

Baltic Sea Hazardous Substances Management: Results and Challenges

The introduction into the Baltic Sea of hazardous substances that are persistent, bioaccumulate, and are toxic is an important environmental and human health problem. Multilateral efforts to address this problem have primarily been taken under the Helsinki Commission (HELCOM). This article examines past HELCOM efforts on hazardous substances, and discusses future challenges regarding their management. The article finds that past actions on hazardous substances have had a positive effect on improving Baltic environmental quality and reducing human health risks, although there are remaining issues and difficulties that need to be addressed. In particular, four related future challenges for HELCOM management of hazardous substances are identified and discussed: *i*) the need to engender further implementation and building public and private sector capacities; *ii*) the need to improve data availability, quality and comparability across the region and international fora; *iii*) the need to strengthen existing regulations and incorporate new issues; and *iv*) the need to effectively coordinate HELCOM activities with efforts on hazardous substances in other international fora.

INTRODUCTION

Hazardous substances, i.e. substances that are generally persistent in the environment, bioaccumulate in living organisms, and are toxic to wildlife and humans, have been identified as a significant environmental problem since the 1960s. Much of the early international efforts on hazardous substances took place around European regional seas and river basins. Regional cooperation designed to protect the Baltic Sea from pollution has been ongoing for over 30 years. These cooperative efforts have been at the forefront of international management of hazardous substances. Hazardous substances abatement continues to be a priority for Baltic Sea environmental cooperation, where specific hydrographic, chemical and physical conditions of the Baltic Sea make it highly sensitive to hazardous substances (1–6).

This article examines Baltic achievements on hazardous substances to date, and discusses continuing challenges for regional hazardous substance pollution control around the Baltic Sea. Multilateral Baltic Sea action on hazardous substances mainly takes place under the auspices of the 1974 and 1992 Helsinki Conventions and the Baltic Marine Environmental Protection Commission—Helsinki Commission (HELCOM). HELCOM sponsored technical, scientific and policy efforts on hazardous substances have resulted in a series of regional environmental assessments and policies over the past three decades. HELCOM's long history of attention to hazardous substances makes it possible to assess results. Moreover, HELCOM concluded a four year project on hazardous substances in December 2002, and Baltic Sea hazardous substances management efforts are currently at an important crossroads.

This article begins with a brief description of environmental

cooperation under HELCOM. It presents HELCOM actions on hazardous substances and assesses the results. This assessment is based on an extensive review of data from published scientific literature, reports from HELCOM and other intergovernmental organizations such as the European Environment Agency (EEA), the United Nations Economic Commission for Europe (UNECE) and the Organisation for Economic Co-operation and Development (OECD), and personal interviews with HELCOM officials and participants. Based on this assessment, the article discusses four challenges for Baltic Sea management of hazardous substances and presents concluding remarks on achievements and challenges for Baltic Sea hazardous substances management.

BALTIC ENVIRONMENTAL COOPERATION AND HELCOM

The first Helsinki Convention, signed in 1974, was negotiated among the seven Baltic Sea littoral states (at that time) as a response to growing scientific and public concern about the state of the Baltic Sea environment (7, 8). The 1974 Convention entered into force in May 1980 and was the first regional multilateral agreement limiting marine pollution from both land-based and sea-based sources, whether airborne or waterborne. The 1992 Helsinki Convention expanded the scope of multilateral cooperation and strengthened joint requirements based on developments in international environmental law (9–12). The 1992 Convention entered into force in January 2000 after ratification by all nine current Baltic Sea littoral states and the European Community.

Both Helsinki Conventions designate HELCOM as the decision-making body. HELCOM decisions are taken by consensus under the principle of one party, one vote. If all HELCOM European Union (EU) member states agree on a policy, the European Commission cannot vote against it. HELCOM meets at least annually, occasionally at the ministerial level. As Baltic cooperative efforts grew over time, HELCOM developed into an important regional center of scientific and policy making activities (13). These activities are coordinated by a small HELCOM staff. HELCOM work is carried out in Subsidiary Bodies focusing on different areas of cooperation. Under the Subsidiary Bodies, smaller *ad hoc* Working Groups and Project Teams can be established. HELCOM sub-groups often include intergovernmental organizations, environmental organizations and industry organizations in addition to the contracting parties.

HELCOM ministerial conferences generally result in Ministerial Declarations, setting interim and long-term goals for joint actions. In addition, the main HELCOM policy instrument is the issuance of "Recommendations" that articulate common technical, scientific and policy standards and procedures. Recommendations are developed in the HELCOM Subsidiary Bodies and Working Groups, which then forward them to meetings of the full Helsinki Commission for unanimous adoption. HELCOM Recommendations are not legally binding, but member states are expected to fully incorporate them into domestic law, regulation and procedures.

