Black Sea Pollution and Pesticide Issues
Ranking of Environmental Priorities

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The Black Sea NGO Network (BSNN) is a regional association of 62 environmental and sustainability NGOs from the six Black Sea coastal countries: Bulgaria, Georgia, Romania, Russia, Turkey and Ukraine. Its mission is to contribute to the protection and rehabilitation of the Black Sea through joining public efforts and involving all key stakeholders. The association was registered in Varna, Bulgaria in 1999. It is observer at the Black Sea Commission and publishes a regional newsletter. More is available at its website www.bseanetwork.org

Overview

The present overview of pollution in the Black Sea with emphasis on pesticide issues has been compiled on the basis of 'Black Sea Pollution Assessment' UN Publications, NY Volume 10 of the Black Sea Environmental Programme series and the BSEP official newsletter. There is also brief reference to the current regional efforts within the Strategic Partnership for the Wider Black Sea Basin supported by GEF/UNDP with counterpart projects for the Danube and the Black Sea. The project for the Black Sea is entitled 'Control of Eutrophication, Hazardous Substances and Related Measures for Rehabilitating the Black Sea Ecosystem' (better known as the Black Sea Ecosystem Recovery Project or BSERP) is the most significant current international intervention in the area aimed at the improvement of the environment.

The pollution assessment of the Black Sea has been compiled in accordance with the requirements of the Black Sea Strategic Action Plan, signed by the ministers of the environment of Bulgaria, Georgia, Romania, Russia, Turkey and Ukraine on 31 October 1996. It contains information on the sources levels and effects of pollution in the Black Sea, as well as the preventative and remedial measures that are being taken in the region. Its main conclusions are the following:

The Black Sea ecosystem has been seriously damaged as a result of pollution. There is clear evidence to relate the decline of shelf seas ecosystems to eutrophication caused by increased loads of nitrogen and phosphorus. Much of these loads arise from major river, notably the Danube but also from smaller sources in all Black Sea countries. According to current estimates, some 70% of the dissolved nitrogen and phosphorus entering the Black Sea comes from the six coastal countries, either through discharge to the major rivers (notably the Danube) or from direct sources. The remaining 30% originate from the 11 non-coastal countries that belong to the Black Sea basin. There is sufficient information to apportion individual responsibility for contribution to these loads among these eleven countries. Furthermore in addition to the dissolved nutrients entering the sea, estimates for nitrogen compounds suggest that an amount equivalent to some 50% of the dissolved may be entering the system from atmospheric sources of indeterminate origin. The dissolved load is particularly significant however, as it directly impacts the shelf zone systems which are critical to the health of the overall Black Sea Ecosystem.

All Black Sea countries contribute to the loads of contaminants entering the Black Sea. In the case of nutrients, the contribution is directly related to agricultural drainage with lesser contributions from domestic sources and industry. The situation was particularly bad in the 1970s and 1980s. Recent economic decline in the coastal countries has lowered inputs. This has resulted in a very gradual improvement in the health of the NW shelf and provides some help that recovery might be possible. However unless urgent measures are taken to keep nutrients on land the recovery may be reversed as economic conditions improve and the use of chemical fertilizers resumes.

Black Sea coastal waters remain heavily impacted by sewage, a situation exacerbated by the weak economies of coastal states. In most countries there is a serious lack of transparency on sewage indicators. Where data exists, it results from studies that are using methodologies that are not intercomparable. Independent investigations and epidemiological data suggests that this situation is serious and warrants urgent action. Oil pollution in the Black Sea does not appear to be generalized

but impacts coastal areas around river mouths, sewerage outfalls, industrial installations and ports. There is no evidence of significant heavy metal pollution in the Black Sea. Further studies are still required around industrial centres and ports but generalized pollution from these substances can be discounted. The Black Sea has a significantly higher concentration of human produced radionuclides than the neighbouring Mediterranean a problem attributed to the 1986 Chernobyl accident. Present levels or radioactivity do not appear to pose a significant health hazard to humans but it will be important to monitor the situation in the future.

