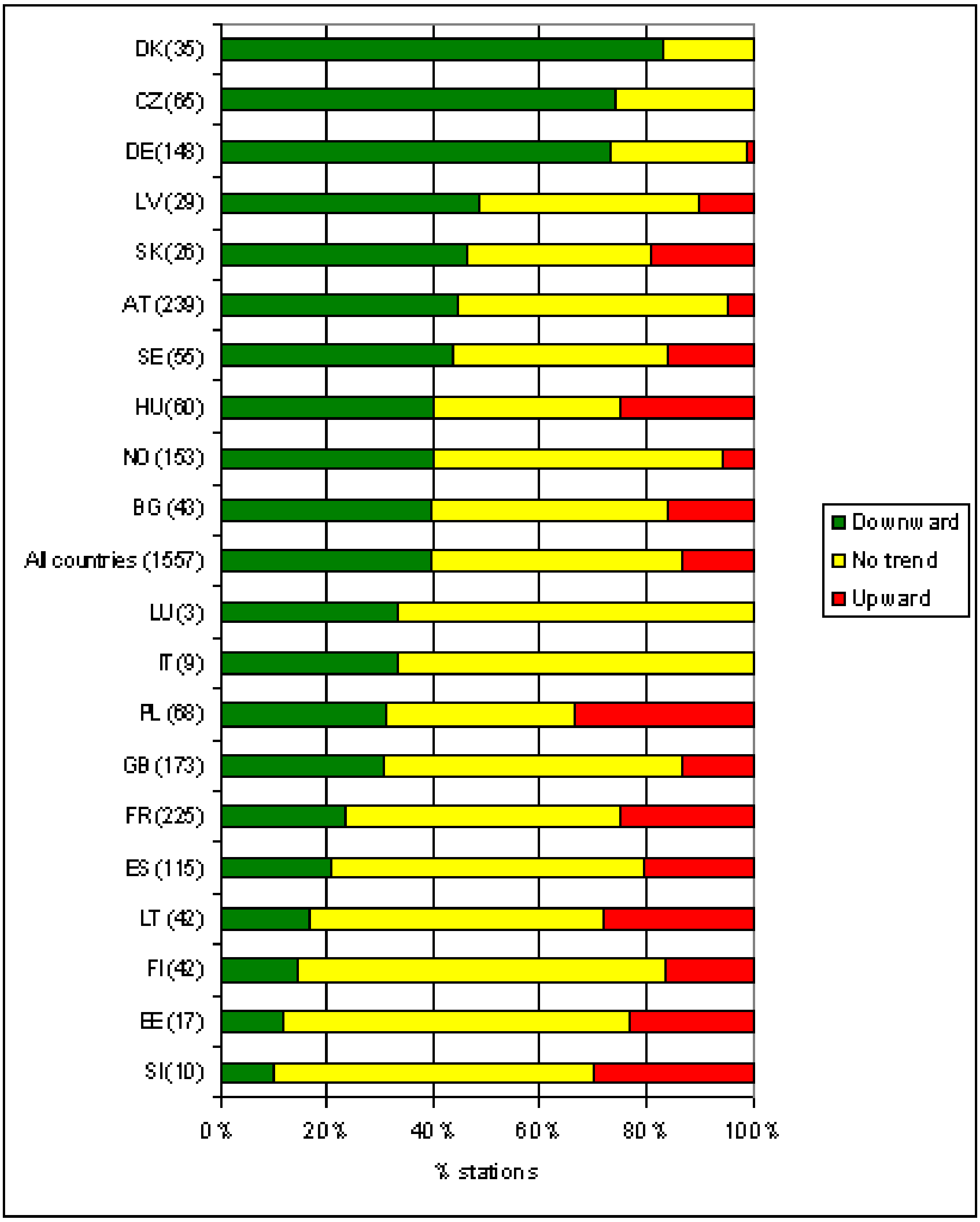
Eastern Europe: Bulgaria (33), Estonia (43), Hungary (89), Lithuania (59), Latvia (51), Poland (89), Slovenia (21).

Nordic countries: Finland (26), Sweden (90).

Background concentrations of orthophosphate in rivers (about 10 micro g P/l) are shown to aid the assessment of the significance of the phosphorus concentrations.