As of June 2002, approximately 200 HELCOM Recommendations had been issued, of which 116 are valid (14). Of these, over 20 address hazardous substances issues. Recommendations tend toward greater stringency and precision over time, and many Recommendations have superseded or supplemented earlier, less stringent, or less specific, ones. HELCOM-organized scientific and technical assessments contribute greatly to the growth in knowledge about the Baltic environment and state policies and practices (15). HELCOM has also become increasingly active in monitoring implementation and building state capacities for policy making and implementation.

Table 1. Hazardous Substances targeted for 50% reduction under the 1988 Ministerial Declaration.

I. Heavy metals	III. Biocides
1. Mercury	26. Trifluralin
2. Cadmium	27. Endosulfan
3. Copper	28. Simazine
4. Zinc	29. Atrazine
5. Lead	30. Fenthion
6. Arsenic	31. Fenitrothion
7. Chromium	32. Azinphos-ethyl
8. Nickel	33. Azinphos-methyl
II. Organic substances other than biocides	34. Triphenyltin-compounds
9. Carbontetrachloride	35. Tributyltin-compounds
10. Chloroform	36. Malathion
11. Trichloroethylene	37. Parathion
12. Tetrachloroethylene	38. Parathion-methyl
13. Trichlorobenzene	39. Dichlorvos
14. Dichloroethane 1,2-	40. Copper-compounds
15. Trichloroethane 1,1,1-	41. Zinc-compounds
16. Xylenes	42. Arsenic-compounds
17. Hexachlorobenzene	43. Carbontetrachloride
18. Hexachlorobutadiene	44. Chlorpicrin
19. Nonylphenolethoxylate	45. 1,2-Dichloroethane
20. Dioxins	46. Hexachlorobenzene
21. Pentachlorophenol	47. Lindane
22. PAH	
23. Tributyltin-compounds	
24. Triphenyltin-compounds	
25. Halogenated organic substances (AOX)	

HELCOM COOPERATION ON HAZARDOUS SUBSTANCES

In the 1974 Helsinki Convention, member states committed to “counteract” the airborne and waterborne introduction of DDT (dichlorodiphenyl trichloroethane) and its derivatives DDE and DDD, PCBs (polychlorinated biphenyls) and PCTs (polychlorinated terphenyls) into the Baltic Sea. States also set out to “strictly limit” emissions of a larger number of hazardous substances, including mercury, cadmium, arsenic, lead, chromium, copper, nickel, zinc, polycyclic aromatic hydrocarbons (PAHs) and “persistent pesticides.” Recommendations from 1982, 1983, and 1985 targeted the gradual phase-out of DDT, PCBs and PCTs. Recommendations from 1985 and 1988 aimed to reduce emissions and discharges of mercury, cadmium, and lead.

By the mid-1980s, it was clear that hazardous substance pollution remained high in the Baltic Sea. Thus, HELCOM’s 1988 Ministerial Declaration on the Protection of the Marine Environment of the Baltic Sea Area declared states’ intention to reduce total discharges of the hazardous substances that were most harmful to Baltic ecosystems on the order of 50% by 1995. In 1991, HELCOM members targeted 46 hazardous substances for the 50% reduction goal. Lindane was added in 1993 as the

47th priority substance (Table 1). Annex 1 of the 1992 Helsinki Convention lists priority groups of hazardous substances and 29 banned or restricted hazardous substances. These 29 substances largely overlap with the substances targeted under the 1988 Ministerial Declaration.

Implementation of the 50% reduction goal proved difficult, however. Reported data on the substances varied greatly because of differences in the amount of data gathered across countries and in sampling and analytical methods used. Moreover, states were unable to set 1987 baseline emissions for many selected substances from which to measure emission reductions. Assessments in the mid-1990s demonstrated that Baltic environmental concentrations of many hazardous substances continued to be high. In response, HELCOM parties adopted the Kalmar Communique of the Council of the Baltic Sea States in 1996. The Kalmar Communique set the objective of continuous reduction of 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 synthetic substances (16).

A 1998 report on the implementation of the 1988 50% reduction goal concluded that these reductions had not been achieved for many of the 47 substances, despite efforts by all member states (17). As a result, HELCOM decided to continue with its efforts towards the 50% reductions. In 1998, HELCOM specified more detailed emission reduction targets to be implemented by 2005. Also in 1998, HELCOM members issued their most important Recommendation to date regarding hazardous substances; Recommendation 19/5 recalls the 1996 Kalmar Communique and stipulates the continuous reduction in discharges, emissions and losses of hazardous substances into the environment toward the target of the cessation of these by 2020. It also commits to the long-term goal of the Kalmar Communique regarding environmental concentrations.

