



The recovery of the beaches of the Gulf of Riga is clearly visible. Beaches are now open for swimming, mainly due to improvement of wastewater treatment in Riga. Several beaches of the Gulf of Riga now even meet the requirements of the EU 'Blue flag', an indicator of good bathing water quality. Photo by Lennart Gladh, Sweden.

The Gulf of Riga – cleaner than expected

by Per Stålnacke, Paul Wassmann, Viesturs Jansons and Andris Andrushaitis

For a long time we believed that the environmental problems in the eastern part of the Baltic Sea were far more serious than in the west. Media and environmental movements contributed to this picture. Recent experiences however, have given us reason to reconsider this view. The results from two sub-projects of the Gulf of Riga project showed that the coastal waters were not as eutrophic as expected. The input of nutrients from the rivers surrounding the Gulf of Riga also proved to be quite low.

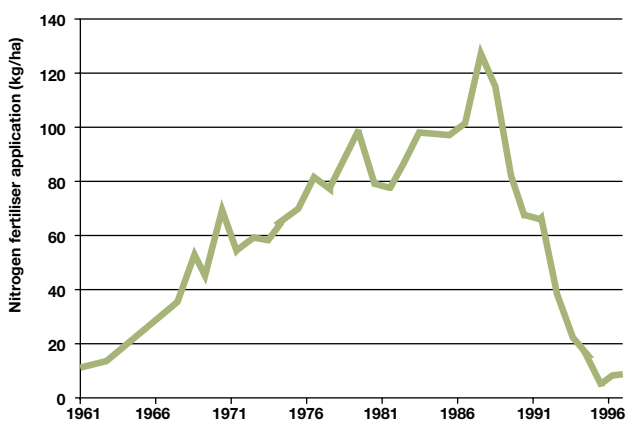
Surrounded by mile after mile of sandy beaches, the Gulf of Riga offers the tourist beautiful scenery. Two shallow sounds connect the gulf with the Baltic Sea and, as it is semi-enclosed and rather a shallow gulf, it is vulnerable to pollution. The first signs of eutrophication were observed in the sixties when the abundance of filamentous algae and bottom-living animals increased and phytoplankton blooms were observed. At the same time the fish stocks decreased due to overfishing. At times the concentration of faecal bacteria was so high that swimming was prohibited. Recently, however, the gulf has started to show signs of recovery, and the Helsinki Commission, HELCOM, has decided to delete two industries located in the drainage area from the list of environmental hot-spots.





► Dramatic changes in land use

In the Soviet era the Baltic Republics produced a lot of milk and meat, providing other parts of the Soviet Union with food. Imports of mineral fertilisers as well as animal feed were substantial, and in the sixties and seventies agriculture rapidly increased in the area. After the independence of the Baltic republics in 1990–1991, demand for farm products suddenly dropped, livestock were slaughtered and imports of fertilisers almost ceased. This led to an abrupt change in land-use practice, the likes of which has hardly ever been recorded. For environmental researchers this was a unique opportunity to study the environmental effects of changed land use and to observe how this influenced nutrient flows as well as the marine environment.



Low levels of nutrients

Agriculture is the main source of nutrients entering the Gulf of Riga from the surrounding rivers and is therefore of great importance for eutrophication of coastal waters. Discharges of untreated sewage water from Riga and other smaller cities also contribute to the nutrient load to coastal areas. One way of seeing the magnitude of nutrient losses to the sea is to look at the figures from the catchment area as a whole. The Riga Bay catchment area, where 40 per cent of the area is used for agriculture, exported on average 4 kilogrammes of nitrate-N per hectare per year and about 0.15 kilogrammes of phosphorous per hectare per year (1977–1995). This rate is far above that reported from forested and sparsely populated areas in the Baltic Sea area. However, a different picture emerges when the Gulf of Riga is compared with the Rhine basin. The area-specific loads of nutrients from the Rhine basin are four (for nitrate) or six (for phosphorous) times higher compared to the Gulf of Riga.

Recent figures from agricultural land (1994–98) show nutrient losses in the Gulf of Riga region ranging from 2–16 kilogrammes of nitrogen per hectare and year. For the Nordic countries, the corresponding figures are 15–45

The application of fertilisers almost ceased after the independence of the Baltic republics in 1990–1991 when the demand for farm products suddenly dropped.

The number of cattle declined drastically when agricultural practices changed after the independence of the Baltic States. In 1995 the number of cattle was less than half of that in 1991. Photo by Ritva Reinilä, Kuvaario, Finland.

kilogrammes nitrogen per hectare per year from areas with intense agriculture. So the conclusions of the project were that the loads from the basin of the Gulf of Riga are moderate or even low compared to similar rivers in Baltic Sea area and Western Europe.