There is no evidence of system-wide pollution of the Black Sea from pesticides and other persistent organic pollutants (such as polychlorinated biphenyls, PCBs, or polyaromatic hydrocarbons, PAHs). Levels of these substances in some nearshore areas are elevated however. Current coastal zone data are restricted to a few sites that were monitored through the efforts of the Black Sea Environmental Programme. Most historical data have been shown to be unreliable. It will be important to complete a study of all coastal countries in order to detect any significant contaminated areas.

The background information below provides some information about the unique geographical characteristics of the Black Sea related to the condition of its environment and more details on pesticide pollution. Though it is not included on the problem list of the assessment as a basin wide issue, its significance to the health of the ecosystem is by no means underestimated, notably in the focus of the current Black Sea project aimed at the control of eutrophication and hazardous substances.

Geographical information

The Black Sea is a natural inland water basin situated between Europe and Asia. Six countries share the Black Sea coast: Bulgaria, Georgia, Romania, Russia, Turkey and Ukraine. The lengths of their respective coastlines are: Bulgaria - 354 km, Georgia - 310 km, Romania - 225 km, Russia - 800 km (including the Azov Sea), Turkey - 1329 km and Ukraine - 2782 km (including the Azov Sea). A population of about 16 million people inhabits the coastal zones of the six countries.
The following are some of the basic geographical characteristics of the Black Sea: total area - 422 000 sq km (441 000 sq km including the shallow Azov Sea), maximum depth - 2212 m, average depth - 1300 m, volume - 540 000 cubic km, wave height up to 6 - 7 m, wave length up to 90 - 100 m, tidal variations - 3 to 10 cm, average winter temperature of seawater - 4°C, average summer temperature of seawater - 22-24°C. The largest bays on the Black Sea are the Karkinitski, the Bourgas, the Kalamitski, the Dnieprovski, the Dniestrovski, the Sinop and the Samsun Bay. The largest rivers flowing into the Black Sea are the Danube, the Dnieper, the Don, the Dniester, the Kuban, the Southern Bug, the Rioni, the Kizil-Irmak and the Kamchia rivers.

The unique environment
The Black Sea with its total area of roughly one third the size of continental Europe is one of the largest inland water basins in the world. It is almost entirely isolated from the world's oceans but is over 2 km deep in places and receives river inputs from a large catchment territory, including major parts from seventeen countries and the second, third and fourth largest rivers in Europe, respectively the Danube, the Dnieper and the Don.
The Black Sea is connected to the Mediterranean only through the narrow and winding Bosphorus Straits, a 35-km natural channel, as little as 40 m deep and 700 m wide in places. It leads to the Sea of Marmara and then to the Aegean Sea through the Dardanelles. This complex natural system makes the replenishment of seawater in the Black Sea very slow.
Every year the rivers pour an average of 350 cubic km of water into the sea and since it receives more fresh water than it loses from evaporation, the average salinity is quite low - 18‰. The surface outflow, a mixture of seawater and fresh water, from the Black Sea to the Aegean amounts to about 610 cubic km annually. To compensate for this loss of water, the Black Sea receives an inflow from the Mediterranean with higher salinity but the volume is roughly twice smaller. It enters the sea as an underflow through the Bosphorus, which also carries the outflow. The two do not mix very easily and as a result the Black Sea has got a surface layer about one hundred metres deep which contains more fresh water than the waters below.