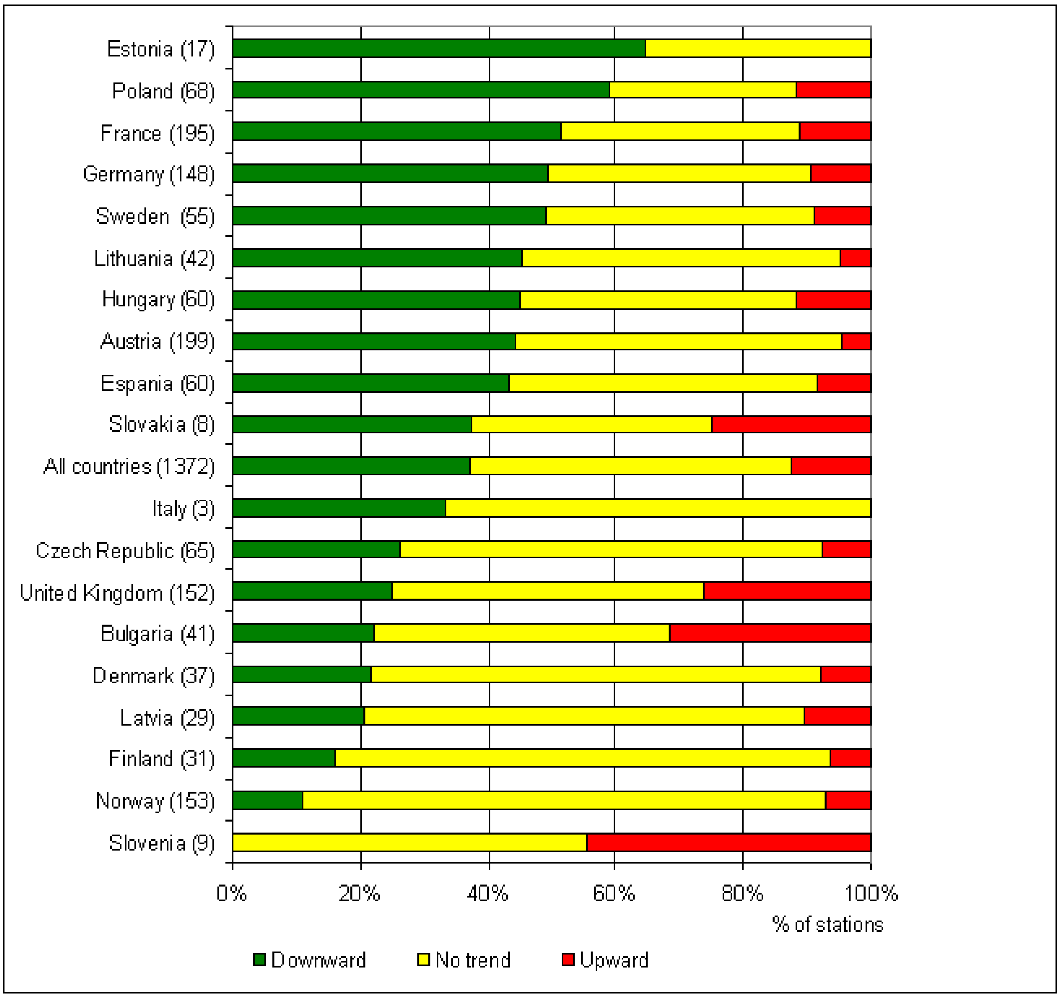
The time series comprise consistent data sets with no data gaps. The arithmetic mean of the station annual average concentrations was used in the regional aggregations.

