WINDS OF CHANGE:

THE INTERNATIONAL RESPONSE TO PERSISTENT ORGANIC POLLUTANTS

IN THE CANADIAN ARCTIC

by

Stephanie Powell

B.A. Laurentian University, 1998

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Abstract

The Canadian Arctic has become a repository for some of the world's highly toxic chemicals. The long-range transport of persistent organic pollutants (POPs) has resulted in increasing levels of POPs throughout the Arctic where they are potentially harmful to the health of humans and the environment. The accumulation of POPs has resulted in concerted regional, national and international efforts to reduce and eventually eliminate their production, use and emission. In 1997 the Governing Council of the United Nations Environment Programme (UNEP) initiated an international effort to assess POPs, resulting from a growing concern over the levels of contaminants in the Arctic. Assessments provided the evidence of long-range transport to the Arctic and to other regions where production and use of POPs had never occurred. As a result of international efforts, the Stockholm Convention on Persistent Organic Pollutants was developed and finalized in May 2001.

Utilizing a conceptual framework assembled from various theories of effective international environmental regimes, this thesis will evaluate the effectiveness of the Stockholm Convention and whether or not it will successfully address the problems of POPs in the Canadian Arctic. Taking an interdisciplinary approach, this thesis will demonstrate that the Stockholm Convention comprises the many essential components of a effective environmental regime and will potentially be effective in addressing the problem of POPs in the Arctic.

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List of Abbreviations

AMAP – Arctic Monitoring and Assessment Programme
BAT – Best available techniques
BEP – Best environmental practices
CAS – Chemical Abstract Service registration number
CEE – Central and Eastern European Countries
CITES – Convention on International Trade in Endangered Species
CLRTAP – Convention on Long-Range Transboundary Air Pollution
COP – Conference of the Parties
DDT – Dichlorodiphenyl trichloroethane
HCB – Hexachlorobenzene
HCH – Hexachlorocyclohexane
IEA – International environmental agreement
INAC – Indian and Northern Affairs Canada
NCP – Northern Contaminants Program
NGO – Non-government organization
PAHs – Polycyclic aromatic hydrocarbons
PCAs – Chlorinated paraffins
PCBs – Polychlorinated biphenyls
POPs – Persistent organic pollutants
PCNs – Polychlorinated naphthalenes
SCCP – Short-chained chlorinated paraffins
SEPA – Swedish Environmental Protection Agency
TDI – Tolerable daily intake
UNECE – United Nations Economic Commission for Europe
UNEP – United Nations Environment Programme
WWF – World Wildlife Fund

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Chapter 1: Introduction

The Canadian Arctic has become a repository for some of the world's highly toxic chemicals. The long-range transport of persistent organic pollutants (POPs) has resulted in an accumulation in the Canadian Arctic suggesting harmful consequences for human health and the environment. Increasing levels of POPs throughout the Arctic environment have resulted in concerted regional, national and international efforts to reduce and eventually eliminate their production, use and emission. In 1997 the Governing Council of the United Nations Environment Programme (UNEP) initiated an international effort to assess POPs, resulting from a growing concern over the levels of contaminants in the Arctic. Assessments provided the evidence of long-range transport to the Arctic and to other regions where production and use of POPs had never occurred. As a result of international efforts, the *Stockholm Convention on Persistent Organic Pollutants* (hereafter called the Stockholm Convention) has been finalized and opened for signature in May 2001. The objective of the UNEP-sponsored convention is to protect human health and the global environment from persistent organic pollutants (UNEP, 2001a; UNEP, 2001b).

Background and Problem Statement

Persistent organic pollutants are organic carbon-based chemicals that contain one or more chlorine atoms (Thornton, 2000, p. 2). For the purpose of this thesis, persistent organic pollutants are categorized into three groups: pesticides, such as dichlorodiphenyl trichloroethane (DDT), chlordane, and toxaphene; industrial chemicals including hexachlorobenzene (HCB) and polychlorinated biphenyls (PCBs); and unintentionally

produced by-products such as dioxins and furans. Certain characteristics of POPs favour their persistence in the environment as they bioaccumulate in the food chain, eventually reaching humans. POPs in all three groups have harmful effects on the health of humans and the environment.

The presence of POPs in the environment is no longer considered solely a regional concern, but a global one. Persistent organic pollutants have been found to pose risks to human health and the environment in regions where they have never been used or produced. The physical and chemical characteristics of these toxic chemicals result in their accumulation in the fatty tissue of living organisms, including humans. Once POPs have accumulated in tissue, there are very limited means to excrete them, but they can be passed on to the next generation through the placenta and via mother's milk. Levels of persistent organic pollutants in tissue have been linked to a number of health effects, including interference with fundamental biological processes. The long-term effects of POPs on human health are still unknown.

Recent studies have confirmed that persistent organic pollutants are present in Arctic environments, including Canada's northern regions, where they either have never been used or have long since been prohibited. POPs are transported via atmospheric processes and ocean currents from southern latitudes to the Arctic environment, where they persist and accumulate in the food chain. As aboriginal populations are dependent on many of the species higher up in the food chain for dietary consumption, these individuals have become particularly susceptible to the adverse effects of POPs. Many of the food sources that aboriginal peoples rely upon, such as marine mammals, have become increasingly contaminated. "Country foods" are the most economical means of

food production and they are also essential to physical, cultural, spiritual and mental well-being of aboriginal peoples in the Arctic. Therefore, this issue is not only an environmental concern, but contamination of the Arctic environment has far-reaching impacts on Arctic residents and their social, cultural and economic well-being.

The UNEP Stockholm Convention addresses the general need for the protection of human health and the environment from persistent organic pollutants. In the long term, the Stockholm Convention will address the needs of the Arctic population and environment by reducing levels of persistent organic pollutants and preventing further emissions from entering the environment, by eliminating their production and use.

Goal

This thesis attempts to articulate how the Stockholm Convention's international environmental regime for management of persistent organic pollutants may protect human health and the environment from POPs, especially in the Canadian Arctic. Based on the examination of literature on international environmental agreements and their effectiveness, this thesis proposes a conceptual framework of elements with which to analyze the Stockholm Convention and its potential effectiveness. In conjunction with a review of the particularities of POP contamination in the Arctic, this analysis contributes to conclusions about the potential effectiveness of the Stockholm Convention in dealing with Arctic needs.

This thesis will contribute to how international environmental issues are contemplated by providing an interdisciplinary approach, combining international political theory, science and social science.

Objectives

The thesis attempts to answer the following research questions: Based on theories on what contributes to an effective international regime, does the Stockholm Convention contain the necessary elements? Does the Stockholm Convention contain the essential elements to successfully address the needs of humans and the environment in the Canadian Arctic? The first objective of this thesis is to develop a conceptual framework based on an analysis of regime theory and the elements of environmental regimes. Along with providing the basis for understanding the problems associated with persistent organic pollutants in the Canadian Arctic, the conceptual framework contributes to the second objective, namely, to evaluate the potential effectiveness of the Stockholm Convention.

Limitations of the Thesis

There are a number of limitations in the undertaking of this thesis. First, negotiations on the Stockholm Convention were recently completed, which made obtaining accurate, timely and complete information difficult. Due to the timing of the completion of the text for the Stockholm Convention, very little additional information and literature is available about implementation and international support. Finally, scientific evidence of the long-term health problems associated with POP contamination is not definite and is still being developed.

Thesis Outline

Chapter two presents the conceptual framework for this thesis. The conceptual framework consists of three main components that have been assembled from various theories on what international environmental regimes should contain in order to be effective. Goals, implementation mechanisms and review mechanisms are the three main components that provide the foundation for an effective regime. I will use this conceptual framework to determine the effectiveness of the Stockholm Convention and whether it will be successful in addressing the needs of the Canadian Arctic.

Chapter three defines and describes the nature of persistent organic pollutants. Details are provided about the characteristics of persistent organic pollutants and how they are transported to the Arctic environment. In addition, the types of persistent organic pollutants are outlined along with what is known about their effects on human health and the environment.

Chapter four defines the nature of the problem of POPs in the Canadian Arctic and discusses the need for an international response. This chapter characterizes the Canadian Arctic environment and the history of contamination there, as well as details of both local and distant sources of POPs. The identification of distant sources provides insight into which countries are continuing to produce and use them, which is essential knowledge in determining how to achieve the ultimate objective of the international agreement: to eliminate the production and use of specified persistent organic pollutants.

Chapter five is an overview of the international response to the problem of POP contamination. Details of the regional agreement under the auspices of the UN/ECE are outlined to establish the process from which the global initiative evolved. An outline of the processes leading up to the final draft of the *Stockholm Convention on Persistent Organic Pollutants* is also included in chapter five to provide the background for the analysis and evaluation undertaken in chapter six.

Chapter six evaluates the UNEP Stockholm Convention and how it specifically addresses the needs of the Arctic population and environment. The evaluation of the Stockholm Convention is completed using the conceptual framework developed in chapter two regarding the elements required for an effective international environmental regime. It will be seen that the Stockholm Convention contains many of the essential components of an effective international environmental agreement and, as a result, has the potential to effectively address the issue of POPs in the Canadian Arctic.

Chapter seven provides a brief conclusion about the effectiveness of the Stockholm Convention in the Canadian Arctic. While it is too soon to determine whether or not the Stockholm Convention will be environmentally effective, it can be hypothesized that it has the long-term potential to effectively address the environmental and human health problems of POPs in the Canadian Arctic. This chapter discusses further research to be considered pertaining to the issue of POPs. Chapter seven also reflects on the importance of regime analysis and the value of studying POPs and international environmental issues.

Chapter 2: Conceptual Framework

Introduction

As the world's states become increasingly interdependent and their actions have implications for the welfare of other states, there is a growing need for international co-operation on environmental issues (Osherenko & Young, 1993, p. 1). States are moving towards the resolution of their transboundary environmental problems via international environmental agreements, through negotiation and implementation (Victor, Raustiala, & Skolinkoff, 1998, p. 1). The *Convention on International Trade in Endangered Species*, the *Antarctic Treaty*, and *Convention on Biological Diversity* are all examples of international environmental agreements which have developed into environmental regimes. Analysts concerned with the effectiveness of international environmental agreements have turned their focus to the development of such regimes and the mechanisms utilized to implement them.

This chapter develops a conceptual framework from regime theory literature about elements that contribute to the effectiveness of international environmental regimes. The conceptual framework developed in this chapter will be used to evaluate the Stockholm Convention in chapter six.

Defining International Environmental Regimes

International environmental agreements are developed, negotiated and implemented to align and coordinate the behaviour of states, thus steering them away from environmentally destructive activities (Weiss & Jacobson, 1998, p. 1). Conventions are used as legal instruments to develop and implement binding environmental

commitments (Swanson & Johnston, 1999, p. 210). Detailed instruments that elaborate on the norms and rules may be added to the Convention, such as protocols which will develop specific obligations. For example, the *1979 Convention on Long-Range Transboundary Air Pollution* (LRTAP) was initially intended to protect human beings and their environment against air pollution and to reduce air pollution (Nordic Environment, 1996, p. 5). Protocols were later added to implement specific obligations under the LRTAP convention, for example the *Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes* (NOx Protocol) and the *Volatile Organic Compounds Protocol* (VOC Protocol). In this example, additional protocols were utilized to strengthen the LRTAP convention with emission targets and timetables.

There have been a number of definitions of regimes, but the one put forth by Young and Levy (1999, p. 1) provides the most detail. Regimes will be defined here as "social institutions composed of agreed principles, norms, and decision-making procedures that govern the interactions of actors in specific issue areas." Regimes often deal with a limited set of well-defined activities as they relate to environmental quality, or a specific geographic area of interest to some sets of states (Osherenko & Young, 1993, p. 2). The question to be discussed in this chapter and later used to evaluate the *Stockholm Convention on Persistent Organic Pollutants* is: What makes an international environmental regime effective?

Regime Effectiveness

Initially, one would expect that the effectiveness of an environmental regime would be equated with problem solving; thus, a regime would be successful if it solved

the environmental problem that prompted its creation. Conversely, if the environmental problem is not solved, then the regime has not been effective. However, a number of definitions of effectiveness have emerged from various authors of environmental regime theory and their definitions of effectiveness are developed from one central concept—behavioural change. The definition of the term *effectiveness*, as put forth by Kütting (2000, p. 3) is the ability of an approach to solve a particular issue. Underdal (1992) suggests that effectiveness is a relative concept that needs to be defined on an individual basis in the case of each regime. Wettestad and Anderson (1991, p. 2) elaborate on Underdal's idea of effectiveness and develop a series of indicators which show whether the regime is dealing with the environmental problem. These indicators are the achievement of the institutional goals set by its states; the degree of correspondence between expert advice and the actual decisions taken; and the degree of improvement compared to the pre-institutional state of the environment (Wettestad & Anderson 1991, p. 2). The evidence of an effective regime according to Young and Levy (1999, p. 1) is that behaviour is channelled in such a way as to eliminate or substantially ameliorate the [environmental] problem that led to its creation. Victor (1999) further suggests that effectiveness is a measure of a law's impact on behaviour, with the most effective laws having the largest impact on the offending behaviour.

For effective international action to be taken to protect and improve the environment, international institutions may be necessary, but they are not sufficient (Keohane, Hass, & Levy, 1993, p. 5). Cioppa and Bruyninckx (2002) assert that there is an inclination to use the term effectiveness in ways that emphasize institutional practices over environmental outcomes, thereby focussing more on the formation and operation of

environmental institutions and less on the ability of these arrangements to actually protect the environment. Furthermore, Cioppa and Bruyninckx state that many definitions of regime effectiveness fail to distinguish between institutional effectiveness and environmental effectiveness, thereby creating confusion in determining what kind of effectiveness a regime is demonstrating. For them, institutional effectiveness occurs when regimes operate in a manner agreed upon by their members, while environmental effectiveness indicates an improvement in the quality of the natural environment through the actions of the regime.

Numerous authors of environmental regime theory have put forth a variety of definitions of effectiveness. There are basically two main concepts of effectiveness, the first based on changing actor behaviour and the second on environmental effectiveness; the latter is argued to be a result of the former. It is premature to determine if the Stockholm Convention has achieved environmental effectiveness. However, its potential for having an impact on offending behaviour, hence effectiveness will be examined in chapter six.

Elements of an Effective International Environmental Agreement

From environmental regime literature, I have summarized and developed three main components of international environmental agreements (IEAs) that can be used to evaluate effectiveness: goals, implementation mechanisms and review mechanisms. This section includes an outline of the importance of these components, with examples of how they have been used in some existing IEAs. The three components have been generated

to provide an outline for evaluating the effectiveness of the Stockholm Convention in chapter six.

Goals

A goal is defined as an objective or something for which an effort is made (*Oxford Dictionary*, 1994). Prior to establishing the goal(s) of an environmental regime, the environmental problem that evoked the need for such an effort needs to be clearly identified. Once the problem has been clearly identified, the goal(s) as well as the strategies for obtaining the overall goal(s) can be established.

Evaluating the goals of environmental regimes to determine their potential effectiveness requires answering the following two key questions: Will the regime result in a change of behaviour needed to achieve the goals of the international environmental agreement? Second, will the regime solve the environmental problem that prompted its creation? Determining environmental effectiveness can only be done well after the Convention has entered into force; until then, only forecasts can be made. Therefore, it is necessary to examine the goals and strategies of the international environmental agreement to determine whether behaviour is likely to change as a result.

An overall goal included in international environmental agreements (IEAs) generally states the purpose and conceptual objective of the environmental agreement and broad problem-oriented goals rather than specific action-oriented goals (Young & Levy, 1999, p. 6). For example, two main goals of the *Convention on International Trade in Endangered Species* (CITES) agreement are to ensure, through international cooperation, that the international trade in species of wild fauna and flora does not threaten the

conservation of the species concerned, and second, to protect certain endangered species from overexploitation by means of a system of import-export permits issued by a management authority under the control of a scientific authority (Nordic Environment 1996, p. 37; UNEP, 2002b). The general goal of an IEA must not only acknowledge the problem that prompted its creation, but also attempt to address it.

The strategies of IEAs are specific, action-oriented goals and are geared toward guiding behaviour to achieve the overall goal of an environmental agreement (Young & Levy, 1999, p. 6). CITES includes a number of strategies to direct behaviour toward achieving the previously stated goals. The regulation of trade in specimens of species as indicated in a number of appendices, implementing permits, certificates, exemptions and other special provisions relating to trade and measures to be taken by the parties are strategies of CITES that direct state behaviour toward the overall goals (UNEP, 2002a). If the success of an IEA is an indication of whether or not the environmental agreement implements and achieves its strategies, then the strategies need to be clear and precise in order to facilitate behavioural change that will potentially result in environmental improvement.

Environmental agreements can be ineffective in attaining the objectives because the agreement had little behavioural impact (Goldschmidt, 2002). Therefore, strategies or measurable targets geared toward improving the problem that prompted the creation of an agreement will help assess trends of improvement or specific improvements as well as the success in achieving the overall goal. Under the *Vienna Convention for the Protection of the Ozone Layer*, for example, the overall goal was a commitment to protecting human health and the environment from the adverse effects of the stratospheric ozone layer's

depletion by human activities (UNEP, 2002b). Specific targets were later outlined in the *Montreal Protocol on Substances that Deplete the Ozone Layer* under the *Vienna Convention for the Protection of the Ozone Layer*. These strategies were geared to improving the ozone layer by phasing out and reducing the consumption of chlorofluorocarbons (CFCs) and halons by the year 2000 and phasing out methyl chloroform by 2005 (UNEP, 2002c).

However, strategies are often developed to ensure compliance rather than to have an impact on behaviour or alleviate the environmental problem (Victor, 1999). In the case of commercial whaling quotas in the 1950s to 1970s, targets were set to existing harvesting quotas and had little impact on behaviour but nearly perfect compliance (Victor, 1999). As a result, populations of great whales saw a dramatic decline and the whaling industry was overcapitalized and inefficient (Victor, 1999). Objectives of an environmental agreement need to include and enforce environmental standards that meet the needs of the main goal and, as a result, impact behaviour.

Implementation Mechanisms

International environmental agreements require the development of mechanisms to induce countries to adopt and implement a given policy (Folmer & von Mouch 2001). At the implementation stage, states party to the environmental regime take certain actions to implement the international environmental agreement through their domestic law (Weiss & Jacobson, 1998, p. 2). Implementation mechanisms include a number of tools such as implementation plans, financial and technical transfers, incentives, and education and public awareness.

Implementing national legislation and regulations improve the possibility of state compliance with an environmental regime (Jacobson & Weiss, 1998, p. 4). New laws and regulations often result from the efforts and activities of non-state actors, firms, scientists and environmental pressure groups. If insufficient attention is given to the implementation of policies at both the national and international level, then there is an increased possibility that the environmental agreement will fall short of its promises (Victor et al., 1998, p. 4).

Implementation Plans

Implementation plans are procedural avenues to assist parties to an international environmental agreement (Downie, 2003, p. 144). Implementation plans can help states gain better understanding of the environmental problem at hand as well as relevant issues and inventories of their state. Mechanisms utilized in implementation plans will help initiate the development and implementation of analytical policy responses (Downie, 2003, p.144). Implementation plans can also help improve the information used to review the implementation and strategic objectives of the IEA.

A study completed in 1999 by UNEP Chemicals on National Action Plans focused on seven international environmental agreements, including CBD and the *Basel Convention* (UNEP, 1999). The study concluded the there are a number of central objectives of implementation processes in IEAs. However, after examining the study, it is apparent that two objectives are essential. The first objective is to provide an incentive or requirement for states to gain knowledge of the key issue, inventories, cause and effect relationships and potential policy options concerning the environmental issue. The

second objective is to provide an incentive, requirement or framework for states to develop specific plans and policies to implement the provisions of the IEA as soon as possible (UNEP, 1999).

Financial Transfers

Some states lack financial capacity to meet the obligations of an international environmental agreement, thereby making implementation difficult. For example, the elimination of specific substances or activities might have little economic importance in some countries but serious consequences for the economies of other countries (Jacobson & Weiss, 1998, p. 6). Therefore, the costs and benefits of regulating substances and activities are an important consideration for some states that might implement an environmental agreement (Jacobson & Weiss, 1998, p. 6). Since implementation requires resources, the larger the country's gross national product (GNP) and the higher the per capita GNP, the greater the chance of implementation of an environmental agreement (Jacobson & Weiss, 1998, p. 9). Countries experiencing high economic growth rates are more likely to comply with relatively costly environmental regulations than poorer countries or countries with economies in transition (Vogel & Kessler, 1998, p. 35). Similarly, the smaller the costs associated with implementing an environmental agreement as well as the greater the benefits, then the greater the possibility of implementation.

States have different internal economic and political forces that influence their environmental policies (Porter, Brown, & Chasek, 2000, p. 10). The costs and risks associated with implementing an environmental agreement for a given state are never

equal to other states', therefore, motivation to become party to an environmental agreement, as well as perceptions of equitable solutions, will differ among states. Financial transfers can aid in the implementation of new environmentally sound technologies, management strategies or other requirements of environmental agreements (Nordic Environment, 1996, p. 188). Providing developing countries with financial assistance, for example through the Global Environment Facility, can enable them to comply with an environmental agreement that might otherwise have been beyond their capabilities. Lack of financial mechanisms to assist parties to CITES, particularly developing countries, has been highlighted as one of the key shortcomings of that agreement (Yamin & Gualdoni, 1996, p. 194).

Technology Transfers

Access to environmentally sound technologies can also be important for the successful implementation of an environmental agreement. Many developing countries lack the environmental or technical capacity to implement an environmental agreement (Biermann, 2000). As a result, developed countries have participated in fostering capacity building in developing countries to help them to deal with global and domestic environmental problems. Increasingly becoming an essential function of environmental regimes, developed countries have been involved in a number of regimes, including those concerning the ozone layer, climate change and biodiversity protection. The environmental regimes have included legally binding obligations to reimburse the costs that developing countries incur in complying with the environmental standards (ibid.).