The replenishment of the bottom waters of the Black Sea with new seawater from the Mediterranean takes hundreds of years. This very slow rate of replenishment and the large input of freshwater have led to a stratification of the Black Sea that has now got a lighter and fresher upper layer and a denser underlying layer.
The slow replenishment and the bad mixing of waters does not provide enough oxygen for the process of decomposition and the bacteria in the lower layers use it up entirely. Consequently the Black Sea is virtually dead below a depth of about 180 metres and this boundary is being pushed up. Moreover the metabolism of some bacteria generates hydrogen sulphide, a soluble poisonous gas associated with the smell of rotten eggs. Hydrogen sulphide is present in the entire lower layer of seawater in the Black Sea.
Therefore the Black Sea is now the largest natural anoxic water basin in the world. This means that 87 % of its volume is practically devoid of marine life, except for some forms of bacteria. However, the Sea is still comparatively rich in living resources. Also, the Black Sea shelf and river deltas are important spawning grounds for sturgeon and other fish species, and the coastal wetlands are migration and breeding grounds for numerous rare and endangered European birds. The warm coastal waters and sunny beaches of the Black Sea, the beauty of its shorelines, plains and mountains attract millions of tourists.

Averting the crisis

Environmental issues and the protection and rehabilitation of the Black Sea are of great interest for the coastal population. In recent time the entire Black Sea environment has suffered a major and very evident decline. The sea has been used for fishing, tourism, mineral extraction and marine transport and as a convenient dumping place for solid and liquid waste. The large influence of the land and the intensive use of the sea by shipping suggested that pollution was the cause of the decline. It was also clear that this pollution was the result of the human activities in all coastal countries and if the crisis was to be averted, the issue had to be addressed jointly.
The legal framework for regional cooperation was elaborated after the 1972 Stockholm Conference on Environment and Development. In the early 1990s representatives of the six Black Sea countries drafted their own Convention for the Protection of the Black Sea against Pollution, signed in Bucharest in 1992 and ratified by the six national assemblies by early 1994. The Bucharest Convention, includes a general framework of agreement and three specific protocols: on the control of land-based sources of pollution, on the dumping of waste and on joint action in the case of accidents, such as oil spills. The implementation of the Convention is overseen by a Commission with a permanent Secretariat based in Istanbul, hence the Istanbul Commission.

Another important step in the regional process was the Ministerial Declaration on the Protection of the Black Sea Environment, signed by the six environmental ministers in Odessa in 1993. Shortly after, the countries requested support to develop a long-term Action Plan. With $9.3 million in funding provided by the Global Environmental Facility (GEF) and collateral international donors, the Black Sea Environmental Programme (BSEP) was launched in 1993. BSEP successfully provided the missing link between experts on Black Sea and environmental issues in the separate countries. One of the basic problems was the provision of reliable information on the state of the environment itself. Such information is vital for the improvement of environmental policy and for long-term policy development and actions, including investments. BSEP established an operating network of 40 institutions in the Black Sea region, which assisted the coastal states and the NGO community in developing regional-based action plans and capacities for better managing the Black Sea environment.
BSEP has invested heavily into recruiting experts and improving the pollution monitoring network. The working parties prepared national and regional thematic reports presenting the available information and analysis to scientists, managers and policy makers. The Transboundary Diagnostic Analysis (TDA) carried out under the GEF project, led to development of the Black Sea Strategic Action Plan (BS-SAP) adopted by the six coastal states in Istanbul in 1996. Both documents explain causes for the environmental crisis of the sea and suggest solutions.
In June 2002, the BS-SAP was revised by the six countries, which reconfirmed their commitment to the original document. Currently the UNDP-GEF Black Sea Ecosystem Recovery Project (2002-2004) is underway, addressing basin wide eutrophication issues through reform of agricultural policies, improved municipal and industrial wastewater treatment, rehabilitation of key basin ecosystems and strengthening the legislative framework.