Fig. 7: Trends in nitrate concentrations in rivers in European countries



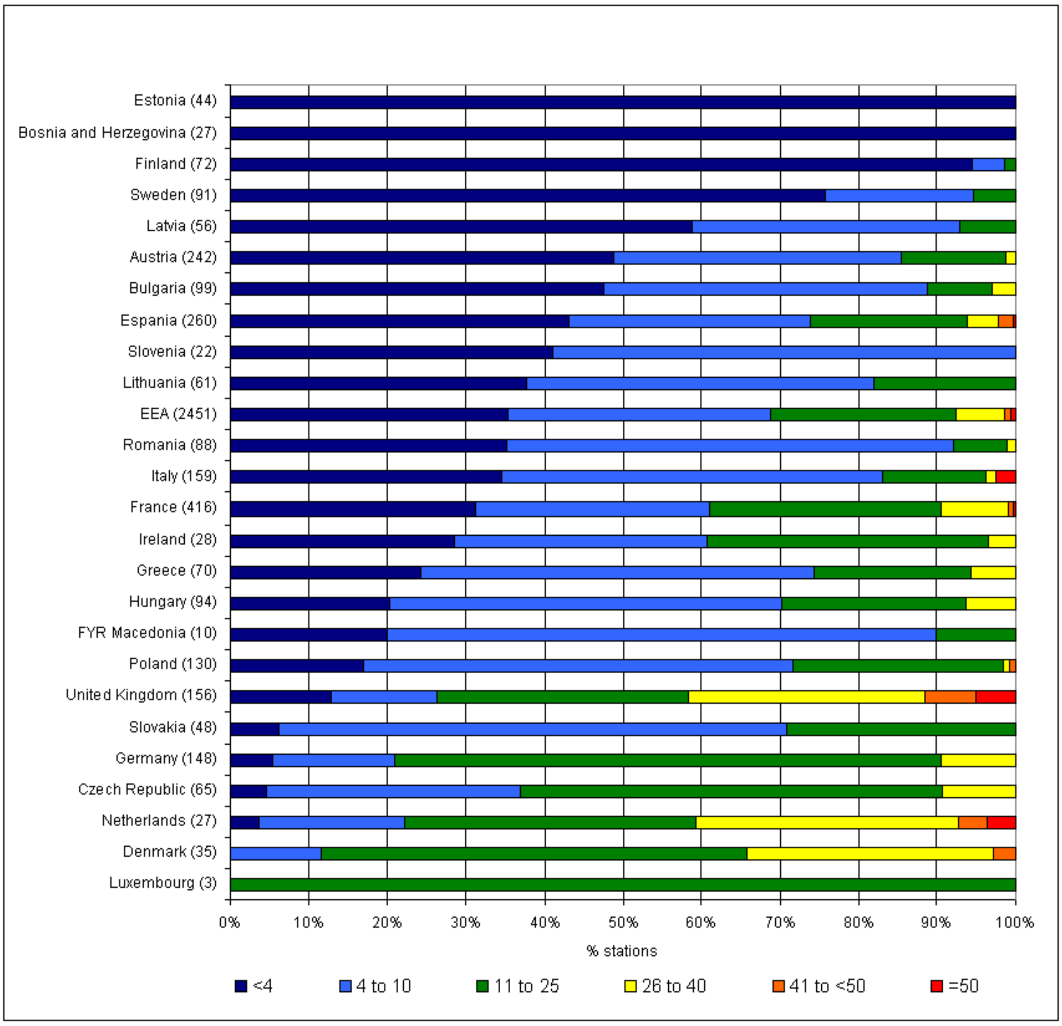
Data source: Waterbase (Version 4)
Note: Number of river stations for each country given in brackets.
Analysis based on representative river monitoring stations except for Norway where flux monitoring stations were used.
Consistent time series (1992 to 2002)

Fig. 8: Trends in phosphorus concentrations in rivers (orthophosphate) in European countries



Data source: Waterbase (Version 4)
Note: Number of river stations for each country given in brackets.
Consistent time series (1992 to 2002)