The transfer of science, technological knowledge, patents or equipment is usually undertaken by developed countries to developing countries (Porter et al., 2000, p. 29). Problems that are often associated with the transfer of technologies are the compatibility of the receiving state and its ability to implement measures. Building the capacity of developing countries and countries with economies in transition through technological transfers can help to implement an environmental agreement. For example, during the Montreal Protocol negotiations, developing countries requested that developed countries and corporations provide the patents and technical knowledge on substitutes for CFCs. Commonly referred to and used in environmental agreements are "Best Available Techniques" (BAT), which involve the use of proven technologies and methods of operation in order to prevent or minimize emissions to the environment and "Best Environmental Practices" (BEP), which are an application of the most appropriate combination of environmental control measures and strategies (UNEP, 2002d).

Incentives

States may refuse to join international environmental agreement negotiations because they fail to see what they have to gain (Susskind, 1994, p. 23). As a result, other states may make an effort to induce their participation by introducing incentives to bargain. Incentives can take the form of monetary or non-monetary transfers (Tema Nord, 1996, p. 27). Monetary incentives or side payments include direct funding that the agreement obligates a country to take, while non-monetary transfers or side payments in kind consist of aid and cooperation measures to help a country to fulfil its obligations (Tema Nord, 1996, p. 27). Positive incentives can include special funds, financial and

technical assistance, training programs, research and development cooperation and materials, access to technology and assistance outside the framework of the environmental agreement (Weiss & Jacobson, 1999; Tema Nord, 1996, p. 27).

Incentives are used to enhance implementation and compliance (Weiss & Jacobson, 1999). Incentives coupled with other mechanisms such as transfers can potentially result in interest modification for individual actors or participants (Tema Nord, 1996, p. 25). Many environmental problems arise from differing environmental values, thereby making international co-operation difficult to achieve. As a result, incentives are sometimes required to encourage the co-operation of countries that stand to lose from an environmental agreement (Tema Nord, 1996, p. 25).

Education and Public Awareness

Education and awareness promote and foster co-operation not only nationally, but also regionally and globally. These two forces influence environmental agreements, especially when there is an increase in public understanding of issues and support for international policies. In some cases, raising public awareness and education provides information on important issues such as the impact of an environmental activity on population health, and it then contributes to policy interventions (Weiss & Jacobson, 1998, p. 10). Increasing the amount, quality and availability of information about environmental issues in a manner that is understood by the general public and governments will enhance the chance of implementation (Weiss & Jacobson, 1998, p. 10).

NGOs (non-government organizations) are often important to the awareness-raising campaign and are able to influence the environmental agenda and local government decisions (Porter et al., 2000, p. 41). NGOs have been effective in defining environmental issues, providing information and monitoring or reporting compliance to both the state and the public. Awareness helps to increase public support and sway local policies.

Public awareness and education can initiate processes that will give rise to social learning which can result in new perspectives on the nature of the problem to be solved, generating new ideas or insights and new solutions (Young, 1999, p. 24). Furthermore, public pressure on states can successfully influence the development and implementation of national legislation and regulations. In the case of long-range transboundary pollution, states were more willing to agree after learning the importance of the impact of air pollution on human health (Young & Levy, 1999, p. 25). Boosting concern and building capacity through public awareness and education will enhance the effectiveness of the environmental regime (Haas, O'Keohane, & Levy, 1993, p. 404).

Funding for Secretariats and Administrative Capacity

Secretariats are needed to manage an environmental agreement and help evaluate and verify information submitted by parties (Porter et al., 2000, pp. 152, 154). Secretariats often lack the staff and funding needed to fulfill the functions they are assigned. Countries that do not want close supervision do not approve the secretariat's request for increased budgets and staff (Porter et al., 2000, p. 154). Ensuring adequate funding for the secretariat and staff will help the process of evaluation and verification,

which in turn will help encourage compliance of states party to the environmental agreement.

Funding for administrative capacity of parties to an agreement is important for compliance. Often many parties to the environmental agreements, especially developing countries, have low administrative capacity, which can result in inadequate compliance (Porter et al., 2000, p. 153).

Implementation is the central process that turns the commitments of states into action (Victor et al., 1998, p. 13). States often accept and implement an environmental agreement for a number of reasons, but fail to follow through with compliance. Whether states accept and implement an environmental agreement due to pressures from other states or because they wanted to jump on the "treaty bandwagon," failure to comply reduces the effectiveness of the regime (Weiss & Jacobson, 1998, p. 2). In some cases, states enter an environmental agreement without intending to modify their behaviour, while in other instances, states find compliance difficult because they lack the capacity. Effective implementation provisions will include clear direction for parties to carry out the IEA, comprising environmental comprehensiveness and timeliness of such direction (Cioppa & Bruyninckx, 2002).

Review Mechanisms

The final component of an effective regime organization is review mechanisms. Assessing the compliance of a country involves evaluating the extent to which it has implemented an agreement (Jacobson & Weiss, 1998, p. 4). Essential to the effectiveness of an environmental agreement are review and evaluation procedures that determine

whether or not parties of the convention are complying with the provisions of the environmental agreement.

Compliance

When states adhere to the provisions of an environmental agreement and adopt the implementing measures that they have agreed to, they are "in compliance" (Jacobson & Weiss, 1998, p. 4). Countries party to an environmental agreement often comply with some of the agreement's provisions while violating others (Mitchell, 1996, p. 6). The level of compliance of any given country is likely to reflect a combination of factors, such as the underlying structure of the environmental problem, in which a single environmental problem may pose different problems for developed and developing countries (ibid.). Compliance may also reflect the relationship of the agreement's requirements to existing behaviour and future interests of the party.

There are a number of reasons why any given state or other actor may or may not comply with an international environmental agreement (Mitchell, 1996, p. 7). A state may be inclined to undertake a given behaviour regulated by an environmental agreement because they believe it furthers their interest. States may also comply because the treaty rules require no change in behaviour. Finally, states may facilitate their own compliance by negotiating vague and ambiguous rules (ibid.).

States may not comply with an environmental agreement simply because the benefits of compliance do not outweigh the costs (Mitchell 1996, 11). However, while a state may perceive compliance as beneficial, it might fail to comply for lack of financial, administrative or technological resources (ibid., p. 12). Conversely, states may take

actions intended and expected to achieve compliance, but nonetheless fail to meet obligations of the environmental agreement. Further barriers that can inhibit state action or compliance include low sense of urgency about the matter, lack of information, internal disagreement about the best policy approach, fear that unreciprocated action will lead to disadvantage, and the belief that cooperation will make no appreciable difference (Peterson, 1998).

Evaluating a country's compliance involves determining whether it adheres to the provisions of the agreement and the domestic steps that it has taken to implement the agreement (Goldschmidt, 2002). Compliance refers to two dimensions. The first are procedural obligations, such as reporting on activities, and the second are substantive obligations, such as ceasing or controlling an activity (Weiss & Jacobson, 1999). It is not only important that countries party to an environmental agreement rigorously follow the details of the agreement, but that the provisions are environmentally informed (Cioppa & Bruyninckx, 2002). Finally, Jacobson & Weiss (1998) indicate that compliance refers not only to substantial details but also to the spirit of the environmental agreement.

Imposing procedural obligations in an environmental agreement has become a common technique for achieving and evaluating compliance (Sands, 1996, p. 54). Countries party to an agreement must usually report to the relevant international institution the measures that they have adopted to implement their international obligations. Information typically required to be reported includes statistical information on production, imports and exports; information on the granting of permits or authorizations including criteria; details of decisions taken by national authorities; scientific information and information on breaches or violations by persons under the

jurisdiction or control of the party (Sands, 1996, p. 54). Problems associated with reporting include the lack of harmonization of national methods for data reporting and differences in reporting systems (Porter et al., 2000, p. 148). These types of reports may be required on an annual or bi-annual basis, or on another specified time frame. Further, secretariats often lack the authority and personnel to evaluate and verify the data reported (ibid., p. 149).

International environmental regimes rely on states to monitor and verify their own compliance, submit data and make the information publicly available. While governments prefer not to publicly disclose compliance information, this information is essential to effective monitoring (Goldschmidt, 2002). Often identified is the need for more reliance on public participation in persuading countries to comply with their environmental obligations (Goldschmidt, 2002). The participation of the public, more specifically non-government organizations (NGOs), plays a crucial role in ensuring compliance of an environmental agreement. NGOs often put pressure on governments to release compliance information and also to provide the public with information about environmental problems (Weiss & Jacobson, 1999).

Enforcement

The traditional view of international law is that countries accept environmental agreements that are in their best interest; because of this, countries generally comply with them (Goldschmidt, 2002). When countries do not comply, three legal and institutional strategies can be used to encourage compliance: sunshine methods, positive incentives and coercive measures (Goldschmidt, 2002).

The first method, as described by Jacobson and Weiss (1998), is the *sunshine method*, which requires bringing the behaviour of parties and targeted actors into the open for scrutiny—employing the "reputation" factor to induce compliance. This method includes regular national reporting; peer scrutiny of reports; on-site monitoring by parties, secretariats and NGOs; access to information by NGOs; media access and coverage to provide public awareness; publication of parties' violations; regional workshops to track behaviour; corporate or private sector monitoring networks; consultants working on-site; and informal pressures by parties and secretariats (Weiss & Jacobson, 1999). Examples of the use of the sunshine method are CITES and the World Heritage Convention, which use NGOs in their implementation (Jacobson & Weiss, 1999; Goldschmidt, 2002; UNEP, 2002a).

The second method is the use of positive incentives to induce countries to comply with an environmental agreement (Jacobson & Weiss, 1998, p. 546; Goldschmidt, 2002). Examples of these types of incentives include special funds that provide a party with benefits, such as financial and technical assistance, training programs and materials, and access to technology. These types of incentives have been discussed in detail in the previous section as an important sub-component of implementation mechanisms. A number of environmental agreements, including the *World Heritage Convention* and the Montreal Protocol, utilize this method of enforcement (Goldschmidt, 2002).

The use of coercive measures for encouraging compliance is the third and final strategy. Sanctions, penalties and the withdrawal of membership privileges to an agreement have been used to punish non-compliance and also to serve as deterrents designed to discourage future non-compliance (Chayes, Chayes, & Mitchell, 1998, p. 39;

Goldschmidt, 2002; Vogel & Kessler, 1998, p. 26). Again, the *World Heritage Convention*, the CITES and the Montreal Protocol are examples of environmental agreements that have used sanctions to ensure compliance (UNEP, 2002a; Goldschmidt, 2002).

Compliance is not an end in itself, but rather a mechanism to achieve effectiveness in managing environmental damage (Victor et al., 1998, p. 7). Despite the provisions in an environmental agreement, determining whether or not states are more likely to comply and hence, to change behaviour, is still difficult and complex.

Table 1 includes the "yardstick" to be used in chapter six to evaluate the *Stockholm Convention on Persistent Organic Pollutants.* These measures are developed from the three main components of an IEA: goals, implementation mechanisms and review mechanisms.

TABLE 1

Measuring Environmental Regime Effectiveness	
GOALS AND STRATEGIES	Has the environmental problem that evoked efforts been clearly identified? Does the overall goal of the environmental agreement clearly identify and address the problem that prompted its creation? Are the strategies of the environmental agreement clear and precise? Are the strategies of the environmental agreement measurable? Do the strategies of the environmental agreement include and enforce environmental standards that meet the needs of the overall goal of the environmental agreement?
IMPLEMENTATION MECHANISMS	Are the costs and benefits of regulating substances and activities an important consideration for the implementation of the environmental agreement? Will financial transfers aid in the implementation of new environmentally sound technologies, management strategies or other requirements of the environmental agreement? Will developing countries be provided with financial assistance to enable them to comply with the environmental agreement that might otherwise have been beyond their capabilities? Will there be access to environmentally sound technologies? Will building the capacity of developing countries and countries with economies in transition through technological transfers help to implement the environmental agreement? Will the best available technologies and best environmental practices be encouraged during the implementation of the environmental agreement? Will quality information about environmental issues be made available to enhance the chance of implementation of the environmental agreement? Will increased awareness help to increase public support and sway local policies to implement the environmental agreement? Will positive incentives such as special funds, financial and technical assistance, and training programs be included in the environmental agreement? Will adequate funding for the secretariat and staff be ensured to help the process of evaluation and verification, which in turn will help encourage compliance of states party to the environmental agreement? Will funding for administrative capacity be provided during the implementation of the environmental agreement to help ensure compliance?
REVIEW MECHANISMS	Does the environmental agreement include procedural obligations, such as the requirement to report? Will the participation of the public; more specifically non-government organizations (NGOs) play an essential role in the monitoring of compliance of the environmental agreement? Will governments disclose compliance information, which is essential to effective monitoring? Will sanctions, penalties and the withdrawal of membership privileges to an agreement be used to punish non-compliance? Will the environmental agreement employ evaluation mechanisms to evaluate compliance and effectiveness?

Summary

International environmental agreements are negotiated and implemented in response to environmental problems that transcend political borders. Changes in the behaviour of states and non-state actors are encouraged by environmental regimes that work towards addressing the environmental problem and attaining the stated goals of the environmental agreement.

The conceptual framework derived from regime theory literature presented in this chapter will be used to evaluate the Stockholm Convention in chapter six. The three main components used in this evaluation are goals, implementation mechanisms and review mechanisms. The first component, goals, will be used to evaluate whether the environmental problem that prompted concern has been clearly identified; if the overall goals of the environmental agreement clearly identify and address the problem that prompted its creation; if the strategies of the environmental agreement are clear and precise; if the strategies of the environmental agreement are measurable; and if the strategies of the environmental agreement include and enforce environmental standards that meet the needs of the overall goals of the environmental agreement and will potentially result in changed actor behaviour.

The second component of IEAs, implementation mechanisms, are the tools that assist states in actively undertaking the changes necessary to achieve the IEA's goals; they include financial transfers, technological transfers, education and public awareness, incentives, funding for secretariats and administrative capacity to help implement the environmental agreement.

The third and final component, review mechanisms, will be used to evaluate whether the environmental agreement includes procedural obligations, such as the requirement to report; public participation including NGOs in the monitoring of compliance to the environmental agreement; inclusion or encouragement for governments to disclose compliance information, which is essential to effective monitoring; inclusion of sanctions and penalties (and the withdrawal of membership privileges to an agreement) to punish non-compliance; and if the environmental agreement employs evaluation mechanisms to determine compliance and effectiveness.

The problem of persistent organic pollutants in the Arctic is increasingly being acknowledged as a transboundary issue, requiring international cooperation. There are a number of properties that make persistent organic pollutants harmful to the Arctic environment and human health. The following chapter outlines the characteristics of POPs and why they are a problem in the Canadian North in preparation for evaluating whether the Stockholm Convention will be effective in dealing with the problem.

Chapter 3: The Problem with Persistent Organic Pollutants

Introduction

A dramatic increase in chemical manufacturing and other chemical-producing activities occurring worldwide has resulted in the release of toxic pollutants and has increased the contamination by persistent organic pollutants (POPs) in the Arctic region (Renzoni, Malteri, Fossi, & Lari, 1994, p. 19). POPs have been found throughout the Arctic environment in the air, surface seawater, sediments, snow, fish, marine mammals, seabirds, terrestrial animals and humans (Barrie et al., 1992; Muir et al., 1992). The fact that there are no significant sources of airborne pollution in the circumpolar North supports the concerns about global contamination arriving via long-range transport, through ocean currents, rivers and atmospheric transport; once there, these pollutants persist for long periods of time (Muir, 1997, p. 56; Voldner & Li, 1995).

This chapter outlines the physical and chemical characteristics of POPs and the processes by which they are transported north. It briefly discusses the specific POPs of concern, what they have been used for, and their current status in international environmental policy. The final section of this chapter provides a brief description of the adverse effects of POPs on human health.

Properties of POPs

Several studies have been undertaken over the past two decades with the aim to improve knowledge and understanding of the properties and behaviour of persistent organic pollutants in the environment (Breivik, Pacyna, & Münch, 1999; Breivik et al., 2002; Muir, 1997; Northern Contaminants Program [NCP], 1997; Arctic Monitoring and

Assessment Programme [AMAP], 1997; NCP, 2003). There are a number of properties of persistent organic pollutants that make them detrimental to both the environment and its inhabitants. It is important to reach an understanding of the physiochemical properties of POPs in order to understand the impact they have on both the Arctic environment and human health (Bacci, 1994, p. 3). Properties of POPs and the nature of the environment into which they are discharged are factors in determining the fate and effects of these contaminants.

Persistent organic pollutants are chlorinated organic compounds, which, due to their chemical makeup, have been found to have toxic properties (Nadakavukaren, 2000, p. 226; Eduljee, 2000, p. 2; Breivik et al., 1999). The stability and persistence of POPs makes them detrimental to the environment and to human health, because POPs are resistant to degradation by chemical or biological action (Bacci, 1994, p. 4; Eduljee, 2000, p. 1). Consequently, they remain in the environment for a long period of time, where they have harmful implications for the health of humans and the environment.

POPs have long environmental half-lives, which results in continued increases in the levels of POPs accumulating in the environment (Breivik et al., 1999). Half-life is used as a descriptor of persistence, a concept adopted from radioactive decay (Mackay, Webster, Beyer, Matthies, & Wania, 2001, p. 17). The half-life of a chemical is a function of both the chemical and its reactive environment. It refers to the time required for half of a given quantity of a substance to break down into the environment (Downie & Elman, 2003, p. 290). Environmental half-life is the rate of loss of the chemical from the environment (Macdonald, 2000). For example, hexachlorobenzene has a half-life of six

years in water, which means its concentration decreases by one half over that time. Examples of environmental half-lives in air and water are included in Table 2.

TABLE 2

Persistence of Contaminants in Air and Water

Chemical	Air	Water	Reference
Hexachlorobenzene	~2 yrs	~6yrs	Mackay et al., 1992
PCBs	~2 yrs	~6yrs	Mackay et al., 1992
Chlordane	~6.2hrs	~ 20 days	Howard, 1991
Dieldrin	--	4+yrs	Howard, 1991
Hexachlorohexane	2 days	~771 hours	Howard, 1991
Lindane	2 days	~771 hours	Howard, 1991
Endosulfan	1.2 hours	~ 7 days	Howard, 1991
DDT	177 hours	--	Eduljee, 2000

Bioaccumulation is another property of persistent organic pollutants. This refers to the transfer and gradual build-up of substances in the tissues of living organisms over time, as organisms take up and store substances such as POPs faster than their bodies can break down or excrete them (Guidotti & Gosselin, 1999, p. 134; NCP, 2003a, p. 114). POPs, which have low water solubility and are highly lipid soluble, are stored in the fatty tissues of organisms without changing to a form that can be digested or eliminated (NCP, 1997, p. 28; AMAP, 2002, p. 8). Younger animals will generally have lower levels of contaminants stored in their tissues, as they have had less time to consume them. POPs remain in the fatty tissue of living organisms and over time will accumulate without any means to excrete them completely. Not only do the harmful effects increase for the organism that accumulated the contaminants, but also for organisms higher up the food chain if they consume the contaminated organism. When an animal consumes a plant or another animal, it then consumes all the contaminant stored there (Guidotti & Gosselin, 1999, p. 135). POPs bioaccumulate up the food chain, which results in the concentration levels of contaminants increasing from prey to predator (ibid.).

Biomagnification is the process by which there is a successive increase in the concentration of a chemical substance with increasing trophic levels. Transfer within the Arctic food webs leads to the process of biomagnification. POPs accumulate in fish and invertebrates through exposure via gills, skin and diet (NCP, 1997, p. 194). Other accumulation of POPs results when they are absorbed onto particle surfaces that are then taken up as food by grazing animals. The dominant pathway for bioaccumulation in larger marine, freshwater and terrestrial organisms is through food ingestion (ibid.).

Persistent organic pollutants are lipid soluble, which means they accumulate in the fatty tissues of living organisms. If the lipid content of the organism decreases, then the concentration of contamination increases (AMAP, 1998, p. 198). A study of polar bears during their seasonal fasting indicated that when the adipose tissues were depleted, the lipid level of PCBs, chlordane and chlorinated benzenes increased. Higher levels of contaminants were found not only in the remaining fatty tissue but also in the milk, a fat-rich substance, which was later ingested by nursing cubs.

Pathways to the Arctic

The transport of pollutants to the North is a complex and dynamic process, which depends upon the characteristics of POPs discussed in the previous section and on global environmental processes such as ocean currents, rivers and atmospheric circulation. These three processes are the primary means of transport of POPs to the Arctic.

Marine Transport of POPs

Many of the major water bodies in the Arctic, including the Arctic Ocean and surrounding seas, receive contaminants from a number of sources, such as air, other oceans, rivers and direct discharge from land-based sources (Barrie et al., 1992). The transport of contaminants in ocean currents has recently been deemed an important source, more so than previously estimated (AMAP, 2002, p. 13). According to a recent study released by the Arctic Monitoring and Assessment Programme (AMAP) (2002), chemicals are efficiently removed from the air by precipitation or air-to-sea gas exchange and may reach the Arctic primarily by ocean currents.

The Atlantic Ocean, Fram Strait and Barents Sea make up 80% of the water source for the Arctic Ocean (see Figure 1). An additional inflow from the Bering Strait and the Pacific Ocean accounts for 17% of water, and precipitation and rivers account for the remaining 3% (NCP, 1997, p. 2). Contamination reaches marine environments in the North via these ocean currents. The interaction of the Arctic Ocean with southern regions is restricted to these few passages (AMAP, 1997, p. 32).