In order to implement Recommendation 19/5, a small Project Team on Hazardous Substances was created. The Project Team consisted of representatives from all HELCOM parties and from industry organizations and environmental groups, and operated with the help of HELCOM staff. The Project Team was tasked with providing an overview of why HELCOM failed to implement the 1988 50% reduction goal and to design and launch a strategy for effective implementation of Recommendation 19/5. The Project Team set out to identify the sources, pathways, and fate of hazardous substances; survey domestic and international legislation and market situations; and help develop policy instruments for the cessation of emissions, losses, and discharges by substitution and/or minimized use. The Project Team prepared guidance documents on selected substances (mercury, cadmium, nonylphenol and nonylphenolethoxylates, short-chain chlorinated paraffins, dioxins, and PCBs) and the substitution of the use of hazardous substances (1).

Recommendation 19/5 lists some 280 hazardous substances as potential substances of concern. Many of these substances are persistent, bioaccumulate, and are toxic, but HELCOM may deem a substance to be hazardous even if it does not fully meet all these criteria, if there are other grounds for concern (e.g. suggestions of endocrine disruptive functions or damage to immune systems). Of the 280 substances of potential concern, Recommendation 19/5 targeted 43 for cessation based on previous HELCOM actions and activities in other international fora such as the Oslo-Paris Commission (OSPAR) for the protection of the Northeast Atlantic. Some targeted substances may be used in closed systems, while others, such as PCBs, should be phased-out entirely. HELCOM’s commitment to achieving the 50% emissions reduction for the 47 substances remained and

that earlier list partly overlapped with the newer list of 43 substances targeted for cessation.

The Project Team cut the priority list of 43 substances to 35 substances, because member states lacked enough domestic data on eight substances (1). Dioxins were added to the list in 2001, leading to 36 priority substances (Table 2). To proceed toward implementation on the 36 substances, the Project Team designed a pilot program to assess the effectiveness of implementation efforts for of the 50% reduction goal. The Project Team requested that member states report national figures on changes in discharges, emissions and losses in the Baltic Sea catchment area for the late 1980s and the late 1990s. Member states were also asked to describe planned measures and activities pursuant to implementation.

In March 2001, the Project Team reported that available data did not allow a definitive quantitatively-based judgment regarding whether the 50% reduction goal had been reached. However, based on qualitative information from states on the domestic legal status of substances, it was deemed likely that the 50% target had been "largely reached," although some substances were judged to be in need of further attention (18, 19). This conclusion was based on information from member states, indicating that the selected substances were no longer in use or subject to strict domestic restrictions. The Project Team concluded its work in October 2002.

ASSESSING BALTIC SEA RESULTS

This section assesses available data on Baltic Sea environmental conditions regarding hazardous substances. It examines national implementation efforts of international policies and it identifies important factors explaining outcomes for environmental conditions and implementation.

Environmental Conditions

The Baltic Sea is one of the most thoroughly researched bodies of water in the world (3). Baltic generation and exchange of technical and scientific assessment information on hazardous substances is commonplace, expanding greatly after the political and economic changes in the 1990s in the eastern Baltic transi-

tion states. The extensive HELCOM "State of the Baltic Environment" reports and the periodic "Pollution Compilation Load" reports, together with an array of domestic and non-HELCOM regional research projects, have significantly increased knowledge about Baltic environmental conditions (2, 20–22).

Available data show that concentrations of hazardous substances such as DDT, PCBs, mercury, and cadmium have declined in Baltic marine mammals over the past two decades (2, 3, 17, 23–25). These and other hazardous substances have been responsible for regional impacts on wildlife, ranging from interference with sexual characteristics to dramatic population losses (2, 26–28). Falling concentrations of hazardous substances have been linked to health improvements in regional wildlife. For example, populations of grey seals, ringed seals, harbor porpoises and some bird species appear to be recovering slowly, especially on the northern side of the Baltic Sea. In part, these environmental improvements result from HELCOM member state compliance with a series of overlapping HELCOM policy measures (18, 19).

Despite declining environmental concentrations of most monitored organic hazardous substances over the last 20–25 years, problems remain. Baltic marine mammals continue to exhibit reproductive disorders, indicating that levels of hazardous substances such as PCBs and dioxins continue to cause ecological harm (2, 29). Dioxin and PCB levels were no longer decreasing during the 1990s and the main sources of these pollutants remain unknown. Concentrations of dioxins in Baltic fish in part exceed EU limits on dioxins in food and feed (1). Although concentrations of DDT have fallen considerably since the 1970s, they remain higher than those observed in many other seas. Organotin compounds (used in anti-fouling agents) are suspected of being behind damage to the reproductive organs of invertebrates, observed in the Kattegat and the Belt Sea (2, 29).

