

# The Black Sea

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## 1. Overview

Black Sea is an inland sea of the Atlantic Ocean basin. The coastal zone contains a population of 39 million people. The Black Sea drainage basin covers almost third part of Europe. The Black Sea has six coastal countries: Bulgaria, Georgia, Romania, the Russian Federation, Turkey and Ukraine. The Black Sea in its properties is a unique sea basin. It is the largest meromictic reservoir on our planet, whose water column deeper than 150 m is filled with oxygen-free waters containing hydrogen sulfide.

### Basic information <sup>1</sup>

Surface area: 432000 km<sup>2</sup>

Volume: 547000 km<sup>3</sup>

Average depth: 1270 m

Maximum depth: 2212 m



Black Sea catchment area (<http://www.envirogrids.net/>)

## 2. Nature

### (1) Background

The Black Sea is the most isolated sea from the World Ocean-connected to the Oceans via the Mediterranean Sea through Istanbul (Bosphorus) and Canakkale (Turkish Straits) and Gibraltar Straits and with the Sea of Azov in the northeast through the Kerch Strait. The ratio of its surface and its catchment area exceeds 6. For this reason, the Black Sea is very vulnerable to pressure from land based human activities and its health is equally dependent on the coastal and non-coastal states of its basin.

The Black Sea in Figures <sup>1</sup>		
Geographical Coordinates:	46°33' - 40°56'N and 27°27' - 41°42' E	
Drainage area	2,000,000	km <sup>2</sup>
Total shoreline (without Sea of Azov shoreline)	4,340	km
River inflow	340.6	km <sup>3</sup>
Surface layer salinity	18	pro mil
Deep water mass salinity	22	pro mil
Average annual fresh water balance	310	km <sup>3</sup>
<b>Black Sea biological species</b>		
Fungi, algae, higher plants	1,619	
Invertebrates	1,983	
Fishes	168	
Marine mammals	4	

### Climate

The Black Sea is situated in the temperate zone. Its climate is temperate, of the Mediterranean type (summer sea surface temperatures exceed 23°C, in winter the sea surface temperatures are 6-7°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.<sup>2</sup>

## Topography

In the bottom topography of the Black Sea three basic forms are clearly distinguished: shelf, continental slope and abyssal plain (the deep-sea depression). The shelf occupies a large area in the north-western part of the Black Sea, where it is over 200 km wide and has a depth ranging from 0 to 160 meters. In other parts of the sea it has a depth of less than 100 m and a width of 2.2 to 15 km. Near the Caucasian and Anatolian coasts the shelf is only a narrow intermittent strip. The deepwater depression of the Black Sea is the result of a relatively young short-term subsidence of the ancient sea bottom surface.

## Hydrology

The Black Sea is a tideless sea. The maximum wave height recorded in the field observations exceeded 12 m, lengths 120m. The Black Sea has positive freshwater balance, which means that it receives more fresh water from the rivers and rainfall than it loses from evaporation. The surplus of water flows through the Bosphorus (in its upper layer) into the Marmara Sea. The Bosphorus is essentially a narrow elongated shallow channel approximately 31 km long, with a width varying between 0.7-3.5 km and a depth of 39 to 100 m. The large European rivers, the Danube, Dnieper, Dniester and Don and Kuban via the Sea of Azov flow into the Black Sea. Other large rivers are: Rioni, Kodori and Inguri Chorokh, Kyzyl-Irmak, Eshil-Irmak, Sakarya, and Southern Bug. The vertical and horizontal distribution of salinity and temperature vary with the season in the upper 150-200m layer.

### *(2) Surrounding environment*

#### Habitat

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. Hydrogen sulphide, over thousands of years, was accumulated from decaying organic matter<sup>6</sup>. Due to the unique geomorphological structure and specific hydrochemical conditions, specific organisms, basically on the

level of protozoa, bacteria, and some multi-cellular invertebrates inhabit the deep-sea waters. Knowledge about biological forms of life in the deep waters of the Black Sea is very limited. The disturbance of the natural balance between the two layers could trigger irreversible damage to the people and ecosystem of the Black Sea.

## Biodiversity

The Biodiversity of the Black Sea is considered low compared to the Mediterranean Sea. However, there are many domains, which are still poorly studied, such as bacteria, Protozoa and Phytoplankton. Due to the large riverine input, there are many freshwater and brackish species, especially in the Northwestern part of the sea. Fishes diversity underwent dramatic changes since the early 1960s under anthropogenic influence and nowadays only the stock of sprat remains commercial.

There are several major drivers of biodiversity change: variability of river runoff, climate change, invasions, chemical pollution and overfishing.

