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# THE BLACK SEA LARGE MARINE ECOSYSTEM

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*Comparative estimation of anthropogenic contamination degree of sea regions environment considered and the influence of pollution on biological resources and health of Large Marine Ecosystem is indentified. The necessary stages for saving of Black Sea Large Marine Ecosystem are defined.*

*Наведено порівняльну оцінку рівня антропогенного забруднення морських регіонів та впливу забруднення на біологічні ресурси і здоров'я екологічної системи Чорного моря. Розглянуто необхідні заходи щодо збереження екологічної системи Чорного моря.*

*Приведена сравнительная оценка уровня антропогенного загрязнения морских акваторий и влияния загрязнения на биологические ресурсы экологической системы Черного моря. Рассмотрены необходимые мероприятия по сохранению экологической системы Черного моря.*

## Statement of purpose

The Black Sea Large Marine Ecosystem (LME) is an almost completely enclosed sea located off of the Mediterranean Sea. It is surrounded by 6 countries, Romania, Bulgaria, Turkey, Georgia, Ukraine and Russia. It communicates with the Mediterranean Sea LME through the Turkish Straits (Bosporus and Dardanelles), and receives fresh water from the Danube, Dniepr, Dniestr, Don, and Kuban Rivers. Eutrophication is the primary force driving the LME, with intensive fishing as the secondary driving force [1].

The Global Environment Facility (GEF) is supporting an LME project in the Black Sea, to address critical threats to the coastal and marine environment, and to promote ecosystem-based management of coastal and marine resources.

## Productivity

The Black Sea LME measures 330 miles from North to South and 630 miles from East to West. The LME has a narrow continental shelf, except in the productive Sea of Azov. It is strongly influenced by river runoff and the lack of rapid exchange with the adjacent Mediterranean Sea LME. The Black Sea Large Marine Ecosystem is considered a highly productive ecosystem based on SeaWiFS global primary production estimates.



River inflows contribute to high phytoplankton production in this LME. In some places, the Black Sea reaches a depth of more than 2,200 m. There is an increase in planktivorous fish, decreasing zooplankton and increasing phytoplankton biomass [1].

## Fish and Fisheries

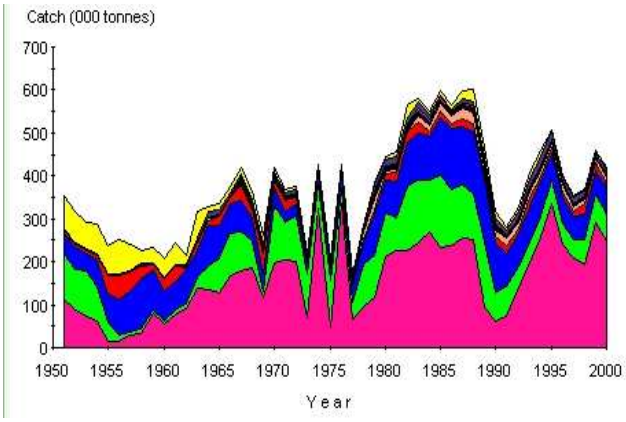
The FAO 10-year trend shows an increase in the catch from 390,000 tons in 1990 to 500,000 in 1999 (see FAO, 2003). However, catch trends were irregular, with a peak of almost 600,000 tons in 1995, and two catch troughs, in 1991 and in 1998.

The average catch is 500,000 tons. The most important species group in terms of shelf catches are clupeoids (herrings, sardines and anchovies).

The combination of uncontrolled fisheries and eutrophication is causing important alterations in the structure and dynamics of this LME. I examine the effect of uncontrolled fisheries and of the removal of predators on trophic interactions. What he calls a trophic cascade is a reduction in apex predators leading to a higher abundance of planktivorous fish that feed on zooplankton biomass. Industrial fisheries began relatively early, especially for small pelagics such as anchovy.

