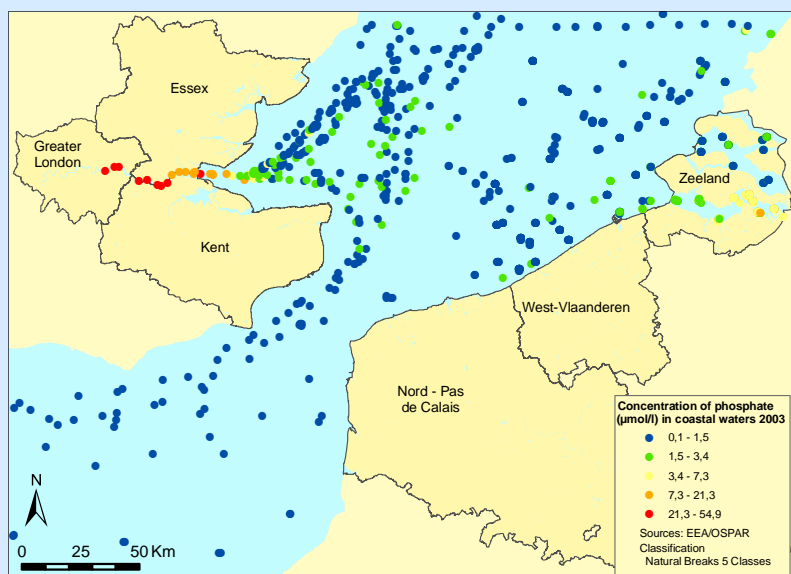
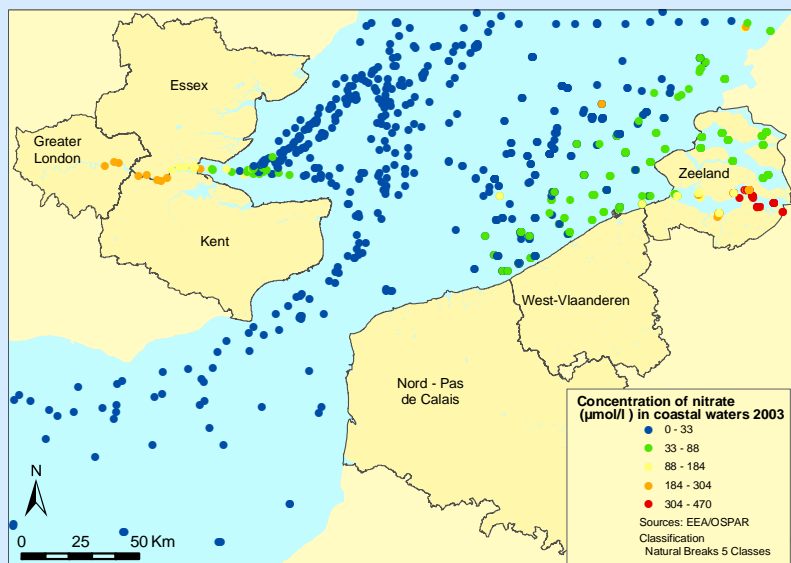
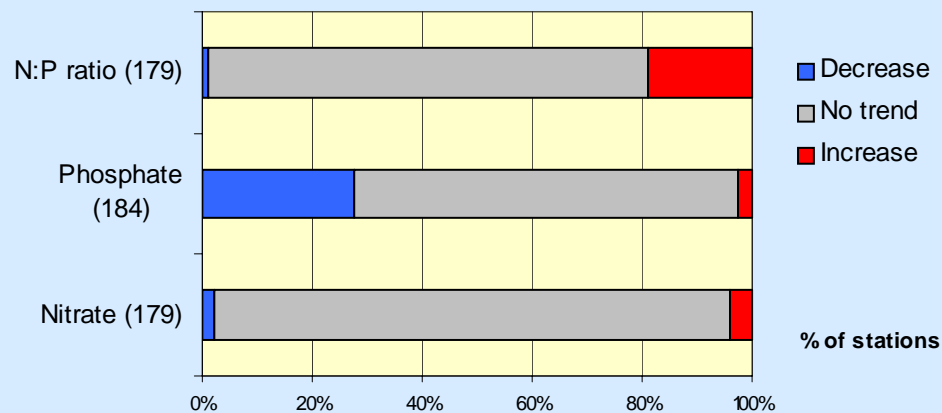