Heavy metal concentrations in the Baltic Sea are generally stable or declining slowly, although they remain problematic around significant past and present point sources. However, cadmium concentrations in fish in the Central Baltic and Bothnian Bay areas have increased recently (2). The causes of these increases remain uncertain, but may be due in part to changes in pH and/or oxygen concentrations, which can lead to releases of cadmium from sediments. In addition, recent HELCOM assessments express concern about the possibility of as yet unknown hazardous substances. This concern stems from studies showing that fish are producing 2–3 times more detoxifying enzymes than previously, despite declining concentrations of many known contaminants. This may indicate the presence of unknown hazardous substances (2).

National Implementation: Three Categories of States

In 2001, HELCOM participants judged the 50% reduction goal formulated in the 1988 Ministerial Declaration to be achieved for 27 pesticides, at least 3 heavy metals (cadmium, lead, and mercury) and PCBs (1, 18, 19, 30). Also, 26 of the pesticides on the list targeted for 50% reductions were no longer (legally) in use in any of the countries in the Baltic region, though some uncertainties about this conclusion were expressed regarding the Russian Federation. Thus, HELCOM members are taking important steps towards the cessation goal for a number of hazardous substances (1).

HELCOM sponsored reviews of domestic implementation on hazardous substances are extensive in comparison to such efforts in most international environmental cooperation arrangements. These reviews have become increasingly comprehensive and detailed regarding the implementation status of individual states, particularly since the inception of the Project Team on

Table 2. Hazardous substances selected for action under HELCOM Recommendation 19/5.

1. Dioxins	19. Dieldrin
2. PCBs	20. Endrin
3. Cadmium	21. DDT
4. Lead	22. HCH
5. Mercury	23. Heptachlor
6. Selenium	24. Hexachlorobenzene
7. Organotin Compounds	25. Isobenzane
8. 1,2-Dibromoethane	26. Isodrin
9. 2,4,5-T	27. Kelevan
10. Acrylonitrile	28. Fluoroacetic acid and derivatives
11. Aldrin	29. Mirex
12. Aramite	30. Morfamquat
13. beta-HCH	31. Nitrophen
14. Chlordane	32. Pentachlorophenol
15. Chlordecone (Kepone)	33. Quintozene
16. Chlordimeform	33. Toxaphene
17. Nonylphenol, 4-	35. Short chained chlorinated paraffins
18. Nonylphenoethoxylate transformation products	36. Lindane

Hazardous Substances in 1998. The reviews demonstrate that the domestic regulatory policies regarding hazardous substances of HELCOM member states generally vary in stringency and timing in accordance with their relationship to the EU. HELCOM member states include four EU members, four EU accession countries, and one country that is neither an EU member nor an accession candidate.

HELCOM's four EU members (Denmark, Finland, Germany, and Sweden) tend to lead HELCOM hazardous substances policy development. They often take domestic regulatory action on the hazardous substances before they are targeted by HELCOM (18, 19, 31). In many cases, their domestic laws and regulations regarding hazardous substances remain more stringent than current HELCOM standards. These countries have generally high implementation levels of HELCOM hazardous substances Recommendations (1). This implementation stems, in part, from these states' influence on many HELCOM standards; they model them after pieces of their national legislation and regulatory practice. Because these states often took earlier and relatively stringent actions *vis-à-vis* hazardous substances, they usually possess higher quality data demonstrating implementation (1, 18, 19, 31).

Those HELCOM member states invited to join the EU at the Copenhagen Summit in December 2002 (Estonia, Latvia, Lithuania, and Poland) have embarked on large expansions of their environmental law and regulation over the past decade (32–40). HELCOM implementation reviews demonstrate that these states often take domestic action on hazardous substances after particular policy areas become subject to HELCOM cooperation and regulation (18, 19, 31). Some of these domestic measures are the result of HELCOM activities. Others are products of domestic desires to gain EU membership, which requires harmonization of domestic regulations with EU law, often helping to fulfil HELCOM obligations (41–44). HELCOM officials and contracting parties have explicitly tried to harmonize HELCOM Recommendations with EU legislation.

A few factors relating to implementation in the four transition countries should be noted, however. First, domestic reductions in emissions of hazardous substances over the past decade result in part from economic contraction and industrial restructuring, rather than active pollution abatement measures (17). As such, future economic growth might reverse some of the emissions reduction trends, if stringent environmental policy is not effectively implemented and enforced. This raises a second area of concern, that important areas of domestic public sector capacity relating to environmental issues remain low (38, 45, 46). EU and HELCOM sponsored programs have improved national level administrative and legal capacities in the accession countries (22, 46). However, enforcement capabilities and local-level public sector capacities continue to be weak, potentially impeding effective implementation on hazardous substances.

