working draft

EEA Core Set of Indicators - CSI 021

Nutrients in transitional, coastal and marine waters

May 2005 assessment

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European Environment Agency

Key policy question: Are nutrient concentrations in our surface waters decreasing?

Key message: Phosphate concentrations have decreased over recent years in some coastal sea areas of the Baltic and North Seas whereas in theCeltic Sea they have remained stable, and have increasedin some Italian coastal areas.Nitrate concentrations have generally remained stable over recent years in the Baltic, North and Celtic Seas but have increased in someItalian coastal areas.

Nitrate

In the OSPAR and HELCOM areas, the available time series show no clear trend in winter surface concentrations of nitrate. Both decreasing and increasing trends are observed at 3-4 % of the stations. The nitrate concentrations appear variable due to the fact that nitrogen loads related to run-off are also highly variable from year to year(Figure 1).

In the Baltic Sea, winter surface nitrate concentrations are low, even in many coastal waters (background concentration in the open Baltic Proper is about 65 ug/l (EEA 2001)). This is due to the long residence time (25-30 years) facilitating the removal of nitrogen by denitrification and burial in the sediments. These sinks balance the loads. The higher concentrations observed in the Belt Sea and the Kattegat are mainly due to the mixing of Baltic waters with the more nutrient-rich North Sea and Skagerrak waters. The enhanced concentrations resulting from local loading are particularly noticeable in the coastal waters of Lithuania, the Gulf of Riga, the Gulf of Finland, the Gulf of Gdansk, the Pommeranian Bay and Swedish estuaries(Figure 2).

In the OSPAR area (the North Sea, the English Channel and the Celtic Seas), the nitrate concentrations are high (>600 ug/l) due to land-based loads into the coastal waters of Belgium, the Netherlands, Germany, Denmark, and in a few UK and Irish estuaries(Figure 13). Background concentrations in the open North Sea and Irish Sea are about 129 ug/l and 149 ug/l, respectively (EEA 2001). In the Dutch costal waters an overall decrease in the trend in concentrations of winter nitrate of 10-20 % has been observed, when normalising the concentration to salinity and using a smoothing trend detection method. Denmark reported significant decreasing trends in the annual mean concentrations of nitrate+nitrite+ammonium, both in coastal waters and in the open Kattegat and Belt Sea (Aertebjerg (ed.) in prep.).

In the Mediterranean Sea, nitrate concentrations have increased at 24 %, and decreased at 5 % of the Italian coastal stations(Figure 1).The background concentration is low, i.e. only 7 ug/l (Figure 12). Relatively low concentrations are observed in the Greek coastal waters, around the Sardinian Island and the Calabrian Peninsula. Slightly higher concentrations are observed along the Italian north-west and south-east coasts. High concentrations are observed in most of the northern and western Adriatic Sea, as well as close to rivers and cities along the Italian west coast.

In the Black Sea, the background concentration of nitrate is very low, i.e. 1.4 ug/l (Figure 11). A slight decrease in nitrate concentration has been reported for the Romanian coastal waters, with a steady decline in the Turkish waters at the entrance to the Bosphorus (Black Sea Commission 2002). An increased level of both nitrate and phosphate in Ukrainian waters during recent years is connected to high run-offs from rivers discharging into the Black Sea (Black Sea Commission 2002).

Phosphate

In the Baltic Sea and the North Sea, phosphate concentrations have decreased at 25 and 33 % of the

coastal stations, respectively(Figure 1).In the Greater North Sea, the decline in phosphate concentrations is especially evident in the Dutch and Belgian coastal waters. This is probably due to reduced phosphate loads from the river Rhine. Decreases in phosphate concentrations have been also observed at some stations in the German, Norwegian and Swedish coastal waters, and in the open North Sea (more than 20 km from the coast). In the Baltic Sea area, decreases in phosphate concentrations were observed in the coastal waters of most countries, except Poland, as well as in the open waters.

In the Baltic Sea area(Figure 10)the winter surface phosphate concentration is very low in the Bothnian Bay compared to the background concentrations in the open Baltic Proper, and is potentially limiting primary production in the area. The concentration is slightly higher in the Gulf of Riga, the Gulf of Gdansk, some Lithuanian, German and Danish coastal waters and in estuaries. Remedial measures have been taken in the catchment areas and a reduction in the use of fertilisers has occurred. However, recent research indicates that phosphate concentrations in, for example, the open Baltic waters including the Kattegat, are strongly influenced by internal processes and transport due to variable oxygen regimes in the bottom water layer (Rasmussen et al. 2003). The phosphate concentration is exceptionally high in the Gulf of Finland due to hypoxia and the up-welling of phosphate-rich bottom water in the late 1990s (HELCOM 2001).

In the North Sea, the English Channel and the Celtic Seas, the phopsphate concentrations in the coastal waters of Belgium, the Netherlands, Germany and Denmark are elevated compared to the concentrations in the open North Sea. The concentrations in the estuaries are generally high due to local loads(Figure 9).

In the Mediterranean Sea, phosphate concentrations have increased at 26 % and decreased at 8 % of the Italian coastal stations(Figure 1).Concentrations higher than the background value (i.e. about 1 ug/l) are observed in most coastal waters, and much higher concentrations are observed in hot spots along the Italian east and west coasts(Figure 8).

In the open Black Sea, the phosphate background concentration is relatively high (about 9 ug/l) compared to the Mediterranean Sea and to the nitrogen background value. This is probably due to the permanently anoxic conditions in the bottom waters of most of the Black Sea, which prevents the phosphate being bound in the sediments. The phosphate concentration along the Turkish coast is lower than in the open sea, while it is higher in the Romanian coastal waters influenced by the Danube River(Figure 7).In the Black Sea, a slow decline in the concentrations of phosphate has been reported for the Turkish waters at the entrance to the Bosphorus (Black Sea Commission 2002).

