The role of environmental science and politics in identifying persistent organic pollutants for international regulatory actions

Henrik Selin and Olof Hjelm

Abstract: The aim of the present study is to describe and analyze the character of the interplay between environmental science and policy-making in the process of identifying persistent organic pollutants (POPs) for initial inclusion in the POPs Protocol under the Convention on Long-Range Transboundary Air Pollution (CLRTAP). The objective of the CLRTAP POPs Protocol is to control, reduce, or eliminate discharges, emissions, and losses of organic compounds that are toxic, persistent, bioaccumulative, and prone to long-range atmospheric transport and deposition within the CLRTAP region, which covers North America and Europe, including the European region of the former Soviet Union. The empirical materials used were documents underlying decisions and personal observations at seven CLRTAP POPs meetings. In order to describe and analyze the role of environmental science and politics in identifying an initial list of regulated substances, we have chronologically recapitulated the CLRTAP POPs process leading up to the adoption of the POPs Protocol. Our work was guided by two research questions: What was the strength of the interplay and were there any key events of interplay? Our analysis revealed a strong interplay between environmental science and policy-making throughout the process, mutually (but not always equally) affecting each other. We have identified four events of interplay that were of significance for the final outcome: the initial problem identification, the selection of CLRTAP as a forum for cooperative actions, the screening of possible protocol POPs, and finally, the concluding protocol negotiations.

Key words: Convention on Long-Range Transboundary Air Pollution, negotiations, persistent organic pollutants, risk assessment.

Résumé : Dans cette étude, les auteurs décrivent et analysent les caractéristiques des interrelations entre la science de l'environnement et le développement des politiques, par rapport à l'identification des polluants organiques persistents (POPs), pour leur première inclusion dans le protocole POPs, dans le cadre de la convention sur les pollutions transfrontalières à longues distances (CLRTAP). L'objectif du protocole CLRTAP POPs est de contrôler, réduire ou éliminer les décharges, les émissions et les pertes de composés organiques toxiques, persistents, bioaccumulés et sujets à être transportés dans l'atmosphère et déposés sur de longues distances dans la région CLRTAP, laquelle couvre l'Amérique du Nord et l'Europe, incluant les régions européennes de l'ancienne Union Soviétique. Les matériaux empiriques utilisés sont des documents sous-jacents aux décisions, et des observations personnelles provenant de sept conférences sur les CLRTAP POPs. Afin de décrire et d'analyser le rôle de la science de l'environnement et des politiques dans l'identification d'une première liste de substances soumises aux réglements, les auteurs récapitulent le processus CLRTAP POPs conduisant au Protocole POPs. Leur démarche a été orientée par deux questions de recherche : quelle a été la vigeur des interrelations et y a t'il eu des évènements clés durant l'interaction? L'analyse révèle une forte interaction entre la science environnementale et le développement politique tout au long du processus, affectant mutuellement (pas nécessairement de façon égale) les deux disciplines. Les auteurs ont identifié quatre évènements de l'interaction ayant eu des effets significatifs sur l'issue finale : l'identification initiale du problème, la sélection du CLRTAP comme forum pour des actions coopératives, le tamisage des POPs du protocole, et finalement, les négociations pour la conclusion du protocole.

Mots clés : convention sur la pollution transfrontalière à longues distances, négociations, polluants organiques persistents, évaluation des risques.

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Introduction

Modern pollution problems are often transnational in character and have as such increasingly become matters of international cooperation. A current example of this trend is related to the recent growing international concern with persistent organic pollutants (POPs), i.e., organic substances that possess toxic characteristics, are persistent, bioaccumulate, are prone to long-range transboundary atmospheric transport and deposition, and as a result are likely to cause significant adverse human health or environmental effects near to and distant from their sources.[2] In addition to the frequently severe environmental and human health consequences of POPs, their connection to politically important sectors such as agriculture, industry, and trade make POPs set to play a central role in the international environmental agenda in the foreseeable future. While more regional forums such as the Helsinki Commission (HELCOM), the Oslo-Paris Commission for the Protection of the Marine Environment of the North-East Atlantic (OSPARCOM), and the North-American Free Trade Agreement (NAFTA) Sound Chemical Management Agreement are active on chemical management, the first major international political forum to take comprehensive actions on POPs as a distinct class of pollutants was the Convention on Long-Range Transboundary Air Pollution (CLRTAP). A first milestone in the CLRTAP POPs work was reached in June 1998 with the adoption of the CLRTAP POPs Protocol. As of 1 February 1999, 35 states and the European Community have signed the Protocol.[3] The objective of the Protocol is to control, reduce, or eliminate discharges, emissions, and losses of POPs.[4] Work on POPs under CLRTAP is now being followed by activities within the Organization for Economic Co-operation and Development (OECD) and the United Nations Environment Programme (UNEP) (Renner 1998).