Pollution problems

The most significant process causing degradation of the Black Sea as far as pollution is concerned has been the massive over-fertilisation by nitrogen and phosphorus compounds, coming largely from agricultural, domestic and industrial sources. This phenomenon called eutrophication has changed the entire Black Sea ecosystem. The compounds enter the sea from sources in the 17 countries in its drainage area. The coastal countries contribute roughly 70 % of the total amount and almost all the remaining amount enters the sea via the Danube River.
Discharge of insufficiently treated sewage: introduce microbiological contaminants into the Black Sea and pose a threat to human health and in some cases hamper the development of sustainable tourism and aquaculture. The discharge is estimated at about 571 million cubic metres annually.
Oil pollution. Oil enters the sea as a result of operational discharges of vessels and accidents, as well as through land based sources. Oil pollution levels are not high in the open sea but are unacceptable in many coastal areas. Annually some 95 000 tons of unrecoverable oil waste is discharged into the Black Sea. Toxic substances such as pesticides and heavy metals do not appear to pollute the whole sea but appear in 'hot spots' near certain well-identified sources. These polluters are usually associated with heavy industry and with the economic decline in the region their use has decreased considerably.

Radioactive substances have been introduced to the Black Sea in small quantities from nuclear power generation and as a result of the Chernobyl accident in 1986.

Uncontrolled deballasting from ships has introduced to the Black Sea exotic species, brought from other parts of the planet and flourishing in the new environment. Some of them have proliferated becoming predators to the indigenous species thus damaging the Black Sea ecosystem.
Solid waste dumped into the sea from ships and coastal towns. As an enclosed sea, the Black Sea is particularly vulnerable to this kind of pollution as any floating or half-submerged waste is inevitably washed ashore. Some beaches have a high accumulation of garbage presenting a risk to marine animals and humans.

The BS-SAP recommends preventive measures to control pollution. Anticipatory action is an underlying principle of the Plan, though it employs the 'polluter pays' principle as well. The Plan calls upon the signatories to agree on common water quality objectives and develop a strategy of gradual step-by-step reduction of loads until the objectives are reached. Places where pollution levels are unreasonably high called "hot spots" are regarded as immediate priorities for action. The Action Plan not only addresses pollution entering the sea from rivers and discharge pipes but also includes detailed provisions for preventing pollution from ships, for minimizing pollution from maritime accidents and controlling illegal dumping of waste into the sea. Another important provision on pollution concerns future monitoring of the state of the Black Sea.

Focus on hydrocarbons and organochlorines
As it is well known some organochlorines often referred to as POPs (persistent organic pollutants) have been associated with significant environmental impact in a wide range of species and at virtually all trophic levels. They are implicated in a wide range of adverse human health and environmental effects. However, as with many other environmental pollutants, it is difficult to attribute a specific illness or a disease to the exposure of a specific POP.

The primary transport routes into the marine and coastal environments include atmospheric deposition and surface run-off, the former being by far the greatest. Over 80% of the total input in the sea is via the atmosphere, the remainder is via rivers. The appreciable analytical uncertainty in measurements of organochlorines in marine samples and the extremely uneven coverage of environmental compartments (air, water, sediments and biota) and geographical locations, make environmental investigation of fluxes and budgets highly problematical.

PCBs which are or have been produced for industrial use (especially as dielectrics, coolants and plasticizers) are now mostly restricted to closed systems. Globally ubiquitous in the aquatic systems these compounds partition onto particulates and bioconcentrate in the lipids of organisms.

DDT, banned in most European countries in the mid 1970s is still used to control mosquito vctors in some countries. In most countries of the Black Sea the use of this pesticide has also been banned on restricted. For example in Turkey and Romania the use of organochlorine pesticides was controlled in the late 1970s, but effective restrictions were not imposed in Turkey until the 1980s. Between 1976

and 1983 the tannual use of organochlorine insecticides in Turkey was 1000 – 2000 tonnes. Despite these restrictions recent studies have shown the presence of DDT in in Turkish rivers, streams, and domestic and industrial discharges, which indicates their illegal use. The use of these chemicals in other Black Sea countries is currently unclear.