The residence time of three layers found in the Arctic Ocean controls the transport of contaminants there. These three layers consist of the Arctic surface water, the Atlantic layer and the deep basin (Figure 2). The Arctic surface water extends to a depth of approximately 200 metres and is "polar mixed", which means it undergoes large seasonal fluctuations due to river runoff, wind mixing and sea-ice melt. The residence time of water in this layer is approximately ten to twelve years (Barrie et al., 1992). This layer of water has direct contact with the atmosphere and is where contaminants are deposited.

The Atlantic layer extends to approximately 800 metres. Water circulating in this layer does so on a time scale of approximately 30 years (AMAP, 1997, p. 31). The Atlantic layer water enters the Arctic Ocean through the Fram Strait and Barents Sea, submerges and circulates around the Arctic basin and exits through the Fram Strait. The final layer, the deep basin, is the oldest and extends another 800 metres (Barrie et al., 1992). Water in this bottom layer takes centuries to replace, thereby continuously circulating contaminants.

Once pollutants reach the Arctic Ocean, they are kept there by oceanic circulation, characterized by two main features. The first is the Beaufort Gyre, a large clockwise gyre that extends over the entire Canadian Basin, slowly rotating approximately once every ten years between the pole and the Canadian Archipelago. The water then circulates toward the second feature, the Transpolar Drift, which runs east to west across the Eurasian Basin and through the western Fram Strait (AMAP, 1997, p. 31). The drift moves at an estimated two kilometres per day (Barrie et al., 1992). As a result, ocean currents can take decades to transport POPs released in other parts of the world to the Arctic (AMAP, 2002, p. 13), and they can contribute to keeping contaminants in the arctic system for long periods.

Figure 1: Ocean Currents in the Arctic (AMAP, 2002)

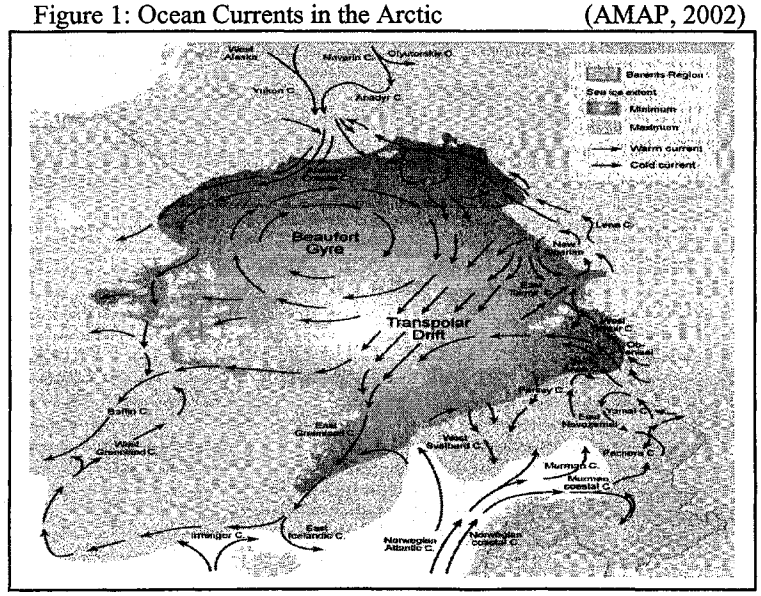
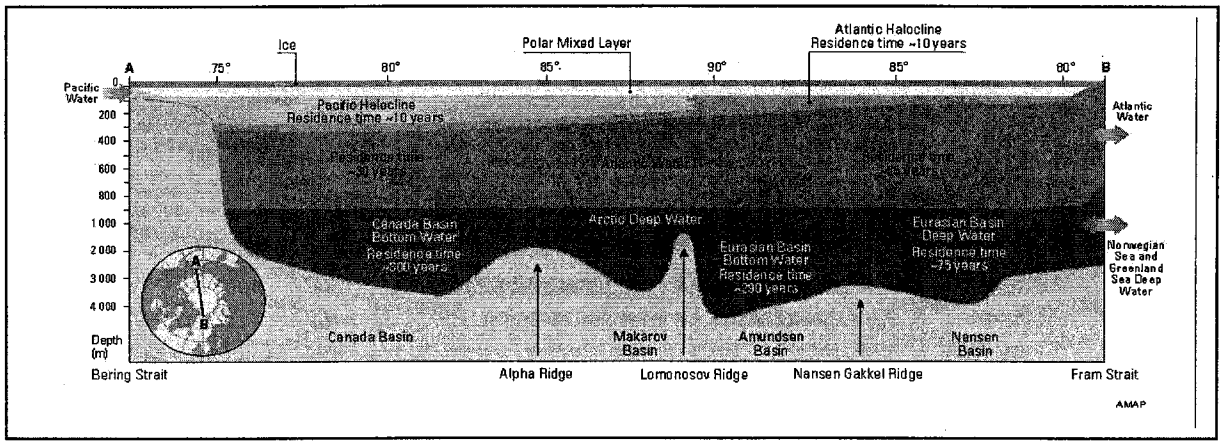


Figure 2: Vertical Stratification of the Arctic Ocean



(AMAP, 2002)

Sea-Ice Transport

The sea ice of the Arctic Ocean is an important means of transport of contaminants (Colony & Thorndike, 1985). The solid surface of the sea ice, which provides a habitat for a number of Arctic species such as polar bears and seals, collects atmospheric deposition throughout the winter months (NCP, 1997, p. 2). Contaminants are released during the spring melt, when biological productivity is at its highest in ponds and surface water on the ice. Another way sea ice can contribute to contaminant transport is that it can be formed in shallow and marginal seas, areas in close proximity to land, which contain contaminants that are then exported to the interior ocean (Muir et al., 1992).

River Transport

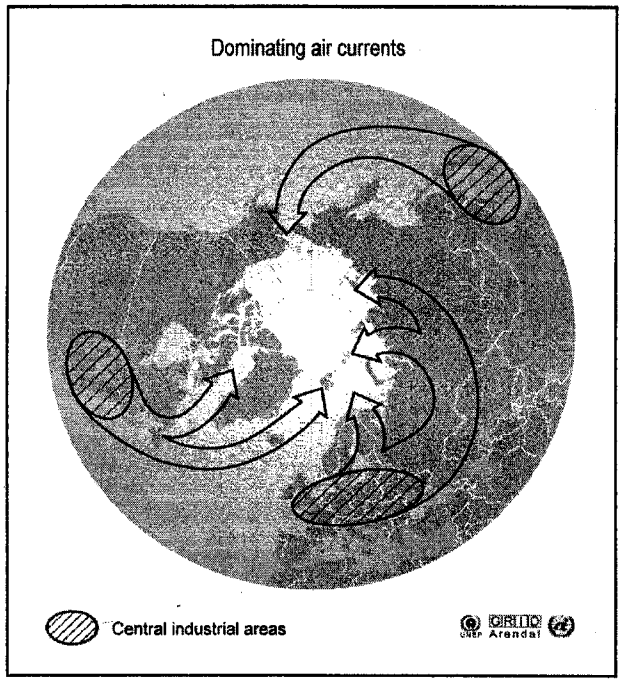
The largest sources of fresh water in the Arctic are north-flowing rivers, draining Northern Asia, Northern Europe and North America (Barrie et al., 1992). Nine Russian rivers and one Canadian River, the Mackenzie, account for 78% of the total river water

input to the Arctic Ocean. 75% of Canadian river input into the Arctic comes from the Mackenzie (NCP, 1997, p. 48). Rivers are another means of bringing contamination into the Arctic and the Arctic Ocean. Arctic rivers are frozen for most of the year, making the flow strongly seasonal, which makes rivers significant in redistributing contaminants within the Arctic (NCP, 1997).

Global Atmospheric Transport

Every day, pollutants are transported into the northern environment by atmospheric winds (Environment Canada, 1998). Atmospheric transport provides an efficient means of moving contaminants from distant sources to the Arctic within days (Barrie et al., 1992; AMAP, 2002, p. 13). The atmospheric pathways of contaminants are influenced by the spatial distribution of distant sources, air circulation patterns and exchanges within the earth's surface (NCP, 1997, p. 2). Due to intense Siberian high-pressure cells, air is forced northward into the Arctic, thereby transporting contaminants from Siberian and European sources to the Arctic region (AMAP, 1997, p. 22). As a result of high-pressure ridges over North America, the mean flow in winter is out of Eurasia into the Arctic (Halsall, 2000, p. 213). During the summer months, the transport of contaminants to the Arctic from mid-latitudes decreases due to the disappearance of the high-pressure cell (Figure 3).

Figure 3: Dominating Air Currents



(UNEP, 2002e)

The atmospheric transport of contaminants to the Arctic region occurs in two modes. In "one-hop" or "single-hop" pathways, the compounds are being deposited to the earth's surface where they stay (Halsall, 2000, p. 211). In the "multi-hop" pathway, known as the "grasshopper effect," the compound goes through cycles of evaporation, transportation and condensation. Atmospheric cycles are efficient and have high carrying potential, able to carry contaminants thousands of kilometres in a matter of days.

Temperature and the properties of the chemicals are important factors in the evaporation and condensation of contaminants (Halsall, 2000, p. 219). The evaporation and condensation of contaminants into and out of the air is directly related to an increase or decrease in temperature; warmer temperatures provide favourable conditions for evaporation while colder temperatures favour deposition (Harrison, 1999, p. 211; Halsall, 2000, p. 219). Therefore, seasonal temperature changes can potentially result in the re-emission of POPs into the atmosphere. When contaminants reach cooler temperatures in

the mid-latitudes, they condense out of the atmosphere. With seasonal change and an increase in temperature, the contaminant can evaporate back into the atmosphere (Halsall, 2000, p. 219). The process of evaporation and condensation continues until the contaminants reach higher latitudes where temperatures are not high enough for the contaminants to re-enter the atmosphere.

The semi-volatility of POPs favours their transport from warmer temperate regions to the cold Arctic environment. Persistent organic pollutants are volatile in warmer temperate regions, which means they will readily evaporate off surfaces such as plants, water, snow and soil back into the environment (McMurry & Castellion, 1999; Ritter, Solomon, & Forget, 1995). The behaviour of the contaminants once redeposited depends on their own physiochemical properties as well as the environmental conditions, most notably temperature (Harrison, 1999, p. 332; Halsall, 2000, p. 211). POPs' persistence in the environment, combined with their volatility, proves favourable for the long-range transport of these chemicals.

Types of Persistent Organic Pollutants

Persistent organic pollutants are grouped into three categories: pesticides, industrial chemicals and unintended by-products. Currently, limited data is available on precise global emissions of POPs, including their sources and pathways to the Arctic. While atmospheric measurements of POPs from approximately the last ten years have been undertaken, research has indicated that domestic controls have been scattered and incomplete, thereby making forecasts of POP trends statistically insignificant (Selin, 2003, p. 116; NCP, 2003b, p. 33).

Pesticides

Pesticides are utilized to control a wide range of pests elsewhere in the world. They make up the majority of the contaminants causing concern in the Arctic. Pesticides are broken down into sub-categories: organophosphates, carbamates and organochlorines. Organophosphates are highly toxic to humans and other mammals; however, they are less persistent than organochlorines. Carbamates are also highly toxic (Harrison, 1999, p. 211). There is little concern in the Arctic regarding either organophosphates or carbamates because they have not been detected in the North. Organochlorines are the pesticides of primary concern in the Arctic. The following section will provide an in-depth examination of their use, sources and effects.

Table 3 outlines the status of the eight major pesticides of concern in the Canadian Arctic. Although not used in the Arctic, these pesticides have been and/or are being used for a variety of purposes in both developed and developing countries. It is believed that many of the pesticides used mainly in agriculture are originating from the northern hemisphere, particularly the mid-latitudes, including North America, Asia and Europe (NCP, 2003a, p. 12). Table 4 is a brief outline of pesticides and their uses.

TABLE 3

Status of Pesticides in the Canadian Arctic

Pesticide	Status in Canada	Found in Arctic
Aldrin	Deregistered[1] 1985	Yes
Chlordane	Deregistered 1990	Yes
DDT	Prohibited[2] 1970	Yes
Dieldrin	Deregistered 1990	Yes
Endosulfan	Restricted[3] use	Yes
Heptachlor	Never registered	Yes
Mirex	Never registered	Yes
Toxaphene	Deregistered 1982	Yes

(Source: AMAP, 1997, 186; NCP, 1997, p. 38)

[1] Under the Pest Control Products Regulations, "registration" means a certificate is issued by the Director General of the Plant Industry indicating that the control product is registered under the Regulations (Pest Control Products Act, 2002). The term "deregistered" means that the control product was once registered under the Regulations.

[2] "Prohibit" is a term used in the 1999 Canadian Environmental Protection Act (CEPA) (CEPA, 1999). This term is not defined in the Act, as it has an ordinary dictionary meaning (to forbid, prevent) (*Oxford Dictionary*, 1994).

[3] The term "restrict" is used in the 1999 CEPA; however, it is not defined in the Act. Restrict means to put a limit on or subject to limitations (*Oxford Dictionary*, 1994).

TABLE 4

Persistent Organic Pollutants: Pesticides	
Pesticide	**Use**
Aldrin	Termiticide used to kill termites, grasshoppers and corn rootworm (UNEP, 2002) Approximately 925 tonnes used in Central and South America in 1988 (Voldner & Ellenton, 1987) United States used 450 to 680 tonnes between 1981 and 1988 (Voldner & Ellenton, 1987) Worldwide sale ceased in 1991(Barrie et al., 1992)
Chlordane	Extensively used to control termites and insects (Ritter et al., 1995) Used extensively in US prior to 1983 and then for termite control 1983–1988 (AMAP, 1998, p. 188) Limited use in Western Europe and former Soviet Union (Lipnick et al., 2000, p. 7)
DDT (dichlorodiphenyl-trichloroethane)	Used as an insecticide and disease vector control (Tesar, 2000) Widely used during WWII for malaria control (Tesar, 2000) Important in controlling vector-borne diseases (UNEP, 1999)
Dieldrin	Uses include insecticide and control of insect vectors of several diseases (Lipnick et al., 2000) Manufactured in Canada and US and used extensively in US until 1973 Manufactured and used in Europe and developing countries until late 1980s Now restricted to termite control (Lipnick et al., 2000)
Endosulfan	Used as insecticide (Ritter et al., 1995) High volumes used in southern latitudes (Environment Canada, 1998)
Endrin	Uses include insecticide and rodenticide (Ritter et al., 1995) Banned and severely restricted in many countries, including Canada
Heptachlor	Used as an insecticide to kill soil insects and termites, cotton insects, grasshoppers, other crop pests and malaria-carrying mosquitoes (UNEP, 2002) Banned in many countries and severely restricted in others, including Canada
Mirex	Uses include insecticide, fire retardant in plastics, rubber, paint, paper and electrical goods (UNEP, 2002)
Toxaphene	Most heavily used insecticides during the 1960s and 1970s in the US (Barrie et al., 1992) Similar products still used in other countries, including Mexico, Central America, Eastern Europe and Russia
Hexachlorocyclohexane (HCH)	Uses include insecticide and pesticide Total global consumption has been estimated at approximately 6 million tonnes (Lipnick et al., 2000) China was once the largest producer of HCH: approximately 4.5 million tonnes between 1945 and 1983 (Lipnick et al., 2000) Lindane, an isomer HCH, still used in North America, Japan and Europe

Industrial Chemicals

The second group of persistent organic pollutants is industrial chemicals such as PCBs and hexachlorobenzene. These industrial chemicals are produced either intentionally or as by-products of industrial processes. The status of industrial chemicals of concern for the Canadian Arctic is outlined in Table 5, and their uses are presented in Table 6.

TABLE 5

Status of Industrial Chemicals in the Canadian Arctic

Industrial Chemical	Status in Canada	Presence in Arctic
Hexachlorobenzene	Deregistered	Yes
PCBs	Restricted Use	Yes

(Source: AMAP, 1997, p. 186; NCP, 1997, p. 38)

TABLE 6

Persistent Organic Pollutants: Industrial Chemicals	
Chemical	**Use**
Hexachlorobenzene (HCB)	Used to kill fungi that affect food crops Major sources worldwide from combustion processes such as waste incineration, casing manufactures and pesticide use
Polychlorinated Biphenyls (PCBs)	Industrial uses: dielectrics in transformers and large capacitors; heat exchange fluids; paint additives; carbonless copy paper and plastics Used for a variety of industrial purposes in Japan, Russia, United States and Europe

(Source: AMAP, 1997, p. 186; NCP, 1997, p. 38; UNEP, 2002)

Unintentionally Produced By-Products

The final class of persistent organic pollutants comprises the unintentionally produced products of industrial processes. In the incineration of various wastes, dioxins and furans are produced and emitted into the environment. The status of dioxins and furans is outlined in Table 7. Table 8 outlines the use of dioxins and furans as well as related health effects.

TABLE 7

Status of By-Products in the Canadian Arctic

By- Products	Use in Canada	Presence in Arctic
Dioxins	N/A	Yes
Furans	N/A	Yes

(Source: AMAP, 1997, p. 186; NCP, 1997, p. 38)

TABLE 8

Persistent Organic Pollutants: Unintentionally Produced By-Products	
Chemical	**Source of Chemical**
Dioxins and Furans	Result of accidental synthesis at high temperatures Both are a result of the production of other chemicals, including pesticides and other chlorinated substances By-products from incineration of hospital wastes, municipal wastes, hazardous wastes; car emissions; incineration of coal, peat and wood; and chlorine bleaching in pulp and paper mills

(Source: AMAP, 1997, p. 186; NCP, 1997, p. 38; Leighton, 1993, p. 74)

The persistence, bioaccumulation and toxicity of POPs are properties that favour their long-range transport to the Arctic and increasing levels in both the environment and humans. As a result, a number of health implications have recently been linked to the levels of POPs in the fatty tissue of humans.

Effects on Human Health

All human populations have been exposed to some sort of persistent organic pollution at some point in time, and store contaminants as a result. Increasing evidence indicates that chemicals in the environment can have adverse health effects on both humans and animals (Krimsky, 2001; Damstra, 2002; Carpenter, Arcaro, & Spink, 2002). In the United States alone, pesticide use has been linked to over 20,000 cases of cancer per year (Environment Canada, 1998). Studies of exposure levels considerably higher than those encountered by the general population found evidence of adverse health effects such as thyroid and liver cancer, developmental and reproductive abnormalities, immune impairment, neurodevelopment changes, reproductive toxicity and reduced birth weight (Damstra, 2002).

Humans are exposed to pollutants, in either chronic or acute doses, through various means, including diet, occupation, accidental exposure and the environment (Ritter et al., 1995). Most human exposure to pollutants comes from dietary sources (Abelsohn, Gibson, Sanborn, & Weir, 2002). Acute exposure occurs when the contaminant is supplied in one large pulse, while chronic contamination occurs when the contaminant is applied in lower concentrations over an extended period of time (Harrison, 1999, p. 339).

Regardless of the chemical, exposures to POPs have significant adverse effects on human health at all levels: local, regional and global. In many developing countries accidental high-level exposure, common for workers in tropical agriculture, has resulted in a large number of deaths and injuries. In a study conducted in the Philippines in 1990, short-term exposures to high concentrations of endosulfan were found to be a significant source of occupational risk (Ritter et al., 1993). Endosulfan poisoning among subsistence rice farmers and mango sprayers was found to be the leading cause of pesticide poisoning. However, due to the socio-economic importance of agriculture, the use of and exposure to toxic contaminants by workers in developing countries is difficult to reduce. A question of particular concern is whether adverse health effects can result from chronic, low-level background exposure levels; more specifically, whether infants and children are more vulnerable because they are developing and growing, have reduced levels of detoxifying enzymes and smaller fat deposits for sequestering lipophilic POPs (Abelsohn et al., 2002, Carpenter et al., 2002; Jacobson & Jacobson, 2002).

Most research on the effects of chemicals on biological systems has been conducted on one chemical at a time (Carpenter et al., 2002). People are generally exposed to mixtures or to a number of chemicals, not single chemicals. The effects of a chemical mixture are extremely complex and may differ for each mixture depending on the chemical composition. This complexity is the major reason that mixtures have not

been well studied, and thus the effects of chemicals on human health and the environment remain uncertain (ibid.).

One of the first warning signs of the harmful effects of chemicals on human health emerged during the 1960s in Japan when PCBs from electrical equipment leaked into rice oil during the manufacturing process (Jacobson & Jacobson, 2002). Symptoms developed both in adults and in children born to women who had consumed the rice oil. Adults developed skin rashes and experienced parethesias, while infants displayed more severe signs, including dark pigmentation in the skin and nails, early eruption of teeth and swollen eyelids and gums, dermatological signs known as "Yusho" signs (ibid.).

Ten years later, a similar accident in Taiwan resulted in similar consequences. Infants and children exposed to chemicals displayed cognitive and neuropsychological problems known as "Yu Cheng" (Jacobson & Jacobson, 2002). Studies later completed found that the children had significantly higher prevalence of middle-ear diseases (Chao & Hsu, 1997; Jacobson & Jacobson, 2002).

Studies concerning elevated levels of PCBs in Lake Michigan fish were completed during the 1970s. Results from this study revealed that PCB exposure was elevated in a sample of children born to women who consumed relatively large quantities of Lake Michigan fish (Jacobson & Jacobson, 2002). Exposure to PCBs was found to be associated with lower birth weights, smaller head circumferences and shorter attention spans compared to babies whose mothers did not eat fish. Poorer intellectual functions, including poorer recognition and memory in infancy, lower scores on a preschool IQ test and poorer verbal IQ and reading comprehension at 11 years of age were also associated with exposure to PCBs (Jacobson & Jacobson, 2002; Abelsohn et al., 2002).

