Hazardous Substances in the Baltic Sea

Draft HELCOM Thematic Assessment in 2006

HELCOM Stakeholder Conference on the Baltic Sea Action Plan

Helsinki, Finland, 7 March 2006

HAZARDOUS SUBSTANCES IN THE BALTIC SEA

DRAFT HELCOM THEMATIC ASSESSMENT IN 2006

1. INTRODUCTION

1.1 Aim of the assessment

The Ecosystem Approach to management of human activities, adopted by the Joint HELCOM/OSPAR Ministerial Meeting in 2003, obliges HELCOM to assess the pressures of human activities as well as the resulting impacts on, and state of, the marine environment and to use the results of such assessments as the foundation for identifying priority actions. HELCOM assessments also aim to reveal how visions, goals and objectives set for the Baltic Sea marine environment are met and to link the quality of the environment to management.

This assessment aims to give an overview of the causes and effects of hazardous substances pollution in the Baltic Sea. The assessment describes the inputs of the hazardous substances to the Baltic Sea and their sources as well as the effects in the sea evaluating also actions taken in HELCOM and initial further measures needed to restore the status of the Baltic Sea. HELCOM has decided to prepare a more comprehensive assessment to the Commission meeting in 2007.

The aim of this thematic assessment is not to provide a comprehensive overview on hazardous substances in the Baltic Sea. The work aims to introduce ecosystem based objectives and targets for hazardous substances on what the future work in HELCOM to reduce pollution will be based on. The objectives and the associated indicators presented in the report are tentative and intended to stimulate the discussion with a view to have more developed proposals at the Commission meeting in 2007.

The Ecological Objectives and their associated indicators will be the cornerstone of the Baltic Sea Action Plan, which the HELCOM Member States and the EU have jointly developed to ensure that all possible measures are taken to reduce pollution in the Baltic Sea and to repair the damage done to the marine environment.

The development of the Action Plan will involve all the Baltic Sea coastal countries. Input and active participation from all major stakeholder groups in the region will also be required, to ensure that the Action Plan is relevant and can be effectively implemented in practice.

1.2 Description of the problem

Pollution by hazardous substances has been a well known problem in the Baltic Sea since the 1960s when the detrimental effects of heavy metals and organochlorines on biota, especially many fish-feeding species, were observed. Although monitoring indicates that the loads of some hazardous substances have been reduced considerably over the past 20–30 years, problems still persist.

Pollution caused by hazardous substances, in contrast to eutrophication with essentially nitrogen and phosphorus compounds to worry about, refers to a massive number of different anthropogenic substances ending up in the marine environment. Hazardous substances in the Baltic Sea include:

- substances that do not occur naturally in the environment, such as PCBs, DDTs, dioxins, organotin compounds, nonylphenolethoxylates (NP/NPE), short-chained chlorinated paraffins (SCCP), brominated flame retardants (PBDEs), certain perfluorinated compounds (PFOS) and certain nitromusks;
- substances occurring at concentrations exceeding natural levels, including heavy metals like lead, copper, cadmium and mercury.

Once released into the Baltic Sea, hazardous substances can remain in the water for very long periods and can accumulate in the marine food web up to levels which are toxic to marine organism. Hazardous substances cause detrimental effects on the ecosystem, such as

- Impaired general health status of animals
- Impaired reproduction of animals, especially top predators
- Increased pollutant levels in fish for human food.

Certain contaminants may be hazardous because of their effects on hormone and immune systems, as well as their toxicity, persistence and bio-accumulating properties.

Relatively few organic pollutants are fully understood or even identified today. Another problem is that the degradation and transformation of these substances in the marine environment may change their structure and reactive properties. These unknown substances could pose a considerable threat to the environment.

1.3 Actions taken

From the beginning of its work, HELCOM has been committed to “counteract” hazardous substances, and already in the 1974 Convention the input of substances such as DDTs, PCBs, heavy metals and some pesticides into the Baltic Sea and its catchment area was prohibited. The 1992 Convention includes 29 banned or restricted hazardous substances and more than 20 Recommendations addressing hazardous substances have been adopted through the years. HELCOM-organised scientific and technical assessments contribute greatly to the growth in knowledge about the Baltic environment and state policies and practices. HELCOM has also become increasingly active in monitoring implementation and building state capacities for policy making and implementation.

The 50 % reduction target of some 46 hazardous substances included in the 1988 Ministerial Declaration has been largely reached. This 50 % reduction target is thus replaced by HELCOM's objective contained in HELCOM Recommendation 19/5 to prevent pollution of the Convention area by continuously reducing discharges, emissions and losses of hazardous substances towards the target of their cessation by the year 2020, with the ultimate aim of achieving concentrations in the environment near background values for naturally occurring substances and close to zero for man-made synthetic substances.

HELCOM has compiled all available data on sources, pathways, markets and the legal situation relating to selected hazardous substances, in order to assess the exposure situation and identify suitable cost-effective measures. Subsequent guidance documents on mercury, cadmium, short-chained chlorinated paraffins, nonylphenol and nonylphenolethoxylates, dioxins and PCBs have been produced to help policy makers to choose the most efficient instruments and measures to eliminate the emissions, discharges and losses of these hazardous substances.

However, there is still too little comprehensive knowledge about the loads and impact of the most widely used chemicals and their cocktail-like combinations on human health and the environment.

The complexity of the issue and often low concentrations makes both load and effect monitoring of hazardous substances difficult and thus expensive.

2. THE ECOSYSTEM APPROACH TO THE MANAGEMENT OF HUMAN ACTIVITIES

The Ecosystem Approach to the Management of Human Activities is the basis for the Baltic Sea Action Plan, putting the ecosystem at the centre when deciding on management option. The ecosystem approach emphasises long-term sustainability and it integrates human activities and conservation of nature. It includes political, economic and social values, and should propose solutions which are socially acceptable.

HELCOM is now in the process of describing the desired health status of the Baltic Sea in the future. This is done by using ecological objectives and associated indicators with relevant target levels to measure the progress towards "good ecological status" within the four priority areas (eutrophication, hazardous substances, nature conservation and biodiversity and maritime activities). For hazardous substances the plain and clear goal of this work is: Baltic Sea life undisturbed by hazardous substances. This comprises HELCOM's cessation target of hazardous substances by 2020 (***Figure 1***).

Based on the desired status and targets to be defined we need to assess the required reductions of current input levels and to identify the further measures needed in a cost-effective way.