N/P Ratio

In the Baltic Sea, the N/P ratio, based on winter surface nitrate and phosphate concentrations, is increasing in all areas, except the Polish coastal waters(Figure 1).The N/P ratio is high (>32) in the Bothnian Bay, where it is likely that phosphorus limits the primary production. However, the N/P ratio was low (<8) to relatively low (<16) in most of the open and coastal Baltic Sea area, indicating potential nitrogen limitation(Figure 6).

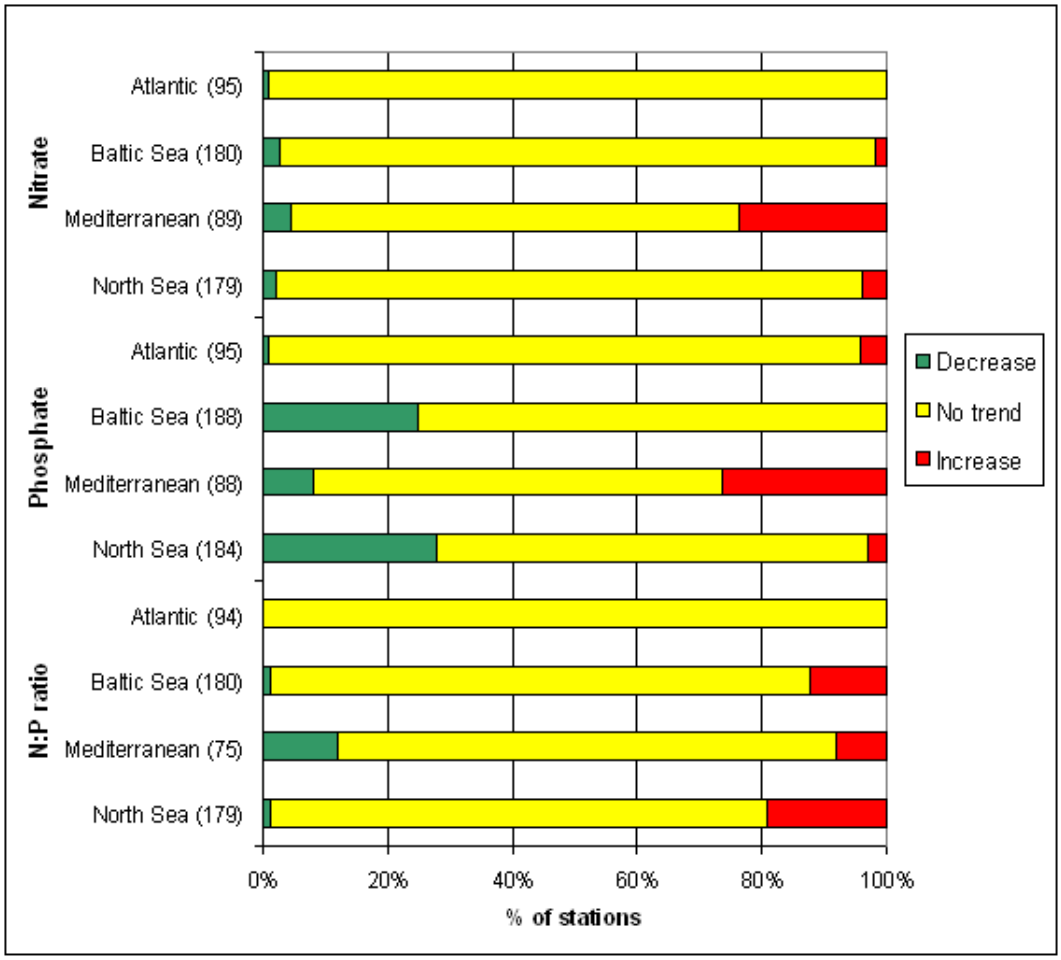
In the Greater North Sea and Celtic Seas, high N/P ratios (>16) are observed in the Belgian, Dutch, German and Danish coastal waters and estuaries (Figure 5), indicating potential phosphorus limitation, at least in early growing season. In more open waters, the N/P ratio was generally below 16, indicating potential nitrogen limitation.

In the Mediterranean Sea, high N/P ratios (>32) are found along the northern Adriatic coast and at hot spots along the Italian coasts and the north coast of the Sardinian Island(Figure 4),indicating potential phosphorus limitation, at least during some periods of the growing season.

In the Black Sea, the N/P ratio is generally low, especially in the open sea and along the Turkish coast,