Demersal trawl fishery landings increased steadily after 1960. By the early 1970s, most of the demersal resources of the Black Sea were close to maximum sustainable yield. In recent decades, landings of turbot, migratory pelagics, and anadromous species, especially sturgeon, have declined. The anchovy fishery has collapsed. There is now a decline for many demersal fish, for pelagic predators and for benthic invertebrates. Dolphins are down to a population of 500,000 due to accidental killings, gill net fishing, the destruction of coastal ecosystems and various forms of pollution.

Other marine mammals are critically endangered. The monk seal is virtually extinct. The productive fishery of the Black Sea Oyster, indigenous to the area, has been destroyed through the introduction of exotic species in ballast waters. The Global International Waters Assessment (GIWA) has issued a matrix that ranks LMEs according to the sustainable exploitation of fisheries and the predicted direction of future changes. GIWA characterizes the LME as severely impacted in terms of overfishing and destructive fishing practices. However, these impacts are decreasing [2]. A fisheries convention is to be negotiated by the 6 Black Sea states to adopt an ecosystem based management approach (see Duda and Sherman, 2002). The University of British Columbia Fisheries Center has detailed fish catch statistics for this Large Marine Ecosystem. A graphical representation of the data is provided below (see figure).




Large Marine Ecosystem

**Pollution and Ecosystem Health**

The Black Sea area is a major industrial and agricultural region, with uncontrolled urban development. In coastal areas there are discharges from rivers, industry, agricultural pollution and domestic sewage. The LME has a huge drainage basin. There is an acceleration of eutrophication due to excessive levels of nitrogen loading. The combination of eutrophication and uncontrolled fisheries has caused important alterations in the structure and dynamics of this LME. The almost entirely enclosed nature of the LME contributes to the eutrophication problem [3]. There is decreasing transparency of Black Sea waters. Beaches are littered, and there are regular beach closures due to sewage discharge problems. There is a growing risk of losing valuable habitats in these areas. For the main human impacts in this LME, see Zaitsev and Mamaev, 1997 [2].

While there is little data on toxic contamination and heavy metal accumulation, the Mussel Watch program in each of the six countries assesses areas with high pollution [4]. A chemical pollution study for the Black Sea was completed by 98 Black Sea scientists. This resulted in the publication of a “State of Pollution of the Black Sea” report. Oil pollution comes from land-based sources, and from shipping [5]. There has been a rapid increase in traffic in Black Sea ports, and an oil spill occurred in 1994 when the "Nassia" collided with an empty freighter. A report on Black Sea Pollution leading to the depletion of fishing stocks raised international concern. In the 1970s and 1980s there were frequent explosions of phytoplankton and jellyfish (Aurelia aurita). Blooms and red tides have been reported in the northern and western sections of the Black Sea [6]. The GIWA has issued a matrix that ranks LMEs according to pollution. GIWA characterizes the LME as severely impacted in terms of eutrophication and ecotone modification. However, these impacts are not increasing, according to GIWA. A series of small GEF projects have focused on reducing nitrogen loadings from the 17 contributing nations of the Black Sea basin. Following the successful completion of a Transboundary

Diagnostic Analysis (TDA) and a Strategic Action Programme (SAP) in the 1990s, there is a political commitment to reduce nutrients and abate persistent toxic substances being released from hotspots. Agriculture pollution is being reduced, and wetlands are being restored in the upstream basins to serve as nutrient sinks to protect the LME. A GEF Strategic Partnership is in place for 2001-2006, to assist the 17 nations [7].

**Socioeconomic conditions**

The Black Sea LME has historically played a very important role, as a crossroads of Greek, oriental, southern, and western influences (through the Danube River). Peoples of many different languages, religions, trades and cultures, lived in this area together. Today, the area's population is 165 million. The Black Sea watershed includes the 6 coastal countries of Romania, Bulgaria, Turkey, Georgia, Ukraine and Russia, as well as 11 others [1].

