

6 Baltic Sea

Overview

The Baltic Sea is the largest brackish sea in the world. It is bordered by 9 countries - Sweden and Finland on the north, Russia, Estonia, Latvia and Lithuania on the east, Poland on the south, and Germany and Denmark on the west. Despite its size, the only connection to the open ocean is through the narrow, shallow strait between Denmark and Sweden.

The Baltic Sea is often divided into 5 main areas - the Baltic Proper, the Gulf of Bothnia, the Gulf of Finland, the Gulf of Riga and the Belt Sea-Kattegat.

Location



Basic information

Surface area : 415,266 km²

Volume : 21,721 km³

Average depth : 52.3 m

Maximum depth : 459 m

Nature

< Background >

The Baltic Sea catchment area extends over an area of 1.7 million km², which ranges over 14 countries, including the 9 that border it.¹

The Baltic Sea is surrounded by a diversity of habitats. The Finnish and Swedish coastline is extremely rocky, and tens of thousands of islands, reefs and rocks are scattered along its coasts. In contrast, the coast of the Kattegat and southern Baltic Proper are mainly comprised of sandy beaches and a sandy sea floor. The latter supports extensive seagrass beds. In the southeastern region, soft bays, sand dunes and coastal lagoons dominate along the coast. In the northern region, along the Bothnian Sea, large forests dominate the coastline.

< <http://jolly.fimr.fi/balticsea.html> >

Climate

The Baltic Sea extends from a relatively mild and humid climate zone in the south to the Arctic region

in the north. The average air temperature between 1994 and 1998 for the whole Baltic Sea was 4.6 °C. Obviously, Bothnian Bay, located in the northern reach, had the lowest average temperature at 0.3 °C and the Baltic proper had the highest average temperature at 7.2 °C. The average annual precipitation between 1994 and 1998 was 631 mm, with higher precipitation recorded in the summer than in the winter.³

Topography

The topography of the Baltic Sea is composed of several deep basins, with depths ranging between 250 and 460 m. However, shallow sills restrict water exchange between these basins.

< <http://jolly.fimr.fi/balticsea.html> >

Hydrology

In the Baltic Sea, water exchange with the open ocean occurs only through the narrow and shallow strait between Sweden and Denmark. Consequently, it takes about 25 to 30 years to replace all of the Baltic Sea water. In contrast to the slow rate of seawater inflow, large amounts of fresh water are supplied to the Baltic Sea from over 200 rivers.

These rivers make the Baltic Sea the largest brackish sea in the world. The annual freshwater input is around 480 km³. Half of the input is supplied through seven rivers - the Neva, Vistula, Nemunas, Daugava, Oder, Gota Alv and Kemijoki.^{3,4}

Due to the large fresh water input and limited tidal movement, the water column of the Baltic Sea has permanent density stratification and the bottom waters are only mixed with the surface waters through wind-driven vertical mixing. When mixing is limited and eutrophic conditions prevail, the deep basins become anoxic and produce hydrogen sulfide. Anoxic conditions are often found in the deep basins of the central Baltic. Occasionally, when strong westerly winds prevail, larger than normal amounts of seawater are pumped into the Baltic Sea, which improves the water quality of the stagnant bottom waters.⁴

Salinity in the Baltic Sea is characterized by a strong south to north gradient. Near-ocean salinity is found in the southern region near the Kattegat, It gradually decreases northward until freshwater is reached in Northern Bothnian Bay.¹