## *3. History and Culture*

### *(1) History*

The Black Sea is surrounded by several high folded mountain chains of the Balkanides-Pontides belts to the south and south-west, of the Great and Little Caucasus to the east and the Crimea Mountains to the north. The Black Sea had a 'troubled' geological history, with claiming that the Bible Flood had happened in the Black Sea and the Noah Arc was still somewhere on the bottom of this sea.<sup>3</sup>

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 of the Russian Federation, coring samples from the bottom of the Black Sea indicate that a white or light colour typical of lake-mud characterizes the deep sediments, while the upper black layers show an iron-sulphide-containing mud found in marine environments. In addition, the mollusc 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.<sup>5</sup>

## 4. Social Environment

### (1) Population

In ancient times the Black Sea was unsympathetically called by the Ionian and Dorian Greeks inhospitable sea (in Greek Pontos Axeinos, first in Pindar mentioned, 475 BC). It is also possible that the name *Axeinos* arose by popular etymology from a Scythian word *axšaina* - "unlit" or "dark".<sup>6</sup> The name was changed to 'Pontos Euxinos' (hospitable sea) after the colonization of the southern Black Sea coasts. In "Odyssey" Homer (800 BC) wrote about the Northern Black Sea coast '....a land of somewhere at the World edge, covered with humid fogs and misty clouds, through which no sunlight could penetrate...'. Nonetheless, such despairing information about the Black Sea coasts has never stopped savage tribes and quasi-civilized nations to inhumanly fight for the rights to settle around and use the actually plentiful goods available. Before Christ in some Black Sea towns up to 80 000 people resided, yet, such sizeable settlements were few, and for centuries most of the coastal population remained rural.<sup>3</sup>

### (2) Land use and Industry

In modern times, the Black Sea coastal zone utilization has largely changed in scope and intensity. Even so, large cities have mainly grown around bays, which *inter alia* harbour intensive port activities<sup>4</sup>. Such coastal locations of high human pressures are relatively low in number (about 22) and the population in them is mostly below 1 mln people. They generate cumulative effects that

usually occur at a local scale. Unfortunately, the severity of such effects is often chronic and substantially amplified by pressures coming from Black Sea rivers, sources outside the coastal zone (via atmosphere and ground waters) and those inflicted by climate change and frequent seismic activity.<sup>3</sup>

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.<sup>7</sup>

## 5. Environmental Problems

The major Black Sea environmental problems, as observed on the coast, were and remain related to: desertification/deforestation, regulation of rivers, inadequate urbanization, environmentally-unfriendly industrial and agricultural/aquaculture practices, and also incompetent developments in the tourism sector (BSC2008, BSC2009)<sup>4</sup>. Twenty European countries discharge industrial and household wastewaters to the Black sea basin. Moreover, the main pressure falls on the north-west shallow part, where the main spawning grounds, habitats of algae and benthos are located. Drainage of agricultural lands and increase of the mineral fertilizer flows lead to the eutrophication of waters and changes in the structure of communities in the second half of the 20<sup>th</sup> century.

In the sea - eutrophication/pollution, habitat degradation, biodiversity change and overfishing remain of major concern. They are all transboundary in nature (TDA2008)<sup>4</sup>, and unlike local effects, such environmental problems require regional cooperation to achieve results in their management. Oil pollution enters the sea as a result of operational discharges by vessels and due to accidents as well as through land-based sources, and appears to be an ongoing concern in particular along major shipping routes and ports (see figure below). Discharge of insufficiently treated sewage introduce microbiological contaminants into the Black Sea and pose a threat to human health,



development of sustainable tourism and aquaculture. The Black Sea is also particularly vulnerable to solid wastes dumped into the sea from ships and coastal towns (eventually washed ashore) and some beaches and the sea have a high accumulation of garbage presenting a risk to marine animals and humans.<sup>7</sup>

cages and new rearing systems) represents new opportunities for marine aquaculture development as well as for regional cooperation and sharing of good practices.<sup>7</sup>

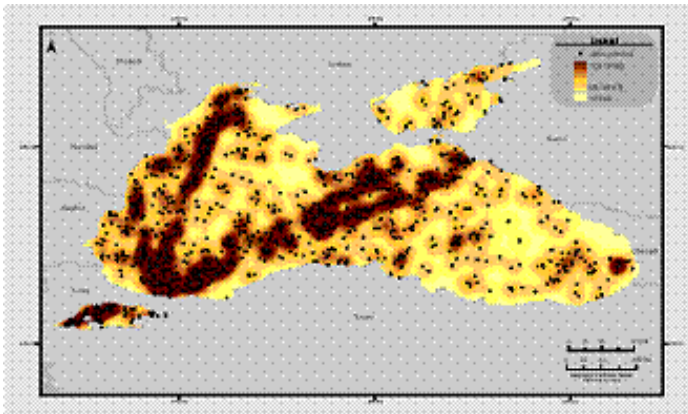
## (2) Invasive species

The List of invasive or non-native species for the Black Sea is long and is being annually updated. Species invasions have been mainly facilitated by human activities. The best documented examples are those of *Rapana venosa* and *Mnemiopsis leidy*. The Pacific gastropod *Rapana venosa* came in 1947 with ballast waters and this species, a regular predator elsewhere, has eaten half of the Black Sea bivalvian species to extinction. The American comb jelly, *Mnemiopsis leidy*, was accidentally introduced into the Black Sea through ship's ballast waters as well 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 was estimated at 500 million dollars per year.<sup>4</sup>

Nowadays, *Mnemiopsis* density substantially declined due to the introduction of its natural predator – *Beroe ovata*.