The HELCOM member state that is neither an EU member nor an accession state is the Russian Federation. The ineffective Soviet measures regarding hazardous substances are well known, and Russian officials working on hazardous substances management face daunting challenges. In comparison to national reports on implementation from the other HELCOM parties, Russian reports tend to be quite vague and have numerous data gaps on substance use, sale, stocks, and emissions (18, 19, 31). Nevertheless, available evidence suggests generally poor Russian implementation of HELCOM commitments, with low levels of domestic public sector capacity often impeding implementation. Further, Russian implementation of HELCOM obligations and Recommendations is more dependent on international assistance than any other Baltic Sea littoral states. At the same time, the Russian Federation has received substantially less interna-

tional assistance – environmental and otherwise – on a per capita basis than the four HELCOM EU accession countries (47).

Explaining Results

HELCOM has stimulated improvements in state-level implementation even as provisions regarding hazardous substances have been substantially strengthened over the past decade. This achievement may in part be explained by HELCOM's comparatively impressive work in assessing both progress toward state implementation of joint commitments and regional environmental and human health conditions associated with hazardous substances. Research on implementation effectiveness suggests that the use of systems for implementation review within cooperation arrangements tends to increase parties' implementation rates (48). They do so by improving the availability of relevant information, identifying parties that lag in implementation, and helping target policy-making and supporting efforts for areas where action is most needed.

HELCOM implementation reviews are used to develop regional and domestic programs for enhancing implementation. Such efforts have been at least partially successful. For example, the Baltic Sea Joint Comprehensive Environmental Action Programme and the HELCOM Programme Implementation Task Force attempt to reduce emissions from particular hotspots. In most industrial and wastewater-treatment plant hotspots, substantial hazardous substance emissions reductions must be achieved to de-list a hotspot. By focusing on many of the region's largest pollution sources, these efforts have contributed to reductions in the levels of hazardous substances in the region (49). In addition, assessment of the failure to implement the 50% reduction goal allowed the Project Team on Hazardous Substances to learn from previous shortcomings and more effectively approach the implementation of Recommendation 19/5.

Furthermore, HELCOM's scientific and technical assessments are explicitly framed in terms of policy relevance. This means that HELCOM assessments can often be effectively used for policy making purposes, alongside implementation reviews. However, effective implementation is ultimately dependent on state action. The HELCOM lead countries Denmark, Germany, Finland, and Sweden have continued with domestic environmental investments, and also often use HELCOM as a mechanism for raising environmental requirements and standards in the eastern part of the Baltic Sea region. To that end, the western lead states have invested significant resources aimed at supporting implementation in the Baltic transition countries and in helping to co-finance large environmental investments in the Baltic region, many with high relevance for hazardous substances abatement.

It is, however, not only the wealthier western states that have invested resources in environmental protection and hazardous substances abatement over the last decade. The growing use of pollution and resource taxes and fees in Estonia, Latvia, Lithuania, and Poland has produced significant public revenues for domestic environmental investments, resulting in reduced dependence on international funding in these countries (50). International funding tends to be important in underwriting domestic legal and regulatory development programs in Estonia, Latvia, Lithuania and Poland. These countries have taken advantage of opportunities offered by EU enlargement by coordinating HELCOM capacity building and co-financing programs with those of the EU. In general, Russian generation of domestic funds for environmental protection has been much smaller than in the other HELCOM member countries.

Finally, the Baltic Sea region is home to a dense web of transnational environmental networks of public and private stake-

holders. These networks connect a wide range of governmental, nongovernmental and private sector actors, and facilitate regional exchange of information and policy collaboration, including on hazardous substances (22). Regional environmental advocacy groups around the Baltic Sea moreover often raise public awareness and push domestic officials to increase environmental protection on hazardous substances and other issues. However, the ability of domestic and international advocacy groups to push for higher domestic environmental standards remains quite constrained in Russia.

FOUR CHALLENGES

HELCOM actions on hazardous substances improved regional environmental quality. Difficulties remain, however. This section discusses four interrelated challenges for Baltic hazardous substances management: *i*) engendering implementation and building public and private sector capacities; *ii*) improving data availability, quality and comparability; *iii*) strengthening existing regulations and incorporating new issues; and *iv*) effectively coordinating international management of hazardous substances.

Engendering Implementation and Building Public and Private Sector Capacities

Wide differences in domestic public sector capacity persist among the nine Baltic countries. Not surprisingly, where public sector capacities are high, implementation measures tend to be more effective, although incapacity to implement international agreements also exists in wealthier states (51). Lack of sufficient domestic public sector capacity is particularly evident in the five Baltic transition states (41, 45). Despite recent economic improvements, many Baltic transition states still struggle to find sufficient domestic resources to participate in all HELCOM activities and fully implement HELCOM Recommendations.