The 17 countries have diverging socioeconomic and political structures. There are socioeconomic problems related to the transition of countries from the former Soviet Block to a market economy. In ancient times, people depended on the Black Sea for fisheries resources, for transportation and for trade [8].

The LME long supported a valuable fishery that was larger than that of the Mediterranean. Fish in these earlier times served as a basis for trade with other areas. Fish, sun-dried or cured with salt, from the Dnieper and Danube estuaries was exchanged for pottery from the Aegean Sea. The Black Sea coast contains many ports for ocean transport and facilities for recreation. It is served by large harbors, and by industrial and resort cities. The city of Istanbul (formerly Byzantium and Constantinople) has played a major historical role. Shipping via the Turkish straits is a major activity. Oil is piped to Black Sea harbors for transportation. The LME's environmental degradation has economic and social consequences.

The fisheries collapse has created a crisis in employment in the fisheries sector and has reduced food security in protein resources. As a result of the reduced availability of fish, market prices for fish have risen. Aquaculture shows promise but is still at an early stage.

There is a long experience of sturgeon culture in the Azov Sea. More recent ventures involve the cultivation of mussels, oysters and Atlantic salmon. Aquaculture would provide an important local source of food, income and employment for fishermen displaced by the stock collapse. Sustainable tourism must address the problems of beach degradation, coastal erosion, water quality and water supply. Reductions in freshwater flow, due to irrigation, have had a major effect on estuarine fauna.

Regular beach closures due to sewage discharge problems affect the tourist industry in the region [1].

**Governance**

In the LME and its large drainage basin, the GEF is supporting its biggest international waters initiative for environmental improvements. This is occurring despite difficulties due to the number of countries and stakeholders involved, and difficulties in harmonizing objectives. Many of these countries are undergoing political change. Romania, Bulgaria, Georgia and Ukraine have emerged from under the aegis of the former Soviet Union. In the early 1990s, a series of small GEF projects focused on reducing nitrogen loadings from the 17 contributing nations.

A TDA and SAP process (see Pollution and Ecosystem Health) was completed in the 1990s. For more information on the perceived transboundary problems and areas where action is proposed to reduce pollution, manage living resources and sustain human development, see GEF, 1997. The Black Sea SAP, signed by the six Ministers of Environment of the coastal Black Sea countries in 1996. The Black Sea and Danube Basin countries are collaborating in an effort to uncover the needed policy, institutional, and legal reforms in each country.

There is a need to increase the level of public concern, increase the flow of information between the countries and involve the public in environmental decision-making. There is a commitment to achieve nutrient reduction and to abate persistent toxic substances being released from hotspots. Reforms in policy, laws, institutions and investments are now being

supported by GEF in each country for nitrogen abatement from the agriculture, municipal, and industrial sectors. There is community and NGO participation for mobilizing support for hotspot cleanup. Protocols to 2 conventions, the Bucharest Convention and the Istanbul Convention, are to be adopted that codify country commitments. In particular the Black Sea Environmental Program contains such necessary stages:

– to protect the Black Sea from pollution;

– to prevent pollution by hazardous substances or matter;

– to prevent, reduce and control the pollution of the marine environment from vessels in accordance with the generally accepted rules and standards;

– to prevent, reduce and control the pollution of the marine environment resulting from emergency situations;

– to prevent, reduce and control the pollution of the marine environment by dumping;

– to prevent, reduce and control the pollution of the marine environment caused by or connected with activities on the continental shelf, including exploration and exploitation of natural resources;

– to prevent, reduce and control the pollution of the marine environment from or through the atmosphere;

– to protect the biodiversity and the marine living resources;

– to prevent the pollution from hazardous wastes in transboundary movement and the illegal traffic thereof;

– to provide framework for scientific and technical co-operation and monitoring activities [7].