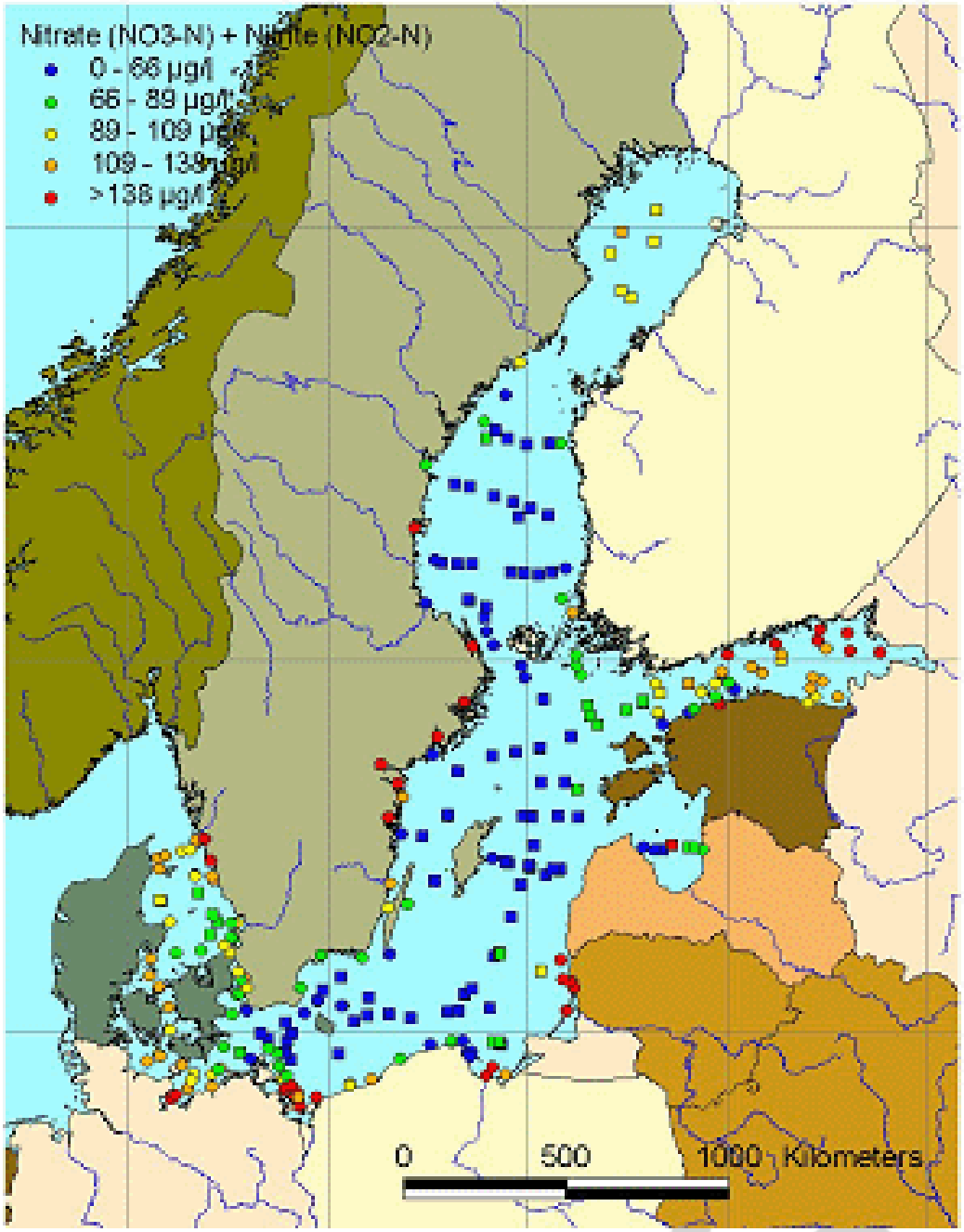
indicating potential nitrogen limitation. High N/P ratios (>32) are only found at a few Romanian coastal stations (Figure 3) indicating potential phosphorus limitation.

Fig. 1: Trends in winter nitrate and phosphate concentration, and N/P ratio in coastal waters of the North Atlantic (mostly Celtic Seas), the Baltic Sea, the Mediterranean and the North Sea.



Data source: Waterbase (data from OSPAR, HELCOM, ICES and EEA member countries compiled by ETC Water).
Note: Trend analyses are based on time series 1985-2003 from each monitoring station having at least 3 years data in the period 1995-2003 and at least 5 years data in all. Number of stations in brackets.
Atlantic (incl. the Celtic Seas) data from: UK, Ireland and ICES.
Baltic Sea (incl. the Belt Sea and the Kattegat) data from: Denmark, Finland, Germany, Lithuania, Poland, Sweden and ICES.
Mediterranean data from: Italy.
North Sea (incl. the Channel and the Skagerrak) data from: Belgium, Denmark, Germany, Netherlands, Norway Sweden, UK and ICES.

Fig. 2: Mean winter surface concentrations of nitrate+nitrite in the Baltic Sea Area



Data source: Waterbase (data from OSPAR, HELCOM and EEA member countries compiled by ETC Water).
Note: Coastal stations are marked by circles and ICES open-water stations (>20 km from coast) by squares.
Level of classification is based on the 20 % 40 %, 60 % and 80 % percentiles of the nitrate+nitrite distribution at coastal stations.
The map is only available as a low resolution picture. The underpinning data is available without selections. In the second half of 2005 the underpinning data will be provided.

Fig. 3: Mean winter surface nitrate/phosphate-ratio in the Black Sea

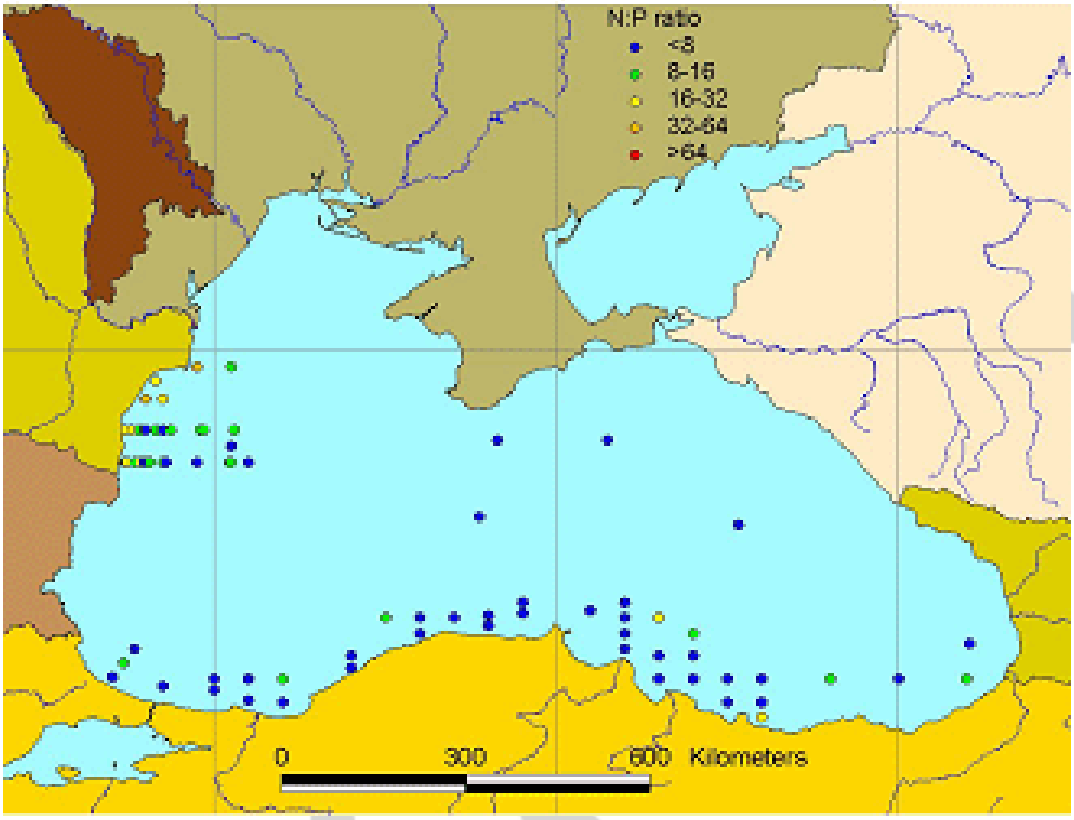


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Fig. 4: Mean winter surface nitrate/phosphate-ratio in the Mediterranean Sea