Attempts to increase the abilities of public and private actors involve strengthening financial, human, technical and organizational capabilities (52). Trying to do so, Estonia, Latvia, Lithuania, and Poland have benefited from assistance from Denmark, Finland, Germany, and Sweden, which are among the largest donors of bilateral assistance in the world. Though a number of multilateral banks and EU assistance programs are active in the region in support of environmental projects and assistance, bilateral aid is (by far) the largest source of foreign environmental assistance in the region (22, 47). Capacity building efforts in Estonia, Latvia, Lithuania, and Poland have expanded national administrative and regulatory capacities. However, continued focus on capacity building at the local level for monitoring and enforcing regulations and standards is likely to benefit implementation on hazardous substances as these capacities continue to be weak (1).

Continued capacity building in the Russian Federation presents a major challenge for Baltic hazardous substances management. In August 2001, Russia embarked on the EU LIFE Third Countries project "Development and Strengthening of the Regional Co-ordination of Council's Activity on the Implementation of HELCOM Decisions in the Russian Baltic Sea Region." The project is supported by HELCOM, and aims to build political and administrative capacity within the North-West Okrug in order to implement the 1992 Helsinki Convention and HELCOM Recommendations through strengthening domestic environmental legislation and developing implementation programs (53). To that end, the project seeks to set up a HELCOM Implementation State Office under the Regional Department of the Ministry of Natural Resources, and to develop a forum for communication with local stakeholders and the public to aid implementation.

Nevertheless, Russian implementation capacity is likely to lag behind the leading Baltic countries for some time (1).

Improving Data Availability, Quality, and Comparability

Cooperation under HELCOM has expanded regional environmental assessment capacities and stimulated dissemination of technical and scientific knowledge on hazardous substances (15). Increasingly, HELCOM collects both societal data (production, sale, use, and emissions sources) and environmental data (concentrations, trends, and impacts) (1). HELCOM assessment work has been instrumental in prioritizing issues and formulating joint policies. Nevertheless, data gaps remain, and continued regional policy making and implementation around the Baltic Sea on hazardous substances are likely to benefit from efforts to improve data availability, quality and comparability both regarding societal and environmental data.

In general, more and better regional and domestic data are needed on how and where hazardous substances are produced, used, traded and released, and in what quantities. Also, improved data on disposal and/or storage of existing stockpiles and major sources of hazardous by-products would be beneficial. Such data would be complemented by increased data on multimedia transport and environmental and human concentration levels and effects. In addition, improving data comparability through agreeing on joint research and assessment methodologies and reporting formats would facilitate cross-country comparisons and the compilation of more reliable regional assessments.

Many issues relating to data availability, quality and comparability are complex and resource intensive. They are also of relevance for other international fora involved in hazardous substances management (54). Recognizing this, HELCOM participates in the EU-funded "Programme for a Baltic Network to Assess and Upgrade an Operational Observation and Forecasting System," which seeks to link and harmonize separate assessment activities. These and other efforts that try to improve data issues on hazardous substances across regional and global fora should be encouraged.

Strengthening Existing Regulations and Incorporating New Issues

Despite existing policies and their accompanying emissions reductions, recent environmental assessments make clear that Baltic hazardous substances problems will not be solved in the short term. Continuing abatement efforts will be required. In general, future abatement measures will likely be more effective if they more fully incorporate controls of the entire life-cycle of production, use, trade, and disposal of intentionally used substances, as well as better target emission sources of unintentionally produced by-products of industrial and combustion processes.

Assessments indicate that some targeted substances have not witnessed adequate emissions reduction. Societal data show that emissions continue and environmental data show continually high environmental concentrations. Many stockpiles of phased-out pesticides remain problematic in the Baltic region. Thousands of tonnes of obsolete, banned, pesticides exist in the post-communist states and the former East Germany (19, 55). Their safe storage and disposal pose logistical and financial challenges for the region's policymakers. Also needed are improved emission controls for unintentionally produced by-products such as dioxins, furans, and PAHs.

HELCOM assessments and other studies suggest that HELCOM participants face the challenge of expanding the current lists of regulated substances. The substance "scoping" exercise undertaken in connection with Recommendation 19/5 identified

some 280 substances that may pose ecological and/or human concern in the Baltic Sea region. Cutting the list to 36 priority substances for practical reasons did not eliminate the risks posed by the other 246. Finally, an increasing number of chemicals are produced and used worldwide, and it is currently impossible to know which, if any, of these will be subject to future concern for Baltic Sea hazardous substances abatement.

Effectively Coordinating International Management of Hazardous Substances

International efforts to manage hazardous substance pollution have increased greatly over the last decade. Different hazardous substances have been prioritized in different international fora, showing that there is no generally agreed upon consensus about which hazardous substances should be controlled. Table 3 illustrates the significant variance in the hazardous substances subject to regulation across four major international fora; EU, HELCOM, OSPAR and the Convention on Long-Range Transboundary Air Pollution (CLRTAP). Table 4 shows the overlapping national membership of these organizations. The variances in substances covered by the international fora and their overlapping membership create a highly complex regulatory situation. As international efforts on hazardous substance abatement expand, the need for greater coordination between different fora grows if costly and/or counterproductive actions are to be avoided (56, 57).