< Surrounding environment >

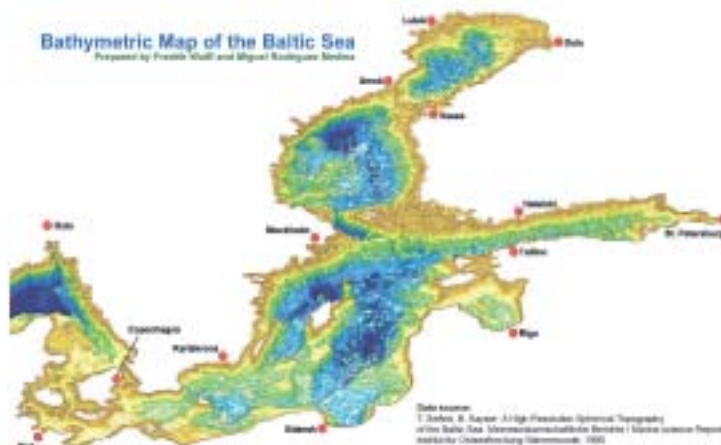
Biodiversity

Biodiversity is low in the Baltic Sea. This is because the sea is geologically very young and brackish, and physically it has extremely low oxygen levels, low water temperature and fluctuating salinities.³ Species distributions are largely determined by these physical factors. The diversity of marine species tends to decrease in proportion to decreasing salinity. This is shown in the adjacent figure, primarily for benthic macrofauna.

The relatively open saline waters in the Kattegat and the Baltic Proper are dominated by marine fish species, such as herring, sprat and cod, whereas fresh and marine species are found in the brackish coastal areas. In the Baltic Sea there are approximately 70 species of marine fish and 30 to 40 species of freshwater fish.

The Baltic Sea also supports 4 species of marine mammals - 3 seal species (ringed, gray and harbor seals) and the harbor porpoise.^{3,5}

< <http://jolly.fimr.fi/balticsea.html> >



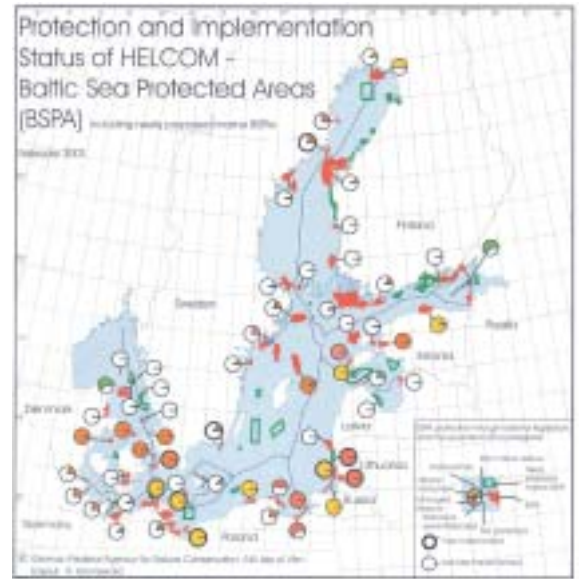
< <http://jolly.fimr.fi/balSeaTopMap.html> >



< <http://jolly.fimr.fi/balticsea.html> >

Baltic Sea Protected Areas (BSPA)

Sixty two protected marine areas in the Baltic Sea have been designated by the Helsinki Commission (HELCOM), the governing body of the Convention on the Protection of the Marine Environment of the Baltic Sea Area. However, protection has been fully implemented in very few of the designated areas. A further 24 areas, including some offshore, are currently proposed for BSPA status.¹



History and Culture

< **Brief history of the Vikings in the Baltic Sea** >

Although, the Vikings have a longstanding reputation as fierce raiders, trade and exploration were probably the most important elements of Viking activity. Sweden, Norway and Denmark were the Viking nations and they were active throughout Europe from about A.D. 780 to 1070. Norwegian and Danish Vikings mostly ventured westward towards England, North Atlantic Islands and Continental Europe, but Swedish Vikings mainly travelled eastward towards Baltija (the region containing the present day Estonia, Latvia and Lithuania) and Russia via the Baltic Sea. Through the extensive river systems of Baltija they even travelled further east and south towards Jerusalem, the Caspian Sea and Baghdad. During these excursion in the Baltic Sea, the Vikings developed advanced navigation techniques, which were used until the 1700s.

Their activities in the Baltic region sparked the development of Baltic coastal cities and states, by initially building ports and trading settlements. Also they developed trade routes inside the Baltic Sea, which laid the foundation for further economic development of Scandinavia.