Fig. 9: Present concentration of nitrate in rivers in European countries



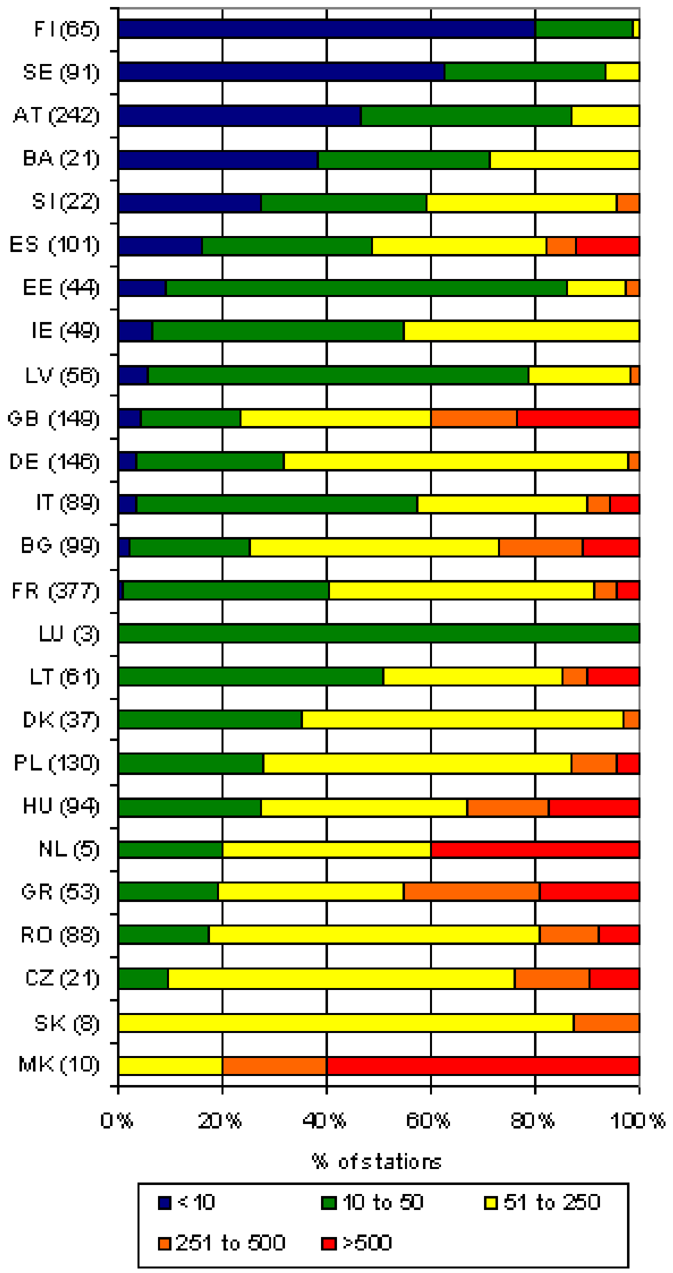
Data source: Waterbase (Version 4)

Note: The number of river monitoring stations in each country is given in brackets.

Figures are based on the most recent year for which data are available (annual average concentrations): this is 2002 except for Ireland (2000), Italy (2001), Netherlands (1998) and Romania (2001).

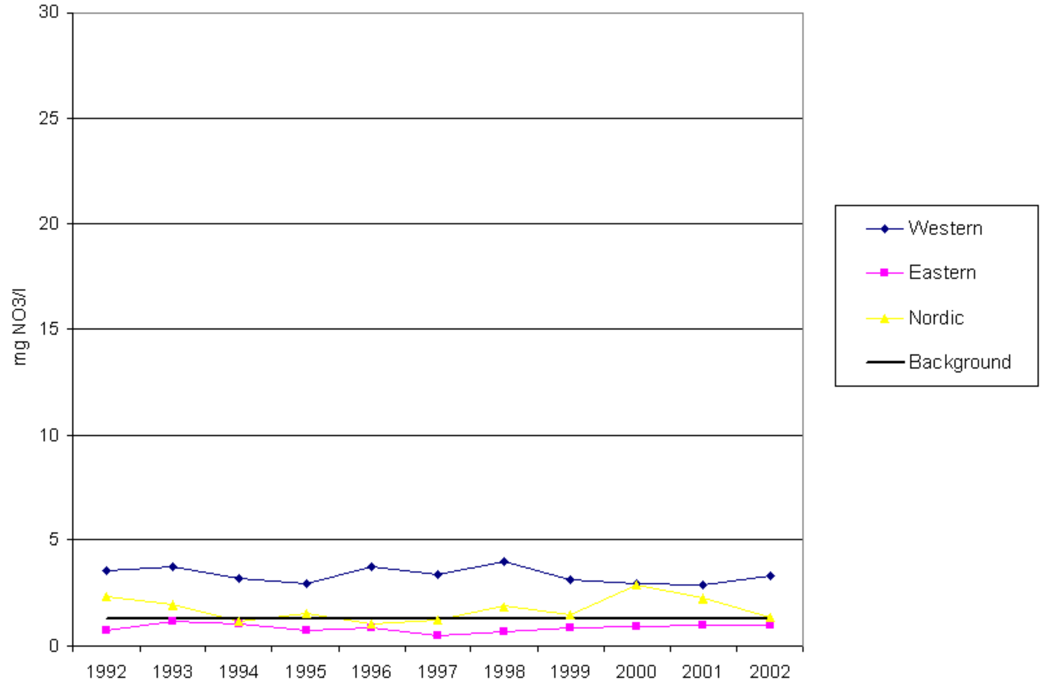
Netherlands and UK data are based on total oxidised nitrogen and nitrate, Denmark, Finland and Sweden total oxidised nitrogen only.