Currently, overlaps between HELCOM and the EU are most apparent. In accordance with EU law, HELCOM EU members can agree on HELCOM Recommendations that include higher standards than EU legislation provided they do not interfere with the common market. This means that HELCOM can adopt Recommendations on, for example, stricter emission limits and other measures as long as they are not considered market obstacles. In practice, HELCOM Recommendations sometimes exceed EU legislation. For example, HELCOM has approved policies that articulate more detailed and specific limit values and requirements for application of pollution control measures (58).

HELCOM Recommendations and EU Directives are also linked regarding state implementation. EU Directives are legally binding on member states, while HELCOM Recommendations are not. This means that states that are members to both fora generally have incentives to implement EU Directives first, and then address any further requirements in HELCOM Recommendations. Evidence suggests that EU Directives take precedence in practice (1).

Table 3. Substances regulated in HELCOM, OSPAR, EU and CLRTAP as of October 2002 (1).

Substance	HELCOM				Substance	OSPAR			
	E	O	E	C		E	O	E	C
	L	S	U	L		L	S	U	L
	P	R				P	R		
	C	A	T			C	A	T	
	O	R	A			O	R	A	
	M	P				M	P		
DDT	✓	✓	✓		Naphthalene, trichloro-	✓	✓		
Chlordane	✓	✓	✓		Naphthalene, hexachloro-	✓	✓		
Lindane	✓	✓	✓		Naphthalene, tetrachloro-	✓	✓		
Dieldrin	✓	✓	✓		Trifluralin	✓	✓		
Choloroform	✓	✓			Pentachloroanisole	✓			
Benzene		✓			Nitrophen	✓			
Endrin	✓	✓	✓		Atrazine		✓		
Methoxychlor		✓			EPN		✓		
Dichloromethane		✓			Tetrasul		✓		
Heptachlor	✓	✓	✓		Naphthalene, octachloro-	✓	✓		
1,3,5-trichlorobenzene		✓	✓		Mercury & organic mercury	✓	✓	✓	✓
TBBA		✓	✓		Lead & organic lead	✓	✓	✓	✓
Quintozone	✓				Nickel		✓		
Benzene, pentabromoethyl		✓			Cadmium	✓	✓	✓	✓
1,2,3-trichlorobenzene		✓	✓		Selenium	✓			
Hexachlorobutadiene			✓		Mirex	✓			✓
Pentachlorophenol	✓	✓	✓		Chlorpyrifos			✓	
Naphthalene			✓		Kelevan	✓			
2,4,5-T	✓	✓			Morfamquat	✓			
4-tert-butyltoluene		✓			Chlordimeform	✓			
4-Nonylphenol	✓				Toxaphene	✓			✓
1,2-Dibromoethane	✓	✓			Alachlor				✓
1,2-Dichloroethane			✓		Heptachloronorborene		✓		
Acrylonitrile	✓				Naphthalene, heptachloro-		✓	✓	
HMDS		✓			Isoproturon				✓
1,3-cyclopentadiene,		✓	✓		Urea, N,N'-bis[(5-isocyanato-1,3,3-tr		✓		
1,2,3,4,5,5-hexachloro-					imethylcyclohexyl)methyl]-				
Endosulphan		✓	✓		Hexabromobiphenyl	✓			✓
Dicofol		✓			Neodecanoic acid, ethenyl ester	✓			
Hexachlorobenzene	✓	✓	✓		Naphthalene, pentachloro-	✓			
Anthracene			✓		Flucythrinate	✓			
1,2,4-trichlorobenzene		✓	✓		Short chained chlorinated paraffins	✓	✓	✓	
Simazine		✓			PCT	✓			
Aramite	✓				Clotrimazole				✓
Octylphenol		✓	✓		1,5,9-Cyclododecatriene	✓			
Chlordecone	✓		✓		Cyclododecane	✓			
Fluoroacetic acid & derivatives	✓				Benzene, 1,3,5-tribromo-2-(2,3-dibromo-2-methylpropoxy)-	✓			
Fluoranthene			✓		Naphthalene, chloro derivatives	✓			
Isobenzene	✓				Diosgenin	✓			
Aldrin	✓	✓	✓		Brominated flame retardants	✓	✓		
4-(dimethylbutylamino) diphenylamin 6PPD		✓			Phthalates: dibutylphthalate & diethylhexylphthalate	✓	✓	✓	
Diuron			✓		Musk xylene	✓	✓		
Isodrin	✓	✓			Nonylphenol/ethoxylates (NP/NPEs)	✓	✓	✓	
Chlorfenvinphos			✓		Organic tin compounds	✓	✓	✓	
Phosphine, triphenyl-			✓		Polyaromatic hydrocarbons	✓	✓	✓	
HCH	✓	✓	✓	✓	Polychlorinated biphenyls	✓	✓	✓	✓
Pentachlorobenzene				✓	Polychlorinated dibenzodioxins	✓	✓		✓
2,4,6-tri-tert-butylphenol				✓	Polychlorinated dibenzofurans	✓	✓		✓
Beta-HCH	✓								