In cooperation on the protection of the Antarctic environment, Mediterranean pollution problems, and climate change, interplay between environmental science and policy-making was a key feature (Elzinga 1993, Haas 1990, Jasanoff and Wynne 1998). Combined, these studies strongly imply that science and politics in general interact closely in modern transnational environmental cooperation. Previous studies on POPs have focused mainly on their chemical and biological characteristics and implications for the environment and human health. Despite the need for international actions on POPs and the importance of science in such processes there are, to our knowledge, no analyses available of the role of environmental science and politics in international regulatory processes on POPs.

Unlike other major air pollutants that are subject to international collaboration (e.g., sulfur, nitrogen, and heavy metals) POPs cannot be easily narrowed down to a few substances. Therefore, one crucial aspect of the current international pops work is to set up evaluation criteria for POPS and to identify substances that meet the stipulated criteria. Hitherto, the most comprehensive international efforts on establishing criteria and assessing potential POPS have been conducted within CLRTAP. The aim of the present study was to describe and analyze the character of the interplay between environmental science and policy-making in the process of identifying POPS for initial inclusion in the CLRTAP POPS Protocol.

Materials and methods

The study is based on analysis of documents underlying CLRTAP decisions and on personal observations at CLRTAP POPS meetings. The documents can be divided into three categories: first, scientific papers investigating the chemical and biological characteristics of substances; second, CLRTAP working group reports; and finally, papers in which Parties argue in favor of the inclusion or exclusion of substances. Personal observations were conducted at seven CLRTAP meetings; (1) Third meeting of the Ad Hoc Preparatory Working Group, May 1996; (2) The Working Group on Strategies, August 1996; (3) Fourth meeting of the Ad Hoc Preparatory Working Group, October 1996; (4) First Negotiating session, January 1997; (5) Second Negotiating session, June 1997; (6) Third Negotiating session, October 1997; and (7) Final Negotiating session, February 1998. They represent all CLRTAP POPS sessions from May 1996 to the final negotiating meeting in February 1998, with the exception of a two-day Head of Delegations meeting in December 1997.

In the study, we have investigated the character of the interplay between environmental science and policy-making in the CLRTAP identification process, rather than the individual interests and strategies of individual Parties. This is, of course, a great simplification, but the advantage of this level of analysis is that it makes it possible to give a brief yet informative account, pointing to important explanatory factors. The creation of international negotiated agreements can, for analytical purposes, be divided into three separate yet closely connected sequences; the preparatory work, negotiations, and implementation. While it can be argued that such a division is artificial because it suggests a nonexisting, strictly causal chain of events, its benefit lies in that it provides a useful conceptualization of a complex process into manageable segments. In this study, focus is on the first two sequences. In order to describe and analyze the interplay between environmental science and policy-making in the work of identifying an initial list of regulated substances, we have chronologically recapitulated the preparatory work and negotiations leading up to the adoption of the POPS Protocol. Our work was guided by two research questions: What was the strength of the interplay and were there any key events of interplay?

The Convention on Long-Range Transboundary Air Pollution

The Convention on Long-Range Transboundary Air Pollution, operating under the auspices of the United Nations Economic Commission for Europe (UNECE) geographically covers North America and Europe, including the European region of the former Soviet Union (Chossudovsky 1989, Larsson 1996). CLRTAP is designed as a framework convention, that is, it does not in itself stipulate any detailed environmental regulations but merely establishes a framework for technical, scientific, and political cooperation within which pollution specific protocols can be created (Levy 1995, Wettestad 1996). To date, separate protocols on sulfur,

[2] Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Persistent Organic Pollutants, Article 1 (7).
[3] The following countries have signed the Protocol: Armenia, Austria, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Republic of Moldavia, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom, and the United States.
[4] Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Persistent Organic Pollutants, Article 2.

nitrogen, volatile organic compounds, heavy metals, and POPS have been negotiated under CLRTAP.

The CLRTAP process of identifying an initial list of regulated POPS

Preparatory work

The first scientific warnings of the negative effects of certain synthesized organic chemicals came in the early 1960s, in connection with local environmental effects (Carson 1962, Mellanby 1992). This resulted in national regulatory measures on specific organic compounds in several countries in the CLRTAP region in the late 1960s and early 1970s, primarily on use and, to a somewhat lesser extent, on production. The introduction of regulations led to a widespread belief that the problem with organic substances was under control, supported by studies in the late 1970s and early 1980s showing a decline in environmental concentration levels and signs of recovery in previously affected wildlife. However, by the mid-1980s scientists found high levels of PCBs at high trophic levels in remote areas in the northern environment, including in the local human population (Dewailly et al. 1989, Kinloch and Kuhnlein 1988). At the same time, other scientific studies reported high environmental depositions of additional organohalogens, such as DDT, toxaphene, and chlordane in the same region (Muir et al. 1988, Pearce 1997). As none of the substances were used in the areas of detection, the new information suggested that depositions largely originated from distant sources.[5] The likely transboundary transport of emissions would make it impossible to counteract the problem at the national level, but coordinated international actions were necessary.