Fig. 10: Present concentration of phosphorus in rivers (orthophosphate) in European countries



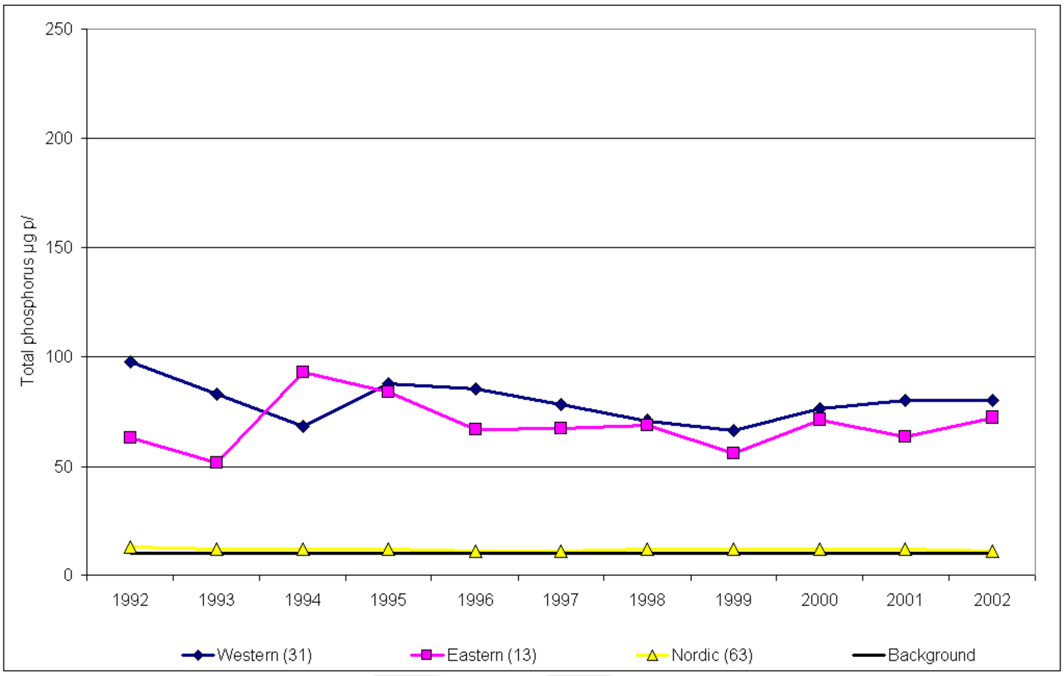
Data source: Waterbase (Version 4)
Note: The number of river monitoring stations in each country is given in brackets. Figures are based on the most recent year for which data are available: this is 2002 except for Ireland (2000), Netherlands (1998) and Romania (2001).

Fig. 11: Nitrate concentrations in lakes in different regions of Europe



Data source: Waterbase (Version 4)
Note: Western Europe: Germany (5), UK (2). Number of stations in brackets.
Eastern Europe: Estonia (1), Hungary (14), Latvia (1).
Nordic countries: Finland (7).
Background concentrations of nitrate in lakes (about 1.3 mg NO3/l) are shown to aid the assessment of the significance of the nitrate concentrations (in association with the drinking water MAC).
The time series comprise consistent data sets with no data gaps. For each time series the arithmetic mean of the station annual average concentrations was used in the regional aggregations.

Fig. 12: Phosphorus concentrations in lakes (total phosphorus) in different regions of Europe



Data source: Waterbase (Version 4)

Note: Number of monitoring stations in brackets

Western Europe: Austria (2), Germany (5), Denmark (23), Ireland (1).