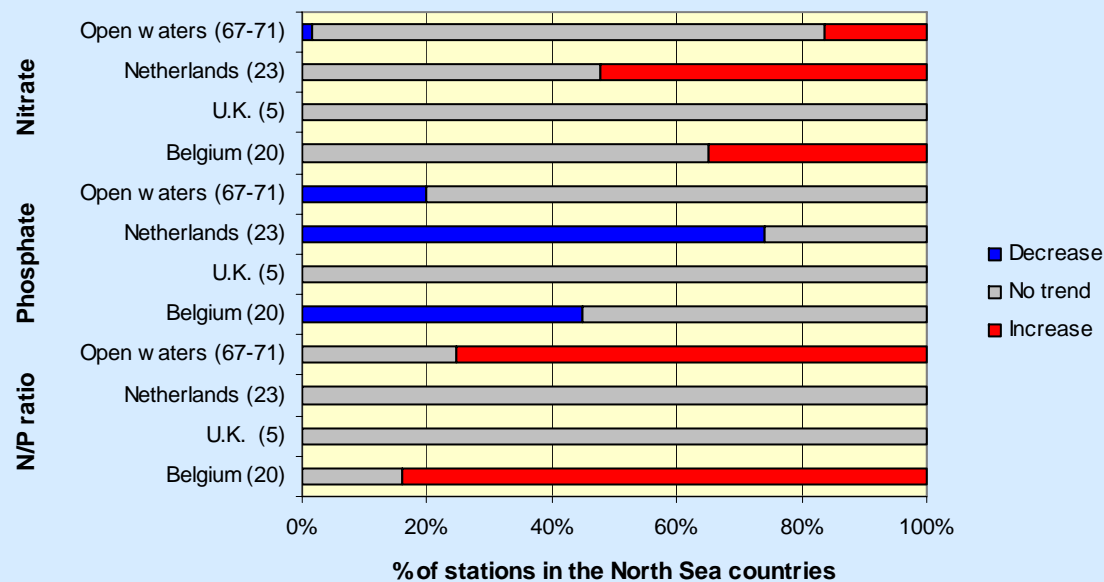
# Indicator 15 Concentration of nutrients in coastal waters



## Overall trends in nitrate, phosphate and N:P ratios in the North Sea (1981-2002, EEA)



## Trends in nutrient concentrations in open and coastal waters of the SAIL countries (1981-2002)





- *Mean winter surface concentrations of nitrate*
- *Mean winter surface concentrations of phosphate*

## Key Message

- No clear trends are observed in the winter surface concentrations of nitrate in the Southern North Sea: in 4% of the stations nitrate concentrations have increased since the 1980s; in only 2% have they decreased. While more than 80% of the stations in the UK were achieving good status during the first half of last decade, this situation has been reversed over the last few years.
- In the Southern North Sea, major reductions in phosphate concentrations are found in Dutch and Belgian coastal waters. Nearly 30% of the stations in the North Sea have reduced phosphate concentrations. This improvement is probably due to increased efforts to reduce riverine loads of phosphate.

## Why monitor the concentration of nutrients in coastal waters?

Nitrogen (N) and phosphorus (P) enrichment can cause a series of undesirable effects induced by excessive growth of plankton algae. Algal blooms increase the amount of organic matter that settles to the bottom. The consequent increase in oxygen consumption can lead to oxygen depletion, changes in community structure and death of the benthic fauna, reduced biodiversity and less nurseries for fish.

Eutrophication also increases the risk of harmful algal blooms that may cause discoloration of the water, foam formation, death of benthic fauna, and even shellfish poisoning of humans and birds.

There is a direct relationship between the input of nutrient loads to coastal waters from diffuse and point sources and the concentration of nutrients in coastal waters. Comparing measured nutrient concentrations in coastal waters to the open sea background levels indicates the degree of human-induced

nutrient enrichment or eutrophication. In winter, biological uptake and turnover is at its lowest, resulting in the highest inorganic nutrient concentrations. Hence, average winter concentrations are monitored as they are considered to better reflect the problem of eutrofication. The ratio of N/P determines the composition of phytoplankton in coastal waters and is in part responsible for algal blooms.