Developmental Problems

Fetuses are very sensitive both to the natural hormones that guide their development and to other foreign chemicals that reach them (Colborn, Dumanoski, &

Myers, 1997, p. 86). While the fetus is developing, chemical exposure has the potential to adversely effect its development, and thus disrupt fetal growth. Enhanced vulnerability to chemicals reflects the sensitivity of the developing brain, especially with respect to migrating neurons and cells undergoing mitosis. The fetus also lacks important protective mechanisms, such as the blood–brain barrier and drug-metabolizing capacities, that may provide protection to the nursing infant (Damstra, 2002). In the early development stages, chemical exposure can cause the developing mass of cells to fail to implant (Thornton, 2000, p. 134; Damstra, 2002). One study indicates that PCBs might deplete circulating thyroid hormones that are important in regulating early central nervous system development (Damstra, 2002). Exposure at later stages of pregnancy may cause the embryo to die. Later disruptions due to exposure may cause miscarriage, stillbirth, birth defects, low birth weight and functional impairments (Thornton, 2000, p. 134).

As previously discussed, a number of studies have been completed on children with high *in utero* PCB exposure from mothers who ate two to three meals per month of fish from the Great Lakes (Krimsky, 2001, Colborn et al., 1997, p. 190). The children who exhibited neurological and neurodevelopmental abnormalities performed significantly worse on intelligence tests and displayed delayed neuromuscular development compared to children who were not exposed to such high levels of PCBs.

Thyroid Problems

Thyroid hormones control metabolism and growth in living organisms. Essential for normal reproduction, they are critical to brain development in the fetus. They also play an important role in learning, memory, auditory function and behaviour (AMAP,

1998, p. 213; Colborn et al., 1997, p. 188). Contaminants are able to attach to the binding sites on the protein complex in plasma and disrupt the normal transport of thyroid hormones and vitamin A. When there is an imbalance in vitamin A, a number of health-related complications may result, including immunosuppression, susceptibility to cancers and disruption of reproduction, growth and development.

Endocrine Disruption

Concerns regarding to exposure to chemicals known as endocrine disruptors are primarily due to adverse effects observed in certain wildlife, fish and ecosystems and to increased incidence of certain endocrine-related human diseases (Damstra, 2002).

Due to the intricacy of the endocrine system, POP exposure has repercussions for immune systems, development and reproductive systems. The endocrine system coordinates and regulates internal communication among cells; for example, it regulates growth, menstrual cycling and metabolism (Environment Canada, 1999; Krimsky, 2001; Colborn et al., 1997, p. 32). Furthermore, the endocrine system releases hormones that act as chemical messengers that interact with receptors in cells. This triggers responses and prompts normal biological functions including growth, embryonic development and reproduction.

What has caused concern in the scientific community is the ability of POPs to disrupt the endocrine system in an exposed organism. Natural hormones send chemical messages to receptors on the surface of and inside cells, which results in the production of protein (Krimsky, 2001). The receptor molecules bind to the body's natural hormones and transmit the hormones' instructions to the cell's DNA. POPs act as hormone

disruptors and interfere with the normal communication between the messenger and the receptor in the cell, either by mimicking or obstructing so the message is not interpreted properly (Guidotti & Gosselin, 2000, p. 189). Even the most minimal effects of POPs can result in changes in the endocrine system, affecting growth, development, reproduction and behaviour, thus influencing not only the exposed organism itself, but also generations to follow.

While scientists have yet to link contaminants directly to diseases such as cancer, it is known that contaminants do have an impact on the immune system. Persistent organic pollutants erode the immune system, thereby leaving it unable to defend against infection (Krimsky, 2001). Research continues on links between endocrine-disrupting chemicals and diseases, declining sperm count, reproductive cancers and neurological disorders (Krimsky, 2001; Eckley & Selin, 2001). Within the major industrialized regions of the world there have been declines in the density and quality of human sperm. Estrogens are known to activate the growth of certain classes of cancer cells, namely breast cancer. However, strong scientific evidence linking endocrine disruptors and cancer is still in question.

Health Effects on Wildlife

Health concerns about chemical exposure originally stemmed from studies of wildlife communities that showed reproductive, developmental, endocrine, immunologic and carcinogenic effects (Carpenter et al., 2002). These studies found that animals had high rates of malformed genitalia, aberrant mating behaviour, sterility, cancer and immune system and thyroid dysfunction. Toxicological and laboratory studies confirmed

the links between POP exposure and effects observed in these studies (Carpenter et al., 2002).

In wildlife the results of industrial chemical or pesticide exposure have included deformities and embryo mortality, impaired reproduction and development in fish, and developmental abnormalities in a number of wildlife species (Environment Canada, 1999; Krimsky, 2001). DDT, PCBs and dioxins can alter the fundamental growth and development of cells in wildlife and possibly result in cancer and adversely affect reproduction and development. Extensive evidence has been found from fish studies that chemicals in pulp-and-paper mill effluents and sewage treatment effluents can affect reproductive endocrine function and contribute to alteration in reproductive development. The reproductive and immune function of some marine mammals such as Baltic seals has been impaired due to endocrine disruptors, resulting in marked declines in population (Damstra, 2002).

A number of field studies carried out in PCB - and DDT- contaminated areas have found that the health of wildlife populations has been compromised due to exposure. The declining populations of alligators in Florida were found to have high levels of DDT, along with genital abnormalities and difficulties reproducing (Colborn et al., 1997, p. 6; Eckley & Selin, 2001; Krimsky, 2001). Other organisms such as molluscs developed a condition called "imposex" when exposed to chemicals, in which the females develop male sexual organs (Krimsky, 2001). Other studies have revealed low reproductive rates in beluga whales in the Gulf of St. Lawrence and abnormal sexual behaviours in bald eagles and gulls from the Great Lakes (Colborn et al., 1997, p. 143; Guidotti & Gosselin, 2000, p. 189). Scientists in Svalbard have recently found that 1% of the island's polar

bears are hermaphroditic which is thought to be caused by exposure to chemicals (World Wildlife Fund Canada, 2002; Kirby, 2000).

Summary

The physiochemical characteristics of POPs, including stability and persistence, result in their long-range transport from original point sources. POPs are transported to the Arctic by atmospheric processes and ocean currents from distant sources, where they are resistant to chemical or biological degradation; as a result, they remain in the environment and bioaccumulate in the food chain. Pesticides, industrial chemicals and unintentionally produced by-products are the three classes of POPs that are of concern in the Canadian Arctic. Levels of POPs in human tissues have recently been linked to a number of health implications, such as thyroid and liver cancer, developmental and reproductive abnormalities, immune impairment, neurodevelopmental changes, reproductive toxicity and reduced birth weight. Similar adverse health effects have been found in wildlife.

Chapter three has provided the fundamentals of the problem of POPs, including their characteristics and general effects on the health of humans. These fundamentals are significant for obtaining a meaningful understanding of the problem of POPs in the Canadian Arctic. The following chapter will examine the sources and levels of POPs in the Arctic as well as specific effects on the local environment and population.

Chapter 4: Persistent Organic Pollutants in the Canadian Arctic

Introduction

The unique characteristics of the Arctic environment make it particularly susceptible to the effects of persistent organic pollutants (POPs). Distant sources of POPs are the major source of contamination found in the Canadian Arctic. Local sources of POPs within the Canadian Arctic have not proven to contribute significantly to levels of contamination (Muir, 1997, p. 55). Large amounts of POPs used in developing countries and countries with economies in transition make their way into the North. Many developing countries continue to rely on POPs to sustain or improve quality of life, especially in agriculture and health. However, the transport of POPs to the North has harmful implications for residents of the Arctic. Due to their reliance on country foods, aboriginals have been found to have higher levels of POPs in their bodies. Evidence from other regions suggests that POPs adversely affect the health of humans.

Chapter 4 outlines the unique characteristics of the Canadian Arctic environment, and explains why it is vulnerable to POPs. It also briefly introduces the history of Canadian Arctic contamination. Finally, this chapter provides a summary of the local and distant sources of POPs and the levels of POPs found throughout the Arctic environment and in country foods.

Characteristics of the Canadian Arctic Environment

Home to over 100,000 people, the Canadian Territorial North occupies over 4 million square kilometres of land (Bone, 2000, p. 442). This region is characterized by the cold environment, which consequently slows the growth of biological life, natural vegetation and soil formation (Bone, 1992, p. 17; AMAP, 1998, p. 149). Low temperatures coupled with the little precipitation that the North receives makes this region among the least productive biological areas of the world (Bone, 1992, p. 17). The

slow rate of biological life causes the environment to recover slowly from natural or anthropogenic damage (Bone, 1992, p. 17).

Cold

As a result of the tilt of the earth's axis, the high Arctic experiences no solar radiation during most winter months but constant sun during the summer months, which causes extreme temperature differences between winter and summer (Lange, 2000, p. 533). Over 50% of the total radiation is received in the late spring and early summer months, melting the snow and ice cover (AMAP, 1998, p. 118).

As a result of the low temperatures, soils are frozen for most of the year and are very immature, thereby shortening the length of the growing season in the North. Soils in this region can only support quick-maturing and shallow-rooted plants. Low temperatures affect biological and physiological processes, slowing the rate of biological activity such as the growth of natural vegetation (AMAP, 1997, p. 36).

Cyclic Annual Productivity

Due to low temperatures and seasonal fluctuations in nutrient inputs and light, ecosystems in the Arctic are highly cyclical (Matveyeva & Chernov, 2000, p. 234; AMAP, 1997, p. 37; NCP, 1997, p. 194). Low productivity in the Arctic is primarily due to low levels of nutrient input (NCP, 1997, p. 195). Biota in the Arctic make physiological and behavioural adaptations to the cyclic productivity in two ways. The first is the ability to consume and store energy and nutrients when food is available and to metabolize lipids from stored energy when only limited food is available (AMAP, 1997,

p. 37). The second adaptation in Arctic biota is migratory behaviour. Species in the North will migrate to over-wintering, feeding and/or spawning and breeding habitats. During periods of starvation, contaminant intake may be affected when Arctic species metabolize body fats and therefore contaminants. Body burdens of POPs may be effectively isolated when fat reserves are high and may become metabolized during periods of starvation or during a poor feeding season (NCP, 1997, p. 195). Due to the low productivity of the Arctic, organisms grow a lot more slowly than organisms in southern regions. As a result, organisms are exposed to contaminants for a longer period of time before being consumed (ibid.).

Arctic Ecosystems and Food Chains

Distinguishing characteristics of the Arctic's physical environment that influence terrestrial and marine ecosystems are the persistent cold temperatures, freeze–thaw cycles, prolonged ice cover and the extreme seasonality of solar radiation (Vincent and Hobbie, 2000; Matveyeva & Chernov, 2000, p. 234). Therefore, terrestrial ecosystems in the Arctic are characterized by slow growth, high degree of adaptation and well-developed response strategies, while marine ecosystems are unusually simple in their overall characteristics (Lange, 2000, p. 533).

Food chains in the North are relatively short, and they are associated with simple predator-prey relationships (AMAP, 1997, p. 40). The lower levels of the food chain are characterized by species such as caribou, muskoxen, ptarmigan and arctic hares, while the higher level species found in the North include terrestrial and marine mammals such as polar bears, beluga whales and seals. Though the food chain is relatively short, there is

an abundance of individuals at each species level. Due to a lower number of species in any given area, food chains in the North are simple with few species existing higher up in the food chain. Diversity within the food chain is associated with the ability of a species to adapt and survive the range of conditions that exist in the North, by adjusting feeding habits, growth rates, migration patterns and reproductive patterns according to either climatic factors or food availability (Stonehouse, 1989, p. 136). As a result, some species have been able to make adaptations to long periods of starvation.

Food webs are a series of overlapping food chains that link plants and animals together in feeding relationships and involve organisms that eat one another (NCP 2003a, p. 116). They are more complex than food chains, as organisms often form part of more than one food chain. As a result, the flow of contaminants and energy from one species to another is complicated (NCP 2003a, p. 116). For example, biomagnification continues at each link in the food web, thereby resulting in a bigger dose for species at the top (NCP 2003a, p. 36).

Foods consumed by Arctic residents are often higher up in the food chain than in southern latitudes and include high-level carnivores such as seals, walruses and polar bears (NCP, 1997, p. 194). Because energy transferred within in the arctic food chain is in the form of lipids, lipid-soluble contaminants are also transferred.

The extreme conditions of the Canadian Arctic will affect the recovery rate of the natural environment from natural or anthropogenic damage. Low temperatures, large seasonal fluctuations in incoming solar radiation, short growing conditions and characteristics of the terrestrial and marine ecosystems make the North an easy environment for POPs to linger in (AMAP, 1997, p. 117). Arctic conditions such as

productivity, species diversity, wildlife migration and food chain characteristics can affect contaminant transfer and storage in Arctic biota, and influence the sensitivity of Arctic ecosystems to contaminants and other stressors (ibid.).

History of Canadian Arctic Contamination of POPs

The presence of contaminants in the Arctic became evident soon after World War II when pilots reported seeing a thin brown haze in the Western Canadian Arctic in late winter and early spring (Bridgman, 1990, p. 163). The phenomenon that became known as "Arctic haze" increased and spread across the circumpolar north. The haze consisted of particles, mainly soot, hydrocarbons, and sulphates of industrial origin (ibid.). Studies later revealed that the particles originated largely from heavily polluted regions of Europe and Asia (ibid., p. 164). Arctic haze was one of the first signs that the northern environment is connected to distant regions of the world.

It was not until the mid-1970s that it became evident that persistent pollutants had reached the Arctic from distant sources and were accumulating in the ecosystem. It was at this time that monitoring of contaminants in the North was initiated. It included the reporting of specific POPs, such as dioxins, furans and PCBs, which had been detected throughout the Arctic environment (Muir, 1999). After significant scientific findings during the mid-1980s, including the identification of contaminants in marine mammals in the Canadian Arctic, concerns surrounding the presence of contaminants increased (Halsall, 2000, p. 212). Contamination of marine mammals in the Canadian Arctic was identified when chlorinated pesticides and PCBs were found in the blubber and fatty tissues of ringed seals on Baffin Island (Holden, 1970; Holden, 1978). A short time later,

more detailed reports revealed DDT-related compounds and PCBs in ringed seals and beluga whales (Addison & Smith, 1974). At this time, studies that had found contaminants in polar bears were also released (Bowes and Jonkel, 1975). Evidence of the presence of contaminants in the North continued to be collected and extensive research and analysis were undertaken in the late 1980s. An understanding of the effects of contaminants in the environment had only just begun.

Local Sources of Contamination

There are few local sources of POP contamination in the Canadian Arctic. The bulk of such contamination is a result of either accidental spills or inappropriate disposal of chemicals. A good example of this would be combustion from the incineration of municipal garbage or the use of pesticides for the control of insects in the Canadian Arctic (Reimer, Bright, Dushenko, Grundy, & Poland, 1993).

PCBs used at military sites in many circumpolar countries have been found to contaminate their local environments. Sources of such pollution in the Canadian Arctic are the Distant Early Warning (DEW) line sites, which contained drums of contaminated oils, discarded electrical equipment and contaminated soils. PCBs were found to have entered the local terrestrial and aquatic environment from landfills, down-the-drain disposal and accidental or intentional spills (Reimer et al., 1993).

PCBs from other local sources contaminate the environment in the Canadian North. PCBs have been used in hydraulic and drilling fluids in mines as well as in oil wells and in electrical transformers. Other sources are emissions from smelters and chlorine-bleached pulp-and-paper mills (Environment and Health Canada, 2000).

Communities in the Arctic are themselves sources of contamination. Settlements

along the Arctic coasts and major Arctic rivers discharge wastewater containing sewage and industrial effluents. Solid wastes are dumped in landfills or incinerated (Reimer et al., 1993). The extent to which settled areas of the Arctic cause local pollution is not presently known. It is understood that landfills are a possible source of long-term pollution due to the leaching of contaminants.

There are a number of pesticides that have been used in the Canadian Arctic for a variety of uses (Environment and Health Canada, 2000). PCBs have been used for the control of insects in and near populated areas in the Arctic, as rodenticide in the treatment of stored grains and other foods, and for medical uses. DDT was used as an insecticide at DEW line sites, by direct application in the Yukon River (Reimer et al., 1993). Along the Athabaska and Saskatchewan Rivers, spraying and ground fogging were used to control mosquitoes (AMAP 1998, p. 194).

While there are local sources of POPs in the Canadian Arctic, they are of little concern due to the small quantity that they release into the local environment. Distant sources have become more of a concern because they contribute much more pollution to contaminant levels found in the Arctic environment and human populations. However, local sources of contamination have provided opportunities for researchers to study the uptake, accumulation and biological effects over a range of contaminant levels which are beneficial in their application to ecological and human health risk assessments (NCP, 2003b, p. 183).

Distant Sources of Contamination

Limited national and global estimates have been made on the production, emissions and use of a number of persistent organic pollutants. However, gaps in available information make a complete analysis difficult. While initial studies have been done in order to understand the fate, behaviour and effects of POPs, there remains a deficiency in detailed information, especially regarding the emissions of POPs (Breivik et al., 1999). Production and use data fluctuate and can often vary from source to source, thereby making it difficult to determine which countries are producing, using or exporting POPs (Schmidt, 1999). Other information gaps are attributed to the fact that many countries lack the resources for compiling information on sources and emissions of POPs (K. Breivik, personal communication, November 21, 2002). Governments and industries alike are reluctant to release production numbers. Finally, POP emission inventories have not been a priority on the research agenda (ibid.).

Available information pertaining to total production and use by specific countries is only an indication of the quantities of POPs being produced, used and released. There are a number of countries that still produce, use, and emit POPs and as a result are sources of contamination for the North. This can be best exemplified by hexachlorocyclohexane (HCH), which was prohibited in most western countries and Japan in the 1970s (see Table 9) (NCP, 1997, p. 48; Li & Bidleman 2003, p. 50). HCH, used for both agricultural and non-agricultural purposes, is one of the most studied pesticides (Breivik et al., 1999).

TABLE 9

Estimated HCH and Lindane Usage in Tonnes (1980 & 1990) for Highest Consuming Countries

Country	HCH 1980	HCH 1990	Lindane 1980	Lindane 1990
China	200521	0	42969	100
India	15100	32900	3376	7050
Former Soviet Union	11718	17528	2511	3756
Former East Germany	2626	84	563	18
Argentina	1470	0	315	not available
Canada	not available	not available	200	284
United States	not available	not available	268	114
Mexico	105	1218	23	261
South Korea	84	0	18	not available

(Source: NCP, 1997, p. 48)
* not available – data was not collected

HCH is the major organochlorine insecticide detected in Arctic air and seawater (Barrie et al., 1992; NCP, 1997, p. 48). China, India and the former Soviet Union have all been found to be major emitters of HCH (see Table 10), including lindane, a form of the chemical HCH. The use of a mixture of HCH isomers is known as technical HCH (Lipnick et al., 2000; Breivik et al., 1999).

TABLE 10

Top 10 countries with highest technical HCH use

Country	Usage (kilo tonnes)	Year of Ban
China	4464	1983
India	1057	Unknown
Former Soviet Union	693	1990
France	520	1988
Egypt	479	1981
Japan	400	1972
United States	343	1976
Germany (East)	142	1982
Spain	133	1992
Mexico	132	1993

(Source: NCP, 2003b, p. 50)

Global consumption of technical HCH has been estimated to be approximately 9.7 million tonnes from 1943 to 1997 (Li & Bidleman, 2003, p. 50). The major emitter of technical HCH has been China, which produced approximately 4.5 million tonnes

between 1945 and 1983. In 1983 China switched to lindane, an isomer of HCH. Russia also prohibited the production and use of technical HCH in the late 1980s. India prohibited the use of technical HCH for agricultural purposes, but allowed its continued use in public health. Since the ban of technical HCH in China, Russia and India, levels have declined in the Arctic environment (Lipnick et al., 2000).

Toxaphene has been one of the most heavily used pesticides (Voldner & Li, 1995). It has been estimated that toxaphene has had a cumulative usage of 1.33 mega tonnes, with the United States having consumed the highest amount, approximately 490 kilo tonnes. The use of toxaphene has been prohibited in 55 countries, never produced or used in one country, severely restricted in twenty, never registered in two, deregistered and voluntarily withdrawn by manufacturer in four and not prohibited in twenty-one countries (Li & Bidleman, 2003, p. 61). Examples of countries that have not prohibited the use of toxaphene include Bangladesh, Chile, Greece, Israel, Malaysia and Spain.

From 1946 until 1972, DDT was the most widely used agricultural insecticide used for controlling insects on agricultural crops and insects carrying diseases such as malaria and typhus (Li & Bidleman, 2003, p. 65). The top ten countries with the highest DDT use in agriculture between 1948 and 2000 are listed in Table 11.

TABLE 11

Top 10 countries with highest DDT use between 1948 and 2000

Country	Usage (kilo tonnes)	Year of Ban
United States	590	1972
Former Soviet Union	320	1971
China	260	1983
Mexico	180	no information
Brazil	106	1998
India	75	no information
Egypt	66	1972
Guatemala	60	1985
Italy	46	no information
Hungary	43	no information

(Li & Bidleman, 2003, p. 68)

As of 1995, DDT has been prohibited in 59 countries, severely restricted in twenty, never registered in two countries, unregistered and voluntarily withdrawn in one country and not prohibited in thirteen countries (Li & Bidleman, 2003, p. 65). Countries that have not yet prohibited the use of DDT include Honduras, Malaysia, New Zealand and Peru.

Emissions of pesticides and PCBs have been calculated in order to create a database of historical, present and predicted global usage of contaminants; however, this inventory is still incomplete (see Table 12) (NCP, 1997, p. 48). For selected pesticides and PCBs an estimate of global cumulative usage was derived (NCP, 1997, p. 48).