Data source: Waterbase (data from OSPAR, HELCOM and EEA member countries compiled by ETC Water).
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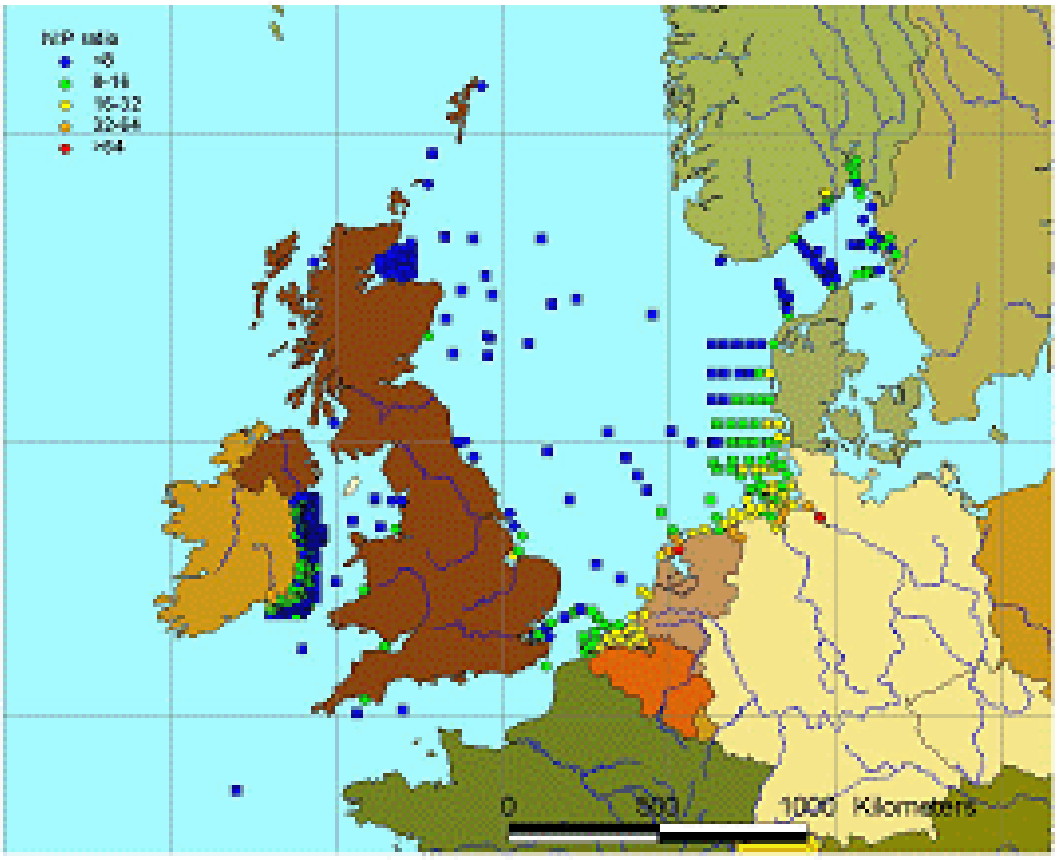
Fig. 5: Mean winter surface nitrate/phosphate-ratio in the Greater North Sea, the Celtic Seas and the Northeast Atlantic



Data source: Waterbase (data from OSPAR, HELCOM and EEA member countries compiled by ETC Water).
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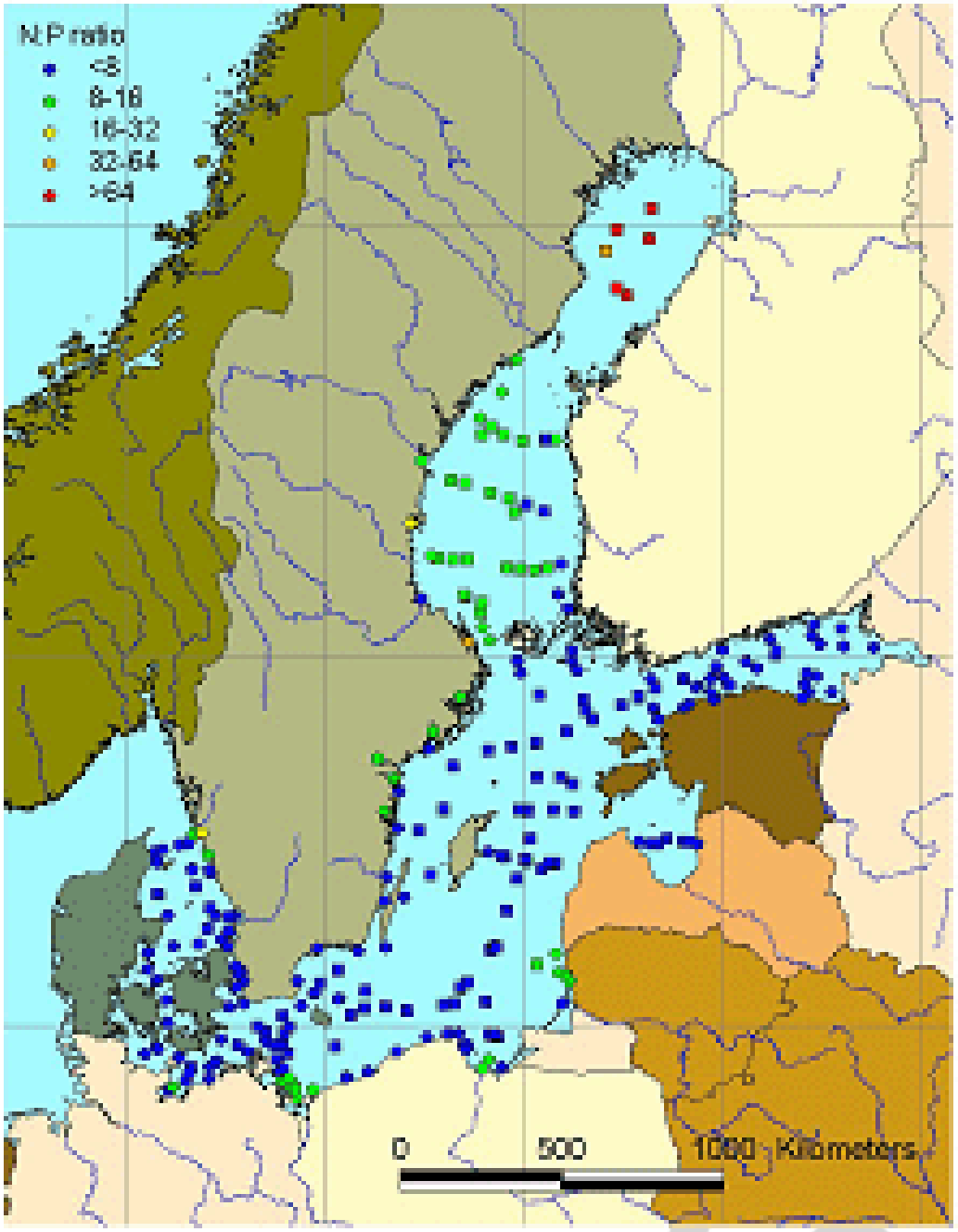
Fig. 6: Mean winter surface nitrate/phosphate-ratio in the Baltic Sea Area