## Where do the data come from?

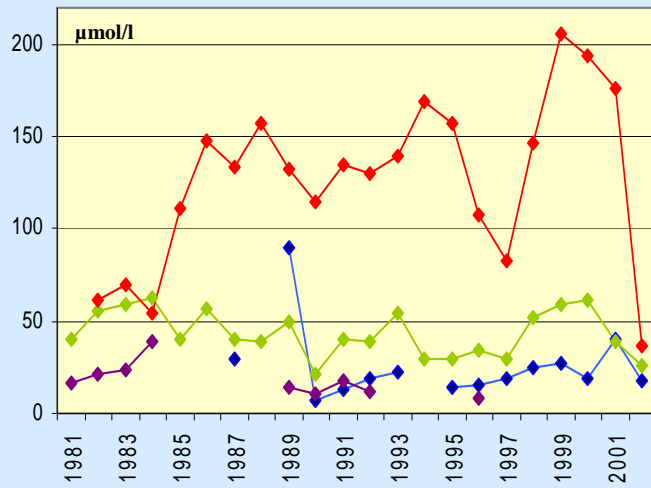
Individual Member States in the Greater North Sea report their monitoring results to OSPAR (the Oslo Paris Commission Secretariat) in the context of the Strategy to Combat Eutrophication. A Common Procedure was adopted in 1997, by which the Contracting Parties assess the eutrophication status of their maritime area. National reports on the first complete application of the Common Procedure were completed in 2002. The International Council for the Exploration of the Sea (ICES) performs monitoring activities in 'open waters' stations. Coastal stations are defined as those located less than 20 kilometres from the coast. The European Topic Centre Water (ETC-Water) compiles and analyzes the data at national and regional sea level.



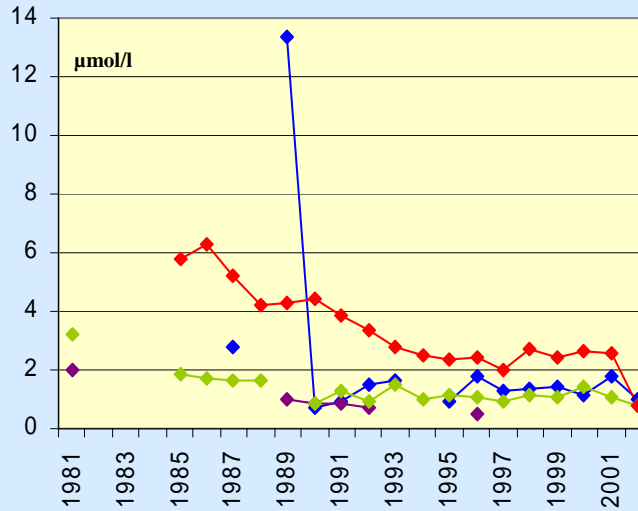
Run-off from agricultural use accounts for much of the nutrient enrichment of the North Sea



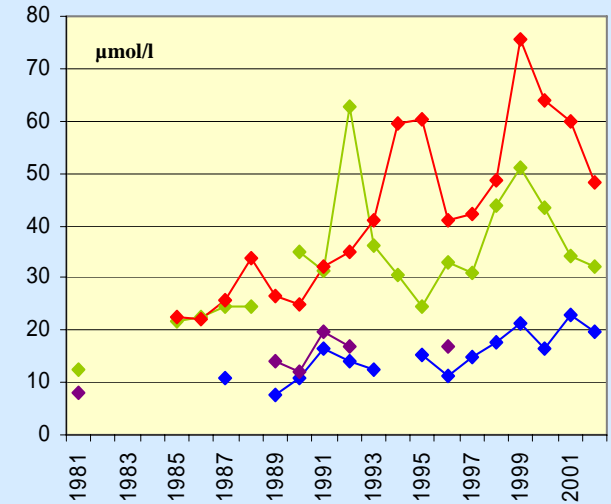
Nitrate concentrations



Phosphate concentrations

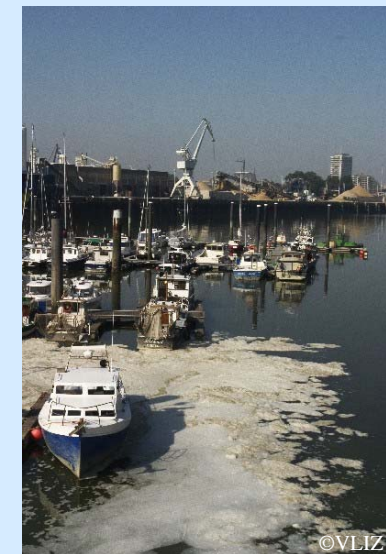
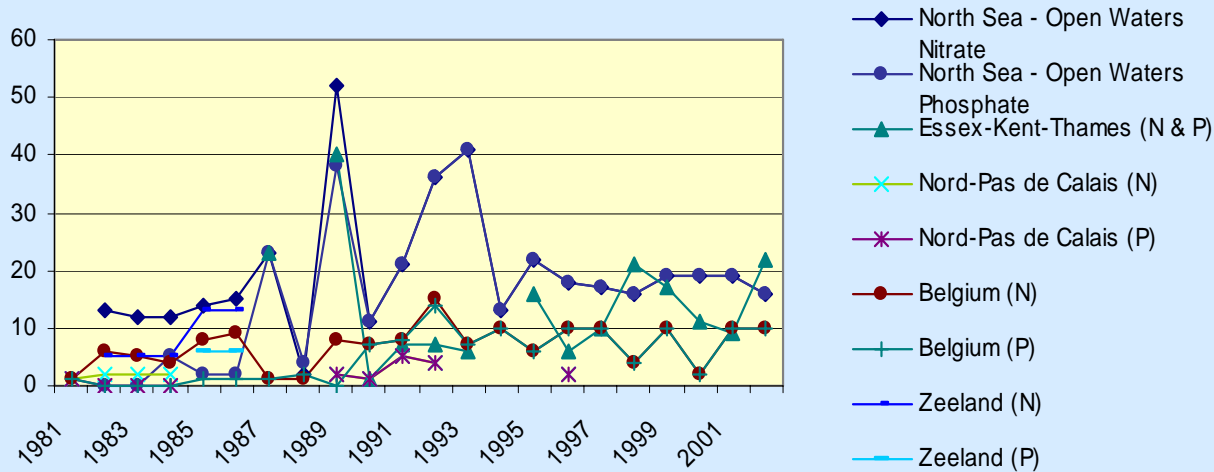