TABLE 12

Estimated Global Usage of Certain POPs

Persistent Organic Pollutant	Use	Time Period	Estimated Total Usage (mega tonnes)
PCBs	commercial	1930-1992	1.20
DDT	pesticide	1950-1992	3.59
Toxaphene	pesticide	1950-1992	2.00
Lindane	pesticide	1950-1992	0.72
Chlordane	pesticide	1945-1988	0.07
Aldrin	pesticide	1950-1992	0.50
Dieldrin	pesticide	1950-1992	0.03
Endosulfan	pesticide	1956-1992	0.05

(NCP 1997, 48)

There are continuous improvements in the technology used in the identification of distant sources of transboundary air pollution. A recent breakthrough has been the development of a technique which can identify the age and source of some of the contaminants. POPs are characterized by right - and left -handed molecules that are mirror images of each other. Newer formulations of POPs have equal amounts of both molecules. Differences in the way the molecules are metabolized in the biological system, either by microbes or enzymes, change the ratio as the chemical ages (Environment Canada, 1998). To determine how long the contaminant has been travelling, an analyst separates the molecules. This technique will also determine whether

they have spent time on land or in water. The final step in identifying the source region is to compare the results with weather records. From this technique, scientists have been able to find where the chemicals originated.

Another method in determining exactly where POPs originate is atmospheric monitoring, which Canadian technology has enabled the Canadian Global Emissions Interpretation Centre to do. Through this type of monitoring the Centre is able to determine pesticide application activities by region, time and mode of application, properties, and meteorological conditions. Improved ability to detect and track the accumulation of POPs in the ecosystem has resulted from these Canadian efforts (Environment Canada, 2001).

Historical data on the global production and use of chemicals such as PCBs are needed for the interpretation of historical, present and future contamination levels around the world (Breivik et al., 2002). There continues to be a need for studies to quantify sources of persistent organic pollutants due to the increasing evidence of the health implications that POPs have on the environment and humans.

Level of POPs in the Canadian Arctic

Many of the most toxic persistent organic pollutants have been found in some proportion throughout the Arctic environment and its food chain. This has harmful implications for residents of the North who rely on country food. "Country food" refers to the food harvested from land and waters, such as land and marine mammals, fish, birds and some plants (Inuit Tapiriit Kanatami, 2002; Usher et al., 1995, p. 1). Food is the primary route for human exposure to contaminants in the Arctic. A number of marine and

atmospheric research projects have been undertaken to determine the level of contaminants found in both the environment and in residents of the Canadian Arctic (Van Oostdam et al., 1999). Recent data regarding POP contamination in various Canadian arctic mammal species showed concentrations of DDT, PCBs, toxaphene and chlordane in sea mammal blubber (Ayotte, Dewailly, Bruneau, Careau, & Vézina, 1995). Many of the traditionally harvested country foods are long-lived land and marine mammals from the highest levels of the food chain, thereby resulting in bioaccumulation and biomagnification of contaminants (NCP, 2003c, p.4).

DDT and PCBs in seals were found in the early 1970s (Holden, 1978); a short time later, high levels were found in polar bears (Bowes & Jonkel, 1975). From this point in time, there have been increasing reports of contaminants in Arctic biota, especially in marine fish and sea birds. Ringed seals, which feed on fish and crustaceans, have recently been found to contain PCBs, chlordane and DDT (AMAP, 2002, p. 20). While the level of POPs such as DDT have been decreasing to below 1975 levels in some ring seals, increasing levels of new contaminants are of greater concern (NCP, 2003b, p. 43). Levels of brominated flame retardants in seal blubber are now nine times higher than they were 1981. Perfluorooctane sulfates, which are used in fire-fighting foams and to protect carpets from stains, are now starting to appear in the blood of ring seals (NCP, 2003b, p. 43).

The levels of POPs, in particular PCBs and DDT, have been found to increase from west to east, with the lowest levels in Alaska and the highest in Baffin Island. In studies comparing levels of contaminants in seals across the circumpolar north, levels are highest in seals from the Canadian Arctic (AMAP, 2002, p. 20).

HCH, DDT, PCBs, toxaphene, chlordane and HCB were at one time found in high levels in the Arctic atmosphere, but they have declined over the past 5 years (NCP, 2003b, p. 32; Barrie et al., 1992; Muir et al., 1992). Many countries have since prohibited or restricted the use of these POPs. Decreases of HCHs and toxaphene are undoubtedly a result of international controls on their production and use (NCP, 2003a, p.21). While many countries have restricted or discontinued the use of dieldrin and endosulfan, their levels in the Arctic environment have not declined. Levels of lindane in the North are expected to remain the same for some years due to residues in Canada, France and China (NCP, 2003b, p. 32).

A recent study of the status of contaminants in fish and marine mammals of the Inuvialuit Settlement Region (ISR) found very high levels of contaminants in marine mammals (Macdonald, 2000). High concentrations of PCBs, chlordane and toxaphene were found in polar bears and beluga whales in the ISR. The study included a comparison with contaminant levels found in other regions of the Arctic and found that levels were equal to or lower than levels reported in other regions (Macdonald, 2000). Table 13 outlines a summary of major contaminants found in Arctic species according to the study's findings for the ISR.

TABLE 13

Major Contaminants found in ISR Species

Contaminant	Source	Species with Highest Levels	Target Site
HCB	Industrial by-products	Polar bear, beluga	fat
HCH	Insecticide still used in Asia	Polar bear, beluga	fat
DDT	Insecticide still used in Asia and C. America	Polar bear, beluga, walrus	fat
PCBs	Discontinued industrial product	Polar bear, beluga, walrus	fat
Chlordane	Discontinued insecticide	Polar bear, beluga	fat
Toxaphene	Discontinued insecticide	Beluga, walrus, freshwater fish	fat
Dioxins/Furans	Industrial by-products	Marine species	fat
Dieldrin	Discontinued insecticide	Polar bear, beluga	fat

(Macdonald, 2000)

In the Arctic, many animals go through periods of fasting, when they use stored fat for energy (AMAP, 2002, p. 27). This can lead to an increase in contaminant concentrations in the remaining fat. Periods of starvation can result in high concentrations of POPs as most dissolve in fat and accumulate in fatty tissue of animals, in the liver or parts of the body that specifically store fat. Contaminant concentration in the tissues of animals increases the risk that sensitive systems such as the brain or reproductive organs will be exposed to toxic levels (AMAP, 2002, p. 27).

A number of new chemicals have been found in the Arctic environment and biota (NCP, 2003d, p. 103). New POPs that have been found in low levels include brominated flame-retardants, which are added to materials to reduce the chance of fire, and chlorinated paraffins (PCAs) (NCP, 2003b, p. 32). Levels of short-chained chlorinated paraffins (SCCPs) and chlorinated naphthalenes have been found in belugas and ringed seals (NCP 2003d, p.103). Other POPs now being detected in the North are polychlorinated naphthalenes (PCNs) and different types of PCBs (NCP, 2003a, p. 23).

Country Food Contamination

Residents of the Canadian Arctic depend on many of the marine and land mammals as well as other Arctic species for their dietary needs. Country food is essential for Northerners not only for their diet, but also for their social, cultural and spiritual health. Country food includes many of the Arctic animal species that have been found with high levels of contamination such as polar bears, seals and Arctic char. Such contamination has become a priority issue for Northern residents.

Marine mammals and fish are rich in polyunsaturated fatty acids, which have been associated with lower risk of heart disease in Greenland and Canada's North (AMAP, 2001). Marine foods are also rich in selenium, which provides the body with antioxidant defence and may protect against cancer and heart disease. Finally, traditional diets provide protein as well as the many vitamins and essential elements necessary for the health of Northern residents (Furgal, Craig, Shortreed, & Keith, 1999). Traditional diets provide a strong nutritional base necessary for the health of Arctic residents while imported or market foods tend to have less nutritional value and are high in fat and carbohydrates.

There are a number of factors other than nutrition that make the availability of traditional country foods necessary. For aboriginal peoples in the Arctic, traditional foods are important to cultural identity and are associated with physical health and well-being. Hunting, fishing and consuming country foods are an integral part of a sense of community (Van Oostdam et al., 1999; Usher, 1995, p. 1). Participation in subsistence is also an important aspect of aboriginal communities: the giving, receiving and consuming of traditional foods. The act of harvesting and sharing ensures that individuals within the

community have access to traditional foods and strengthens cultural and societal ties (Wenzel, 1995). Finally, traditional foods are economically necessary in Arctic communities due to high prices of imported foods and low employment rates.

Human Exposure to Contaminants

Contaminant exposure is often of greater concern for mothers and infants due to the contaminant transfer through the placenta or mother's milk. Therefore, human milk has often been used for measuring contaminants and the intergenerational transfer of contaminants (Van Oostdam et al., 1999). If inadequate milk data was available then cord blood, which is also a good indicator of intergenerational transfer of contaminants, has been used.

During the late 1980s, the mean intake of chlordane and toxaphene by Inuit of Baffin Island exceed the Canadian dietary guidelines. Studies undertaken from 1988 to 1989 indicated that the Baffin Inuit mean intake continued to exceed guidelines for chlordane and toxaphene (AMAP, 2002, p. 85). Some preliminary data released in 1989 indicated that the breast milk of Inuit women from the east coast of Hudson Bay contained unusually high concentrations of PCBs (Ayotte et al., 1995). A follow-up study in 1990 found levels of PCBs, heptachlor, epoxide, hexachlorobenzene, chlordane, dieldrin and endrin in the breast milk of Inuit women (Ayotte et al., 1995).

The "level of concern" for maternal blood guidelines for PCBs as determined by Health Canada are set at five micrograms per litre and the "action level" at concentrations exceeding 100 micrograms per litre (AMAP, 2002, p. 89). Although none of the samples

taken from Inuit women from both Northwest Territories and Nunavut exceeded the "action level," approximately 16% to 73% exceeded the "level of concern."

Inuit from northern Quebec exhibited unusually high body burdens, which are attributed to their location at the highest trophic level of the aquatic food web (Ayotte et al., 1995). A comparison of mother's milk in southern Quebec and Inuit in Northern Quebec was undertaken to determine the level of contaminants in human fatty tissue (NCP, 1997, p. 352). As Table 14 indicates, the levels of contaminants in Inuit women from northern Quebec were considerably higher than in women from southern regions of Quebec. As indicated in the previous chapter, there are a number of potential health effects that may result from infants receiving contaminants from their mother's milk.

TABLE 14

Comparison of Contaminant Levels Found in Human Milk: Arctic Quebec	
DDT	Arctic Quebec were four to five times greater than Southern Quebec
PCBs	Arctic Quebec were four to five times greater than Southern Quebec
Mirex	Arctic Quebec were ten times greater than Southern Quebec
Chlordane	Arctic Quebec were ten times greater than Southern Quebec
HCHs	Arctic Quebec were five times greater than Southern Quebec
HCB	Arctic Quebec were five to nine times greater than Southern Quebec

(NCP, 1997, p. 352)

Intake of contaminants in Arctic populations is entirely dependent on the type and amount of traditional or country food consumed (Van Oostdam et al., 1999). For example, in the Eastern Arctic there is more reliance on marine mammals than in the Western Arctic. Marine mammals such as narwhals and beluga whales have higher levels of toxaphene than other species found in the region; therefore, exposures of eastern Inuit are greater (Muir et al., 1992). Land and marine mammals are long-lived, and many form the higher trophic levels of the food chain; therefore, they are greater sources of contaminants to their consumers due to bioaccumulation and biomagnification (Van Oostdam et al., 1999; Kinloch et al., 1992). Arctic populations relying on these land and

marine mammals are then exposed to the contaminants that they have accumulated over time. Currently, there are limited data available on the levels of certain POPs in the tissues of Arctic Inuit populations. Research, however, is ongoing. These studies will be essential not only for the future health of Arctic populations, but also for setting the political framework for the prevention of the use of POPs by demonstrating the importance of eliminating their use, production and emission.

Spatial variation in contaminant levels can be best exemplified in the results of maternal/cord blood contaminant studies undertaken in the Northwest Territories, Nunavut and Nunavik in 1994 to 2000 (NCP, 2003c, p. 14). Levels of the major contaminants found most commonly in the maternal blood samples were chlordane, DDT, HCB, HCH mirex and toxaphene. The levels of chlordane, HCB, mirex and toxaphene found in the Inuit women were six to ten times higher than those found in Caucasians, Dene and Métis (NCP, 2003c, p.15). PCBs are also a major concern as Inuit mothers have the highest levels as compared to Caucasians, Dene and Métis (NCP, 2003c, p. 21).

Summary

Environmental conditions of the Canadian Arctic are favourable for accumulating and storing persistent organic pollutants originating from both local and distant sources. Low temperatures, large seasonal fluctuations of incoming solar radiation and short growing conditions make the Arctic an easy environment for POPs to linger in, and at the same time a difficult environment to recover from natural or anthropogenic damage. Local sources of POPs in the Canadian Arctic are of little concern due to the small quantity that they release into the local environment. On the other hand, distant sources

are of increasing concern as it has become evident that the Arctic has become the final "sink" for many of the POPs produced, used and released elsewhere in the world. This has potentially harmful socio-economic consequences for Arctic populations, as it threatens not only their food security and their traditional way of life, but also their health.

Recent international efforts have attempted to protect the environment and human health from the effects of persistent organic pollutants. The following chapter will outline these international efforts and summarize the *Stockholm Convention on Persistent Organic Pollutants*.

Chapter 5: International Action on POPs

Introduction

In recognition of the global threat of long-range transport of persistent organic pollutants, the international community has negotiated two separate environmental agreements. The initial agreement, under the auspices of the Economic Commission for Europe (UN/ECE), was a regional collaboration that included only member states from North America, Eastern and Western Europe and Russia (UN/ECE, 1997). Soon after the Protocol to the *1979 Convention on Long-Range Transboundary Air Pollution on Persistent Organic Pollutants* was initiated in the early 1970s, the need was acknowledged for a global convention to include all states. This second agreement, the *Stockholm Convention on Persistent Organic Pollutants* was initiated in the late 1990s and sponsored by the United Nations Environment Programme (UNEP).

Chapter five reviews the regional agreement developed under UN/ECE, the *Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Persistent Organic Pollutants*. This background information is necessary for understanding the initiation and establishment of the global agreement under UNEP, the *Stockholm Convention on Persistent Organic Pollutants*. Details of the Stockholm Convention are outlined in this chapter and will subsequently be used to analyze its potential to address the needs of the Canadian Arctic.

Regional Agreement: United Nations Economic Commission for Europe

In recognition of the adverse effects of transboundary air pollution, the *1979 Convention on Long-Range Transboundary Air Pollution* (LRTAP) was launched to

address the increasing problem of acid rain (Munton, Soroos, Nikitina, & Levy, 1999, p. 155; Selin, 2003, p. 113). The Convention was drafted after scientists were able to demonstrate the link between sulphur emissions in Europe and the acidification of Scandinavian lakes. The 1979 Convention was the first to provide an international instrument to deal with problems of air pollution on a broad regional basis (UN/ECE, 1998; Kütting, 2000, p. 83). The Convention recognized the need to study the implications of long-range transboundary air pollutants and to develop solutions to address such problems. Furthermore, the Convention promoted international cooperation in the development of appropriate national policies and the exchange of information, consultation, research and monitoring to coordinate national action on pollution (UN/ECE, 1997). LRTAP entered into force in 1983 and expanded over the years to include eight additional protocols dealing with various types of transboundary air pollution, including, recently, persistent organic pollutants.

The Convention had four main focal points. The first was the recognition that transboundary airborne pollutants were in fact a major problem (Wettestad, 1996; Kütting, 2000, p. 85). Second, parties stated they would attempt to limit, reduce and prevent air pollution. Furthermore, all signatory states would participate in the exchange of information, consultation, research and monitoring and develop, without delay, policies and strategies to combat transboundary air pollution. Finally, parties were to use the best available and most economical technology to address the strategies of the convention. The Convention and its eight protocols attempt not only to foster international cooperation on issues of air pollution, but also to enhance research and

policy development (UN/ECE, 2000). Based on information provided by UN/ECE on LRTAP, Appendix 1 includes a summary of the eight protocols to LRTAP.

1998 Protocol on Persistent Organic Pollutants

During the 1980s, Indian and Northern Affairs Canada (INAC) conducted environmental surveys to assess the levels of PCBs at abandoned DEW line sites in the Canadian Arctic. The survey results were compared with surveys completed in remote areas in the Arctic, where the environment was thought to be pristine. Contrary to what INAC expected to find, the results indicated that these remote areas contained high levels of PCBs (Selin, 2003, p. 12). Due to these surprising results, INAC undertook a multidisciplinary review of the findings and found other contaminants in the environment, including DDT, toxaphene, chlordane, HCH, endrin, dieldrin, HCB and mirex (Selin, 2003, p. 112).

Although it was soon determined that the high levels of contaminants in the Arctic originating outside the Canadian North had potential environmental and human health implications, only limited political action was taken (Selin, 2003, p. 112). Out of concern for the Canadian Arctic population, INAC sought political action. In 1989, Canada approached several international organizations with scientific evidence of the presence of POPs in northern regions. Organizations such the United Nations Food and Agriculture Organization (FAO), the World Health Organization (WHO) and the Organization for Economic Co-operation and Development showed no interest in any international controls on POPs as suggested by Canada (Eckley & Selin, 2001).

During that same time, the Swedish Environmental Protection Agency (SEPA) found similar data indicating high levels of contaminants originating outside their environment. Pooling their resources, INAC and SEPA decided to collectively voice their concerns about hazardous contaminants in northern environments resulting from long-range transport, far from the North. In August of 1990, Canada presented its findings to the Executive Body of the UN/ECE, who then established a task force on POPs under the joint leadership of Canada and Sweden. The task force, which also involved Germany, the Netherlands, Norway, Spain, the United Kingdom and the United States, met four times and focused on areas of uncertainty that were crucial for assessing the need for an agreement (Selin, 2003, p. 114). After examining the science to support the initiation of a regional instrument, 36 member states of the UN/ECE, consisting of European countries, Russia, Canada and the United States, who were already party to LRTAP, agreed to establish an Ad Hoc Preparatory Working Group on POPs in 1994 (UN/ECE, 1998). The goal of the Working Group was to prepare a draft protocol under the LRTAP Convention, which would form the basis for further negotiations (UN/ECE, 1998).

Negotiations during January 1997 set the stage for the POPs Protocol (UN/ECE, 1997). The negotiations covered issues concerning the effects of POPs on humans and the agricultural and human health reasons to continue the use of such substances. Table 15 includes the highlights of the Protocol on POPs. Initially, eighteen substances were under consideration during the negotiations, of which seven were unproblematic because there was no remaining production or use in the UN/ECE region and therefore no new domestic limitations would be required for any states (Eckley & Selin, 2001; Selin, 2003, p. 122). However, the eight other intentionally produced substances were still in

production and/or use, although chlordecone, HCB, DDT and PCBs were eventually accepted as substances to be included in the protocol. Substances in question were lindane, heptachlor, PCP and SCCP. Four unintentionally produced by-products (dioxins, furans, HCB and PAHs) were included in the Protocol, and negotiations surrounded the different types of possible control options for emission sources (Eckley & Selin, 2001). Eventually included in the negotiations were sixteen substances slated for eventual elimination (Table 16) which had been determined through scientific and socio-economic means (UN/ECE, 2002). The negotiations concluded with an agreement to further consider other substances for possible inclusion.

In June 1998 the Executive Body of the UN/ECE adopted the Protocol on POPs in Aarhus, Denmark (UN/ECE, 1998). Currently, fifteen countries have ratified the Protocol which needs sixteen ratifications to come into force (UN/ECE, 2003). Countries that have ratified the Protocol include Austria, Bulgaria, Canada, Czech Republic, Denmark, Finland, Germany, Iceland, Luxembourg, Netherlands, Norway, Republic of Moldova, Slovakia, Sweden and Switzerland. While the United Kingdom and the United States played a crucial role in the preparatory work, they have yet to ratify the Protocol. Also, the only circumpolar countries that have yet to ratify are Russia and the United States. Russia and a few other eastern European countries will be essential to reducing the emissions of POPs and improving environmental effectiveness, because it is in these countries that many of the POPs included in the Protocol are still in production and use (Selin, 2003, p. 129). The implementation of the POPs Protocol in these regions will be difficult, as they lack the domestic regulatory structure; no provisions were made to provide technology or financial transfers to help states implement the Protocol.

TABLE 15

Highlights of the Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Persistent Organic Pollutants

Objective	Control, reduce or eliminate discharges, emissions and losses of persistent organic pollutants
Basic Obligations	▪ Eliminate production and use of 12 POPs: Aldrin, chlordane, chlordecone, DDT, Dieldrin, endrin, heptachlor, hexabromobiphenyl, hexachlorobenzene, mirex, PCB, toxaphene ▪ Dispose of existing POPs in an environmentally sound manner ▪ Restrict DDT, HCH and PCBs ▪ Reduce total annual emissions of PAHs, dioxins/furans, hexachlorobenzene according to timescale guidelines ▪ Exemptions – according to set guidelines pertaining to research, public health emergency and minor applications
Exchange of Information and Technology	▪ Facilitate the exchange of information and technology designed to reduce the generation and emission of POPs and to develop cost-effective alternatives
Public Awareness	▪ Promote the provision of information to the general public, including individuals who are direct users of POPs
Strategies, Policies, Programmes, Measures and Information	▪ No longer than 6 months after Protocol enters into force, develop strategies, policies and programmes in order to discharge its obligations ▪ Encourage use of economically feasible, environmentally sound management techniques
Research, Development and Monitoring	▪ Encourage research, development, monitoring and cooperation: emissions, long-range transport and deposition levels in their modelling, existing levels in the biotic and abiotic environment, pollutant pathways and inventories in ecosystems, relevant effects on human health and the environment, best available techniques, methods for estimating national emissions and projecting future emissions
Reporting	▪ Each Party shall report information on the measures it has taken to implement the present Protocol to Executive Secretary of the Commission ▪ Report levels of emissions of POPs
Compliance	▪ Implementation Committee shall carry out compliance reviews and report to the parties

(Source: UN/ECE, 1999)

TABLE 16

UN/ECE Protocol on Persistent Organic Pollutants

Substance	Ban Production/Use	Scheduled for Elimination	Restriction
Aldrin	♦		
Chlordane	♦		
Chlordecone	♦		
Dieldrin	♦		
Dioxin		♦	
DDT	♦	♦	♦
Endrin	♦		
Furan		♦	
Heptachlor	♦		
Hexabromobiphenyl	♦		
Hexachlorocyclohexane			♦
Hexachlorobenzene		♦	
Lindane			♦
PCBs		♦	
Mirex	♦		
Toxaphene	♦		

(Source: UN/ECE, 2002)

United Nations Environment Programme: Global Agreement on POPs

During the UN/ECE negotiations on persistent organic pollutants, the need for international action involving major source states outside Europe was recognized. Scientific assessments on POPs completed under the LRTAP agreement provided the strong basis for broader international action and are credited with advancing the international process (Eckley, 2000). In March 1995 the UNEP Governing Council decided to initiate an assessment of a shortlist of twelve POPs. This was to be an international effort to protect human health and the environment through the implementation of reduction and eventual elimination standards for emissions and discharges (Bankes, 1998). The global assessment was to take into account the circumstances of developing countries and countries with economies in transition. Available information on chemistry, sources, toxicity, environmental dispersion and socio-economic impacts was to be included in the assessment.