Concentrations of DDTs, HCHs and PCBs in Black Sea fish and mammals are comparatively high by comparison with those reported for some other regional seas. The data from selected chlorinated compounds from sediments ranks them as follows:DDTs>HCHs ≥PCBs>HCBs>Cyclodienes. A similar ranking has also been observed in organisms from the Black Sea. The concentration of PCBs (sum of 13 congeners) in some sediments of the Black Sea is low in comparison with those reported for other locations. As with hydrocarbons, the some of the locations with the highest concentrations are situated in the vicinity of the River Danube. The highest concentration (24.3 ng/g) was found in a sample taken from the port Constanta on the Romanian coastline. Among the PCB congeners the toxic di-*ortho* and mono-*ortho* showed predominance. The usage pattern and major sources of PCBs in other countries surrounding the Black Sea are still unclear.

Highest concentration of DDTs is in the Black Sea are associated with lipid rich sediments in the coastal waters of Romania and Ukraine that are under the influence of River Danube discharges. Elevated concentrations are also reported for sediments in the vicinity of Odessa and Port Constanta. Concentrations of DDT related compounds are shown to be generally lower than those reported for the Baltic Sea and most Asian sites. They are comparable (or slightly higher) than those reported for other regions of the Russian Federation (e.g. lake Baikal), the USA and Mexico. The low DDE/DDT values combined with the relatively high concentrations (especially in Odessa sediments and in sediments under the influence of Danube discharges) indicate current DDT usage around the Black Sea.

Concentrations of lindane and other HCH isomers are low in samples from the Ukrainian coastline, Russian Federation and Turkey. These levels are comparable to the lower-medium range of values for estuarine sediments from eastern and southern Asia and Oceania. However they are much lower than values reported for areas that are subject to intensive sources of HCH contamination. Elevated concentrations in samples from Romanian coast stations , under the influence of the River Danube, indicate substantial usage of HCH as a pesticide in the River Danube watershed. The composition of the HCH isomers in the sediments showed a high percentage of the isomer at some sampling locations along the Romanian coastline (56 to 81%) indicating usage of lindane in the region. Conversely, the the values found at Odessa, Sochi, along the Ukrainian coastline, the Ukrainian Danube coastline and the Bosphorus suggest that HCH contamination at some locations arises through use of both formulations. HCB and cyclodienes were also found in sediments from the Black Sea, albeit at much lower concentrations than those recorded for the other compounds. The highest values of HCB were recorded along the Romanian and Ukrainian coastlines adjacent to the River Danube.

The Black Sea Ecosystem Recovery Project

The GEF-UNDP Black Sea Ecosystem Recovery Project, currently implemented completed its first phase in the 2002 – 2004 period. It addresses control of eutrohication and hazardous substances through reform of agricultural policies to reduce non-point sources run-off of fertilizers and manure (buffer zones, erosion control, organic agriculture, manure storage clamps etc.), rehabilitation of key basin ecosystems to enhance their capacities as nutrient sinks (wetland restoration) and strengthening of the legislative framework and enforcement, enhancing public awareness, promoting changes in consumer practices (including phosphate free detergents). In addition to control and abatement BSERP also aims to improve management of critical marine and coastal areas. In addition to that the project serves as mechanism for funding research activity aimed at the improvement of knowledge on nutrient flow and budget such as: riverine inputs with respect to the role of dissolved organic nutrients and unknown; the role of the sediment/water fluxes on the NW shelf is unclear; the contribution of atmospheric deposition has not been evaluated; mixing along the thermocline and horizontal mixing has been poorly evaluated; article flux out of the system is poorly understood; there is uncertainty on the operation of the water column with respect to the nutriemts which are limiting algal growth; there is speculation about which nutrient (nitrogen, phosphorus or silica) is limiting the growth of algae between the NW shelf and the Bosphorus gyre; the status of the marine ecosystem is unclear, also what are the signs of benthic recovery.

The complexity of the Black Sea hydroogpahy and the development of the region present an enormous challenge to scientists, politicians and societies. There are gaps in knowledge and monitoring data bigger than the immediate objectives to be achieved by the BSERP. A basin-wide study of pesticides and POPs is a task for the future. Urgent efforts are needed by the Black Sea countries and the international community to enable the full implementation of comprehensive instruments like the Strategic Action Plan and other measures of policies and lawenabling pollutionto be controlled and abated.