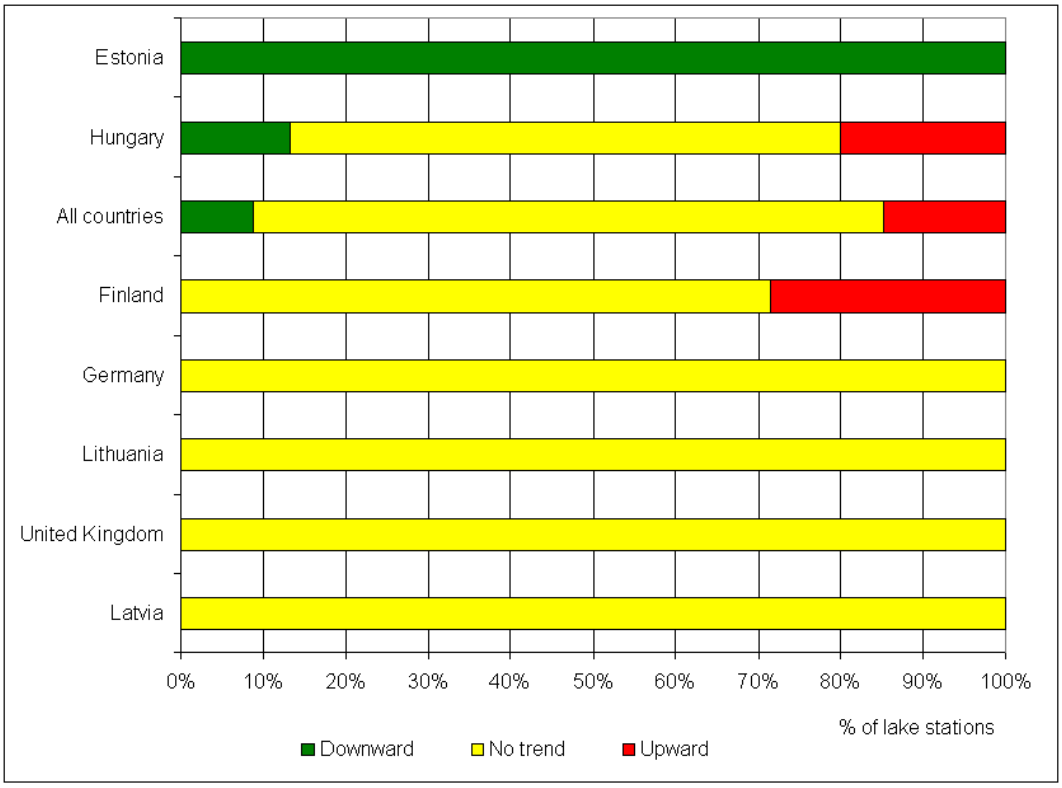
Eastern Europe: Estonia (1), Hungary (11), Latvia (1).

Nordic countries: Finland (63).

Background concentrations of total phosphorus in lakes (about 10 micro g P/l) are shown to aid the assessment of the significance of the phosphorus concentrations.