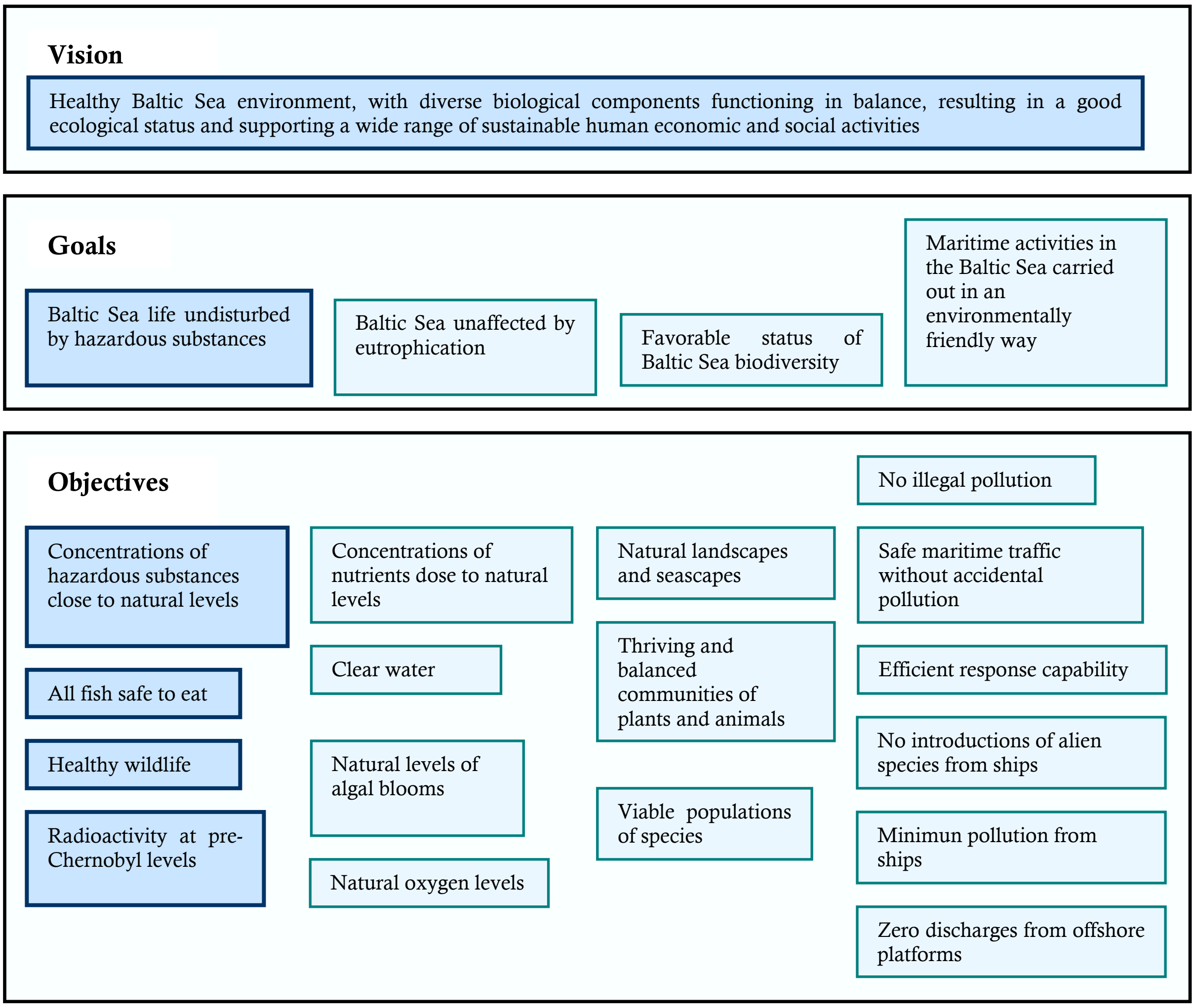

***Figure 1**. HELCOM vision, strategic goals and objectives. This assessment addresses the targets with the darker highlight. (Source: HELCOM).*

Ecological Objectives

The ecological objectives point to the critical processes in the ecosystem reflecting the causes and effects. They can be used to communicate the current status of the Baltic Sea to a wider community. The ecological objectives reflect the core of the ecosystem and are the starting point in defining and planning the management of human activities.

Indicators with targets

To show how we are progressing towards our objectives we need supporting indicators, showing whether we are going in the right direction. The indicators shall have set targets which, when reached, reflect the good ecological status. In order to decide upon the targets, we need to know "historical" reference levels for naturally occurring hazardous substances such as heavy metals, i.e. the situation before human influence. When we know these reference levels that result from natural processes, we can use them as a reference for "an unaffected sea" – or a sea with high ecological status.

Reference levels are presently very hard, if not impossible to regain at least in the near future due to e.g. high amounts of hazardous substances already stored in the sediments and slow exchange of water with the North Sea. Target levels should thus be based on an acceptable deviation from the reference levels (***Figure 2***) taking also into account the work ongoing on environmental quality standards for hazardous substances under the EU Water Framework Directive. In some cases, such as in the standards for hazardous substances set for human food e.g. dioxin levels in fish, a limit level can be used as an assessment criteria. A precautionary level includes the risks due to uncertainties associated with estimations of current levels.

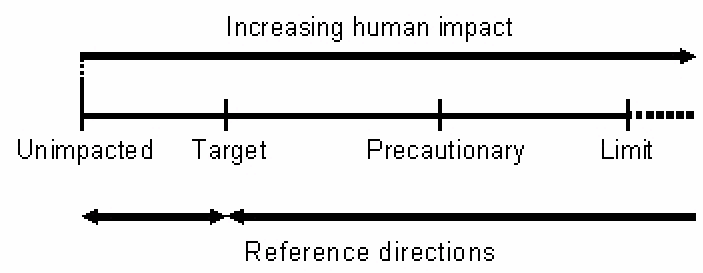

Figure 2. *Defining target levels for hazardous substances.*

In practical, terms defining a target level means agreeing on a reference levels for naturally occurring substances as well as, even more importantly, an acceptable deviation from this level in the different sub-regions of the Baltic Sea.

2.1 Proposed ecological objectives and tentative associated indicators

Concentrations of hazardous substances in the Baltic Sea marine environment and specifically in fish, as well as wildlife health problems due to hazardous substances and radioactivity in the environment were chosen as topics for ecological objectives.