Nature's self purification

Another surprising result was that the nutrient loads to the Gulf of Riga have not changed much during the 1990s, despite dramatic changes in land use, decreased industrial production and improved treatment of sewage water. This is probably due to the retention of nutrients and a large self-purification capacity in the drainage basin. Contributing factors are: (I) long water retention times in soil and groundwater; (II) water-saturated soils; (III) large pools of organic nitrogen in the soil; (IV) flat landscape and (V) large wetland areas.

Only now, ten years after the transformation of agriculture began, we are seeing the first signs of decreasing nutrient concentrations in the freshwater entering the gulf (M. Laznik, researcher at Latvian Hydrometeorological Agency, personal communication).

Still eutrophic

The results of the Gulf of Riga project showed that, though still eutrophic, the gulf is only moderately eutrophic compared to other coastal areas in the Baltic Sea. It seems as if the nutrients reaching the gulf are efficiently taken up in the ecosystem. This high buffering capacity, however, does not prevent blue-green algal blooms, but these are less prevalent in the Gulf of Riga than in other areas of the Baltic Sea. The variations of the algal blooms were shown to depend largely on weather conditions, especially wind direction. However, nutrient conditions vary within the Gulf: some parts are clearly eutrophic, while others are in better conditions.

Recent monitoring results from the Gulf of Riga are encouraging. The coastal ecosystems show signs of improvement, faecal coliform bacteria are decreasing (A. Ikaunieca, head of Biological laboratory, Institute of Aquatic Ecology, University of Latvia, personal communication), and the bottom-living communities seem to be recovering (G. Martin, Head of Department of Marine Biology, Estonian Marine Institute, personal communication).

References and further information

Laznik, M., Stålnacke, P., Grimvall, A. and Wittgren, H.B. 1999. Riverine input of nutrients to the Gulf of Riga – temporal and spatial variability. *Journal of Marine Systems* 23: 11–25.

Löfgren, S., Gustafson, A., Steineck, S., and Stålnacke, P. 1999. Agricultural development and nutrient flows in the Baltic states and Sweden after 1988. *AMBIO* 28: 320–327.

Stålnacke, P., Tamminen, T., Vagstad, N. Wassmann, P. Loigu, E. and Jansons, V. 1999. Nutrient runoff and transfer from land and rivers to the Gulf of Riga. *Hydrobiologia* 410: 103–110.

Vagstad, N., Jansons, V., Loigu, E. and Deelstra, J. 2000. Nutrient losses from agricultural areas in the Gulf of Riga drainage basin. *Ecological Engineering* 14: 435–441.

Wassmann, P. and Tamminen, T. (Eds.). 1999. Pelagic eutrophication and sedimentation in the Gulf of Riga. A contribution to the Nordic Environment Research Programme 1993–1997. *Journal of Marine Systems* 23 (special issue). 283 p.

The Gulf of Riga Project

The Gulf of Riga project was financed by the Nordic Council of Ministers within the Nordic Environmental Research programme for 1993–1997. The objective was to study environmental problems in the gulf and its drainage area, and to determine their impact on the rest of the Baltic Sea. The project offered opportunities for Nordic scientists and scientists from the Baltic republics to join forces in a common international project.

More information

Nordic Environmental Research Programme for 1993–1997: Final Report and Self-Evaluation. TemaNord Environment. TemaNord 1999:548. 260 pp. Nordic Council of Ministers, Copenhagen.

Nordic Environmental Research Programme for 1993–1997: The Gulf of Riga Project – summary of research results and conclusions. DIVS 1999:833. 16 pp. Nordic Council of Ministers, Copenhagen.

www.giwa.net/areas/GoR-project.htm with links to other relevant sites.

Authors

All four authors participated in the Gulf of Riga project:

Dr. Per Stålnacke works as research scientist at Jordforsk – the Norwegian Centre for Soil and Environmental Studies. His main scientific interests are in statistical analysis of nutrient fluxes in rivers and agricultural streams.

Dr. Paul Wassmann works as a research scientist at the Norwegian College of Fishery Science, University of Tromsø. His main scientific interests are carbon cycling, regulation of vertical flux of biogenic matter, arctic plankton ecology and eutrophication.

Dr. Viesturs Jansons is associated professor in the Department of Environmental Engineering and Water Management of Latvia University of Agriculture. He has been involved in several research projects regarding agricultural impact on environment.

Dr. Andris Andrushaitis is director of Institute of Aquatic Ecology at the University of Latvia. His main interests are eutrophication, primary productivity and cycling of organic carbon in coastal areas.