The first actions on POPs in CLRTAP were taken in August 1989. To assess the nature and extent of the POPs problem within the CLRTAP region a special CLRTAP Task Force on POPs was created in 1990. Based on the new concern focus was on emission sources, long-range transport patterns, distributions between media, and possible abatement options.[6] In June 1994, the Task Force presented its final report, concluding that CLRTAP actions on POPs were warranted, which led to continued work on POPs with a focus on a future possible protocol.[7] Within CLRTAP, the fundamental regulatory approach towards POPs is to control compounds on a substance-to-substance basis. In order to identify substances that could qualify for initial inclusion in the CLRTAP POPs protocol in a consistent and transparent manner, it was agreed to design a methodology based on common criteria according to which all substances should be assessed, rather than selecting substances on an ad hoc basis. For that purpose, several alternatives were compared, including a methodology developed by the CLRTAP Task Force on POPs, the Canadian Toxic Substances Management Policy Criteria, and the Fraunhofer Institute Methodology for Pesticides.[8] In the summer of 1995 it was decided to use an evaluation method known as the Modified Task Force Methodology.

The task of selecting candidate POPs was not so much a question of finding new, previously unknown hazardous organic chemicals as it was, for specific CLRTAP POPs purposes, to evaluate substances already known or seriously suspected to be hazardous. The evaluation process did not involve any new laboratory testing or field studies, but was directed at compiling and evaluating available information.[9] Risk information on substances was collected from other international forums (e.g., OSPARCOM, the European Union (EU), the World Health Organisation (WHO), the United Nations International Programme on Chemical Safety (IPCS), and OECD) and information was supplied by member states. Before the CLRTAP POPs work began, available information regarding different substances and their characteristics was scattered. Much of the screening work was therefore directed towards collecting information on the causal chains of events linking compounds from emission sources via transport patterns to environmental and human health effects. Then, available material was often based on different analytical methods, which made comparative analysis difficult. As an important side effect, the CLRTAP POPs work has enhanced the establishment of more joint international standards and methods for chemical assessment work within the CLRTAP region.

The Modified Task Force Methodology (presented in Fig. 1) consisted of three stages. A step-by-step analysis of the criteria applied follows here.

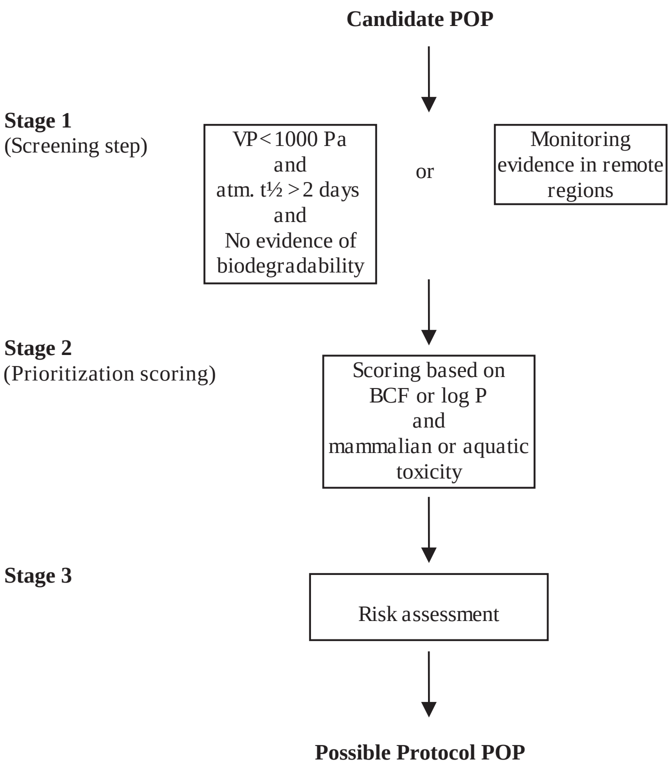
In accordance with CLRTAP's focus on transboundary air pollution, substances in Stage 1 were evaluated for their propensities for long-range atmospheric transport. Initially, 107 candidate POPs were screened. Three different criteria were used: persistence, vapor pressure, and monitoring evidence. Persistence was assessed on the basis of atmospheric half-life and biodegradation in water and soil. To pass, a substance had to have an atmospheric half-life longer than 2 days or a biodegradability of less than 30% in 28 days under environmental conditions. The cut-off value for vapor pressure was set to 1000 Pa, where only substances with a lower vapor pressure passed. This cut-off value was set to exclude substances of high volatility (e.g., CFCs) as such compounds were not of interest in the POPs work.