Taking both concentrations and biological effects of hazardous substances to the objectives is important as a very large number of hazardous substances have been released to the Baltic Sea, often in low concentrations. Such substances may be possible to observe if special concern for the substance is raised for e.g. human health risks. In other cases the only way to detect the impact of previously unknown substances is through applying biological effects monitoring methods, just like the observations in seal and predatory bird reproductive health indicating pollution by PCBs and DDTs during the 1970s. Specific methods to detect biological effects (such as molecular biomarkers) caused by unknown and known substances are presently on the way to reach maturity.

Radioactivity is presently not of high concern in the Baltic Sea, but a functioning monitoring system is operating within HELCOM MORS-PRO.

Proposals for the Ecological Objectives and associated indicators describing the future of the Baltic Sea environment functioning in good ecological balance are:

Concentrations of hazardous substances close to natural levels

Proposed ecological objective

Despite reductions in inputs, concentrations of heavy metals and organic pollutants in the Baltic Sea are still up to 20 times higher than in the Northern Atlantic (see ***Table 1*** and ***Figure 3***).

Table 1*. Concentrations of dissolved trace metals in the North Atlantic and the Baltic Sea (ng/kg). Source: Kremling, K. & Streu, P. (submitted); Pohl, C. et al. (1993); Pohl, C. & Hennings, U. (1999); Dalziel, J. A. (1995).*

Heavy metal	***North Atlantic***	***Baltic Sea***
Mercury	0.15-0.3	5-6
Cadmium	2-6	12-16
Lead	5-9	12-20
Zink	10-75	600-1000
Copper	65-85	500-700

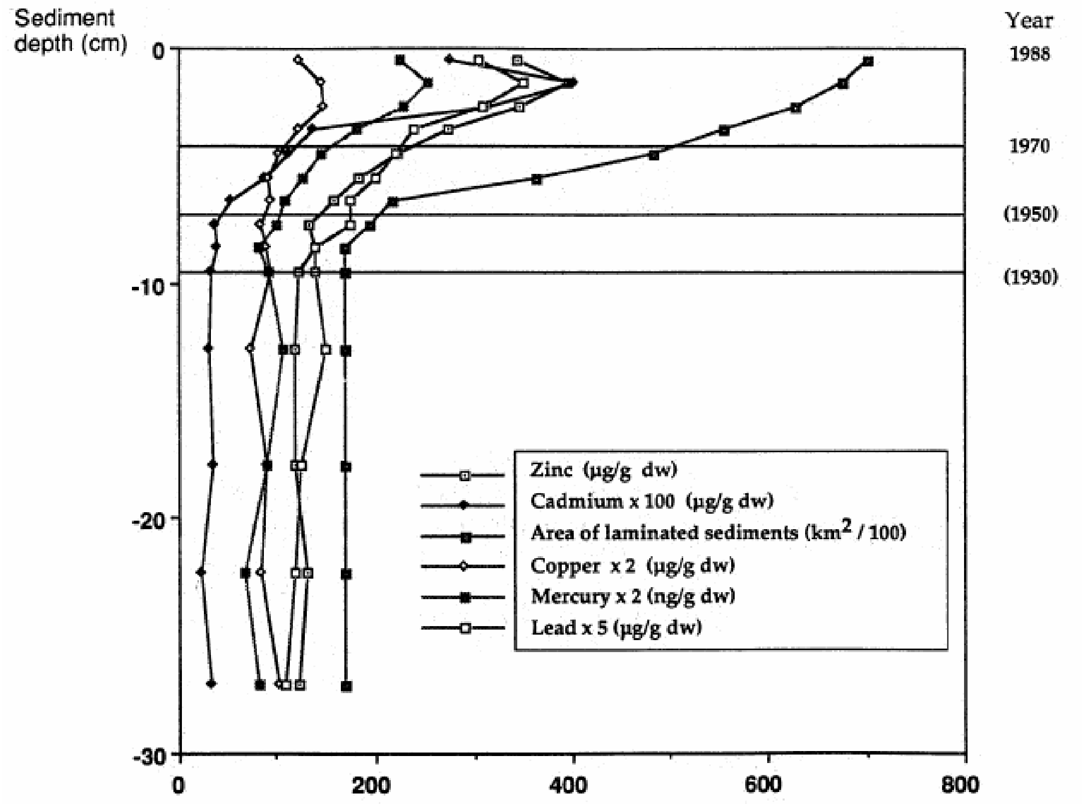

***Figure 3**. Mean vertical distributions of Cd, Zn, Cu, Pb & Hg in sediment cores (n=10) from the Baltic Proper. The recent expansion of laminated sediments is also indicated. The dating has been performed by varve counting, to the year 1970 (sediment depth 4.2 cm). The levels for the years 1930 (7.0 cm) and 1950 (9.6 cm) have been estimated from the dry matter curve, assuming a constant mean deposition rate of dry matter Graph from Borg and Jonsson (1996)*

In the Baltic marine environment, concentrations of some metals, such as cadmium, are declining in organisms in some areas (e.g. the Gulf of Bothnia and the Gulf of Finland) but increasing in others (e.g. the western Baltic Proper). Concentrations of HCH-isomers (lindane) in water and biota have decreased considerably since the early 1980s.

TBT concentration levels are still so high that they have potential biological effects, at least in the Kattegat, the Belt Sea and the Sound. For other endocrine disrupting substances and new contaminants, like flame retardants, a full assessment of their levels or effects is not possible due to the lack of monitoring data.

<u>Proposed indicators and targets</u>

As a huge number of different hazardous substances are affecting the Baltic Sea, and as all can not be monitored, some representative substances have to be selected for which target values are defined. Traditionally HELCOM has assessed the trends of concentrations of heavy metals and some historic organic pollutants such as DDT and PCB.

The partition of hazardous substances among the different compartments of the marine environment (water phase, sediments or biota) varies depending on the physical properties of each particular substance (e.g. bioaccumulation, adsorption, water solubility). Therefore, different compounds are measured in the different compartments and also the assessment should consider all three compartments at the same time.

For many of the HELCOM priority substances, which have defined to be so called PBT substances (toxic, persistant and liable to bioaccumulate), concentrations in biota are considered to be the most relevant matrix. For other types of substances (e.g. endocrine disrupters), biological effect monitoring can be considered to be more practical and of higher value. For substances, which do not belong to PBT substances, but give a reason for concern due to their widespread use, monitoring of concentrations in water is regarded a more valid strategy. In conclusion, decisions on which substances to monitor in which compartments is based on their properties, potential effects and the extent of use.