<<http://www.viking.no/e/index.html>>

<<http://depts.washington.edu/baltic/papers/vikings.html>>

<http://college.hmco.com/history/readerscomp/mil/html/mh_056200_vikings.htm>

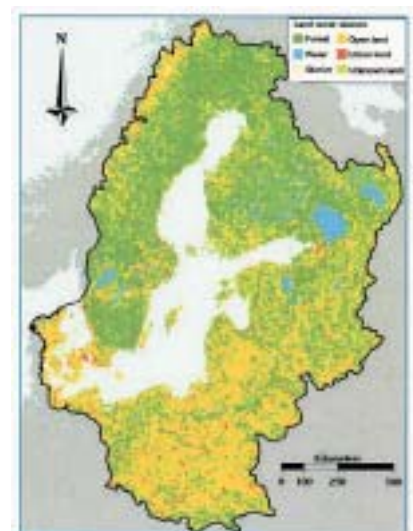
Social Environment

< **Population** >

Approximately 85 million people live in the Baltic Sea catchment area and nearly 15 million of these live within 10 km of the coast. Populations are most concentrated in the urban areas of Poland, Germany and Denmark, where the population density reaches 500 inhabitants/km². The least densely populated areas are in northern Finland, Sweden and Norway, with 10 inhabitants/km².³

< **Land use** >

The catchment area is composed of forest (48%), arable land (20%), non-productive open land (11%), pasture (6%), lakes (6%) and urban areas (1%).³



Land use in the Baltic Sea catchment area³

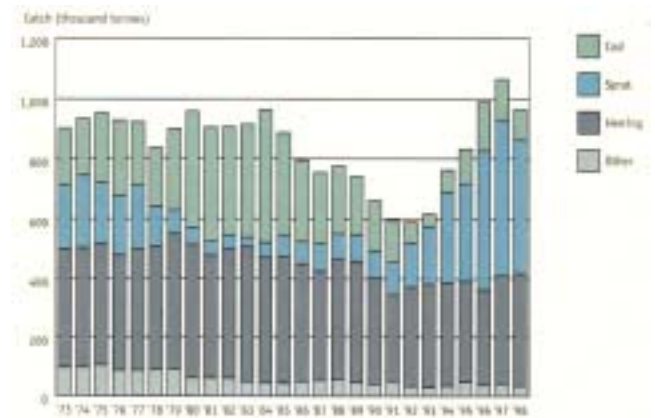
< Industry >

The major industries in the Baltic Sea region include agriculture, fisheries, manufacturing, oil production, shipping and tourism.³

Fisheries

The Baltic Sea has supported commercial fisheries for many years, with the annual catch generally ranging between 0.9 and 1.0 million tonnes. Commercially, the most important fish species are herring, sprat and cod. These dominate the total catch. Other important commercial species include eel, salmon, trout, flounder, pike, perch, smelt, blue mussel, whitefish and shrimp.

Aquaculture is conducted in several countries, including Denmark, Finland and Sweden. The main species are salmon, rainbow trout, blue mussel and oysters. In 1998, aquaculture production in the Baltic Sea totaled 22,400 tonnes.³



Fish catch in the Baltic Sea from 1973 to 1998³

Shipping

The seaborne transport of goods is extensive in the Baltic Sea, with over 500 million tonnes of cargo being transported annually. A high proportion of the larger ships are ferries and tankers, with many of them carrying dangerous products, such as chemicals, coal and oil. Approximately 13,000 to 14,000 harbour calls are made by oil tankers each year, mainly passing through the Kattegat and the Great Belt, on to the southeastern part of the Baltic Sea and then into the Gulf of Finland. There are plans for new and enlarged oil terminals in many of the coastal countries. Consequently, the volume of oil transported is expected to increase.³

Environmental Problems

< Water quality >

The enclosed nature of the Baltic Sea makes it sensitive to pollution. Currently, its water quality is under pressure from various anthropogenic activities. The main threats are eutrophication and pollution by persistent organic compounds, heavy metals and oil.