The applied persistence and vapor pressure criteria are possible to determine accurately; however, it is possible that a compound that does not meet the set criteria is nevertheless subject to long-range atmospheric transport. This possibility was partly taken into consideration by using monitoring evidence in remote regions as a reason for including a compound. Of the 107 substances that were evaluated, 20 substances were screened out at the first stage.

At Stage 2, substances were assessed for their harmfulness by examining their bioaccumulation potential and their toxicity. Of the 87 substances remaining after the first stage,

[5] Draft Discussion Paper on the Effects of Airborne Organochlorine Compounds. Presented by Canada at the CLRTAP Working Group on Effects Meeting, August 27–29, 1990, Geneva.
[6] UNECE/EB.AIR/24. Report of the Eighth Session of the Executive Body, 11 December 1990.
[7] UNECE/EB.AIR/WG.6/R.20/Add.1. Draft Executive Summary of the State of Knowledge Report of the Task Force on Persistent Organic Pollutants led by Canada and Sweden, 25 April 1994.
[8] AEA/CS/RCEC 16419225, Issue 3. Selection Criteria for Prioritising Persistent Organic Pollutants, July 1995.
[9] AEA/CS/RCEC 16419225, Issue 3. Selection Criteria for Prioritising Persistent Organic Pollutants, July 1995.

Fig. 1. A schematic presentation of the Modified Task Force Methodology. VP = Vapor pressure, atm. t½ = atmospheric half-life, BCF = Bio-Concentration Factor, P = octanol/water partition coefficient.



17 could not be assessed because relevant data were lacking; therefore, only 70 substances were assessed in Stage 2. Bioaccumulation potential was determined by looking at bioconcentration factors (BCF) for fish or, where such data were not available, by looking at the octanol–water partition coefficient *P*. In determining toxicity, mammalian toxicity and aquatic toxicity were considered in parallel. Mammalian toxicity scoring was largely based on the EU labeling classification criteria for carcinogenicity, mutagenicity, teratogenicity, and repeated exposure effects.[10] Aquatic toxicity scoring was based on the lowest "no observed effects concentration" (NOEC) data, where available, and, by default, on the lowest LC50 data (the concentration that kills 50% of a tested population). Bioaccumulation and toxicity potential were determined by applying a numerical scoring system. Bioaccumulation scores were given on a scale of 0.5 to 6, and toxicity scores were given on a scale of 0.5 to 6 for mammalian toxicity and 0.5 to 4 for aquatic toxicity. The total scores were obtained by multiplying the score of the bioaccumulation potential by the highest score of mammalian or aquatic toxicity effects. The bioaccumulation and toxicity scores were given arbitrarily in order to identify substances of interest to CLRTAP; that is, particularly high scores were given for the types of properties of particular concern to CLRTAP and lower scores were given for those that were not. The scoring was done mainly on the basis of past experience with priority schemes gained in the EU under the Existing Substances Regulation.[11] After they were scored and ranked, compounds with less than 50% of the maximum score (36) were eliminated. This arbitrary cut-off point at 50% was set to make it possible to move forward with a manageable list without losing any of the more hazardous substances. After Stage 2, 32 priority substances remained.

In Stage 3, a risk assessment of the remaining 32 substances was performed. Factors considered were production/use/emissions, volatilization/vapor pressure, chemical/biodegradation, bioaccumulation, aquatic/eco-toxicity, mammalian toxicity, measured environmental levels, direct evidence of long-range atmospheric transport, partitioning in environmental compartments, and risk from degradation products. The risk assessment was conducted to assess the overall case for including a substance in the Protocol, and the scientific criteria were reviewed in combination with a broader socioeconomic risk analysis. Based on the full risk assessment, 14 substances were identified. These substances are listed in Table 1.

Negotiations

Protocol negotiations commenced in January 1997 and were concluded in February 1998 after five meetings. The CLRTAP regulatory system for POPs is designed as a two-track approach. Track 1 involved agreeing on an initial list of substances to be regulated in the new protocol and designing regulatory methods for each of the compounds. Track 2 was to set up a mechanism for future evaluation and possible inclusion of additional compounds into the Protocol, thereby aiming to strengthen the long-term regulatory effectiveness of the Protocol. In accordance with Track 1, during the protocol negotiations, the Parties, operating under a consensus rule, decided which compounds should be initially regulated and the types of management options that were to be used. As a format for controls, annexes were created. Annexes I and II contain the pesticides and industrial chemicals. Annex I lists substances scheduled for elimination and covers their production and use. Annex II contains substances scheduled for restrictions on use and identifies permitted exemptions. The unintentional by-products are regulated in Annexes III to VII through emission limit values and best available technologies. In the end, 16 substances were included in the initial list. These are listed in Table 2.