HELCOM: Strategy with regard to hazardous substances, Recommendation 19/5, 1998

OSPAR: Strategy with regard to hazardous substances, 1998

EU: Water Framework Directive 2000/60 Prioritised substances, 2001; Directive 76/464

Discharge of dangerous substances into aquatic environment of the Community; and Council Regulation 793/93 on the evaluation and control of the risks of existing substances. Substances included from Directive 76/464 and Council Regulation 793/93 are only substances in common in one or several of HELCOM, OSPAR, Water Framework Directive 2000/60 and CLRTAP.

CLRTAP: POPs and Heavy Metals Protocols, 1998.

Table 4. Membership in the EU, HELCOM, OSPAR and CLRTAP. Only those CLRTAP members that are members of at least one of the other three fora are listed.

Parties	E U	H E L C O M	O S P A R	C L R T A P
Austria	✓			✓
Belgium	✓		✓	✓
Denmark	✓	✓	✓	✓
Finland	✓	✓	✓	✓
France	✓		✓	✓
Germany	✓	✓	✓	✓
Greece	✓			✓
Ireland	✓		✓	✓
Italy	✓			✓
Luxembourg	✓		✓	✓
Netherlands	✓		✓	✓
Portugal	✓		✓	✓
Spain	✓		✓	✓
Sweden	✓	✓	✓	✓
United Kingdom	✓		✓	✓
European Community	✓	✓	✓	✓
Estonia	2004	✓		✓
Iceland			✓	✓
Lithuania	2004	✓		✓
Latvia	2004			✓
Norway			✓	✓
Poland	2004	✓		✓
Russian Federation		✓		✓

These linkages between HELCOM and EU policy making and implementation, and efforts to harmonize activities between the two fora, influence actions by HELCOM EU members and accession countries in HELCOM and the EU. For example, at the 2002 HELCOM meeting, HELCOM parties changed a number of HELCOM Recommendations to bring them into line with EU legislation, without lowering any HELCOM standards. HELCOM has also sought to harmonize HELCOM Recommendations with controls under OSPAR, based on recommendations in a 2001 HELCOM-sponsored report (59). Other possible revisions remain under review and HELCOM and OSPAR seek to improve coordination by holding joint Ministerial level conferences.

The relationship between HELCOM and the EU is likely to become more complex. Because the EU has a stronger legal standing than HELCOM, once Estonia, Latvia, Lithuania and Poland become EU members in 2004, HELCOM's relevance may depend more on whether HELCOM Recommendations continue to go further than EU Directives or cover technical, scientific and policy aspects of Baltic cooperation that fall outside the scope of the EU. HELCOM may also concentrate on designing regulations that take into account specific Baltic regional circumstances and support Russian efforts to raise domestic environmental standards and practices.

Improved coordination between separate international fora might also be used to harmonize state reporting requirements in order to optimize the use of state resources. Since the late 1990s, the European Environment Agency, the European Commission, HELCOM and OSPAR have also shown greater interest in standardizing reporting requirements, monitoring systems, data gathering, and calibration procedures, with the hope of simul-

taneously improving data quality and availability, and reducing the administrative burden on state officials (2, 5, 17, 18, 21, 59–61).

CONCLUDING REMARKS

Compared to most regional seas, environmental protection efforts around the Baltic Sea have produced significant political and environmental progress. Since the 1970s, HELCOM activities have worked to increase knowledge and improve the management of hazardous substances through technical, scientific and policy cooperation. Hazardous substance assessment and policy making efforts have intensified during the past decade, resulting in higher regional environmental standards and improved environmental conditions. Several characteristics of this cooperation help to generate results, including an increasing use of implementation review, close links between assessments and policy making, and a willingness of wealthier member states to work with Baltic transition states to enhance public and private sector capacity towards securing effective implementation on hazardous substances. Other international environmental protection arrangements would do well to learn from HELCOM's experiences.

Declining levels of many monitored hazardous substances have resulted in improved environmental and human health conditions, although important challenges remain. If necessary progress regarding hazardous substances management is to continue, four interrelated challenges will require sustained attention from regional policy makers, scientific and technical experts and other stakeholders: *i)* engendering further implementation and building public and private sector capacities; *ii)* improving data availability, quality and comparability across the region and international fora; *iii)* strengthening existing regulations and incorporate new issues into regional policy making; *iv)* and effectively coordinating HELCOM hazardous substance management efforts with those of other international fora (62).

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