The Black Sea hosts over 200 alien species with 110 (52 invertebrates, 6 vertebrates, 52 primary producers) introduced after 1970, and with 64 of them introduced after 2000<sup>4</sup>.



Composite map of oil spills anomalies (illicit vessel discharges) in the Black Sea during 2000-2004: the darker areas signify the high anomaly regions<sup>8</sup>

## (1) Agriculture and aquaculture

Though the agricultural sector has generally declined in the Black Sea Basin countries, it is still a substantial or major component of most of their economies, in particular in terms of employment, e.g. providing over 45% of employment in Georgia and Armenia, or in terms of exports.

The development of sustainable aquaculture in the Black Sea basin also seems to present good potential including in all the categories (fresh, brackish and marine water species). The production from aquaculture has increased from 185,000 tons in 1999 to 320,000 tons in 2009 with an average annual growth rate of about 7.3 %. This increased production mainly came from freshwater aquaculture (74 %), represented largely by carps and other ciprinidae, meanwhile Mollusca and finfish (European sea bass, mussels, oysters, sea trout and turbot) characterise the production of brackish and marine aquaculture (26%)<sup>1</sup>. The actual development of brackish and marine aquaculture in the region is not homogenous and shows different patterns according to the technology applied and species reared (e.g. focusing on mussels in Bulgaria and on sea bass and sea trout in Turkey). Technology development during the last years (including

### **(3) Protection Measures**

As mentioned above, most of the Black Sea environmental problems are of transboundary character and require regional cooperation. Besides, many Black Sea resources are shared and in need for common regional policies. These policies are implemented by the Black Sea Commission (<http://www.blacksea-commission.org/>), and namely, they are the Bucharest Convention, its four Protocols and the Black Sea Strategic Action Plan 2009 (BS-SAP2009). The ultimate goal of the Commission is to “rehabilitate” the Black Sea, and ‘to preserve it as a valuable natural endowment of the region, while ensuring the sustainable use of its marine and coastal resources for the economic development, well-being, health and security of the population of the Black Sea coastal States’<sup>8</sup> (BS-SAP2009). The Ecosystem quality objectives in the BS-SAP2009 were formulated to address the major environmental problems in the Black Sea region and they are:

#### **1. Preserve commercial marine living resources through:**

*Sustainable use of commercial fish stocks and other marine living resources.*

*Restore/rehabilitate stocks of commercial marine living resources.*

#### **2. Conservation of Black Sea Biodiversity and Habitats through:**

*Reduce the risk of extinction of threatened species.*

*Conserve coastal and marine habitats and landscapes.*

*Reduce and manage human mediated species introductions*

#### **3. Reduce eutrophication through:**

*Reduce nutrients originating from land based sources, including atmospheric emissions.*

#### **4. Ensure Good Water Quality for Human Health, Recreational Use and Aquatic Biota through:**

*Reduce pollutants originating from land based sources, including atmospheric emissions.*

*Reduce pollutants originating from shipping activities and offshore installations*

Presently, as a result of the efforts of the countries signatories to the Convention on the

Protection of the Black Sea Against Pollution, numerous coastal and marine protected areas have been designated, hot spots are addressed, environmental safety aspects of shipping are better ensured, the populations of endangered species are given time to recover while applying different measures of protection, sensitive areas are identified to proceed thoughtfully to spatial planning, dumping is prohibited, in fishery bans, fishing-free zones, prohibited gears and other protection measures are in place. Decreasing trends in emissions and atmospheric deposition of pollutants are observed and the amount of insufficiently treated or untreated waters decreases during the last years.

As to global agreements, the Black Sea countries are parties to many of them and comply with their requirements. The number of protected areas (NATURE2000, Emerald network, Ramsar sites) increases (under RAMSAR, CBD Conventions, etc), covering also marine areas. Climate change, Espoo and Marpol challenges are better addressed, Kyoto Protocol is paid due attention, etc. Among biosphere reserves the largest one is the Danube reserve, which has a management plan unlike many other protected areas.

The efforts to recognize and protect the natural environment do, however, face serious limitations. Overall, the extent of terrestrial and marine protected areas varies, but still falls significantly short (less than 2% in Moldova and Turkey) in comparison to the EU, where protected areas cover 15.1% of the total territorial area. Many reserves also lack effective management plans and infrastructure, so that reinforced cooperation in those areas would seem to be of crucial importance, considering the rich and vulnerable environment of the Black Sea region.<sup>7</sup>

#### **Related organizations and NGOs**

- The Commission on the Protection of the Black Sea Against Pollution  
< <http://www.blacksea-commission.org/> >
- Black Sea NGO Network  
< <http://www.bsnn.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/> >
- Black Sea Economic Cooperation (BSEC)  
< <http://www.bsec-organization.org/>>

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