The Modified Task Force Methodology served as the principal means for identifying possible protocol POPs. Of the 14 substances that came out of the Modified Task Force Methodology, there was, early on, consensus regarding the inclusion of all substances, with the exception of pentachlorophenol (PCP). On some of the other 13 substances there were tough negotiations on exemptions, but with a

[10]EU Directive 91/325/EEC. Commission Directive of 1 March 1991 Adapting to Technical Progress for the Twelfth Time Council Directive 67/548/EEC on the Approximation of the Laws, Regulations and Administrative Provisions Relating to the Classification, Packaging and Labeling of Dangerous Substances, March 1991.

[11]EU Regulation 793/93. Council Regulation of 23 March 1993 on the Evaluation and Control of the Risks of Existing Substances, March 1993.

Table 1. List of the 14 substances identified by the Modified Task Force Methodology. The compounds are grouped according to the categories of pesticides, industrial chemicals, and unintentional by-products.

Pesticides	Industrial chemicals	Unintentional by-products
Hexachlorobenzene	PCB	PAHs
Toxaphene	Hexabromobiphenyl	Dioxins
Chlordane	Pentachlorophenol	Furans
Aldrin		
DDT		
Mirex		
Dieldrin		
Endrin		

Table 2. List of the 16 substances initially included in the CLRTAP POPs protocol. The compounds are grouped according to categories and the annexes. Note that DDT and PCB are listed in both Annex I and Annex II, while hexachlorobenzene is covered in both Annex I and Annex III.

Annex	Pesticides	Industrial chemicals	Unintentional by-products
I	Aldrin	Hexabrombiphenyl	
	Chlordane	PCB	
	Chlordecone		
	DDT		
	Dieldrin		
	Endrin		
	Heptachlor		
	Hexachlorobenzene		
	Mirex		
	Toxaphene		
II	DDT	PCB	
	HCH		
III–VII			Dioxins
			Furans
			Hexachlorobenzene
			PAHs

general understanding that they should be covered by the Protocol. With PCP, however, it was its inclusion per se that was questioned. PCP was contested mainly on the basis of whether it met the specific criteria for bioaccumulation, but also on whether it was subject to long-range transport. During the negotiations, new information on bioaccumulation was introduced, showing lower figures than the data used in the first run of the Modified Task Force Methodology.[12] Previously, agreement had been reached on using the numerical criteria for guidance rather than as strict cut-off values, but the question of where to draw the line still remained. The inescapable need for interpretation is equally true for the issue of long-range transport. Long-range transboundary air pollution is defined in the Convention as “air pollution whose physical origin is situated wholly or in part within the area under the national jurisdiction of one State and which has adverse effects in the area under the jurisdiction of another State at such distance that it is not generally possible to distinguish the contribution of individual emission sources or groups of sources.”[13] This is not further specified either in the Convention or in any other CLRTAP documents, where the actual distance for transboundary pollution is, moreover, much shorter in Europe than in North America or the Russian Federation. Most parties agreed that PCP has the potential to travel up to 700 to 900 km, and the controversy was not so much over the actual distance of transport as if whether that distance could be considered to constitute long-range (transboundary) transport. Based on the new data and on the strong reluctance of some Parties to include PCP in the Protocol, PCP was excluded from the initial list at the final negotiating session. However, as a compromise, PCP specifically was identified in the Research, Development,

[12]Chrostowski, P.C. Environmental Fate and Transport of Pentachlorophenol. Presented by the United States at the CLRTAP Working Group on Strategies Meeting, October 20–24, 1997, Geneva; Rodan, B.D. Review of Screening Criteria Data for Persistent Organic Pollutants. Presented by the United States at the CLRTAP Working Group on Strategies Meeting, October 20–24, 1997, Geneva; Woltering, D.M. What Does the Science Show Regarding Pentachlorophenol as a UNECE LRTAP POP? Presented by the United States at the CLRTAP Working Group on Strategies Meeting, October 20–24, 1997, Geneva.