At a meeting in Manila in June 1996, it was concluded that sufficient information existed to justify international action and the creation of a global legally binding instrument. Based on the findings about the risks to human health and the environment from twelve specified POPs, the need to implement measures to reduce and eventually eliminate emissions and discharges was recognized. While there had been disagreements about the selection of chemicals for negotiation under the LRTAP agreement, the substances selected for international control were the least controversial aspect of the POPs assessment (Eckley, 2000). The quick acceptance of the chemicals selected has been credited to the political influence of countries such as the United States, Canada and the European Union as well as to the scientific evidence from the LRTAP POPs Protocol

(Eckley & Selin, 2001). As noted earlier, the substances were already well known and prohibited or severely restricted in many countries.

During February 1997, UNEP along with other relevant international organizations prepared and organized an Intergovernmental Negotiating Committee (INC) for an *International Legally Binding Instrument for Implementing International Action on Certain Persistent Organic Pollutants* (Downie, 2003, p. 137). The mandate of the INC was to prepare an international, legally binding instrument for global action, beginning with the specified twelve POPs. Between 1997 and 1998, UNEP and the Intergovernmental Forum on Chemical Safety (IFCS) conducted eight regional awareness-raising workshops, in which 138 countries participated (Downie, 2003, p. 137). The IFCS was established in order to provide guidance for policies and strategies in coordinated risk assessments and chemical classifications, as well as to strengthen information exchange and chemical management capacity building. The overall goal of the workshops was to increase the awareness of POPs and prepare populations in developing countries and countries with economies in transition to develop and implement an Action Plan for the Stockholm Convention.

From 1998 to 2000 five INC meetings were held, in which over 100 countries worked towards an agreement. A brief summary of the INC meetings in Table 17 has been developed from the information provided by UNEP. At INC-5, all 140 participating states agreed on the text. The UNEP agreement is now referred to as the *Stockholm Convention on Persistent Organic Pollutants*. The agreement will require 50 ratifications before entering into force and bringing into effect the immediate ban on, or eventual elimination of, the "Dirty Dozen" (Table 18) (UNEP, 2001). The Stockholm Convention

is currently open for signature by all states and by regional economic integration organizations. As of December 2003, 151 countries have signed the Stockholm Convention and 41 countries have ratified it, Canada among them.

TABLE 17

Summary of INC Meetings on Global Agreement on Persistent Organic Pollutants

INC	Summary of Negotiations
INC-1 Montreal, Canada, June 1998	▪ Examined future mechanisms to implement agreement ▪ Technological and financial assistance ▪ UNEP organized 8 regional workshops to raise awareness and educate on risks associated with POPs
INC-2 Nairobi, Kenya, January 1999	▪ Derived scientific criteria and procedures for identification of additional pollutants ▪ Issues raised surrounding the number of obsolete and uncontrolled stockpiles of pesticides and toxic chemicals ▪ Concerns raised over development of black markets in prohibited chemicals
INC-3 Geneva, Switzerland, September 1999	▪ Participating countries agreed to eliminate the production of 10 intentionally produced POPs. ▪ Exception for DDT – continue use for the sole purpose of controlling vector-borne diseases ▪ Established scientific criteria and procedures for further identification of POPs
INC-4 Bonn, Germany	▪ Proposals for ensuring access to funding were made to enable developing countries and countries with economies in transition to be partners under agreement ▪ Technology requirements discussed ▪ Funding initiatives to aid developing countries in alternatives
INC-5 Johannesburg, South Africa, December 2000	▪ Finalized the text of a legally binding treaty to minimize and eliminate the "Dirty Dozen" ▪ Control measures set out covering production, import, export, disposal and use of POPs ▪ Governments to promote best available technologies and practices for replacing existing POPs ▪ Financial mechanism to help developing countries to minimize and eliminate POPs ▪ Scientific criteria for the eventual inclusion of other POPs

(Source: UNEP, 2000)

TABLE 18

"The Dirty Dozen": Stockholm Convention On POPs

Pesticides	Industrial Chemicals	Unintended By-products
Aldrin	Hexachlorobenzene	Dioxins
Chlordane	PCBs	Furans
DDT		
Dieldrin		
Endosulfan		
Heptachlor		
Mirex		
Toxaphene		

(Source: UNEP, 2000)

Information on the physical nature of the POPs problem including chemical uses, emission sources, transport patterns and environmental and human health effects was utilized by the POPs Protocol to help spur the international process on the Stockholm Convention. The identification of potential policy options also helped to determine the activities that needed to be covered under the agreement and how controls and procedures should be designed (Eckley & Selin 2001; Selin, 2003, p. 112). The regulatory measures of the Stockholm Convention focus on controls on the production, use, import and export of the substances selected.

Political Highlights of the INC Sessions

While limited information is available at this time about issues that arose during the INC sessions, there are a few highlights to be noted. The first occurred at INC-3, where it became obvious that the opinions of developed countries significantly differed from those of the Group of 77 (G-77)[4] and China (Buccini, 2003, p. 243). The developed countries were adamant that there not be a new "stand-alone" fund created for the Stockholm Convention, while the G-77 and China were not satisfied with the performance of Global Environment Facility (GEF) and pushed for a stand-alone fund. (Buccini, 2003, p. 243). During the fourth INC session, Canada contributed twenty million (CDN) dollars to the World Bank for capacity building in developing countries (Buccini, 2003, p. 244). It was at the same session (INC-4) that differences among

[4] The Group of 77 (G-77) was established in 1964 by 77 developing countries signatories of the "Joint Declaration of the Seventy-Seven Countries" issued at the end of the first session of the United Nations Conference on Trade and Development (UNCTAD) in Geneva. A permanent institutional structure gradually developed which led to the creation of chapters of the Group of 77 in Rome (FAO), Vienna (UNIDO), Paris (UNESCO), Nairobi (UNEP) and the Group of 24 in Washington, D.C. (IMF and World Bank). The membership of the G-77 has increased to 133 countries, but the original name was retained because of its historic significance.

various groups became obvious and began to develop (Buccini, 2003, p. 244). G-77 and China and the CEE group (Central and Eastern European countries) and two groups of donor countries (EU and JUSCANZ[5] Group) were divided on such issues as trade, the precautionary approach and the convention objective and whether or not to aim for minimization versus elimination of unintentionally produced POPs as the objective of the convention. The major impasse at INC-4 that was later addressed at INC-5 was between two groups, G-77 and China versus the developed countries and countries with economies in transition (Buccini, 2003, p. 245). The G-77 and China continued to show strong support for an independent multilateral fund under the Stockholm Convention, while the other group wanted the GEF. The decision on financial and technical assistance and the stand-alone mechanism became the highest priority for G-77 and China at the fifth INC session (Buccini, 2003, p. 248).

Highlights of the Stockholm Convention

The text of the Stockholm Convention (see Appendix 2) contains 30 articles, commencing with the "objective" (Article 1):

> Mindful of the precautionary approach as set forth in Principle 15 of the Rio Declaration on Environment and Development, the objective of this Convention is to protect human health and the environment from persistent organic pollutants.

The Stockholm Convention outlines control measures to obtain four objectives of the agreement, which include eliminating the production and use of specific POPs, eliminating the trade of specific POPs, minimizing emissions of POPs, and prohibiting

[5] JUSCANZ group of countries includes Japan, United States, Canada, Australia, New Zealand, Iceland, Liechtenstein, Norway, the Republic of Korea and Switzerland (Buccini, 2003, p. 255).

the production and use of new POPs. The following section outlines the key elements of these control strategies for the Stockholm Convention. Articles from the text of the Stockholm Convention are summarized in Table 19 (see Appendix 2 for the full text of the Stockholm Convention).

TABLE 19

Articles of the *Stockholm Convention on Persistent Organic Pollutants*

Article Number	Component	Article Number	Component
Article 1	Objective	**Article 16**	Effectiveness Evaluation
Article 2	Definitions	**Article 17**	Non-Compliance
Article 3	Measures to reduce or eliminate releases from intentional production and use	**Article 18**	Settlement of Disputes
Article 4	Register for Specific Exemptions	**Article 19**	Conference of the Parties
Article 5	Measures to reduce or eliminate releases from unintentional production	**Article 20**	Secretariat
Article 6	Measures to reduce or eliminate releases from stockpiles and wastes	**Article 21**	Amendments to the Convention
Article 7	Implementation Plans	**Article 22**	Adoption and Amendments of Annexes
Article 8	Listing of Chemicals in Annexes A, B and C	**Article 23**	Right to Vote
Article 9	Information Exchange	**Article 24**	Signature
Article 10	Public Information, Awareness and Education	**Article 25**	Ratification, Acceptance, Approval or Accession
Article 11	Research, Development and Monitoring	**Article 26**	Entry into Force
Article 12	Technical Assistance	**Article 27**	Reservations
Article 13	Financial Resources and Mechanisms	**Article 28**	Withdrawal
Article 14	Interim Financial Arrangements	**Article 29**	Depositary
Article 15	Reporting	**Article 30**	Authentic texts

(Source: UNEP 2001b)

Precautionary Principle

The Precautionary Principle states that protective measures should be taken when scientific evidence suggests that an activity threatens wildlife, the environment, or human health, even in the absence of full scientific certainty (Susskind, 1994, p. 79). The precautionary principle is used in policy-making to ensure that states act to protect the natural environment (Weintraub, 1992). The precautionary principle is essential in the Stockholm Convention as it addresses any uncertainty about the nature and extent of harmful POPs and other toxic chemicals. It is important that this principle guide the Stockholm Convention if it is to be effective in protecting human health and the environment from POPs, because the long-term effects of POPs on health are uncertain.

Eliminating Intentionally Produced POPs

The Stockholm Convention includes short-term and long-term elimination of targeted POPs. Upon entry into force, parties to the Stockholm Convention will take measures (as indicated in Article 3) to reduce or eliminate chemicals released through intentional production and use as listed in Annex A (aldrin, chlordane, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, PCBs and toxaphene). The import and export of chemicals listed in Annex A are prohibited with the exception of importing for the purpose of environmentally sound disposal. Longer-term commitments as listed in Part II of Annex A include the eventual elimination of PCBs in equipment by the year 2025.

Specific Exemptions

As indicated in Article 4 of the Stockholm Convention, a variety of exemptions for the continued use and production of specific POPs by specific parties are permitted. For example, limited use of DDT is permitted as a disease vector control in accordance with World Health Organization (WHO) guidelines in countries that require DDT to protect their populations from malaria. The Stockholm Convention does call for the eventual elimination of DDT (Table 20). The Stockholm Convention also calls for research, development and implementation of safe, effective and affordable alternatives to DDT. The use of PCBs in existing equipment is also permitted until the year 2025 providing the caution is taken to prevent leaks.

TABLE 20

Short-term and Long-term Elimination of the "Dirty Dozen"

Pesticides	Industrial Chemicals	Unintended by-products
Aldrin	Hexachlorobenzene	Dioxins**
Chlordane	PCBs**	Furans**
DDT**		
Dieldrin		
Endosulfan		
Heptachlor		
Mirex		
Toxaphene		

** Long-term elimination

Ultimate Elimination of Unintentional Production

Under Article 5 of the Stockholm Convention, parties are required to reduce total releases of unintentionally produced chemicals such as dioxins, furans, PCBs and HCB. These chemicals are unintentionally produced and released during thermal processes involving organic matter and chlorine as a result of incomplete combustion (UNEP, 2000). Further, the Stockholm Convention requires parties to develop action plans within two years of the date of entry into force that will include evaluations of current and

projected releases, implementation strategies and plans to promote education and training with regard to awareness. Substitutes or modified materials, products and processes to prevent the formation and release of dioxins, furans, PCBs and HCB are also to be implemented. Best available techniques and best environmental practices are to be promoted and further implemented in the party's action plan.

Environmentally Sound Management and Disposal of Wastes and Stockpiles

The Stockholm Convention (Article 6) requires all parties to account for and dispose of all products, articles in use and materials contaminated with POPs. Waste is to be destroyed or irreversibly transformed. In very limited situations, POP content in stockpiles is to be disposed of in an environmentally sound manner according to the requirements of the Basel Convention. Limitations on the trade of POPs are strict and trade is only permitted for the purposes of environmentally sound disposal. Trade will be permitted in very limited circumstances, when the importing state provides certification as outlined in the Convention indicating its commitment to environmental and human health and its compliance with the Convention's waste disposal provisions. These measures will help in reducing the levels of POPs found in the environment.

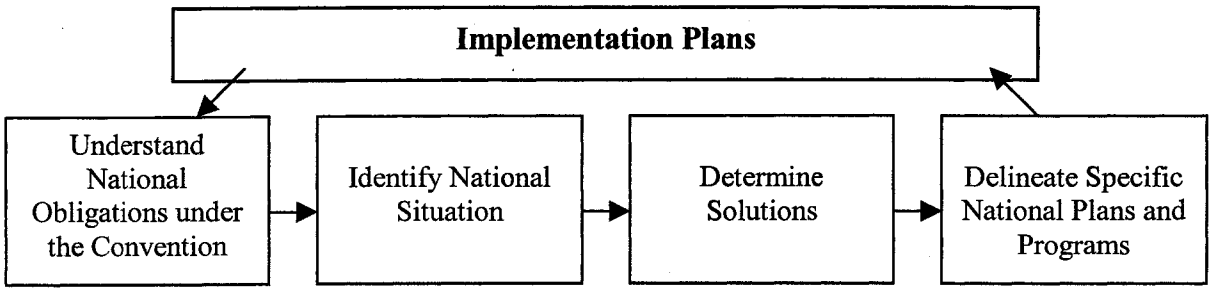
Implementation Plans

As indicated in Article 7, parties to the Stockholm Convention must develop action plans or National Implementation Plans (NIPs) within two years following its entry into force (UNEP, 2001). A plan for implementation must be developed to meet the obligations of the Convention while addressing specific criteria in the action plans,

including the identification and characterization of the release of POPs (see Figure 4). Each party is required to examine the Stockholm Convention and outline obligations that apply to their state (Downie, 2003, p. 145). This examination will include compiling inventories of POP sources and estimating releases, assessing regulatory mechanisms, assessing needs and plan development, and determining the state's capacity to manage and dispose of stockpiles and wastes (Downie, 2003, p. 145). Identifying solutions will also be an important factor for implementing national plans. The designation of a state focal point to set national priorities and further identify the needs for enhancing regulatory mechanisms that utilize the best available techniques and best available practices for environmental control and release must be completed within four years of the Convention's entry into force (UNEP, 2001; Downie, 2003, p. 145).

The promotion of information, awareness and education measures pertaining to POPs and further research and development will be encouraged in implementation plans as part of the solution. Finally, developing specific national plans and programs that will fully implement the Stockholm Convention and reflect national circumstances will be essential if the agreement is to be feasibly implemented in a state. The Conference of Plenipotentiaries have appealed to states, UNEP and GEF to voluntarily implement the provisions of the agreement even before full ratification in hopes that it will speed things along (Downie, 2003, p. 145).

Figure 4: Process of Implementation Plans



(Adapted from Downie, 2003, p.145)

Listing Chemicals for Elimination or Restriction

Under Article 8 of the agreement, parties may submit a proposal for listing a chemical in either Annex A, B and/or C. The proposal must contain the information requirements and screening criteria listed in Annex D. The information and screening criteria include chemical identity, persistence, bioaccumulation, potential for long-range environmental transport and adverse effects. Parties to the agreement can submit a proposal to the Secretariat to list a chemical for elimination, restriction or unintentional production. The chemical is then reviewed by the Persistent Organic Pollutants Review Committee to examine whether the screening criteria have been fulfilled. The Conference of the Parties (COP) will then make the final decisions as to whether or not the new chemical is listed as a POP. Parties to the agreement will not be obligated to take measures such as ceasing production and use of POPs when additional POPs are included in the Stockholm Convention.

Information Exchange

According to Article 9, information needs to be exchanged between parties; the substance and mechanisms of the exchange are included in the Stockholm Convention. Information to be exchanged between parties and the public includes data on reduction and elimination of production, use and release of POPs, the risks, the social and economic costs and information on the alternatives to POPs. A clearing-house mechanism for information will be set up through the Secretariat for use by governments, intergovernmental organizations and NGOs.

Public Information, Awareness and Education

Adequate information, awareness raising and education about POPs are to be made available to the public and decision-makers as listed in Article 10. The Stockholm Convention acknowledges the need to include programs in the community setting to increase the chances of effectively assisting the implementation of the POPs agreement. It was identified from the outset of the POPs negotiations that the inclusion and consideration of developing countries and countries with economies in transition was essential to the success of the Stockholm Convention. As a result, capacity building in states not previously involved in the POPs Protocol process was undertaken. Eight awareness-raising workshops were held on the risks and international issues associated with POPs. National decision-makers and international organizations presented case study workshops in such places as Bangkok, Buenos Aires, St. Petersburg and Bamako (Eckley & Selin, 2001). As a result, many countries initiated assessments of their

domestic status regarding POPs and regulations, and collected their own scientific information on these chemicals.

Research, Development and Monitoring

Parties are to encourage and/or undertake research, development, monitoring and cooperation at the national and international levels to the best of their capabilities (Article 11). Under the Stockholm Convention, parties are to monitor the presence and impact of POPs and conduct research on POPs and alternative POPs. Parties to the agreement are also to attempt to develop and promote the use of environmentally safe alternatives to POPs.

Technical Transfers

The Stockholm Convention will provide technical assistance to developing countries and countries with economies in transition that will strengthen their capacity to implement the objectives of the agreement (Article 12). Technical assistance, such as providing pesticide alternatives, will be essential for the full participation of all states, thereby making it essential to the success of full implementation.

Financial Resources and Mechanisms

Article 13 recognizes the need for financial resources to help developing countries and countries with economies in transition. The Stockholm Convention will establish funding to enable countries to meet the obligations of the POPs agreement. Through the Global Environmental Facility (GEF), funds will be made available to parties requesting

financial assistance. UNEP is currently administering projects with a budget of $10 million US to countries seeking assistance to develop their National Implementation Plans. The specific needs of the socio-economic situation of each country, as well as the chemical properties and uses of the POPs, will be considered before administering financial transfers. The Stockholm Convention requires a regular review by the Conference of Parties of the level of funding and the effectiveness of the GEF or any other institutions entrusted with finances of the treaty.

Interim Financial Arrangements

Article 14 of the Stockholm Convention states that the Global Environment Facility will be, on a temporary basis, the principal entity entrusted with the operations of the financial mechanism.

Reporting

Under Article 15 of the Stockholm Convention, countries are to report to the COP on the measures that they have taken to implement the agreement. Making the reports available to the public will not be required, although they will be made accessible.

Evaluation

The evaluation process of the Stockholm Convention will begin four years after the date of entry into force (Article 16). At this time, arrangements will be made to collect comparable monitoring data and information on activities using available scientific, environmental, technical and economic information.

Non-Compliance

Procedures and institutional mechanisms for non-compliance still need to be developed and approved under the provisions of the Stockholm Convention (Article 17).

Administration

Under the remaining articles (Articles 18–30), administration issues are addressed. These include settlement of disputes; Conference of the Parties; secretariat, amendments to the Convention; adoption and amendment of annexes; right to vote; signature; ratification, acceptance, approval or accession; entry into force; reservations; withdrawal; depositary; and authentic texts.

The Politics of POPs

The negotiations of the Stockholm Convention were completed with relative urgency, taking only 5 INC sessions over the span of 30 months. The foundation for these negotiations was without a doubt provided by the POPs Protocol to LRTAP. Many of the decisions and recommendations put forth in the POPs Protocol process were brought forth and included in the negotiations of the Stockholm Convention. More specifically, the argument about the science or reality of the problem presented during the LRTAP negotiations was not challenged and so the scientific evidence was accepted, thereby somewhat simplifying the complexities of this environmental and human health issue.

As indicated in Appendix 3 of this thesis, 151 countries have signed the *Stockholm Convention on Persistent Organic Pollutants* and 41 have ratified and become party. Canada, Denmark (Greenland), Finland, Iceland, Norway and Sweden have signed

and ratified the agreement, while the remaining two circumpolar countries, the United States and the Russian Federation, have signed but have yet to ratify.

