

11 Black Sea

Overview

The Black Sea covers an area of 508,000 km², is 2,245 m deep and drains an area of 1,900,000 km² (one-third of continental Europe) containing over 160 million inhabitants. The coastal zone contains a population of some 20 or 39 million people, depending on whether the Istanbul administrative unit is included in the total. This has a short Black Sea coastline. The Sea has six coastal countries: Bulgaria, Georgia, Romania, the Russian Federation, Turkey and Ukraine.

Location

Basic information^{4,15}

Surface area : 508,000 km²

Volume : 629,920 km³

Average depth : 1,240 m

Maximum depth : 2,245 m



Nature

< Background >

The Black Sea is one of the world's largest inland seas. The catchment area of the Black Sea covers entirely or partially 23 countries: 6 countries are located in its coastal zone and 17 countries are closely linked with the sea via the largest European rivers – Danube, Dniester, and Don Rivers – that flow into the sea.²

Climate

The Black Sea is situated in the temperate zone. Its climate is subtropical, of the Mediterranean type (summer sea temperatures exceed 25°C, in winter the open sea temperatures are 6–8°C). Only two areas, the south Crimea and Caucasian coasts, belong to the subtropical zone. The Sea of Azov has a continental climate: in winter the sea is covered by ice for two to three months.³

Topography

The maximum depth of the Black Sea obtained from various sources of echo-sounding surveys is about 2,200 m. In the bottom topography of the Black Sea three basic forms are clearly distinguished: shelf, continental slope and abyssal plain.⁴

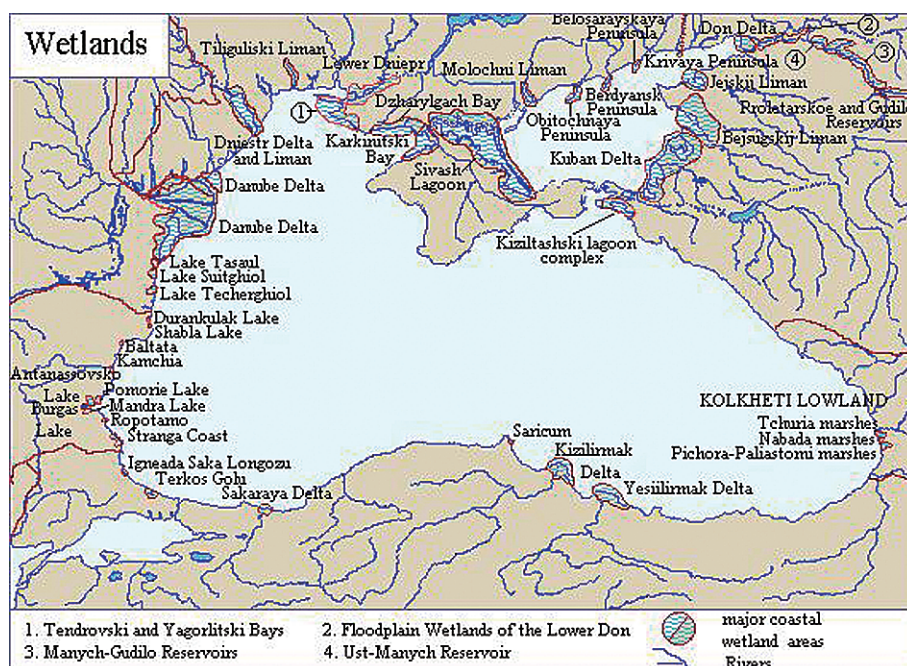
Hydrology

The intense fresh water supply by rivers reduces the basin salinity by comparison with what is typical for the Mediterranean Sea. Therefore the pressure gradient induces a deep flow of the saline water along the bottom of the Bosphorus Strait. The contrast between the fresh and salt-water produces a buoyancy flux, which forms the density stratification of the basin. Theoretical analysis, laboratory models and assimilation of the climatic hydrography show that the deep-water upwelling at the open sea should support the permanent pycnocline. The upwelling directly determines the age of the deep water and position of the hydrogen sulphide surface in the basin. Compensating down welling induces the buoyancy-driven cyclonic circulation in the upper layer of the sea and modulates the mixing of saline water entering through the Bosphorus Strait with ambient waters.⁵

< Surrounding environment >

Habitat

The coastal zone wetland ecosystems occupy large areas and act as a form of relaying mechanism, linking the huge catchment area with the Black Sea itself. Wetlands are highly productive ecosystems whose formation, functioning and characteristics are determined by the water regime. They support a unique diversity of flora and fauna that exist there because of the constant inflow of water and alternating dry and wet periods.⁶

Distribution of Wetlands in the Black Sea⁷

Biota

The freshwater, flowing in from the northern rivers and out via the Bosphorus, floats on top. This phenomenon represses the natural convective heat exchange that causes water to circulate and reoxygenate in seas and lakes elsewhere in the world. As a result, while the top 140 m layer of the Black Sea is constantly renewed and can support a vigorous indigenous marine life, below this level the waters are anoxic, with a high concentration of hydrogen sulphide, and inimical to life.⁸

History and Culture

< History >

Once upon a time, the Black Sea was actually a large freshwater lake. Then came the end of the last ice age, under rapid climactic warming, glaciers began to melt quickly. Subsequently, the world's oceans and seas started to rise. Around 5600 BC, it is believed that the Mediterranean Sea broke through a land "dam" at present-day Istanbul, creating the short and narrow (about one-mile wide) Bosphorus Strait and allowing vast amounts of seawater to flow into the previously fresh waters of the Black Sea. Carbon-14 radio-dating methods support this viewpoint.