[13]UNECE/EB.AIR/50. Convention on Long-Range Transboundary Air Pollution. In 1979 Convention on Long-Range Transboundary Air Pollution and its Protocols. United Nations Publication: Geneva, 1996.

and Monitoring Article of the Protocol as a substance that warrants special attention.[14]

In the summer of 1996, 6 additional compounds besides the 14 that had come out above the cut-off point of the Modified Task Force Methodology were considered: endosulfan, quintozene, short-chain chlorinated paraffins (SCCP), heptachlor, chlordecone, and lindane. There were diverging opinions on all of these. In an attempt to achieve progress, it was decided, based on the original criteria, to conduct a reassessment of the six substances, taking into account the latest available scientific information. The reassessment concluded that quintozene and endosulfan did not satisfactorily meet the criteria.[15] Quintozene failed on all accounts. There was no evidence of long-range atmospheric transport, and it scored low on persistence and biomagnification. Endosulfan was found to be capable of long-range transport, but failed to meet the bioaccumulation criteria (low BCFs) and displayed no evidence of the chronic toxic effects associated with POPs. As a result, quintozene and endosulfan were eliminated from the process. The other four substances — SCCP, heptachlor, chlordecone, and lindane — still came out as borderline substances and became subject to negotiations.

Short-chain chlorinated paraffins, like PCP, was strongly argued over on the basis of whether it met the basic criteria of a CLRTAP POP.[16] In the case of SCCP, it was the substance's propensity for long-range transport that was questioned where the reassessment showed little evidence of its presence in remote environments. In the end, it was not possible to reach a consensus on its inclusion, and SCCP was left out of the Protocol.

As with PCP, the fates of heptachlor and chlordecone were affected by new scientific data, but in both of these cases it contributed to their inclusion in Annex I. In the case of heptachlor, this was partly a result of other international activities, illustrating that the CLRTAP POPs work was not conducted in a vacuum. Partially in parallel to CLRTAP, UNEP initiated a POPs process with the aim of establishing a global POPs convention. In May 1995, the Governing Council of UNEP identified a list of 12 POPs, the so-called dirty dozen, as warranting global actions.[17] Heptachlor was the only UNEP POP that was not on the CLRTAP list. In the initial assessement, heptachlor had already been screened out in Stage 1 because its half-life in the atmosphere was only 1.5 to 6 h; however, when heptachlor was identified by UNEP, voices were quickly raised within CLRTAP, declaring that it should also be included in the CLRTAP list.[18] This was supported by the reevaluation, which identified new monitoring evidence of depositions in the polar environment.[19]

Chlordecone is a chlorinated cyclopentadiene cage dimer structurally identical to mirex except for the substitution of a chlorinated methylene group by a ketone group. In the first run of the Modified Task Force Methodology, chlordecone did not fully meet the bioaccumulation and toxicity criteria.[20] Despite this, some Parties continued to argue for its inclusion, which led to it being reassessed. As a result of new data, it was concluded that the bioaccumulation and toxicity characteristics of chlordecone were, in fact, such that it could be regarded to satisfactorily meet the stipulated criteria of Stage 2.[21] Moreover, the use of chlordecone had declined steadily since the late 1970s and by the time of the negotiations there were few remaining uses in the region, which facilitated its inclusion.

Lindane is a development of technical HCH, which is an "old" first-generation pesticide that consists of a mix of isomers. Early on, it became known that the beta isomer biomagnified, leading the chemical industry to start synthesizing lindane that consists of at least 99% of the less toxic gamma isomer. As lindane is the most commonly used HCH mix within the CLRTAP region, it was decided in the preparatory work to focus on lindane. In the negotiations, however, lindane turned out to be a stumbling block. Some Parties claimed that there was no evidence supporting bioaccumulation of lindane and that it should consequently not be included. Others argued that even though no direct evidence on bioaccumulation was available, its chemical and biological characteristics were such that, based on the precautionary principle, it still warranted inclusion.[22] In addition, during the negotiations, another aspect of the lindane issue was raised. Addressing lindane only would leave the use of other mixtures of HCH open, which could then rise and result in higher HCH depositions in the CLRTAP region. The two problems were jointly solved by a compromise.[23] A reference to HCH was made in Annex II, but HCH was then divided into two categories: one on technical HCH and one on lindane. In the Protocol, no exemptions on technical HCH are given, while certain uses of lindane are still permitted. It can be noted that the lindane exemptions cover almost all known uses in the region, which in practice means that few new lindane restrictions were introduced.