It will be important for the United States and Russia to ratify the Stockholm Convention if it is to be truly successful. The two remaining circumpolar countries have signed the environmental agreement but show no intentions of ratifying it. Russia, one of the largest sources of contaminants, lacks the financial and technological capacity to implement measures to reduce and eliminate the production, use and emissions of POPs. While the United States has the financial and technological resources, it is in their own interest to continue the use of POPs, as it would be costly for the US to stop the production and use and implement measures that would reduce and/or eliminate POPs. Without the ratification of the U.S. and Russia, two sources of POPs, the Stockholm Convention may not be effective in protecting the health of humans and the environment from POPs.

As indicated earlier in this thesis, there are a number of countries that are sources of POPs, including most developing countries and countries with economies in transition. Many of the suspected source countries have signed the Stockholm Convention, including countries in South America, China, India, Indonesia and the Russian Federation, but few have ratified it. Many if not all of these countries lack the technological capacity and the financial resources to implement and comply with the provisions of the Stockholm Convention. Many developing countries and countries with economies in transition rely on the pesticides listed for elimination and restriction, as they are the most cost-efficient means to produce food, which in some instances is already scarce in their country. Developing and implementing environmentally friendly

alternative pesticides will require financial and technological resources. Finding the best available techniques and environmental practices for reducing and eliminating unintentionally produced POPs will also require financial and technological resources that might not be available in developing countries and countries with economies in transition.

While complete and comprehensive information about countries producing, using and emitting POPs is so far incomplete, table 9 (p. 58), table 10 (p. 58) and table 11 (p. 59) list some of the source countries of POPs. These countries include China, India, the Russian Federation, Germany, Canada, the United States and Mexico. All of these countries have signed the agreement, but as of July 2003, only Canada, Germany and Mexico have become party to the Stockholm Convention.

Uncertainty remains as to why many of the countries have yet to ratify the Stockholm Convention, especially the United States. On April 19, 2001, President George Bush praised the Stockholm Convention, commenting on the highlights and importance of the agreement (US Department of State, 2001). The Administrator of the US Environmental Protection Agency announced on behalf of President Bush that the US fully endorses the agreement and had already taken steps toward implementing it (Buenker, 2001). Furthermore, the US government contributed over $22 million (US) to technical and financial assistance to help developing countries with POP-related activities.

Summary

Both the Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Persistent Organic Pollutants and the UNEP *Stockholm Convention on Persistent Organic Pollutants* are currently awaiting full ratification. When both agreements are ratified by a sufficient number of parties, they will enter into force, banning and reducing the production, use and emissions of selected POPs. Building on the momentum and science developed during the UN/ECE negotiations of the POPs Protocol, the finalized text of the Stockholm Convention on POPs signifies international concern for the global threat of long-range transboundary air pollution.

The following chapter will use the key elements highlighted in this chapter to analyze how effective the Stockholm Convention will be as an international environmental regime, and whether or not it will address the needs of the Canadian Arctic.

Chapter 6: Analysis and Evaluation

Introduction

Persistent organic pollutants in the Canadian North and other circumpolar countries are increasingly being recognized as an international issue. As demonstrated in the previous sections, POPs have harmful implications for the health of humans and the environment, especially in the Arctic. The *Stockholm Convention on Persistent Organic Pollutants* was initiated to address these issues for the health of the general population and the environment.

This chapter will evaluate the Stockholm Convention, employing the conceptual framework devised in chapter two. The components of the Stockholm Convention that will be evaluated are goals, implementation mechanisms and review mechanisms. The focus here is the Stockholm Convention's potential to effectively address the needs of the Canadian Arctic environment and human health. It will be seen that while it is too soon to determine the environmental effectiveness of the Stockholm Convention, institutionally the agreement will be effective, thereby resulting in potential environmental effectiveness. After evaluating the Stockholm Convention employing the conceptual framework, it is evident that this agreement has the long-term possibility of effectively addressing the problem of POPs in the Canadian Arctic.

Evaluating the Stockholm Convention and the POPs Regime

For the Stockholm Convention to be a potentially effective international environmental regime, it must result in changed behaviour of actors' use, production and emission of persistent organic pollutants and must reduce the level of POP contamination

in both humans and the environment. The following evaluation will utilize the components of an effective regime as devised in chapter two: goals, implementation mechanisms and review mechanisms.

Goals

As stated in chapter two, evaluating environmental regimes requires satisfying two key questions: Will the regime result in changed behaviour to achieve the objectives of the international environmental agreement? Will the regime solve the environmental problem that prompted its creation? As previously discussed, it is too soon to determine whether the Stockholm Convention will solve the environmental problems associated with the production and use of POPs. At best, utilizing the data provided in chapters three and four, only an insightful forecast can be made, which can potentially evoke further debate about how best to define the environmental effectiveness of the Stockholm Convention. For example, if there is a 50% reduction in contaminants produced, used and emitted, has the IEA been environmentally effective? Or is the Stockholm Convention only environmentally effective if it completely eliminates persistent organic pollutants from both human populations and the global environment? Given the limitations of this thesis and the complex nature of defining environmental effectiveness in terms of contaminants in the global environment, this thesis will provide a perceptive guess.

As stated in chapter two, goals are to be achieved through the implementation of solutions that address the problems that prompted the creation of the environmental regime. The following questions pertaining to the goals of an effective environmental

regime were raised in chapter two. Table 21 includes the specific questions raised in chapter two, which guide the evaluation of the goals of the Stockholm Convention.

TABLE 21

Goals of an Effective Environmental Regime	
Criteria	**Stockholm Convention**
1. Has the environmental problem that evoked efforts been clearly identified?	YES
2. Do the overall goals of the environmental agreement clearly identify and address the problem that prompted its creation?	YES
3. Are the strategies of the environmental agreement clear and precise?	YES
4. Are the strategies of the environmental agreement measurable?	YES
5. Do the strategies of the environmental agreement include and enforce environmental standards that meet the needs of the overall goals of the environmental agreement?	YES

The environmental problems that evoked the efforts for an international environmental agreement on persistent organic pollutants have been clearly identified, as stated in chapters three and four. The short-term potential effects of these toxic chemicals on the health of humans and the environment have been recognized, while the long-term health effects continue to be researched, monitored and assessed.

The overall goals of the Stockholm Convention have been clearly identified. The main objective of the Stockholm Convention is the protection of human health and the environment from persistent organic pollutants. While this goal is very general, it addresses the problem that prompted the need for an environmental agreement on POPs to protect the health of humans and the environment. The strategies of the Stockholm Convention have been clearly outlined and are precise. Table 22 summarizes the more precise strategies of the Stockholm Convention. As indicated in Table 22, measures are to be taken on intentionally produced chemicals, unintentionally produced by-products and stockpiles and wastes. Actions to be taken on certain specific chemicals are clearly

outlined in Articles 3, 5 and 6 of the Stockholm Convention, while other chemicals to be reduced or eliminated are listed in Annexes A, B and C.

TABLE 22

Strategies of the Stockholm Convention
1. Measures to reduce or eliminate releases from intentional production and use of chemicals aldrin, chlordane, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, toxaphene and polychlorinated biphenyls and restrict production and use of DDT
2. Measures to reduce or eliminate releases from unintentional production
3. Measures to reduce or eliminate releases from stockpiles and wastes
4. Listing of chemicals for measures to be taken to reduce or eliminate releases from intentional production or measures to be taken to reduce or eliminate releases from unintentional production.

The strategies of the environmental agreement identify that specific measures are to be taken to reduce or eliminate the production, use and existing stockpiles and wastes of 12 POPs. The need for measures to eliminate the intentional production and use of aldrin, chlordane, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, toxaphene and polychlorinated biphenyls have been recognized and restrictions have been placed on the production and use of DDT for the purpose of disease vector control. The unintentional production of dioxins, furans, hexachlorobenzene and PCBs is to be reduced or eliminated. Stockpiles and waste are to be reduced and, where possible, eliminated. Finally, the Stockholm Convention outlines a process whereby other chemicals can be added to the list for elimination or reduction.

The Stockholm Convention plans for the short-term and long-term elimination of twelve target POPs, as outlined in chapter five. While many of these chemicals have already been prohibited or restricted in circumpolar countries and some other states, developing countries and countries with economies in transition continue their production and use. Also noted earlier (Table 14), the UN/ECE POPs Protocol bans or restricts a list of sixteen chemicals. Table 23 outlines the chemicals of concern in the Canadian Arctic

and the different chemicals scheduled in both the UNEP Stockholm Convention and UN/ECE POPs Protocol. The Stockholm Convention has so far included the chemicals of concern in the Canadian Arctic. With the exception of endosulfan, the UN/ECE POPs Protocol includes the chemicals of most concern in the Canadian Arctic.

Environmental standards are enforced in the strategies of the Stockholm Convention. For example, although wastes are best treated or destroyed close to the site of waste generation, this is not always viable; therefore, reducing or completely destroying stockpiles of POPs safely will likely require shipping them to developed countries (Schmidt, 1999). The POPs Convention will encourage on-site preventative management, limiting waste transport in general. Furthermore, while it is common practice to treat waste by combustion technologies, even the most advanced incinerator does not destroy all the POPs and will release emissions into the environment (Gregory & Puckett, 2002). Modern technologies that achieve 100% destruction of POPs do exist, and examples include gas-phase chemical reduction and catalytic hydrogenation. These modern technologies are already in use in some developed countries and could be the focus of technology transfers.

Future inclusion of additional persistent organic pollutants for reduction and elimination will potentially help the Stockholm Convention remain dynamic and all-encompassing. States are expected to evaluate whether the chemical under consideration is likely to lead to significant adverse human health and/or environmental effects and whether control measures encompass the full range of options given the socio-economic considerations of the state. However, the Stockholm Convention includes an option which exempts a Party from being bound by the addition of future POPs to the

Convention. This opt-out for future inclusion of POPs may prevent the environmental agreement from progressing to eliminate the hundreds of toxic chemicals that are currently produced, used and emitted.

TABLE 23
Chemicals of Concern in the Canadian Arctic: Stockholm Convention and UN/ECE POPs Protocol Coverage

Chemical	Chemical of Concern in Canadian Arctic	UNEP Stockholm Convention	UN/ECE POPs Protocol
Aldrin	√	√	√
Chlordane	√	√	√
Chlordecone			√
Dieldrin	√	√	√
Dioxin	√	√	√
DDT	√	√	√
Endrin			√
Endosulfan	√	√	
Furan	√	√	√
Heptachlor	√	√	√
Hexabromobiphenyl			√
Hexachlorocyclohexane			√
Hexachlorobenzene	√	√	√
Lindane			√
PCBs	√	√	√
Mirex	√	√	√
Toxaphene	√	√	√

Ensuring that the strategies of an environmental agreement are measurable will enhance the success of obtaining the overall goals of an environmental agreement. The strategies outlined in the Stockholm Convention include measures to be taken to eliminate the production and use of some specified chemicals while placing restrictions on other chemicals. The production and use of intentionally produced chemicals such as pesticides are to be eliminated, and restrictions have been placed on the production and use of unintentionally produced chemicals, such as DDT and HCH. Restrictions have been placed on the use of PCBs in existing equipment such as transformers and capacitors, and these uses are to be eliminated by 2025. Sources of intentionally produced

chemicals such as waste incinerators and production of pulp have been indicated in the Stockholm Convention for future action to ensure reduction of production and use.

Ensuring that the strategies of the environmental agreement include and enforce environmental standards that meet the needs of the overall goals of the environmental agreement will help address the environmental problem that prompted its creation. Recognizing the potential adverse health effects on both humans and the environment, the Stockholm Convention has initiated action to reduce and eventually eliminate the production, use and emission of persistent organic pollutants. The strategies included in the text of the Stockholm Convention recognize and address the three main sources of POPs: intentionally produced POPs, unintentionally produced POPs and POPs that already exist in the form of stockpiles and waste. The strategies to reduce and eliminate these sources of POPs are realistic and achievable targets, enabling parties to implement measures and take action.

Implementation Mechanisms

The criteria for implementation mechanisms of an effective environmental regime were developed in chapter two. Table 24 includes the specific questions raised in chapter two, which guide the evaluation of implementation mechanisms in the Stockholm Convention. This table also indicates whether or not the agreement answers the questions previously raised.

TABLE 24

Implementation Mechanisms of an Effective Environmental Regime		
Criteria		**Stockholm Convention**
1. Are the costs and benefits of regulating substances and activities an important consideration for the implementation of the environmental agreement?	YES	Financial resource and mechanisms
Will financial transfers aid in the implementation of new environmentally sound technologies, management strategies or other requirements of the environmental agreement?	YES	Financial resource and mechanisms
Will developing countries be provided with financial assistance to enable them to comply with the environmental agreement that might otherwise have been beyond their capabilities?	YES	Financial resource and mechanisms
2. Will there be access to environmentally sound technologies?	YES	Technical assistance
Will building the capacity of developing countries and countries with economies in transition through technological transfers help to implement the environmental agreement?	YES	Technical assistance Public information, awareness and education
Will the best available technologies and best environmental practices be encouraged during the implementation of the environmental agreement?	YES	Technical assistance
Will positive incentives such as special funds, financial and technical assistance and training programs be included in the environmental agreement?	YES	Financial resource Technical assistance
3. Will quality information about environmental issues be made available to enhance the chance of implementation of the environmental agreement?	YES	Information Exchange Research, development and monitoring
Will increased awareness help to increase public support and sway local policies to implement the environmental agreement?	YES	Public information, awareness and education
4. Will adequate funding for the secretariat and staff be ensured to help the process of evaluation and verification, which in turn will help encourage compliance of states party to the environmental agreement?	?	To be determined
Will funding for administrative capacity be provided during the implementation of the environmental agreement to help ensure compliance?	?	Financial resource To be determined

As established in chapter two, environmental regimes need to provide a number of mechanisms, including financial and technical transfers, education and awareness, to assist signatory parties in the implementation of an environmental agreement. The Stockholm Convention has so far been successful in establishing implementation

mechanisms to provide the tools for countries to become party to the agreement (see Table 25).

TABLE 25

Implementation Mechanisms of the Stockholm Convention
1. Implementation Plans
2. Information Exchange
3. Public information, awareness and education
4. Research, development and monitoring
5. Technical assistance
6. Financial resource and mechanisms

Implementation Plans

Each country party to the Stockholm Convention is to develop an implementation plan and include the obligations specified in the environmental agreement. Within two years of the date on which the agreement enters into force, parties are to release their implementation plans to the Conference of the Parties. Regular reviews and updates are to take place on a periodic basis as specified by the Conference of the Parties. Parties are encouraged to cooperate with global, regional and national stakeholders to facilitate the development, implementation and updating of their plans, which will potentially promote dynamic and progressive national implementation plans.

As outlined in chapter five, the Stockholm Convention will provide financial transfers to assist countries with the development and implementation of their National Implementation Plans (NIPS). The use of financial transfers will enable developing countries and countries with economies in transition to participate in the agreement when they might otherwise not be financially able to afford to comply. Involvement of developing countries in the Stockholm Convention is essential to the POPs regime if it is to be successful in attaining its goals due to reliance on many of the chemicals of

concern. Financial resources will help developing countries fulfill their obligations by implementing alternative technologies to POPs and capacity building.

The UNEP POPs Club was set up to finance the POPs negotiations, a financing mechanism seeking to promote contributions to a trust fund from various donors, including governments, intergovernmental organizations and non-governmental organizations. Initially, the goal of the POPs Club was to raise enough funds to ensure that the Stockholm Convention was finalized by the year 2000 (IISD, 2002). At that time, the POPs Club raised $5,114,305 US, falling short of the $ 5,932,546 required for the sessions of the five INC meetings, which was later matched by UNEP. Donors to the POPs Club fund receive recognition through certificates, with those providing the largest sums receiving silver and gold pins.

The Stockholm Convention is currently in an interim period until it enters into force. The Conference has adopted a resolution on the interim arrangements, including appeals to Governments to make contributions to support the POPs Club fund.

The Stockholm Convention recognizes the need for timely and appropriate technical assistance for developing countries and counties with economies in transition in order to successfully implement the environmental agreement. The use of pesticide alternatives and environmentally sound technologies such as combustion technologies for waste incineration and modern technologies that achieve 100% destruction efficiency of POPs will be important for many countries to incorporate into their NIPs to meet the obligations of the Stockholm Convention. Under the agreement, technical resources may be made available to countries requiring technological alternatives to the production and use of POPs and environmentally sound disposal of stockpiles. The future establishment

of regional and sub-regional centres for capacity-building and transfer of technology will aid in the successful implementation of new and more environmentally sound technologies.

Provisions for the exchange of information have been incorporated into the Stockholm Convention. Parties are expected to share information as well as facilitate awareness of POPs in the general public. Exchanging information on alternatives to POPs and related risks and economic and social costs will enhance capacity-building within and between signatory states.

Education and public awareness are important tools for the Stockholm Convention to utilize in order to increase support for eliminating the production and use of POPs. As discussed in chapter five, workshops and community awareness programs have already been undertaken in developing countries that currently are major producers and users of POPs. Continuing to raise awareness and promote alternatives will be an essential mechanism for the Convention, especially in developing countries. Education and awareness may also be important in circumpolar countries, including the Canadian Arctic, where most POPs are transported. Furthermore, public awareness of the POPs issue may pressure states to change their national legislation on the production and use of POPs as well as their rates of emissions. These mechanisms may be an effective tool in stimulating behavioural change, especially in scheduling additional POPs for elimination.

Public information, awareness and education are important agents to facilitate international cooperation and encourage states to implement and comply with the Stockholm Convention. The Stockholm Convention requires the promotion of awareness among policy and decision makers and, further, provides the public with all available

information regarding POPs. Educational and public awareness programs on the effects of POPs on health and the environment may enable residents of states party to the Convention to make informed decisions about the potential risks they may be exposed to in a given situation, such as country food consumption.

As of July 2003, a number of capacity-building activities have taken place under the auspices of UNEP. The governments of Canada, Denmark, Germany, Sweden, Switzerland and the United States, as well as the GEF, World Bank and the Inuit Circumpolar Conference have assisted in financing workshops on POPs. Workshops have included PCB inventory projects, alternatives to POP pesticides, dioxin/furan inventories, POPs waste disposal, a chemical information exchange network project, and regionally based assessment of persistent toxic substances. Awareness-raising workshops on POPs have taken place in St. Petersburg, Russian Federation (1997); Cartagena, Columbia (1998); and Lusaka, Zambia (1998). National strategy and action plans for reducing and eliminating POPs were released in Moscow, Russia, in 1998, and a workshop on the management of PCBs, dioxins and furans was held in Seoul, Republic of Korea, in 2000 (UNEP, 2003). Such support for the Stockholm Convention, NIPs and other related activities have helped capacity-building for the Stockholm Convention.

The Stockholm Convention outlines research, development and monitoring strategies to indicate that parties to the agreement will, within their capabilities, research and develop means of dealing with the effects of POPs on human health and the environment. Furthermore, parties are to gear research work towards alleviating the effects of POPs on reproductive health. However, no mention is made of researching and

developing methods of reducing present contaminant levels in the environment and in the tissues of humans.

The Secretariat for the Stockholm Convention is a position held by the Executive Director of the United Nations' Environment Programme. Functions of the Secretariat include making arrangements for meetings, facilitating assistance to the parties of the Stockholm Convention, ensuring the necessary coordination with secretariats of other relevant international bodies, preparing reports and guiding administrative and contractual arrangements as required.

Initially, funds allocated by UNEP Chemicals from the Environment Fund and the in-kind support provided by UNEP helped finance the Secretariat. However, recently this funding was discontinued and now these funds have to be financed (IISD, 2002). The Stockholm Convention Secretariat now depends on funding from the POPs Club. Compounding the problem of funding is not only the recent decline of financial contributions to the POPs Club, but also the fact that the Secretariat is not eligible to receive direct funding from GEF. At a recent Intergovernmental Negotiating Committee (INC-6) the need and effectiveness of the Secretariat to carry out activities was identified, and future plans for further financing and funding were made.

Review Mechanisms

The final component of effective regime organization is review mechanisms, which indicate how much change may result from countries' complying with an environmental agreement (see Table 26). The Stockholm Convention has been signed but has yet to enter into force, so it is too early to evaluate the effectiveness of its review

mechanisms. Table 27 outlines the review mechanisms comprised in the Stockholm Convention.

TABLE 26

Review Mechanisms of an Effective Environmental Regime	
Criteria	**Stockholm Convention**
1. Does the environmental agreement include procedural obligations, such as the requirement to report?	YES
2. Will the participation of the public, more specifically non-government organizations (NGOs), play an essential role in the monitoring of compliance to the environmental agreement?	YES
3. Will governments disclose compliance information, which is essential to effective monitoring?	YES
4. Will sanctions, penalties and the withdrawal of membership privileges to an agreement be used to punish non-compliance?	Yet to be included
5. Will the environmental agreement employ evaluation mechanisms to evaluate compliance and effectiveness?	YES

TABLE 27

Review Mechanisms of the Stockholm Convention
1. Reporting
2. Effectiveness evaluation
3. Non-compliance

The Stockholm Convention includes procedural obligations, such as the requirement for parties to report. There is a reliance on parties to report to the Secretariat about data being monitored, but the specifics of the monitoring requirements have yet to be determined. Statistical data on total quantities of production, import and export of each of the chemicals listed in the agreement are to be reported to the Secretariat. Further, parties are expected to provide a list of countries from which they have imported each chemical as well as the countries to which they have exported each chemical. As previously stated, parties are also to report their implementation plans and the measures they intend to take to implement the Stockholm Convention. The inclusion of monitoring and verification measures will potentially be useful to the overall effectiveness of the

agreement, as they will help ensure that obligations proposed by the Stockholm Convention are being met and that parties to the agreement are complying.