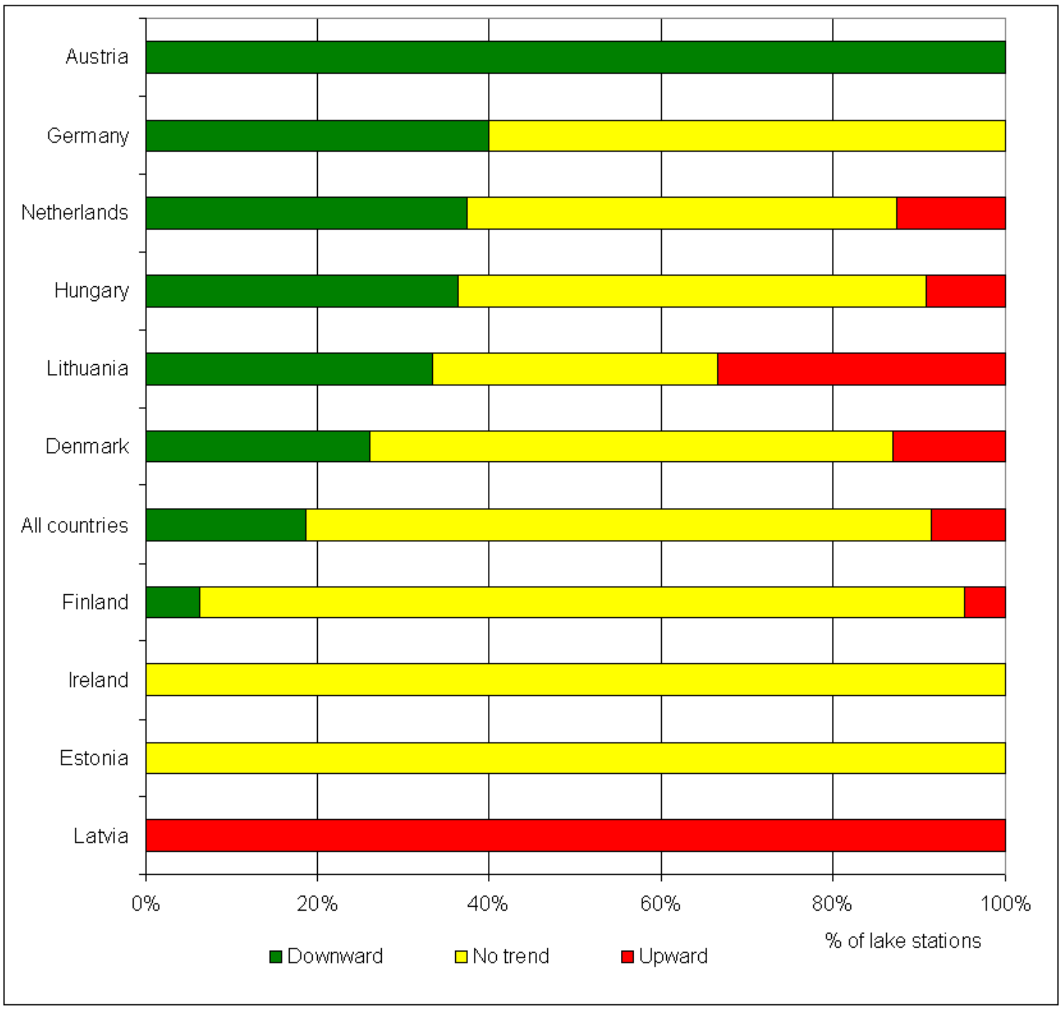
The time series comprise consistent data sets with no data gaps. The arithmetic mean of the station annual average concentrations was used in the regional aggregations.

Fig. 13: Trends in nitrate concentrations in lakes in European countries



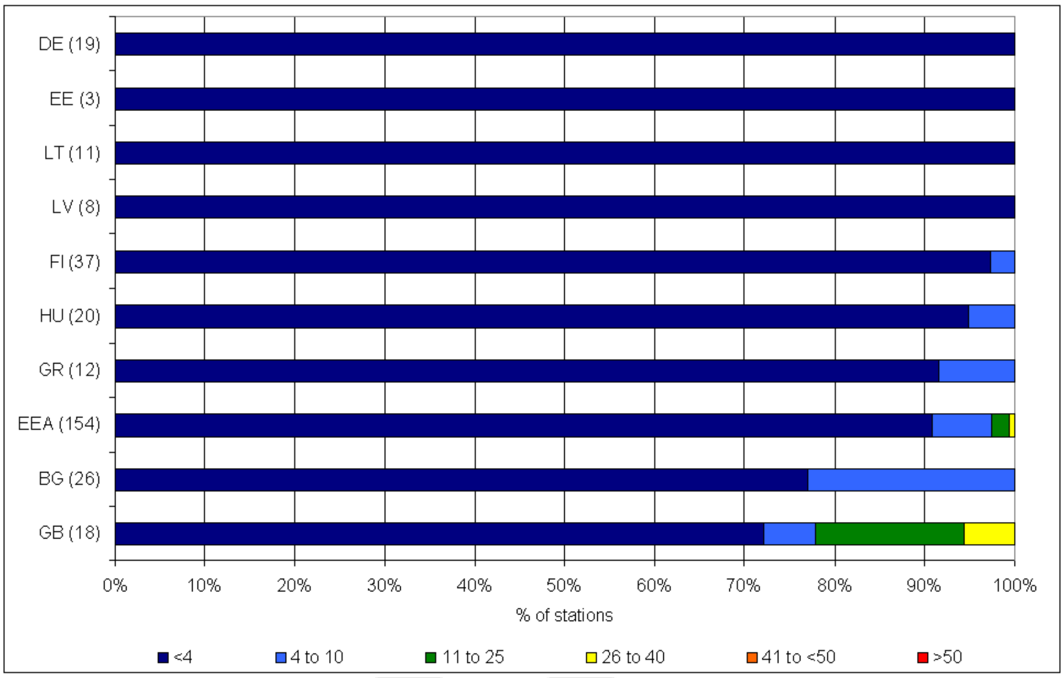
Data source: Waterbase (Version 4)
Note: Number of lake stations for each country given in brackets.
Analysis based on representative lake monitoring stations.
Consistent time series (1992 to 2002) except for Lithuania (1993 to 2002).