[14]Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Persistent Organic Pollutants, Article 8 (h).
[15]Review of Risk Characterisation Information on Selected Persistent Organic Pollutants. Presented by United Kingdom at the CLRTAP Ad Hoc Preparatory Working Group Persistent Organic Pollutants Meeting, October 21–23, 1996, Aylmer, Canada.
[16]Short Chain Chlorinated Paraffins. Presented by Sweden at the CLRTAP Ad Hoc Preparatory Working Group on Persistent Organic Pollutants Meeting, October 21–23, 1996, Aylmer, Canada; Short Chain Chlorinated Paraffins — Additional Risk Information Presented by Sweden at the CLRTAP Working Group on Strategies Meeting, January 20–24, 1997, Geneva.
[17]UNEP/GC. Persistent Organic Pollutants. Decision 18/32, 25 May 1995.
[18]AEA/CS/RCEC 16419225, Issue 3. Selection Criteria for Prioritising Persistent Organic Pollutants, July 1995.
[19]Review of Risk Characterisation Information on Selected Persistent Organic Pollutants. Presented by United Kingdom at the CLRTAP Ad Hoc Preparatory Working Group Persistent Organic Pollutants Meeting, October 21–23, 1996, Aylmer, Canada.
[20]Review of Risk Characterisation Information on Selected Persistent Organic Pollutants. Presented by United Kingdom at the CLRTAP Ad Hoc Preparatory Working Group Persistent Organic Pollutants Meeting, October 21–23, 1996, Aylmer, Canada.
[21]Review of Risk Characterisation Information on Selected Persistent Organic Pollutants. Presented by United Kingdom at the CLRTAP Ad Hoc Preparatory Working Group Persistent Organic Pollutants Meeting, October 21–23, 1996, Aylmer, Canada.
[22]Risk Assessment of Lindane. Presented by Sweden at the CLRTAP Working Group on Strategies Meeting, January 20–24, 1997, Geneva.
[23]A Compromise Proposal for Lindane. Presented by the Netherlands at the CLRTAP Working Group on Strategies Meeting, January 20–24, 1997, Geneva.

Discussion

Our study shows a strong interplay between environmental science and policy-making in the CLRTAP POPs work. Scientific work and political considerations were intimately linked and interacted throughout the process, mutually (but not always equally) affecting each other. Analyzing the CLRTAP POPs process in detail, it was possible to identify four key events of interplay that were of significance for the final outcome: the initial problem identification, the selection of CLRTAP as a forum for cooperative actions, the screening of possible protocol POPs, and finally, the concluding protocol negotiations.

Studies of international cooperation tend to focus on the negotiations. As shown in our study, the preparatory work on identifying, framing, and assessing the POPs problem was of high significance for the outcome. Thus, by focusing solely on the negotiations there is an obvious risk that key courses of events are overlooked. The origin of the CLRTAP interest in POPs can be traced back to the detection of toxic persistent organic compounds at high trophic levels in remote areas in the northern environment in the mid-1980s. As a result of the new scientific information the POPs problem was framed initially as being the long-range transport of substances, having actual and potential environmental and human health implications in areas far from any emission sources. Political interest in addressing the transboundary transport of emissions led to POPs becoming subject to transnational cooperation.

In the selection of CLRTAP as a forum in which to initiate scientific and political cooperation on POPs, the purpose and membership of CLRTAP affected the initial problem identification. CLRTAP has, by international standards, a good track record of successful environmental work. This, and the fact that other forums were regarded as either too limited in geographical coverage and (or) too limited in the issues they focused on, are the main reasons CLRTAP was chosen.[24] This choice, however, had a direct bearing on future political and scientific work. CLRTAP, as reflected in its name, is a convention on long-range transboundary air pollution. It is designed to deal with situations in which emissions originating from sources within one Party are transported (if not exclusively, at least predominantly) through the atmosphere, across state boundaries, adversely affecting other Parties. Although POPs are transported via air, water, and ice, interest was now directed solely at atmospheric transport.[25] Moreover, the membership of the Convention is regional. While POPs emissions, in some cases, are transported on a global scale (Wania and Mackay 1996), CLRTAP addresses only pollution problems in which emissions originate and cause damage within its limited geographical area.

The third event, the screening of possible protocol POPs, was central in that it set the basis for which compounds were to be considered in the negotiations. The evaluation process is best understood as science based, conducted within a set political frame shaped by the problem identification and the objective and scope of CLRTAP. The criteria applied in the Modified Task Force Methodology, which was the main screening mechanism, were selected with the intention of identifying persistent substances with high toxicity and bioaccumulation potentials that are subject to long-range transboundary transport within the CLRTAP region. The persistence, bioaccumulation, and toxicity criteria were chosen because they were seen to reflect the environmental and human health potential of substances.