The ongoing HELCOM activity to survey the occurrence of selected hazardous substances is also foreseen to give some input to the work to choose indicators. It should be considered if substances such as brominated flame retardants or perfluorochemicals could be chosen as indicators.

At this stage the following indicator topics are proposed to be considered for hazardous substances concentrations based on partition of hazardous substances among the different compartments (details to be determined). Target levels for the different sub-regions have to be defined separately:

- Concentrations in seawater suspended matter, sediment or biota
- Possible indicator substances: Hg, Cd, Pb, organotin compounds, PCB, dioxins, PBDE, PFOS, PAH
- Some of the species selected for contaminant control in the HELCOM monitoring programme COMBINE in marine environment:

  herring (*Clupea harengus*), cod (*Gadus morhua*), guillemot (*Uria algae*), bladder wrack (*Fucus vesiculosus*), blue mussel (*Mytilus edulis*), *Macoma balthica*, *Saduria entomon*, flounder (*Platichtys flesus*), perch (*Perca fluviatilis*), viviparous blenny (*Zoarces viviparus*), common tern (*Sterna hirundo*), grey seal (*Halichoerus glypus*), ringed seal (*Pusa hispida*), common seal (*Phoca vitulina*), white tailed sea eagle (*Haliaetus albicilla*).

All fish safe to eat

<u>Proposed ecological objective</u>

Of life living in, and around, the Baltic Sea people have a special relation to fish. Even if birds such as eider duck (*Somateria mollissima*) are hunted for food the most common members of the Baltic Sea biota ending up on the dinner table are different fish species. The recent news about the alarmingly high levels of various hazardous substances such as TBT and dioxins has made the polluted state of the Baltic Sea very concrete for many people. People should feel safe when eating fish caught anywhere in the Baltic.

Concentrations of dioxin and PCBs in marine ecosystems declined in the 1980s but this decrease levelled off in the 1990s. Dioxin levels in fish still exceed the new EU food safety limits in some areas, particularly further north (***Figure 4***).

Among the positive trends concerning hazardous substances is the clear decrease in lead concentrations in herring observed in most areas. Cadmium levels have been increasing during the same period.

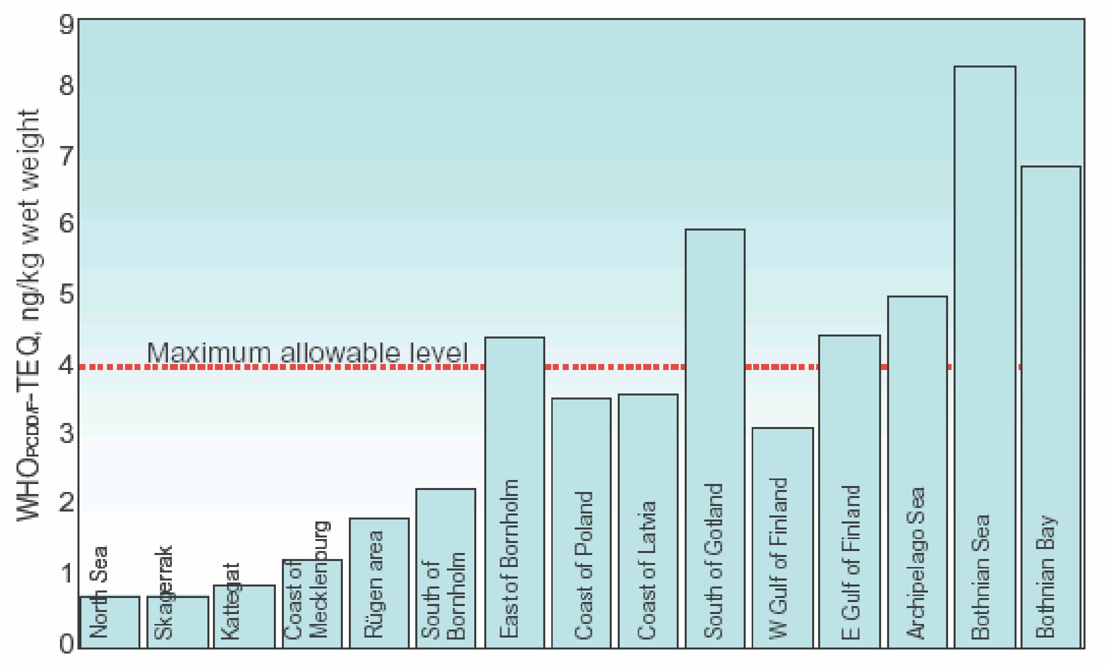

***Figure 4**. The dioxin content in herring muscle at different fishing grounds.*

Recently a study showed that the standing stock of the most abundant fish species in the Baltic Sea was a sink for 260 kg of PCBs in the late 1980s to early 1990s, and that the fisheries removed 31 kg PCB per year which ends up in the consumers.

Proposed indicators and targets

EU has adopted regulations concerning limit values on maximum levels for certain hazardous substances in food stuff, including fish. WHO has also developed recommendations on daily intake of some hazardous substances from fish. In addition some Contracting Parties recommend limitations in consumption of Baltic herring and salmon due to dioxins, furan and PCB contamination for children and women of childbearing age. It is proposed that the EU regulations as presented in ***Table 2*** for maximum levels are used when considering indicators and target levels for fish in the Baltic Sea.

***Table 2**. Maximum allowable concentrations of Dioxin (WHO-PCDD/F), sum of Dioxins (WHO-PCDD/F) & PCBs, and heavy metals (Cd, Hg Pb) in fish meat meant for foodstuff as regulated by EC 466/2001 with amendments.*

Substance	**Maximum levels in fish meat (µg per kgWWt fish (EC 466/2001).** Note that exceptions (in parenthesis) listed include only eel and pike, other species named in the regulation but less common in the Baltic are excluded.
Hg	500 (1 000 in pike *E. lucius,* eel *A. anguilla*)
Pb	200 (400 in eel *A. anguilla*)
Cd	50 (100 in eel *A. anguilla*)
Dioxins (WHO-PCDD/F) Teq	$4 * 10^{-3}$
Dioxins (PCDD/F)+PCBs (WHO-TEq) [1]	$8 * 10^{-3}$

Healthy wildlife

<u>Proposed ecological objective</u>

In addition to being directly harmful to humans, the hazardous substances found in Baltic Sea animals (as well as plants) cause various health problems to other organisms even in low dosages. Such sublethal poisonings endanger the reproduction and viability of many Baltic species.