N/P ratio



◆ Kent-Essex-Thames ◆ Nord-Pas de Calais ◆ West-Vlaanderen ◆ Zeeland

Number of nutrient sampling stations in the SAIL region (1981-2002)



Foam formation resulting from algal blooms



## What does the indicator show?

Available time series (1982-2002) indicate no clear trend in winter surface concentrations of nitrate. The variability observed is due to the link between nitrogen loads and highly variable runoff from rivers. Although an improvement in Belgian waters took place in the '90s, and an overall decrease is observed in the Dutch Delta between 1985 (170 $\mu$ mol/l) and 2002 (37 $\mu$ mol/l) nutrient concentrations in Belgian waters and the Dutch Delta area still have 'elevated assessment levels' (>18-30 $\mu$ mol/l). The Westerschelde estuary (between Belgium and The Netherlands) estuary is classified as a 'problem area', both in terms of nutrient enrichment as because of direct and indirect effects of eutrophication. In the UK, average nitrate concentrations have fluctuated around the background value since the early 1990s. While more than 80% of the stations in the UK were achieving good status during the first half the of last decade, this situation has been reversed over the last few years. In 7 out of 179 stations in the North Sea, nitrate concentrations have increased over the study period (1982-2002 EEA).

In the North Sea, nearly 30% of the stations have seen a reduction in phosphate concentrations while an increase has been observed at only five stations. Important reductions in phosphate concentrations are found in the Dutch and Belgian coastal zone. This improvement is probably due to increased efforts to reduce riverine phosphate loads.

As a consequence of the decrease in phosphate and the slight increase in nitrate concentrations, the N/P ratio has increased in 19% of the sampling stations. The N/P ratio, also known as the Redfield ratio, should be as close to 16 as possible to achieve balanced phytoplankton communities.

Most nitrate is generated by leaching from agricultural soils and carried to coastal waters by rivers, mainly during winter/spring. Most phosphate is discharged from sewages and industrial wastewater all year round. The optimal nitrogen to phosphorus ratio is 16:1. Significant deviations from the ratio 16 might indicate nitrogen-limitation or phosphorus-limitation in phytoplankton growth.

## What are the implications for planning and managing the coast?

Nutrient enrichment is a widespread problem in European coastal waters. Political targets to reduce eutrophication have focused on load reductions. The EU Nitrate Directive and Urban Wastewater Treatment Directive aim at reducing nitrate loads to eutrophication sensitive areas, mostly from agriculture (leaching soil) and sewage works.

Member countries of the North Sea Ministerial Conference have agreed to 50% reduction of the nutrient load (based on mid-1980 levels) to areas affected by eutrophication.

Current knowledge confirms that the colony blooming of phytoplankton species (*Phaeocystis* sp.) cause eutrophication-related problems in the eastern Southern Bight of the North Sea. The blooming has adverse impacts on biological resources, the fishing industry and tourism (through water quality and impact of algal blooms). Colony blooms can be observed as deposits of foam on the beaches or as clogging of fishing nets.

The EU Water Framework Directive (RL 2000/60/EG) also requires Member states to achieve coastal waters of 'good ecological quality' by 2015 and 'good chemical status' by 2015. Target concentrations have been set for nutrients in the different regional seas.

### How reliable is the indicator?

Large spatial and temporal variations are inherent to the datasets used to calculate this indicator at the European level. Datasets and the trend analyses for the North Sea area, however, are considered consistent. It is necessary to obtain longer time series in a larger number of permanent measuring stations to calculate trends for the Southern North Sea. A second field of improvement concerns the methodology for comparing data over different years. More work is needed regarding the influence of varying salinity levels on the measurements and estimations of uncertainty in the data and trends.