At least two aspects of selecting substances for screening are of importance. First, once an international evaluation process like the CLRTAP POPs work has begun and gained momentum, it can be difficult to go back to Stage 1 and add new substances; therefore, it is important to carefully select the substances to be evaluated at the beginning. The 107 candidate POPs were selected mainly using information from other international forums. Given the nature of the evaluation process, that is, compiling and evaluating available information rather than conducting new scientific testing, the amount and character of existing scientific information on individual substances were crucial. Lack of data was also stated as a reason for not evaluating certain substances. There was simply no knowledge available regarding their possible fulfillment of the criteria, which resulted in their omission.[26] Second, a POP is sometimes a large and complex group of compounds, and it can be difficult to decide which specific compounds within a group should or should not be evaluated. For example, the flame retardant polybrominated biphenyls (PBBs) are the brominated analogues of PCB, and for both these groups of compounds 209 congeners are possible. For PBBs, only the congener hexabromobiphenyl was included in the candidate list, but for PCBs, seven congeners were evaluated. At Stage 2, the assessed PBB and only one of the eight PCB congeners were above the cut-off value. Although seven of the assessed PCB congeners were not over the cut-off value, they were still accepted by the Parties as dangerous. In contrast, the only PBB included was the assessed congener. The definition of PCB in the protocol also caused some last-minute confusion. Early on, there was strong support for the inclusion of PCB in the Protocol, but in the later stages of the negotiations, it became apparent that the Parties had been defining PCB differently all along. Most European countries in their national legislation apply a broad definition of PCB that includes polychlorinated terphenyls (PCTs) and some diphenylmethanes. This broader definition is not used in Canadian and U.S. legislation, where the additional compounds of the broader definition are viewed as separate chemical entities. In the end, the more narrow North American definition was chosen in the Protocol.

During the fourth and final event, through a series of political negotiations, the Parties reached an agreement on an initial list of regulated substances. While political considerations were present during the three first phases, they became more explicit in the negotiations. The difficulties of agreeing on a joint set of regulated substances arose from a

[24]UNECE/EB.AIR/WG.6/R.20/Add.1. Draft Executive Summary of the State of Knowledge Report of the Task Force on Persistent Organic Pollutants led by Canada and Sweden, 25 April 1994.
[25]Arctic Monitoring Assessment Programme. Arctic Pollution Issues: A State of the Arctic Environment Report. Oslo, 1997.
[26]UNECE/EB.AIR/WG.7/R.3. Review of the Methodology for Selection of the Initial List of Persistent Organic Pollutants (POPs) for the Proposed UN/ECE Protocol, 18 June 1996.

high degree of scientific uncertainty, differences in national risk perceptions, and mixed and interdependent interests among Parties, which led to diverging views. It is interesting to note that compounds were both added and removed during the negotiations. A more general part of the explanation for this lies in that the Modified Task Force Methodology was merely a means for identifying substances that could be of interest to the Parties and that the arbitrary cut-off point of 50% always was intended to be flexible. The Parties did not commit themselves during the screening work to accepting the results of the Modified Task Force Methodology. According to Convention stipulations, formal decisions on which substances should be initially included were taken first during political negotiations.

There were two reasons for creating annexes in the protocol. First, because emissions from pesticides, industrial chemicals, and unintentionally produced by-products are the result of very different activities, making it difficult to effectively regulate them in a uniform manner. The second reason was more political in that some Parties did not want to introduce total bans on all substances but to allow certain exemptions. This enhanced possibilities of reaching an agreement. Similarly, consensus on lindane was made possible in that the agreed exemptions cover virtually all known uses, as was agreement on chlordecone facilitated by the decline in its use during the 1990s. The inclusion of lindane in the Protocol is best understood as a political signal to the chemical industry that it is a substance on the way to being phased out. Still, political differences resulted in that PCP and SCCP, the two substances with the highest commercial interest among those that were negotiated, were excluded.

Future challenges for environmental science and politics

The adoption of the CLRTAP POPs Protocol signified a first important scientific and political closure in the CLRTAP POPs work, but efforts need to continue. The next step in the CLRTAP POPs process will be to work for effective implementation of the Protocol as well as make use of Track 2 as a means to assess additional organic chemicals for possible inclusion in the Protocol. The former involves political efforts to push for national ratifications of the agreement and the scientific community working together with industry and policy-makers to ensure that the Protocol stipulations are implemented in a cost-effective manner. The latter requires that the Parties look beyond the recently agreed regulations and continue to evaluate the need for additional controls.

Much of the CLRTAP POPs work hitherto can be characterized as reactive, i.e., control measures are aimed at substances already known to be hazardous. To improve future management activities there is a need to take a more proactive strategy by seeking to identify POPs and their sources before they cause environmental and human health damage. This involves focusing on the whole life cycle of POPs; future disposal of POPs-contaminated wastes and particularly PCB-containing wastes pose major management challenges. Here, the development and use of management options will benefit by an increased understanding of sources, transport, fate and environmental and human health effects of various POPs (Vallack et al. 1998). Finally, the CLRTAP POPs work is but one case of international chemical cooperation. In a broader perspective, a growing number of international regulatory mechanisms on chemicals raise questions and demands on both political and scientific coordination so as to avoid overlapping, or even counterproductive, activities.[27]

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