Data source: Waterbase (data from OSPAR, HELCOM and EEA member countries compiled by ETC Water).
Note: Coastal stations are marked by circles and ICES open-water stations (>20 km from coast) by squares.
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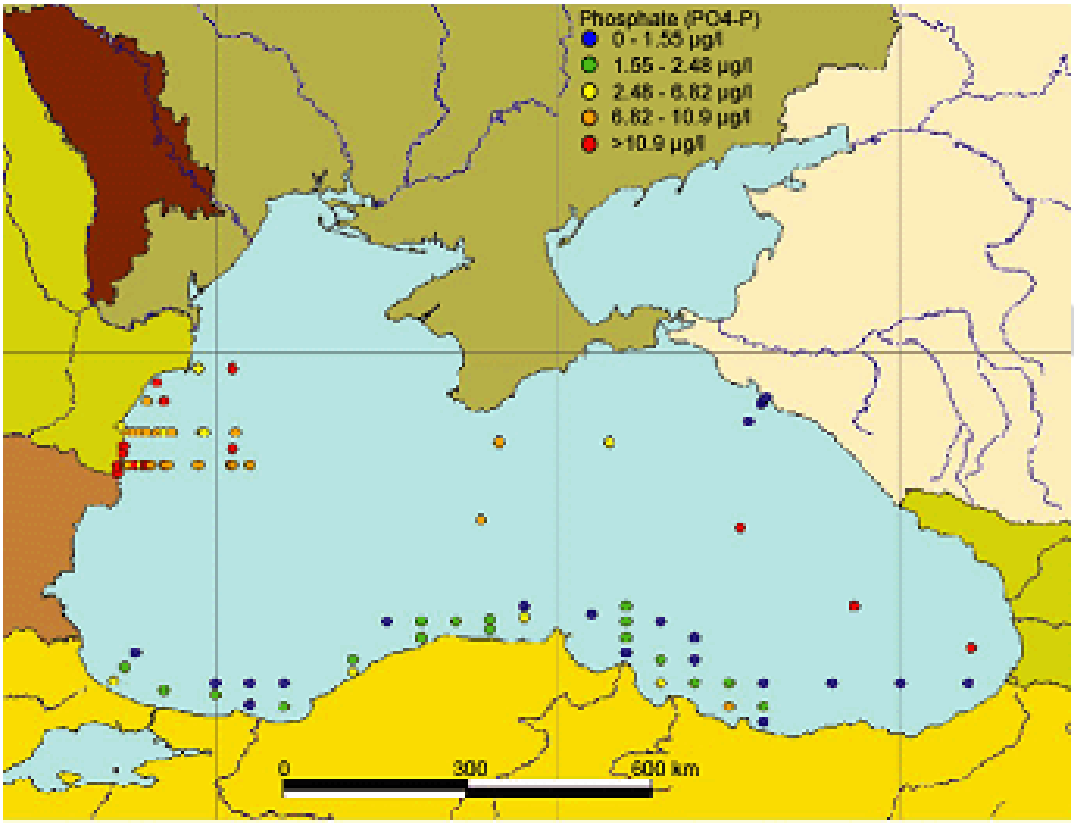
Fig. 7: Mean winter surface concentrations of phosphate in the Black Sea