In research undertaken recently by the National Geographic Society, coring samples from the bottom of the Black Sea indicate that a white or light color typical of lake-mud characterizes the deep sediments, while the upper black layers show an iron-sulfide-containing mud found in marine environments. In addition, the mollusk shells trapped in those same layers shift from freshwater types in the deep sediments to saltwater varieties in the more recently deposited top ones. These sediments show a rapid transition from freshwater to marine, further supporting theories of a fast and violent change.⁹

Social Environment

< Population >

The Black Sea coastal zone is densely populated with approximately 160 million inhabitants and with 4 million tourists visiting the seacoast in summer seasons. For all Black Sea coastal zones except of Turkey, the demographic trends are negative.^{1,10}

< Land use and Industry >

In the past 50 years, the Black Sea Region has seen many land-use changes. These are continuing today. On land, the coastal zone is being increasingly used for intensive agriculture, industry, power generation, mineral works, shipping, urban development and, of course, tourism. As a consequence, significant parts of the coast have been built upon, and development continues to threaten the nature of the Black Sea Region in both Bulgaria and Romania.¹¹

Environmental Problems

Land reclamation

Black sea coasts are under continuous threat from land reclamation projects and infrastructure developments. In recent years, wind farms have become a particular issue of concern. Famous cliffs like Kaliakra provide ideal locations for such farms as they are almost always windy and already 250 windmills have been built here. North of the port of Constanta, plans were recently announced for the development of the largest onshore wind park in the world, requiring an investment of 1.1 billion

Euros. If not properly planned and assessed, respecting the protection safeguards set out in the Habitats Directive (the foundation for the EU's environmental conservation policies), windfarms and other developments could pose a potentially serious threat to species and habitats in and around Natura 2000 protected areas in view of the fact that the Black Sea Coast is strategically located along the Via Pontica – one of the most important migration routes in Europe for birds and bats.¹¹

Agriculture

Further inland, agriculture takes over as the main land use, providing an important source of income for many rural populations. Much of it has remained relatively small scale until recently, but here, too things are changing rapidly. Wetlands, important for birds and other species, are being degraded by pollutants or drained and diverted for agriculture. It is estimated that around 400 km² of wetlands in the Danube Delta have been transformed into agricultural and forestry polders. Many of its natural water channels have also been dredged and canalized to facilitate inland waterway transport. All these activities not only affect wildlife but also reduce the delta's ability to retain water and clean itself of pollutants and excess nutrients.⁵

Invasive species

The American comb jelly, *Mnemiopsis leidyi*, was accidentally introduced into the Black Sea through ship's ballast water in the early 1980s. With no natural enemies in sight, its population soon exploded, consuming vast amounts of zooplankton, larvae and fish eggs. This eventually led to the collapse of pelagic fish populations and caused a major shift in the marine ecosystem. The jellyfish had literally eaten its way through the food chain. By the mid-1990s, it was estimated that the Black Sea contained over a billion tons of American jellyfish, which is more than the weight of the world's entire annual commercial fish catch combined.

The mass occurrence of *Mnemiopsis* is now acknowledged to have contributed to the sharp decrease in no less than 26 commercial Black Sea fish stocks, including anchovy and chub mackerel. Local oyster fisheries, indigenous jellyfish and even endemic dolphins also suffered. The impact was all the more devastating as the Black Sea was already under stress for heavy fishing and eutrophication. The economic cost attributed to the collapse of fisheries and tourism industries around the Black Sea is estimated at 500 million dollars per year.¹¹



Invasive species, American comb jelly (*Mnemiopsis leidyi*): a major problem for the Black Sea¹¹

< Environmental Protection Measures >

The following measures could be considered at the level of the Black Sea Economic Cooperation (BSEC) institution and member states:

- ☐ To agree in principle and to start preparatory work for a new comprehensive intergovernmental agreement of the BSEC member states, complementary to the 1992 Convention, covering all aspects of environmental policies in the region in accordance with the principles of sustainable development: climate change mitigation; clean energy and industrial processes; air, water and soil quality; green urban and rural development; waste management; rational land use and sustainable farming practices; regulated use of chemicals; biodiversity, protected areas and wildlife conservation; development of eco-tourism; integrated development of coastal areas; wetlands; fisheries; product and food safety, etc.;
- ☐ To establish functional links with other regional environmental programmes, in particular those for the Mediterranean, Caspian and the Danube, with a view to enhancing the scientific underpinnings and operational capabilities of the BSEC performance;
- ☐ To encourage the development of national parks and nature reserves, including agreed procedures for the joint administration of such units that stretch across national boundaries, following the pattern and experience of the Natura 2000 programme;
- ☐ To support the exchange of information and best practice among the Ministries and government agencies in the BSEC member states that are responsible for the design and implementation of environment-related policies, and to encourage professional networking among the scientific research units and the non-governmental organizations that are active in this sphere;
- ☐ To support integration and cohesion of actions towards 'greening' all sector policies, mainly transport, energy, infrastructure and regional development policy;
- ☐ To encourage multi-lateral environmental agreements among Black Sea states for waste management, pollution, biodiversity preservation, fisheries, integrated coastal zone management, better balance of fossil fuels and alternative energy resources;
- ☐ To enhance "smart greening" of enterprises, public institutions, Universities and Municipalities by the implementation of environmental management systems (e.g. EMAS12, ISO 14001) and environmentally friendly "clean" technologies;

- To encourage trans-national and cross-border cooperation, concerning environmental data collection, cross-country and cross-regional comparability, assessment and evaluation (e.g. through the use of innovative tools, such as Geographical Information Systems GIS).¹²

Related organizations and NGO

- Black Sea NGO Network < <http://www.bssn.org/>>
- Agreement for the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) < <http://www.accobams.org/>>
- Mediterranean Coastal Foundation (MEDCOAST) < <https://www.medcoast.net/>>

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