The monitoring of biological effects of hazardous substances provides information on their adverse effects on marine organisms *in situ*. Detection of biological effects is of strategic importance to the overall monitoring of hazardous substances since many methods reveal the potential presence of substances or groups that are not feasible to be measured on regular basis due to their huge number and technical difficulties in analysis.

These problems are visible both as direct physical changes in some animals in the form of sterility and failing breeding among birds but also as physiological changes measurable as biomarkers and other ecotoxicological tools.

Generally, the reproductive success of top predators is an indicator of detrimental effects of accumulating hazardous substances. Shell thickness of common guillemot (Uria aalge) eggs from Stora Karlsö in the Central Baltic Proper has been monitored in Sweden since the 1970s (cf. ***Figure 5***). During 1990s the thickness of guillemot eggshells in the area returned to the dimensions prior to the 1940s. The thin eggshells observed during 1960 were attributable to the severe DDT pollution during that period. Similar effects of, and recovery from, DDT and other substances can also be seen in Swedish time series of white-tailed eagle (Haliaeetus albicilla) brood size and nesting success (HELCOM 2002b).

[1] Proposed limit value

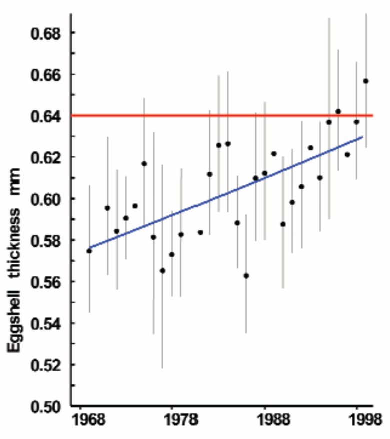

Figure 5*. Temporal trends in the thickness of common guillemot (Uria aalge) eggshells collected in Stora Karlsö in the central Baltic Proper. The solid red line indicates the thickness prior to 1940 (HELCOM 2002b).*

The pregnancy rate among female grey seals in the Baltic Sea has increased very significantly in recent years, reflecting the fact that uttering damage is now rare. Intestinal ulcers, on the other hand, are still common, even in young individuals (cf. ***Figure 6***). The figures in the pie charts are the number of seals examined (data from Museum of Natural History, Stockholm).

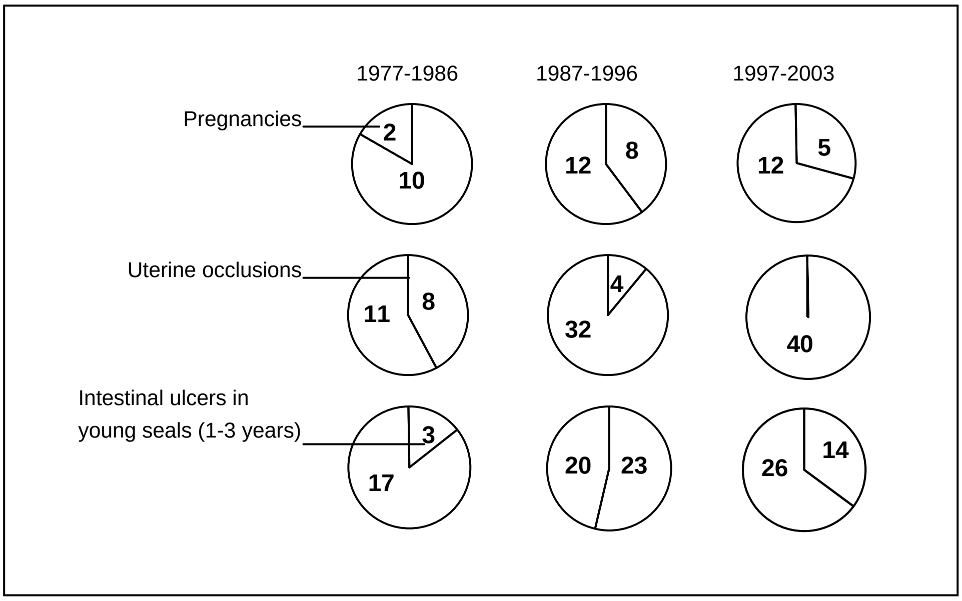

Figure 6*. Health status of the grey seals in the Baltic Sea. Numbers in the pie charts are the numbers of seals examined (data from Museum of Natural History, Stockholm, Sweden). Redrawn from Bernes (2005).*

<u>Proposed indicators and targets</u>

Research on health effects caused by hazardous substances is ongoing on different species around the Baltic. However, the data is mostly scarce and limited to some regions, which at this stage seems not to allow for developing target levels in the different regions. Most information with long-time series available concern predatory birds, such as the white-tailed eagle as well as seals. Therefore, the following indicator topics (details to be determined) are proposed to be considered for healthy wildlife. Target levels for the different sub-regions have to be defined separately:

- Predatory bird health
- Seal health.

Radioactivity at pre-Chernobyl levels

Proposed ecological objective

The levels of anthropogenic radionuclides are higher in the Baltic Sea than in other water bodies around the world. Compared to the North East Atlantic and the North Sea the concentrations of caesium-137 in the Baltic Sea are 40 and 10 times higher, respectively. This is due to atmospheric nuclear testing in the 1960s and the Chernobyl accident in 1986. Also discharges of radionuclides into the Irish Sea from Sellafield are traceable in the Baltic Sea. Liquid discharges from nuclear power plants in the Baltic Sea are estimated to be low.

HELCOM has since 1984 collected monitoring data on radioactivity in the Baltic Sea. These data cover both radioactivities in the Baltic marine environment and in discharges from nuclear installations (nuclear power plants and nuclear research facilities) within the catchment area of the Contracting Parties to HELCOM.

Overall the levels of radioactivity in the Baltic Sea water and biota have shown declining trends since the Chernobyl accident in 1986, which caused significant fallout over the area. Radioactivity is now slowly transported from the Baltic Sea to the North Sea via Kattegat (cf. ***Figure 7***). The amount of caesium-137 in Baltic Sea sediments, however, has remained largely unchanged, with highest concentrations in the Bothnian Sea and the Gulf of Finland.

Proposed indicators and targets

HELCOM will in the future continue to monitor and follow closely both radioactivity concentrations in the marine environment as well as the level of radioactivity in the discharges from Baltic nuclear installations. This includes both elaborations of annual indicator reports on the trends and levels of artificial radionuclides as well as more thematic assessment reports. The results from the monitoring are also used to assess potential health risk to humans due to radioactive exposure.