Data source: Waterbase (data from OSPAR, HELCOM and EEA member countries compiled by ETC Water).
Note: Coastal stations are marked by circles and ICES open-water stations (>20 km from coast) by squares.
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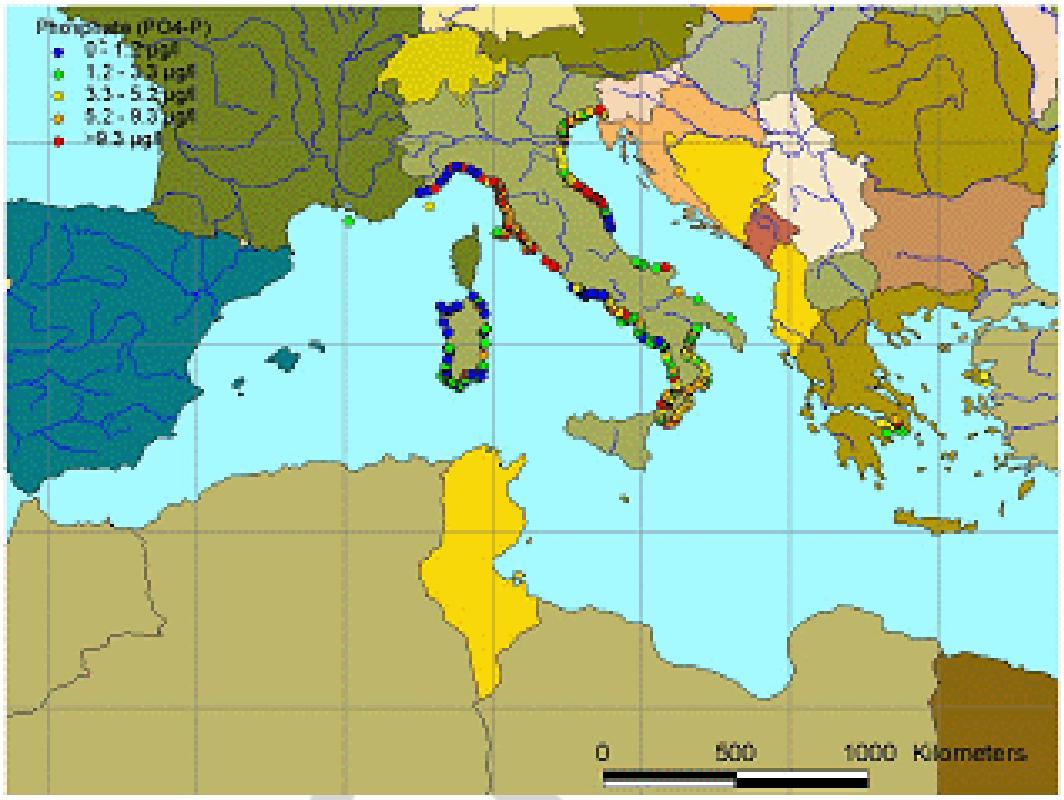
Fig. 8: Mean winter surface concentrations of phosphate in the Mediterranean Sea



Data source: Waterbase (data from OSPAR, HELCOM and EEA member countries compiled by ETC Water).
Note: Coastal stations are marked by circles and ICES open-water stations (>20 km from coast) by squares.
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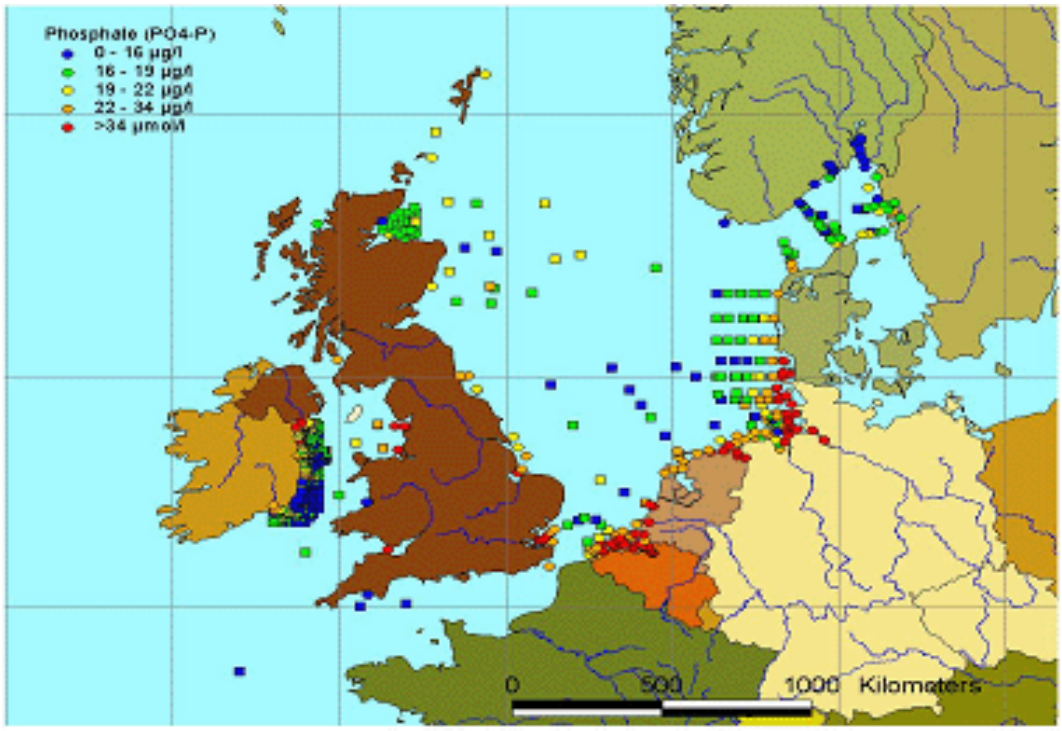
Fig. 9: Mean winter surface concentrations of phosphate in the Greater North Sea, the Celtic Seas and the Northeast Atlantic



Data source: Waterbase (data from OSPAR, HELCOM and EEA member countries compiled by ETC Water).
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Fig. 10: Mean winter surface concentrations of phosphate in the Baltic Sea Area