Fig. 14: Trends in phosphorus concentrations in lakes (total phosphorus) in European countries



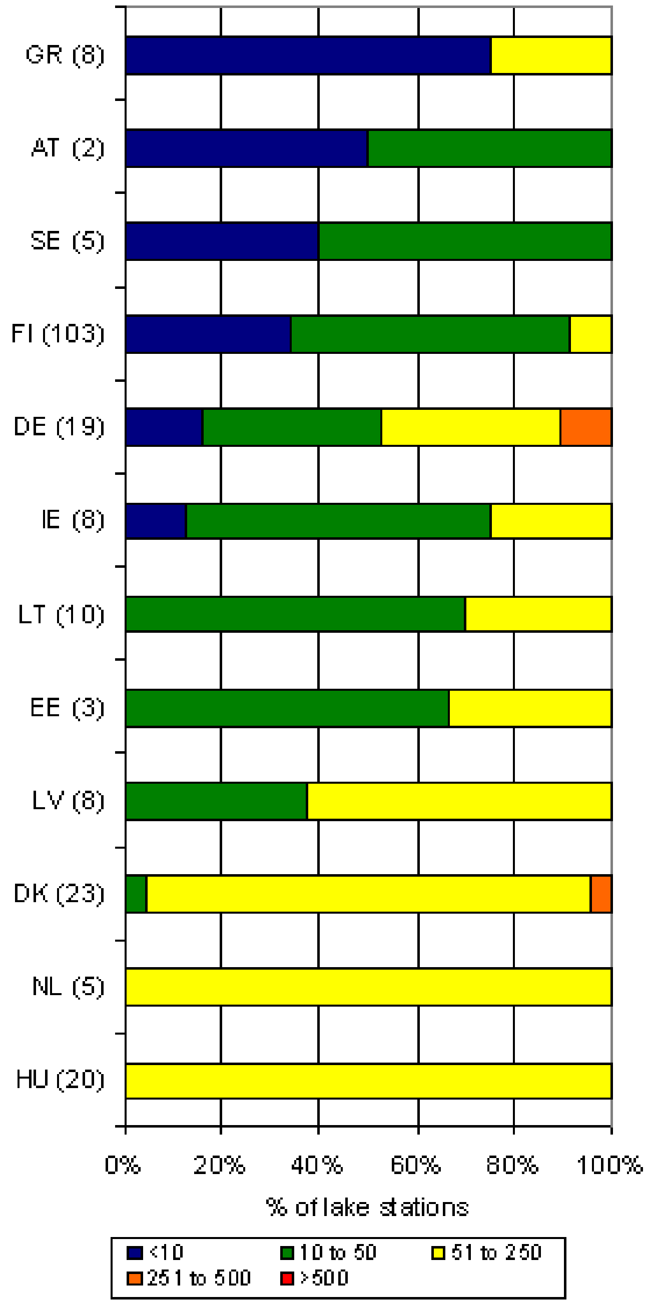
Data source: Waterbase (Version 4)
Note: Number of lake stations for each country given in brackets.
Consistent time series (1992 to 2002) except for Lithuania (1993 to 2002) and Netherlands (1992 to 2000).

Fig. 15: Present concentration of nitrate in lakes in European countries



Data source: Waterbase (Version 4)
Note: The number of lake monitoring stations in each country is given in brackets.
Figures are based on the most recent year for which data are available (annual average concentrations): this is 2002 except for Bulgaria (2000).

Fig. 16: Present concentration of phosphorus in lakes (total phosphorus) in European countries



Data source: Waterbase (Version 4)

Note: The number of lake monitoring stations in each country is given in brackets. Figures are based on the most recent year for which data are available: this is 2002 except for the Netherlands (2000).