The following indicator topics (details to be determined) are proposed to be considered for radioactivity. Target levels for the different sub-regions have to be defined separately to be set at pre-Chernobyl levels:

- Concentrations in seawater
- Concentrations in biota
- Concentrations in sediments.

Together with the information that HELCOM holds and regular updates on sources, emissions and inputs of radioactive material as well as their impacts in the marine ecosystem, the ecological objectives and the associated indicators will provide the basis for HELCOM's sound management decisions.

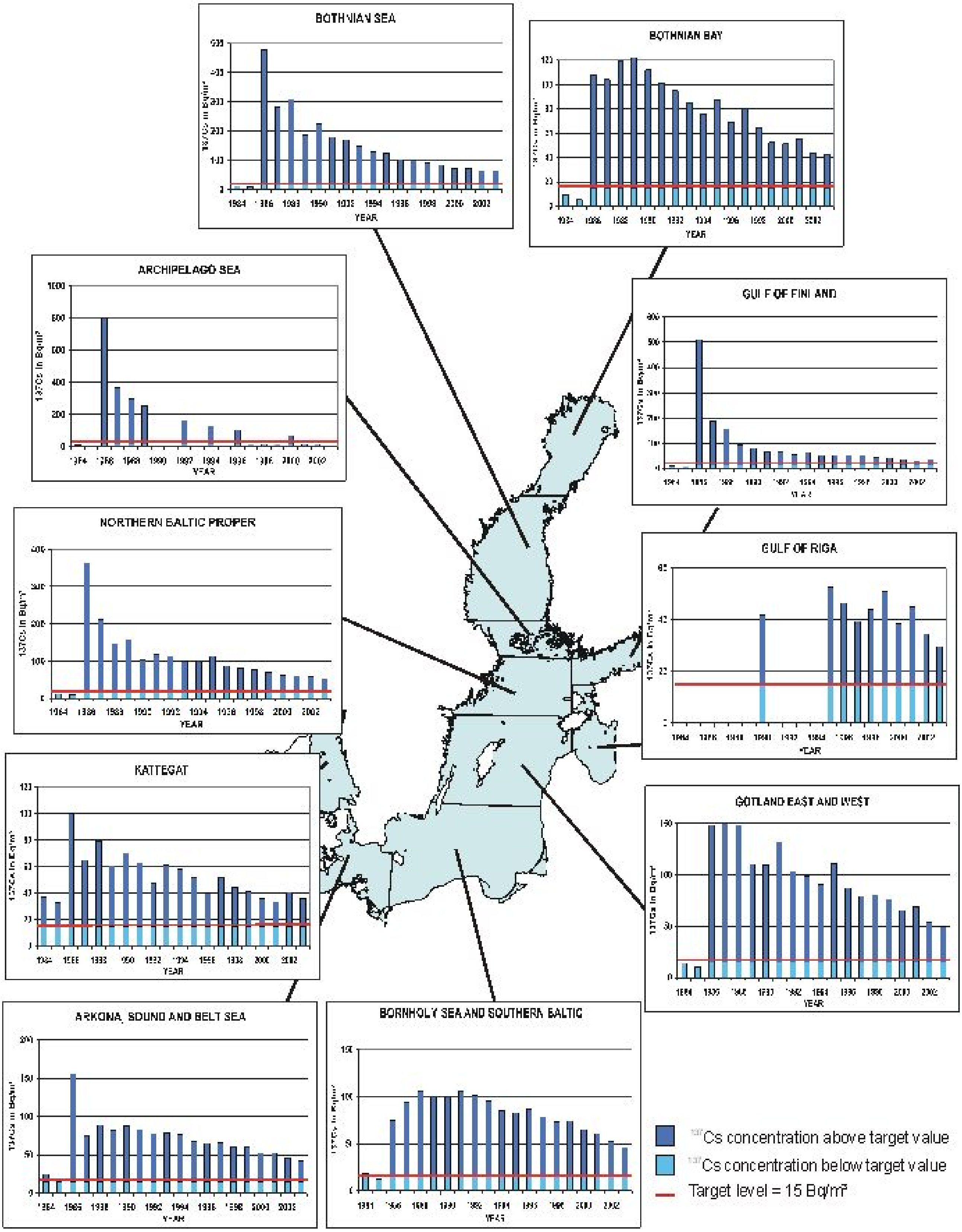

***Figure 7**. Cesium-137 concentrations (in Bq/kg wet weight) in surface water (sampling depth = < 10 m)in 1984-2003, as annual mean values by basin. Target value has been calculated as average of pre-Chernobyl (1984-1985) concentrations. (NOTE: variable scales in the graphs)*

3. INPUTS AND SOURCES

Concerning hazardous substances HELCOM monitoring programmes provide regular information on the water- and airborne inputs and sources to the Baltic Sea and their trends of mainly heavy metals and some organic pollutants. Compared to nutrients data on sources and inputs of hazardous substances is scarce.

The loads of some hazardous substances to the Baltic Sea have been reduced considerably over the past 20 to 30 years. In particular, discharges of heavy metals have decreased although no clear general trends have been observed for some heavy metal concentrations in marine biota since 1990.

The main pathways of hazardous substances to the marine environment are industrial wastewater, municipal wastewater - discharged directly or transported in rivers - and atmospheric deposition. Contaminants also originate from shipping. Special problems include the anti-fouling agents used in paints, and illegal as well as oil releases.

For mercury, lead and cadmium waterborne inputs to the Baltic Sea via rivers, or as direct discharges, are the main contributor. The remaining share is mainly from atmospheric deposition of these heavy metals.

3.1 Airborne input

HELCOM monitoring programmes provide information mainly on heavy metals and is presented in this chapter. In 2003 total annual emissions by the HELCOM countries amounted to 116 tonnes of cadmium, 61 tonnes of mercury, and 3 271 tonnes of lead.

Depositions of cadmium and lead show a decrease from south to north, due to the distance from the main emission sources. The total annual atmospheric depositions of heavy metals into the Baltic Sea are over 7 tonnes of cadmium, 4.2 tonnes of mercury, and ca. 134 tonnes of lead. The highest levels of heavy metal deposition are experienced in the Belt Sea sub-basin. In addition 0.5 tonnes of lindane was deposited on the Baltic Sea.

Anthropogenic emission sources, such as industries, energy production and waste incineration, of heavy metals in the HELCOM countries accounted for about 30-50% of the total atmospheric deposition into the Baltic Sea in 2003. Natural and distant sources from outside the Baltic Sea catchment area also contributed significantly. HELCOM assessments also show that the contribution from HELCOM Contracting Parties of the deposition to the Baltic Sea has decreased since 1995, especially with regard to cadmium and lead.