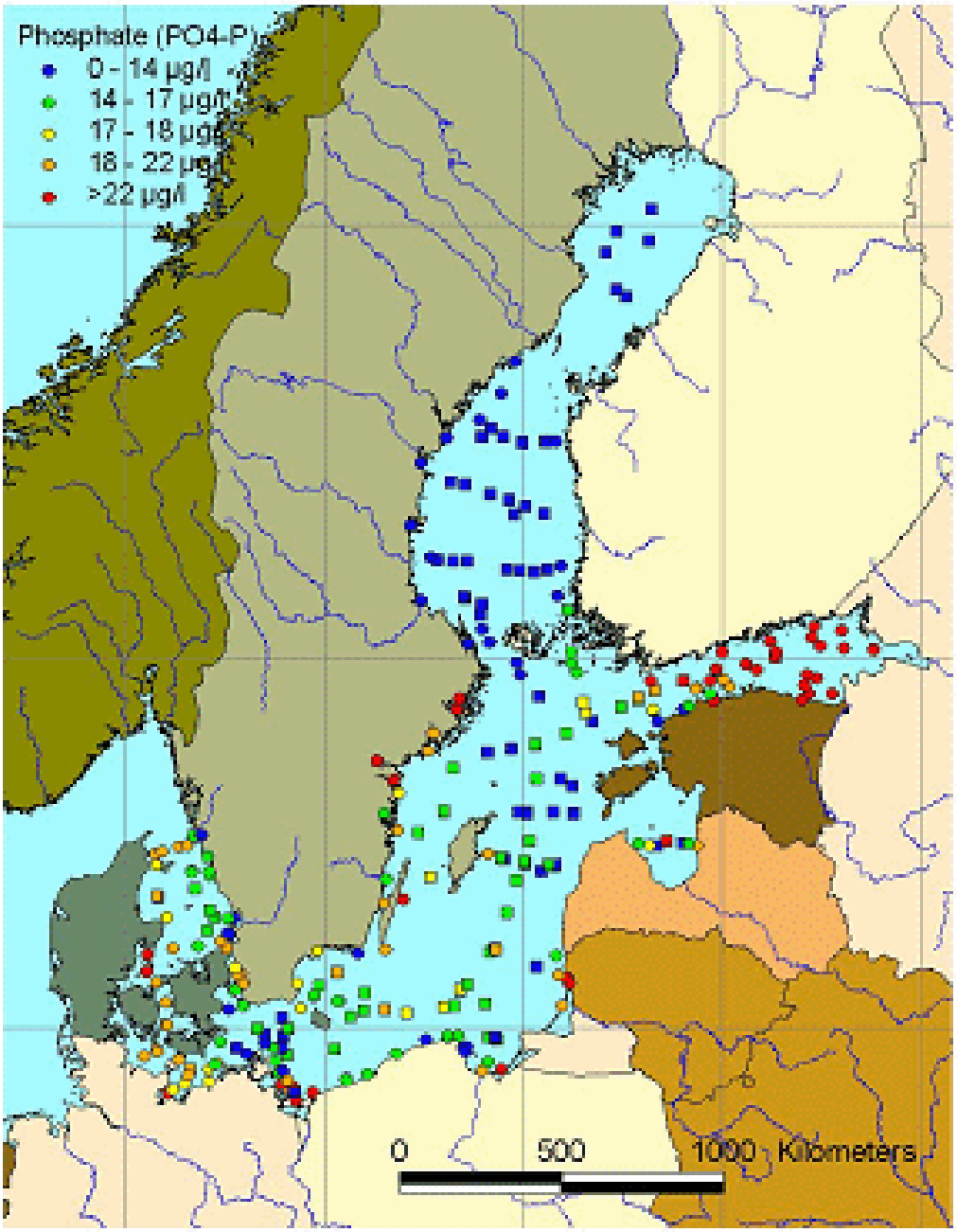

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Fig. 11: Mean winter surface concentrations of nitrate+nitrite in the Black Sea

