

FACT SHEET

SUMMARY

Coastal eutrophication (excessive plant growth resulting from nutrient enrichment by human activity) has become a wide-spread phenomenon in recent decades. It can have significant negative environmental and economic impacts at local and even trans-national level.

In larger river basins and coastal sea areas of Europe, 50-80% of total nitrogen pollution is caused by run-off from agricultural land. Furthermore, households and industry still tend to be the most significant source of phosphorus pollution. Discharges from households have decreased significantly during the past 30 years whereas the loss from agriculture has remained static. Recently, several attempts have been made to restrict nutrient inputs, which have, in some cases, resulted in reduced eutrophication and recovery of marine environments.



Foam on the beach caused by the decaying remains of the brown slimy algae *Phaeocystis globosa*, Texel, Netherlands

POSSIBLE IMPACTS



Satellite image of a phytoplankton bloom in the Baltic Sea

Eutrophication usually leads to increased growth, primary production and biomass of algae, and normally favours relatively large phytoplankton species.

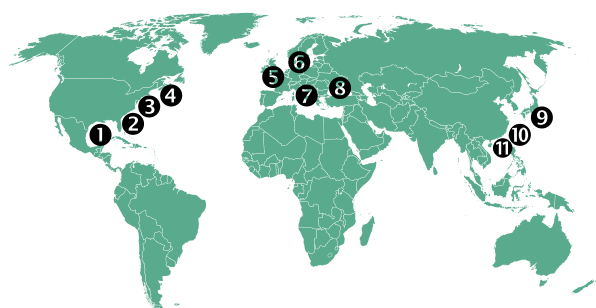
Moreover, changes in the balance of organisms caused by eutrophication can disturb local food chains. Reorganization of plankton communities might have dramatic socio-economic impacts through effects on commercial fisheries in coastal and shelf seas.

Harmful algal blooms, which occur more frequently in eutrophic waters, can significantly degrade water quality. Under particular circumstances the increase of primary production can result in the creation of hypoxic (low oxygen) conditions in aquatic ecosystems.

WHAT ARE THE FUTURE PROJECTIONS?

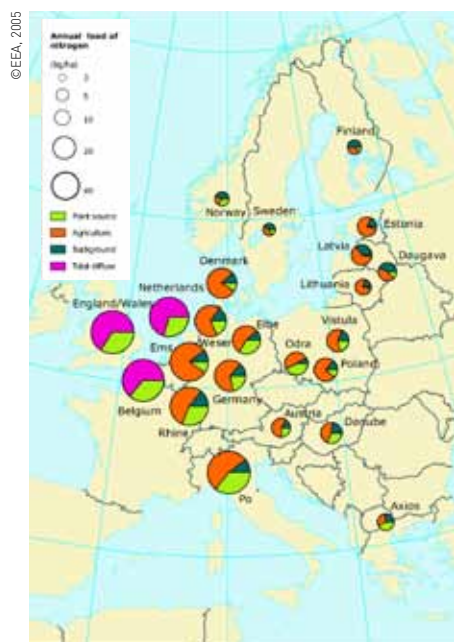
How climate change affects eutrophication patterns will vary across different coastal ecosystems as a result of complex contributing factors. For example, changes in precipitation regimes could enhance nutrient run off from the land to coastal areas. The same changes in precipitation patterns, however, could also increase freshwater discharges, thereby diluting nutrient concentrations and masking the increased loading of nutrients in freshwater and brackish reaches of estuaries.

Climate change is also expected to affect primary production through acidification and changes in light, circulation and temperature. Modeling efforts have shown, however, that the increase of primary production due to eutrophication could also counter the effects of ocean acidification in coastal environments.



- 1 N Gulf of Mexico
- 2 Albemarle-Pamlico Sound
- 3 Chesapeake Bay
- 4 Long Island Sound
- 5 E North Sea
- 6 Kattegat / Baltic Sea
- 7 N Adriatic
- 8 NW Black Sea
- 9 Seto Inland Sea
- 10 Yellow Sea
- 11 E China Sea

Locations of regions of large-scale nutrient over-enrichment leading to eutrophication, with 4 of the 12 areas located in Europe (Based on Boesch 2002)



FURTHER READING

- Beman JM, Arrigo K, Matson PA (2005). Agricultural runoff fuels large phytoplankton blooms in vulnerable areas of the ocean. *Nature* 434:211-214.
- Boesch DF (2002). Challenges and opportunities for science in reducing nutrient over-enrichment of coastal ecosystems. *Estuaries* 25:744-758.
- Cloern JE(2001). Our evolving conceptual model of the coastal eutrophication problem. *Marine Ecology Progress Series* 210:223-253.
- Nielsen E, Richardson K (1996). Can changes in the fisheries yield in the Kattegat (1950-1992) be linked to changes in primary production? *ICES Journal of Marine Science* 53:988-994.
- Schindler DW (2006). Recent advances in the understanding and management of eutrophication. *Limnology and Oceanography* 51:356-363.
- Smith VH, Schindler DW (2009) Eutrophication science: where do we go from here? *Trends in Ecology and Evolution* 24, 201-207.

ONGOING RESEARCH

Improved monitoring and research mean that changes in abundance, community structure, seasonality and geographical range of phytoplankton species are now well documented. Effects on commercial fisheries and oxygen concentrations have also been studied extensively.

Research is currently focused on the growth of phytoplankton, in light of multiple potential stresses such as limitation of light and macronutrients and how these changes in primary production will affect shellfish and fish stocks. The growing knowledge about the different factors driving eutrophication, including climate change, and the impacts it will have on the ecosystem can now be used to develop models in an attempt to make reliable projections.

RESEARCH GAPS AND PRIORITIES

To develop realistic and ecologically sound management strategies for sustainable use of coastal seas in a changing environment, it will be essential to:

- Improve our understanding of the impacts of nutrient loads on primary production;
- Identify and quantify trophic transfers between primary and secondary producers; and
- Develop a better understanding of ecosystem resilience to eutrophication, particularly in light of climate-induced changes.

To gain a better understanding of the effects of climate change on eutrophication there is a need for:

- Consistent measurements of pelagic primary production;
- Long-term data on benthic primary production in shallow seas;
- Knowledge on how to differentiate between the factors simultaneously affecting growth and loss rates of microalgae.