The most significant contributions to total annual cadmium depositions over the Baltic Sea and its catchment area in 2003 belong to Poland, Germany, and Russia. At the same time considerable input is originated from emission sources of the United Kingdom, France, Slovakia, Romania, Czech Republic, and Belarus.

Anthropogenic sources of cadmium emissions of HELCOM countries contribute to the deposition over the Baltic Sea about 49% with main contributions from Poland (30%) and Germany (8%) (***Figure 8***). Sources of other HELCOM countries contribute about 11%. Contribution of European countries outside the Baltic Sea region amounts to 10%. Contribution to cadmium depositions over the Baltic Sea from re-emission, natural and remote sources is accounted for 41%.

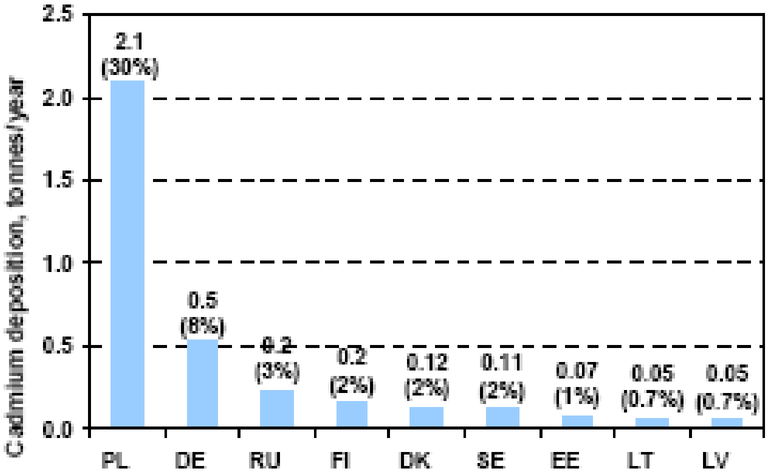

Figure 8. *Contributions of HELCOM countries emissions from anthropogenic sources to total cadmium depositions to the Baltic Sea (EMEP 2005).*

The most significant contributions to total annual lead depositions over the Baltic Sea and its catchment area in 2003 belong to Germany, Poland, and Russia. At the same time considerable input is originated from emission sources of the United Kingdom, France, the Ukraine, Czech Republic, and Belgium.

Anthropogenic sources of HELCOM countries contribute 46% to lead depositions over the Baltic Sea among which main contributions belong to Poland (17%), Germany (14%), and Russia (5%) (***Figure 9***). The sources of other HELCOM countries contribute about 10% and contribution of European countries outside the Baltic Sea region amounts to 16%. The contribution of re-emission and natural sources accounts for 37%.

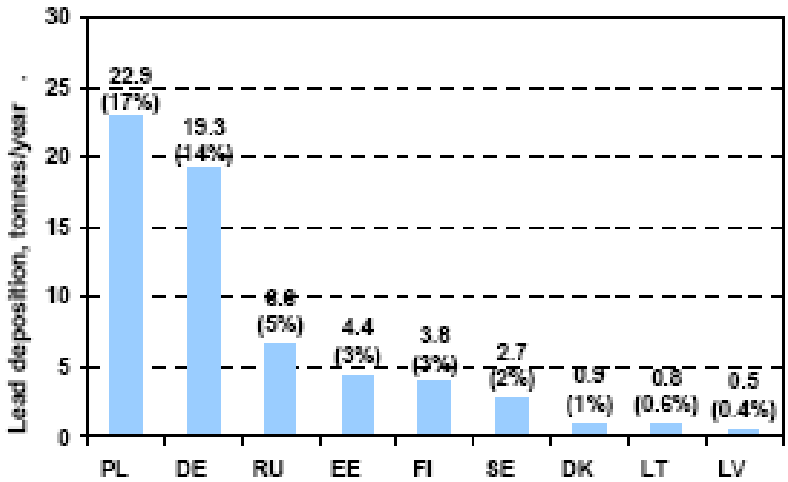

Figure 9. *Contributions of HELCOM countries emissions from anthropogenic sources to total lead depositions to the Baltic Sea (EMEP 2005).*

The most significant contributions to total annual mercury depositions over the Baltic Sea and its catchment area in 2003 belong to Germany, Poland, and Denmark. Considerable input is originated also from emission sources of the United Kingdom, France, the Ukraine, and Czech Republic.

Anthropogenic sources of mercury emissions of HELCOM countries contribute to the deposition over the Baltic Sea about 30% with main contributions from Germany (12%) and Poland (7%) (***Figure 10***). Other HELCOM countries contribute about 10%. Contribution of European countries outside the Baltic Sea region amounts to 5%. Major part of mercury depositions is due to re-emission, natural and remote sources (68%).

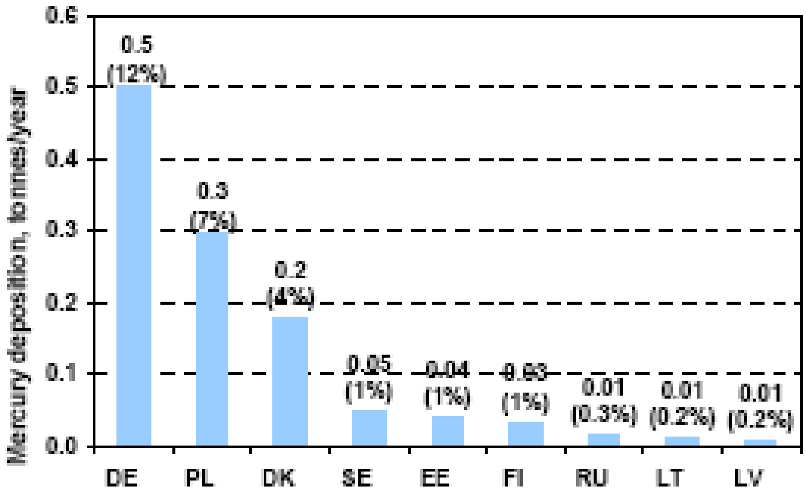

Figure 10. *Contributions of HELCOM countries emissions from anthropogenic sources to total mercury depositions to the Baltic Sea (EMEP 2005).*

3.2 Waterborne input

The reported riverine loads including direct discharges from coastal areas to the Baltic Sea amounted to 7.3 tonnes of mercury, 285.8 tonnes of lead and 8.1 tonnes of cadmium. The riverine inputs of heavy metals are for cadmium, lead and copper highest in the Gulf of Finland, while mercury inputs are highest in the Baltic Proper. A few large rivers account for very large proportions of the total riverine heavy metal loads.