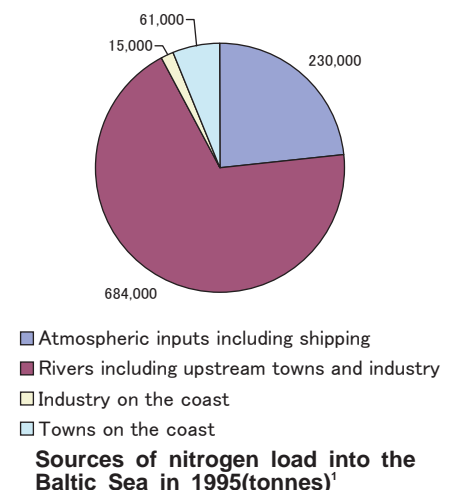
Eutrophication

Eutrophication is one of the major factors that creates oxygen-depleted areas in the Baltic Sea. These areas have frequently resulted in the large-scale death of benthic animals.

Nutrients enter the Baltic Sea through rivers, atmospheric deposition and by direct discharge from coastal-pollution sources. Rivers are responsible for the majority of the nutrient load, which is mainly derived from upstream-point sources and farmland. From 1994 to 1998, between 550,000 and 900,000 tonnes of nitrogen were discharged into the Baltic Sea annually. The main sources were the Neva, Nemunas, Vistula and Oder rivers. The annual variation in nitrogen load closely follows the fluctuation of river runoff.^{1,2}

Although nitrogen and phosphorus concentrations have slowly declined in the Baltic Sea over the past decade, high nitrogen concentrations are still prevalent in many parts of the Sea, especially near the mouths of large rivers. Relative to nitrogen, phosphorus levels have improved and show a decreasing trend in many parts of the Sea.^{1,2}

Significant amounts of nutrients are also transported through the atmosphere. Between 1996 and 2000 the annual atmospheric nitrogen



deposition shifted by about 300,000 tonnes.¹

Contamination by hazardous substances

Although concentrations of certain hazardous substances have reduced considerably over the past 20 to 30 years, contamination problems still persist. Heavy metal concentrations in the Baltic Sea are much higher than in the northern Atlantic, and their concentrations have decreased very little since the 1990s. High concentrations are often found in the southwestern Baltic Sea. Also, high concentrations of the heavy metals lead, cadmium and mercury are found in marine organisms, most notably in Baltic herring. Cadmium concentrations in Baltic herring is particularly high, and generally show an increasing trend since the 1980s.¹

Concentrations of dissolved trace metals in the North Atlantic and Baltic Sea¹

Metal	North Atlantic (ng / kg)	Baltic Sea (ng / kg)
Mercury (Hg)	0.10 - 0.3	5 - 6
Cadmium (Cd)	4 ± 2	12 - 16
Lead (Pb)	7 ± 2	12 - 20
Copper (Cu)	75 ± 10	500 - 700
Zinc (Zn)	10 - 75	600 - 1000

Heavy metals are either discharged through rivers or the atmosphere, with the Gulf of Finland and the Baltic Proper receiving the majority of riverine heavy-metal loads. In 2000, approximately 800 kg of cadmium and 288 tonnes of lead were discharged into the Gulf of Finland via rivers. Between 1996 and 2000, annual atmospheric emissions of heavy metals decreased, with reductions of 26 per cent for cadmium, 15 per cent for mercury and 10 per cent for lead. Cadmium reduction was mainly due to the significant reduction of emissions from Poland and lead reduction was mostly due to the increased use of unleaded gasoline.¹

Over the last 50 years, there have been substantial inputs of POPs into the Baltic Sea from numerous sources. These sources include industrial discharges, such as the organochlorines in effluent from pulp and paper mills, runoff from farmland, the special paints used on ships and boats, and dumped waste. Concentrations of HCH, PCBs and lindane have declined steadily over the years, probably due to banning and stricter regulations enforced in the Baltic Sea countries.¹

< Other Environmental Problems >

Oil pollution

Oil pollution poses a significant threat to the Baltic ecosystem and wildlife, particularly because oil decomposes slowly in the cold Baltic Sea waters. Most of the oil input comes from rivers, municipal stormwater and the atmosphere.