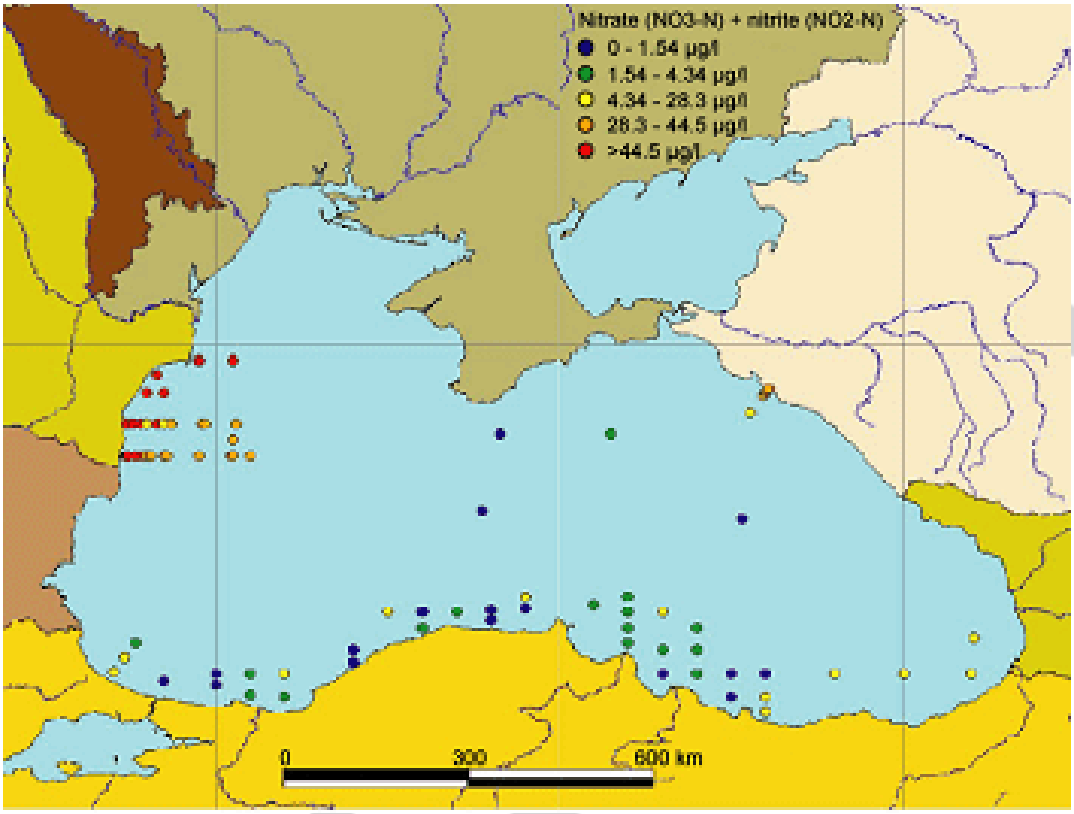

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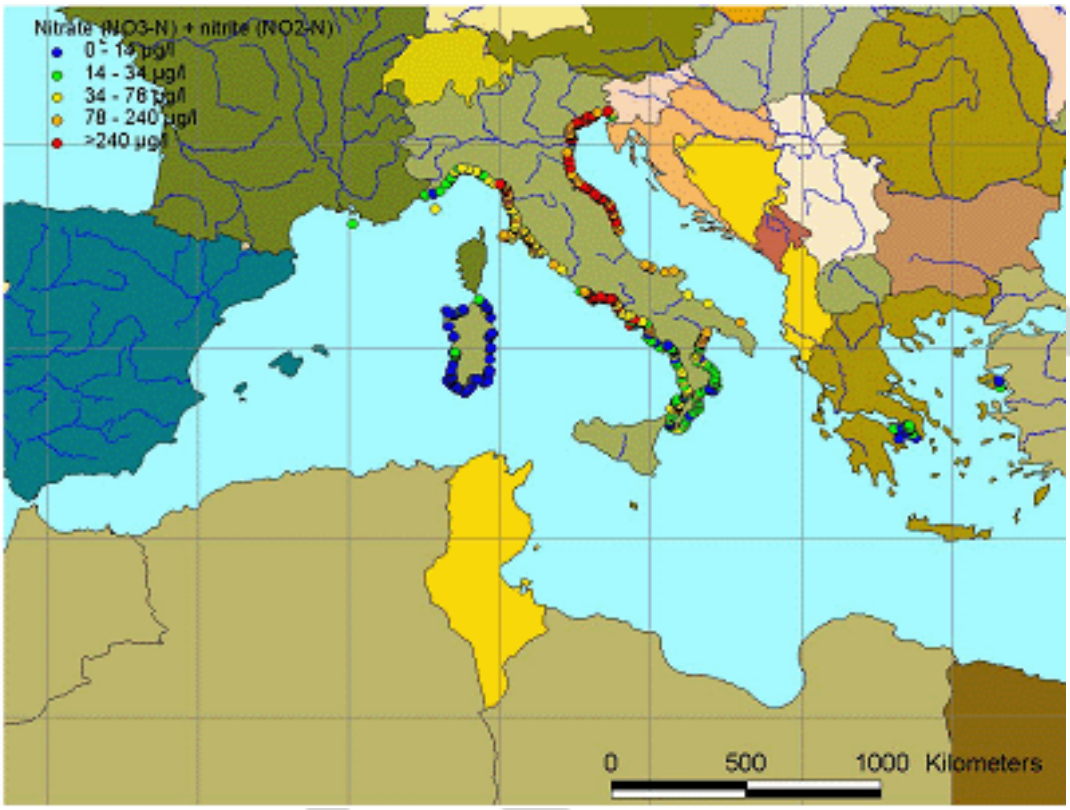
Fig. 12: Mean winter surface concentrations of nitrate+nitrite in the Mediterranean Sea



Data source: Waterbase (data from OSPAR, HELCOM and EEA member countries compiled by ETC Water).
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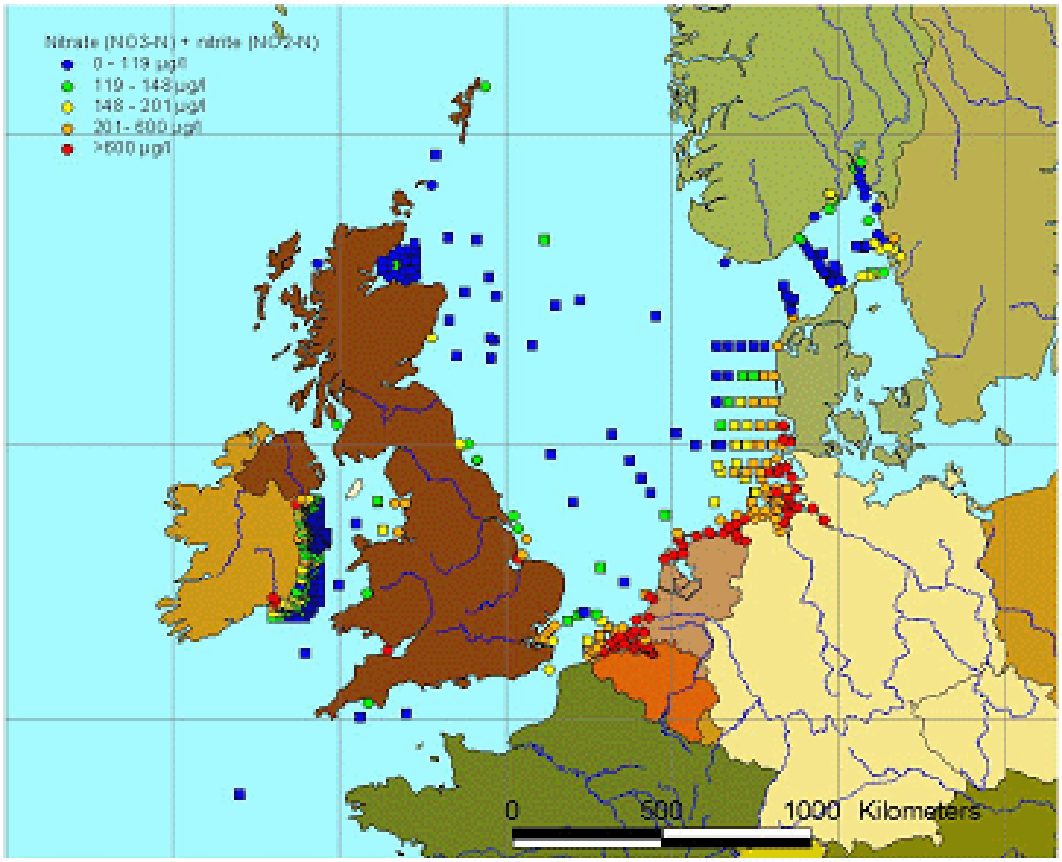
Fig. 13: Mean winter surface concentrations of nitrate+nitrite in the Greater North Sea, the Celtic Seas and the Northeast Atlantic



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