Heavy metals and other hazardous substances end up in the waters from different sources such as industrial activities, urban waste waters, agriculture and waste management.

3.3 Transboundary pollution

Transboundary pollution loads from Belarus, the Czech Republic and Ukraine are significant also for heavy metals. The proportions of the total pollution loads entering the Baltic Sea that originate from these upstream countries are in the range of 5% to 15% for selected heavy metals such as mercury, cadmium and lead. The significance of this transboundary pollution is naturally higher in certain sub-catchments than in the Baltic Sea overall.

3.4 Long-term trends in emissions and inputs of hazardous substances

Emissions of heavy metals from the HELCOM countries decreased during the period 1990–2002 by 46% for cadmium, 62% for mercury, and 61% for lead (cf. ***Figure 11***).

The reduction in heavy metal emission to the atmosphere is a consequence of increased use of lead-free fuels, use of cleaner production technologies as well as of economic decline and industrial restructuring in Poland, Estonia, Latvia, Lithuania, and Russia in early 1990s.

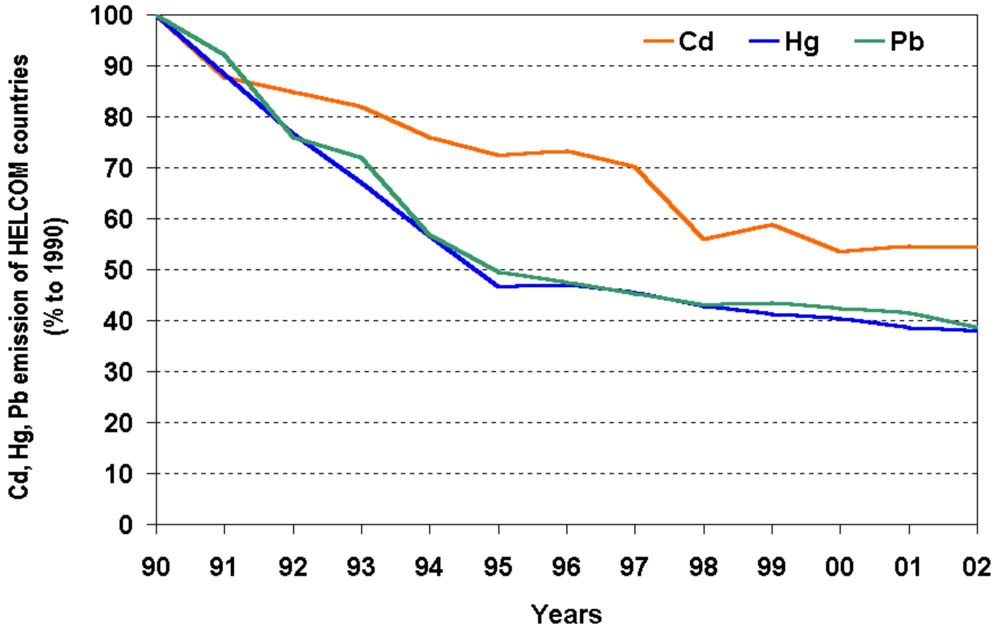

Figure 11. *Total annual emissions of cadmium (Cd), mercury (Hg), and lead (Pb) to air from HELCOM countries in the period 1990-2002 (% of 1990).*

Annual deposition rates of these heavy metals have halved since 1990 in the Baltic Sea as a whole. Deposition rates for mercury have not decreased since the mid-1990s, however. During the 1990s the use of lindane in HELCOM countries was practically ceased, and atmospheric depositions of lindane in the Baltic Sea region have decreased significantly. Due to the variability of meteorological conditions the decrease in emissions does not always lead to corresponding reduction in deposition rates on the Baltic Sea.

Since the mid-1990s riverine heavy metal loads (notably cadmium and lead) have decreased in several countries. According to HELCOM evaluation it can also be assumed that the 50 % reduction target has been largely achieved for 46 hazardous substances prioritised by HELCOM.

4. FURTHER ACTIONS

With the EU enlargement and development of new EU measures, there is a reduced need for corresponding HELCOM measures. There remain, nevertheless, continuing needs for identifying the specific problems of the Baltic marine environment and reviewing whether measures by the various organisations (Global organisations, EU, HELCOM or national) adequately cover the general obligations of the Helsinki Convention and the HELCOM Objective with regard to the cessation target for hazardous substances by 2020 in the whole catchment area. Particular care should be taken that the interests of all HELCOM Contracting Parties are taken into account. This might generate the need for HELCOM to adopt own measures.

The basic steps for taking action in HELCOM are:

- Identification of threats;
- Identification of fields of action and the need for measures;
- Screening the coverage of existing international and national provisions; and
- Deciding whether to develop measures at international, regional or national level.

The HELCOM assessments show that significant a share of both the air- and waterborne inputs to the Baltic Sea originate in non-Contracting Parties. This also means that it is of utmost importance that the results of HELCOM assessments are taken into account in other fora.

The information available on inputs and sources for hazardous substances is much more scarce compared to nutrients and does not allow for a comprehensive assessment of the situation in the Baltic at present.

In order for HELCOM to be able to influence the development and to co-ordinate its measures with the European Marine Strategy and other international activities affecting the Baltic Sea, HELCOM has started an activity where all available information on certain hazardous substances shall be jointly evaluated. The aim is to assess the impacts on the Baltic Sea environment serving also the development of the HELCOM Baltic Sea Action Plan.

The activity will focus on a limited number of hazardous substances that have already been prioritized by HELCOM and other international fora for which initial information is available for the start of the activity. The activity includes also some hazardous substances such as brominated flame retardants and perfluorochemicals (PFOS), which have not been thoroughly assessed in HELCOM.

The activity will contribute to the capability of HELCOM to make better assessments concerning hazardous substances, linking sources with the effects contributing also to the implementation of the HELCOM Baltic Sea Action Plan. The results would also serve the needs for decisions for taking measures and/or complementing the HELCOM COMBINE monitoring programme on hazardous substances as well as the work to define indicators and target levels.

Further work to define indicators and target levels for the ecological objectives with regard to hazardous substances has to be carried out.

HELSINKI COMMISSION
Baltic Marine Environment Protection Commission

Katajanokanlaituri 6 B
FI-00160 Helsinki
Finland
www.helcom.fi