About 10 per cent of the oil discharged into the Baltic Sea originates from deliberate and illegal discharges from incoming vessels, with around 400 illegal oil discharges occurring each year. Accidental oil spills are another source of oil pollution. In 2000 and 2001, a total of 2,756 m³ was spilt into the Baltic Sea. The risk of oil spills is on the rise, due to ever-increasing maritime traffic. In 2000, 80 million tons of oil was transported into the Baltic. This figure is expected to increase to 130 million tonnes by 2015.¹

Threats to biodiversity

Many of the marine species inhabiting the Baltic Sea are under threat. This is partly due to over-fishing, environmental degradation and other anthropogenic activities. Important commercial species, such as wild salmon and cod, have drastically reduced in abundance over the years. In 1998, the proportion of wild salmon accounted for only 8 per cent of the entire salmon population, due to the physical obstructions built in the many rivers.³ The cod population has shown a rapid decrease since the mid 1980s and it has almost disappeared from its former habitats of the Archipelago Sea, the Bothnian Sea and coastal areas of the Baltic proper.²

< Environmental Protection Measures >

Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention)

On 24 March, 1974, the Baltic Sea states signed the Convention on the Protection of the Marine Environment of the Baltic Sea Area, known as the 1974 Helsinki Convention. This was the first international agreement to cover all sources of pollution, whether from land, sea or air. It also regulated cooperation to combat marine pollution by oil and other hazardous substances. Considerable progress was achieved through this convention, including improvements in the sanitary conditions of previously polluted water, significant reductions in discharges of organochlorine compounds from industry and of lead emissions from land-transport, and the rehabilitation of some formerly, seriously-endangered species.

In light of political changes and developments in international environmental and maritime law, the 1974 Helsinki Convention was replaced by the 1992 Helsinki Convention. Since then, work has been undertaken to limit the discharge of nutrients and hazardous substances from land-based activities, prevent pollution by shipping, conserve natural habitats and biological diversity, and bring about the long-term restoration of the ecological balance of the Baltic Sea.

These works are implemented through HELCOM, the governing body of the Helsinki Convention.

< <http://www.unep.ch/seas/helcom.html> >

Monitoring Program

All environmental monitoring within HELCOM and the Baltic marine environment is carried out under the COMBINE Program, which consists of various sub-programs that examine physical, chemical and biological variables. COMBINE is continuously evolving, and the program will soon also encompass the monitoring of biodiversity and protected areas in the Baltic Sea. The data collected under the COMBINE program are used for wide-ranging periodic assessments of the state of the Baltic marine environment.

Discharges and emissions within the Baltic Sea catchment area are mainly monitored under HELCOM's Pollution Load Compilation program (PLC). PLC-Water monitors discharges into water and pollutant loads in rivers, and PLC-Air monitors atmospheric emissions and atmospheric deposition into the sea.

< <http://www.helcom.fi/helcom/grouptaskforce/helcommonas.html> >

Related organizations and NGO

- International Council for the Exploration of the Sea - An intergovernmental marine science organization researching the physical, chemical and biological system of North Atlantic
< <http://www.ices.dk/> >
- International Baltic Sea Fishery Commission - Focuses on the preservation and increase of living resources in the Baltic Sea < <http://www.ibsfc.org/> >
- Coalition Clean Baltic (CCB) - An NGO network for the protection and improvement of the Baltic Sea environment and natural resources < <http://www.ccb.se/ccb/indexccb.shtml> >
- Baltic Sea Research Institute Warnemunde - A non-university research institute dedicated to marine research of the Baltic Sea ecosystem < <http://www.io-warnemuende.de/> >

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2. HELCOM, 2001. Environment of the Baltic Sea area 1994 - 1998. Baltic Sea Environment Proceedings No. 82A.
3. HELCOM, 2002. Environment of the Baltic Sea area 1994 - 1998. Baltic Sea Environment Proceedings No. 82B.
4. Department of Systems Ecology, Stockholm University. 1999. Baltic Basin Case Study - Towards a Sustainable Baltic Europe 1996 - 1999.
5. HELCOM, 1993. The Baltic Sea Joint Comprehensive Environmental Action Programme. Baltic Sea Environment Proceedings No.48.