## Conclusion

The Black Sea is the world's largest meromictic basin where the deep waters do not mix with the upper layers of water that receive oxygen from the atmosphere. As a result, over 90% of the deeper Black Sea volume is anoxic water. The current hydrochemical configuration is primarily controlled by basin topography and fluvial inputs, which result in a strongly stratified vertical structure and a positive water balance.

The upper layers are generally cooler, less dense and less salty than the deeper waters, as they are fed by large fluvial systems, whereas the deep waters originate from the warm, salty waters of the Mediterranean. This influx of dense water from Mediterranean is balanced by an outflow of fresher Black Sea surface-water into the Marmara Sea, maintaining the stratification and salinity levels.

The Black Sea is a "shallow" sea with functional depth of water exchange of 100-200 m, it appears as an almost closed hydrographic system.

It is well known that the environmental condition of the Black Sea and its ecosystem has deteriorated markedly in the last 10–15 years. The contamination of seawaters with hydrocarbons has contributed these processes too. Shipping is considered to be one of the greatest pollutants and in particular the intensive flow of liquid cargoes, which are needed for the industry of all Black Sea states.

According to the list of investments, the 410 km of sewers and wastewater plants capable of handling 1,4 million m /day require construction and renovation at a cost of approximately 660 million USD. Additional investments that would be required to stop marine dumping, protect bio-diversity areas and to establish the sustainable economic developments are necessary. From this long list of projects a short list often pollution hot spots was identified by the BSEP worth H2.5 mi/lion USD. The investment portfolio to be developed as part of the National Black Sea Strategic Action Plan (NBS-SAP) is expected to include many if not all of these hot spot projects.

The Ukrainian economy is under a lot of pressure and is facing a serious crisis. GDP has fallen by 55%, national income by 59% and consumption by 32%. The most important Black Sea industrial centers are in Odessa and in the Crimea. Despite the overall decline in industrial output since 1991, the rate of decline in the coastal zone is lower than the national average. The main industries on the coastal zone are currently machine building, metallurgy, food, consumer goods and construction materials.

These industries are highly polluting to coastal waters. As in the case of agriculture, the decline in industrial production resulted in a reduction of the pollution load, which is not the outcome of any improvement in treatment capacity or efficiency. There has also been a decrease in fish catches in the past two decades and although tourism has been a significant industry for the coastal zone, the deterioration of water quality has led to its recent decline. However, tourism remains a potential area for growth.

The current economic crisis is largely perceived to be the outcome of tine former centrally-planned system. Environmental spending used to be among the lowest priority areas of the government. Unfortunately, this attitude has only changed slightly; expenditure on environmental spending in 1990 was 1,3% of GDP and increased only marginally to 2,7% in 1994. The Ministry of Environmental Protection and Nuclear Safety of Ukraine has proposed an increase of environmental expenditures up to a level of 3–5% of GDP. Further, an increase of environmental protection funds is expected in local budgets.

Pollution of the Black Sea LME is one of the greatest problems in ecology of Ukraine. Pollution damages animals like a fishes and sea birds, and can destroy the health of human been. To solve such serious problems we need a help of other countries whose has collide with such situation and successfully come out of it. Also there is a convention of the Protection of the Black Sea against pollution. Such countries as Bulgaria, Georgia, Romania, Turkey, Russia and Ukraine comes in this convention [9].

But, unfortunately, not all this countries provide the recommendations or plans of this convention. In the result of this the Black Sea is the most polluted sea in the world now.

We all need to choose. Are we going to be stewards of our natural inheritance or are we going to place that in jeopardy in order to use oil. The situation in the Black Sea highlights this choice. It will not be possible to have both as the oil business is not compatible with a healthy ecosystem [7].

The Black Sea is small and narrow and cannot support all the oil tankers and other traffic thatmust use this important port. In fact oil traffic is significantly slowed down as ships lineup and wait their turn. But more importantly, the Black Sea is a very unique and delicate ecosystem that can easily succumb to oil spills and other accidents that are common with thiskind of activity.

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