The Stockholm Convention has yet to include measures other than reporting for monitoring activities. However, at the recent intergovernmental negotiations (INC-6), delegates considered a number of arrangements for monitoring, including assessing existing monitoring programs, initiating arrangements for the provision of comparable monitoring data and providing the facilitation of obtaining monitoring information for regions where information would otherwise not be available. The participation of the public and NGOs has played an essential role in bringing this issue to international attention. Effective monitoring programs will be essential to the environmental effectiveness of the Stockholm Convention. Without such programs, measuring and comparing baseline data with data submitted after measures have been taken to reduce and eliminate the production, use and emissions of POPs will be inaccurate.

Governments will be expected to report statistical data outlined above on a periodic basis as specified by the Conference of Parties. Governments are further expected to submit, within two years of the agreement's entry into force, a report on the steps they have taken to meet the obligations of the Stockholm Convention in their National Implementation Plans.

The Stockholm Convention has yet to develop and approve procedures and institutional mechanisms for determining non-compliance. At the recent INC-6, elements to be included for non-compliance and the process of developing this mechanism were introduced to delegates. While specific details of the non-compliance mechanism have yet to be released, delegates recommended a number of approaches to developing this

mechanism, including analyzing other environmental agreements and having the Secretariat compile and organize submissions and information on regimes. At the recent INC-6, delegates stressed the need to develop a strategic framework for the evaluation obligation that would focus on POPs covered under the agreement, considering both environmental and health effects. The Stockholm Convention so far states that effectiveness is to be evaluated periodically by the Conference of Parties, starting four years after the date of entry into force. Periodic evaluations will need to be further defined in terms of timelines if the Stockholm Convention is to be effective in protecting the health of humans and the environment from the potentially harmful effects of POPs. Without set evaluations, there will be total reliance on parties to monitor and report their data, which can potentially result in inaccurate data, due to technological differences or even misrepresented data. Arrangements providing comparable monitoring data on the presence of the specified chemicals will be initiated at the first meeting after the agreement enters into force. Evaluations will be conducted on the basis of available scientific, environmental, technical and economic information, including reports and monitoring information, national reports and non-compliance information.

The Future of the Stockholm Convention

The Stockholm Convention is only in the early stages, and so the process of regime strengthening has yet to occur. However, there are a number of measures that should be included in the Stockholm Convention to enhance the effectiveness of the POPs regime. Continuing research on the health implications of POPs in the environment and humans can provide more conclusive evidence, which will aid in developing future

policies to control the use and production of substances of concern. Research should also focus on how to deal with POPs that already exist in the environment and, more importantly, in humans. Further research could lead to reducing existing levels in the environment and in humans. Protocols to the Stockholm Convention with timetables, emission limits and reduction levels will further strengthen the regime by setting specific standards the eventual elimination of POPs from the environment. The Stockholm Convention needs to protect the health of the environment and humans from the harmful effects of POPs with promptness and urgency.

The nature of the problem of persistent organic pollutants and the international environmental agreement currently awaiting ratification to deal with the problem of POPs exemplifies the time lag between science and politics. While the problem of POPs requires immediate action, international policies and further action will take time, resulting in a significant delay. It is essential that all source countries sign and ratify the Stockholm Convention. This will take a significant amount of time, requiring most developing countries to determine what exactly their country needs to implement and comply with the agreement. In most situations, technical and financial assistance will be required to develop their National Implementation Plans, to build their capacity and implement measures. The significance of the delay will be further magnified by the characteristics of POPs, which continue to persist and accumulate in living tissue.

Continuing to find financing for the Stockholm Convention may also be a challenge for the agreement. Continual financing will be required to ensure the position of Secretariat, which is essential in guiding the process and maintaining consistency in

the implementation procedure. Ongoing financing will also be essential for the agreement to remain dynamic, contributing to its potential overall success.

Without further inclusion of new information on potential chemicals to list as POPs to be reduced or eliminated, the Stockholm Convention will not be successful in protecting the health of humans and the environment from POPs. As a result, identifying and implementing measures for the addition of future POPs in the agreement will require both financial and technical assistance.

One final potential foreseeable challenge will be not only bridging the gap between North and South, but also between the Eastern Arctic and Western Arctic. Differences in available technology and financial resources are extensive, as are the implementation capacity and issues surrounding the production and use of POPs. For example, many countries still rely on many of the pesticides outlined in the Stockholm Convention to sustain their dwindling agriculture and growing populations. Without an environmentally safe alternative, reducing or eliminating these pesticides would be impossible, potentially resulting in starvation. Another example often cited is the use of DDT to control disease in many developing countries. These countries lack alternatives and require DDT control the spread of malaria.

Bridging the gap between the European and North American Arctic is important, as it has become evident that many of the Eastern Arctic countries continue to produce and use many of the POPs of concern. The amount of pollution generated in the Eastern or European Arctic is considerably greater than that produced in the Western Arctic and this continues to contribute to the levels found in the Canadian Arctic. Settlements and harbours in Svalbard, Norway and Russia have been identified as having higher

concentrations of PCBs and constituting a source of PCBs in the Arctic marine environment (AMAP, 2002, p.8). Russia continues to use PCBs in many electrical installations and has not taken measures to reduce many industrial by-products such as dioxins and furans. As a result, Russia and northern European countries are significant sources of POPs for the Canadian North. Implementation of the Stockholm Convention in Eastern Arctic countries will be essential. Ratification and full compliance from these countries, especially Russia will help reduce the levels of POPs found in the Arctic.

The Problem of POPs in the Canadian Arctic and the Stockholm Convention

The following section will draw on the highlights from the other chapters and discuss whether the Stockholm Convention has so far addressed the problem of POPs in the Canadian Arctic. After evaluating the Stockholm Convention employing the conceptual framework, it will be seen that the agreement has the potential for eventually addressing the problem of POPs in the Canadian Arctic.

As we have seen, high levels of persistent organic pollutants are evident in the Canadian Arctic environment and populations. The physiochemical properties of POPs, combined with the characteristics of the Arctic environment, make the Arctic particularly susceptible to the potential effects of contaminants. POPs emitted elsewhere end up in the Arctic where they persist and bioaccumulate in the food chain, and as a result species higher up in the food chain, such as land and marine mammals and humans, accumulate higher levels of contaminants. Body burdens of POPs have health implications not only for the species higher up in the food chain, but also for Northern residents who depend on many of the species for their traditional food. There are also a number of potential socio-

economic consequences that can result from contamination of traditional food, such as loss of the most economical and nutritious means of food production and the physical, cultural, spiritual and mental well-being of aboriginal people in the Arctic.

Sources of POP contamination are activities that continue to take place far from the Canadian Arctic. While extensive data on countries producing, using and emitting POPs is scarce, countries such as India, China and the Russian Federation are often cited as source countries. The long-range, transboundary nature of the POPs problem requires international collaboration and cooperation, which has so far been initiated and fostered through the Stockholm Convention and, to a lesser extent, by the UN/ECE. The negotiations encouraged the participation of all states, especially developing countries and countries with economies in transition. The participation of these states is essential if the problem of POP contamination is to be addressed, because many of these states still produce, use and emit many of the POPs that are of concern in the Canadian Arctic. For example, the continued use of many of the pesticides in developing countries for agricultural use will not only need to be reduced but eventually eliminated. Upon entry into force of the Stockholm Convention, many of the chemicals of concern are scheduled for elimination or restriction as outlined in the Stockholm Convention. If states party to the Convention comply, the production, use and emissions of the specified POPs should be reduced. As stated in chapter four, levels of HCH in the North have started to decrease since the ban of use and production in China, Russia and India.

Provisions made by developed countries for financial and technical assistance to developing countries may promote the success of the Stockholm Convention. This assistance will aid developing countries to establish and implement environmentally

sound technologies and alternatives, which will possibly reduce and eventually eliminate the POP contamination that the Canadian Arctic receives. Periodic evaluations of the effectiveness of these measures will be taken commencing four years after the Stockholm Convention enters into force. However, this may be a lengthy process due to the time lag between an agreement's adoption and its fulfillment, the physical and chemical properties of POPs and their atmospheric and marine pathways to the Arctic. Even if production, use and release of POPs were immediately halted, they would continue to linger in the environment for decades, thereby continuing to affect human health and the environment.

The international response to the problem of POPs has so far acknowledged and addressed the toxic and persistent nature of POPs and will eventually reduce the long-range transport of POPs to the Canadian Arctic. The goals of the Stockholm Convention have been clearly defined with reference to the elimination and restriction of twelve specified chemicals. Criteria for future inclusion of other chemicals with similar physical and chemical properties may help keep the agreement dynamic and progressive in reducing POPs in the environment. The Stockholm Convention has the mechanisms essential for signatories to implement the agreement; financial transfers, technical transfers and education and awareness may enable states, especially developing countries, to implement and comply with the Stockholm Convention. If signatories, especially states that are the primary sources of POPs, comply with the Stockholm Convention, the production, use and emissions of POPs may be reduced over a long period of time, thereby eventually reducing the level of POPs in the Canadian Arctic environment and populations.

The Stockholm Convention sets out to address the issue of protecting the environment and human health from the harmful effects of persistent organic pollutants. It is too early in the process to determine whether the Stockholm Convention will solve the problem of POPs and their effects on the environment and human health. The Stockholm Convention has many of the essential components of an effective environmental regime; therefore it will be potentially institutionally effective. However, it is premature to determine its environmental effectiveness and whether the problem of POPs will be alleviated or eradicated. In the long term, levels of POPs may be reduced if states fully comply with the goals defined in the Stockholm Convention. However, even if all POPs ceased to be produced, used and released immediately, they would still exist in the environment and in humans for decades.

Summary

Protecting the health of humans and the environment from POPs, especially in the Canadian Arctic and other circumpolar countries, needs to be at the forefront of the global agenda on POPs due to the potential health effects on humans and the environment. While the problem of POPs has yet to be at the forefront of the global agenda, the international response to the problem of POPs occurred with a relative sense of urgency, cooperation and organization. The Stockholm Convention so far contains the three main components of effective IEAs developed in chapter two (see Table 28).

TABLE 28

Measuring the Effectiveness of the Stockholm Convention	
CRITERIA	Stockholm Convention
Has the environmental problem that evoked efforts been clearly identified? Do the overall goals of the environmental agreement clearly identify and address the problem that prompted its creation?	YES
Are the strategies of the environmental agreement clear and precise?	YES
Are the strategies of the environmental agreement measurable?	YES
Do the strategies of the environmental agreement include and enforce environmental standards that meet the needs of the overall goals of the environmental agreement?	YES
Are the costs and benefits of regulating substances and activities an important consideration for the implementation of the environmental agreement?	YES
Will financial transfers aid in the implementation of new environmentally sound technologies, management strategies or other requirements of the environmental agreement?	YES
Will developing countries be provided with financial assistance to enable them to comply with the environmental agreement that might otherwise have been beyond their capabilities?	YES
Will building the capacity of developing countries and countries with economies in transition through technological transfers help to implement the environmental agreement?	YES
Will the best available technologies and best environmental practices be encouraged during the implementation of the environmental agreement?	YES
Will there be access to environmentally sound technologies?	YES
Will quality information about environmental issues be made available to enhance the chance of implementation of the environmental agreement?	YES
Will increased awareness help to increase public support and sway local policies to implement the environmental agreement?	YES
Will positive incentives such as special funds, financial and technical assistance and training programs be included in the environmental agreement?	YES
Will adequate funding for the Secretariat and staff be ensured to help the process of evaluation and verification, which in turn will help encourage compliance of states party to the environmental agreement?	IN PROCESS
Will funding for administrative capacity be provided during the implementation of the environmental agreement to help ensure compliance?	IN PROCESS
Does the environmental agreement include procedural obligations, such as the requirement to report?	YES
Will the participation of the public, more specifically non-government organizations (NGOs), play an essential role in the monitoring of compliance of the environmental agreement?	YES
Will governments disclose compliance information, which is essential to effective monitoring?	YES
Will sanctions, penalties and the withdrawal of membership privileges to an agreement be used to punish non-compliance?	Yet to be included
Will the environmental agreement employ evaluation mechanisms to evaluate compliance and effectiveness?	YES

In the short term, it is too soon to determine whether the Stockholm Convention will achieve environmental effectiveness. However, utilizing the framework developed in Chapter two, the Stockholm Convention has the potential to have an impact on both state and non-state actors, thereby increasing the potential for establishing an effective environmental regime on POPs.

Chapter 7: Conclusion

Recognizing and acknowledging the toxic and persistent nature of POPs, the Stockholm Convention sets out to protect the health of humans and the environment from the harmful effects of persistent organic pollutants. Utilizing components derived from regime theory, this thesis has evaluated the potential effectiveness of the Stockholm Convention and further analyzed whether the Convention will be successful in addressing the problem of POPs in the Canadian Arctic. It was found that while it is too premature to determine whether the Stockholm Convention will be environmentally effective, this international environmental agreement contains many of the essential components of an effective IEA. Therefore, the Stockholm Convention has the potential to eventually be effective.

The production, use and emission of persistent organic pollutants in developed and developing countries have become a particular environmental problem for circumpolar regions. The long-range transport of these contaminants along with the physical and chemical properties of POPs has resulted in the accumulation of POPs in the fragile Canadian Arctic environment. Once in the environment, POPs persist and bioaccumulate in Arctic species, with higher levels of contaminants found in the species higher up in the food chain. Arctic human populations rely on many of the species higher up in the food chain for their daily dietary needs and are themselves at the top of the Arctic food chain. As a result, these individuals have become susceptible to many of the adverse effects of POPs.

International environmental agreements are developed and implemented to steer the behaviour of states away from environmentally destructive activities. There have been

international environmental agreements negotiated on numerous issues, ranging from transboundary pollution to climate change. There have also been many ideas as to what constitutes an effective environmental regime. Environmental regimes encouraging changes in the behaviour of states and non-state actors work toward addressing the environmental problem and attaining the stated goals of the environmental agreement. Components of an international environmental agreement such as goals, implementation mechanisms and review mechanisms, specifically those regarding alleviating environmental damage, will enhance the effectiveness of the environmental regime.

In recognition of the problems that POPs create for the global environment and particularly for the Arctic, a regional and eventually a global initiative were undertaken. The UN/ECE 1998 Protocol which was added to the *1979 Convention on Long-Range Transboundary Air Pollution* helped establish the need for a global response. The 1998 Protocol reflected the scientific justification that was needed for an international environmental agreement to deal with POPs. Responding to the growing concern, in 1997 the Governing Council of the United Nations Environment Programme (UNEP) initiated an international effort to assess POPs and the evidence of their long-range transport. As a result of international efforts, the *Stockholm Convention on Persistent Organic Pollutants* was negotiated and signed in May 2001. The objective of the UNEP Convention is to protect human health and the environment from persistent organic pollutants.

In chapter two, a conceptual framework for an evaluation of the Stockholm Convention was constructed from literature examining the effectiveness of regimes. Examining environmental regime theory and piecing together the effective components

of an international environmental agreement provides the foundation for evaluating such regimes.

Essential components of an effective environmental regime include goals, implementation mechanisms and review mechanisms. Environmental regimes that include these components may result in changed behaviour that will eliminate or minimize the problem that led to its creation. The first component, goals, requires an assessment of whether the environmental problem that evoked efforts has been clearly identified; whether the overall goals of the environmental agreement clearly identify and address the problem that prompted its creation; whether the strategies of the environmental agreement are clear and precise; whether the strategies of the environmental agreement are measurable; and whether the strategies of the environmental agreement include and enforce environmental standards that meet the needs of the overall goals of the environmental agreement. Implementation mechanisms, the second component, are the tools that provide assistance to states party to the convention. These include financial transfers, technological transfers, education and public awareness, incentives, funding for secretariats and administrative capacity help to implement the environmental agreement. The final component, review mechanisms, are used to examine whether the environmental agreement includes procedural obligations, such as the requirement to report; public participation, including NGOs, in the monitoring of compliance of the environmental agreement; encouragement for governments to disclose compliance information, which is essential to effective monitoring; inclusion of sanctions, penalties and the withdrawal of membership privileges to an agreement to

punish non-compliance; and evaluation mechanisms to evaluate compliance and effectiveness.

The Stockholm Convention addresses a very difficult and complex environmental problem that transcends national borders. Unlike the regional agreement of the POPs Protocol, the Stockholm Convention covers a large geographic area, including developed and developing countries. Available information and monitoring data and the availability of financial and technical resources in many of these countries vary, further contributing to the complexity of this issue. The environmental problems of POPs are also very complex, from their production and use to their physical and chemical properties. For example, the value of POPs in developing countries versus circumpolar countries differs greatly, as many developing countries rely on POPs for their short-term survival while circumpolar countries have encountered harmful long-term environmental and health problems.

The Stockholm Convention exemplifies the issue of time lag between science and political action. While negotiations of the agreement were relatively short, full ratification will take a considerable amount of time, further delaying its entry into force. Even after all source countries cease to produce, use and emit POPs, contaminants will continue to accumulate in the Arctic environment due to their physical and chemical properties.

Further research pertaining to POPs and the Stockholm Convention will be essential to fully understanding the complex problem of POPs and the international response. Research on the cleanup or management of POPs in the environment needs to be initiated to determine whether the levels of contaminants can be significantly reduced.

If the Stockholm Convention is to be effective in protecting the health of humans and the environment from POPs, then research on existing contaminant levels, long-term associated health effects and ways to rid the environment and humans of contaminants needs to be completed. A more comprehensive understanding of the problem of POPs could potentially encourage a quicker international response, thereby bringing the Stockholm Convention into force sooner. Source countries will need to take a more comprehensive approach to monitoring their production, use and emission of POPs to provide baseline data and further evaluate the effectiveness of the measures they have implemented. Parties will also need to collaborate and share their data to aid in addressing the international issue of POPs contamination.

After evaluating the Stockholm Convention with the conceptual framework, it is obvious that the agreement comprises many of the essential components of an effective international environmental agreement. It is too early to determine whether or not the Stockholm Convention will effectively address the environmental problem of POPs; however, an educated forecast can be made. The success of this agreement hinges on the participation of countries that are the sources of POPs. If these countries implement and comply with the Stockholm Convention, this environmental agreement will be potentially effective in addressing the environmentally complex issue of persistent organic pollutants.

Over the long term, reducing the levels of POPs and eventually eliminating them from the global environment will address the needs of the Canadian Arctic. However, this will take years due to the physical and chemical properties of POPs, the characteristics of the Arctic environment and the time lag before states fully meet the obligations of the

agreement on eliminating the production, use and release of POPs. A significant delay in the changed behaviour of states may have even more an apparent effect on the health of humans and the environment if POPs continue to accumulate in the Arctic. We are only beginning to understand the relatively short-term effects of POPs on human and wildlife health and in the long term, their effects may be even more harmful.

Again, the success of the Stockholm Convention hinges on the participation of states who are major sources of POPs. If they successfully implement and comply with the Stockholm Convention, in the long term the Stockholm Convention may prove to be an environmentally effective regime, fully addressing the needs of the Canadian Arctic environment and protecting the health of humans and the environment from the harmful effects of persistent organic pollutants.

This thesis has demonstrated the importance of using regime analysis to evaluate international environmental agreements. Regime theory was examined to determine what constitutes an effective environmental regime and devise a conceptual framework for evaluating the Stockholm Convention. Utilizing regime theory was beneficial for developing a conceptual framework for a number of reasons. First, regime theory summarizes past lessons in developing and implementing environmental agreements and the regimes that may result. Second, regime theory highlights the conditions under which regimes are successful and how the success of regimes can vary. Finally, regime theory literature describes how effective regimes are designed and identifies elements that help environmental regimes achieve success. In concert with this, examining the issue of persistent organic pollutants helped identify the complex nature of environmental issues which require international cooperation and collaboration in order to solve them. An

environmental problem transcending international borders, POPs pose potential health problems not only for receiving countries accumulating these contaminants in their environment and population, but also for the source countries which, if they ceased production and use, could experience detrimental effects in the absence of effective alternatives.

While the importance of using regime theory to evaluate environmental agreements has been made evident in this thesis, it is important to address the limitations of such theory. As previously stated, each environmental problem is complex and unique. The Stockholm Convention included elements not found in regime theory, such as provisions for adding chemicals to the list for elimination or reduction. This is an indication that practice needs to go beyond theory and that environmental issues are dynamic while regime theory remains relatively static. With an emphasis on political science, regime theory fails to address scientific and social aspects of environmental problems. Scientific discrepancies between states and social controversies are a reality of many environmental problems, as seen in the issue of POPs. Furthermore, the time lag between science and political action is not considered to the full extent it should be in regime theory. For example, even if all POPs ceased to be produced, used and emitted today, it would be a number of years before the accumulation of contaminants in the Arctic would stop. Regime theory cannot examine and address what an effective environmental regime should entail. Therefore, it was essential to combine the approach of regime analysis with an examination of other perspectives, such as the science, geography, social science and history of environmental issue of POPs in the Canadian Arctic.

Due to the nature of POPs and international politics, it will be a significant amount of

time before substantial results are evident, leaving the Arctic environment and northern populations out in the cold. However, as this thesis demonstrates, in the long term, the Stockholm Convention has the potential to be environmentally effective and to address the problem of POPs in the Canadian Arctic.

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Appendix 1

Protocols to the 1979 Convention on Long-Range Transboundary Air Pollution

Protocol	Summary of Protocol
1984 Protocol on Long-term Financing of the Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP)	▪ Instrument for international cost-sharing of monitoring programs to collect data for various pollutants ▪ Included sulphur dioxides, nitrogen oxides and volatile organic compounds ▪ Implemented measurement of air and precipitation quality ▪ Developed models of atmospheric dispersion
1985 Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30%	▪ Reduction of sulphur emissions by 30% by the year 1993 ▪ All Parties have reached reduction target
1988 Protocol Concerning the Control of Nitrogen Oxides or their Transboundary Fluxes	▪ Guidelines for the control and reduction of national annual emissions of nitrous oxides and their transboundary fluxes from stationary and mobile sources ▪ Applied national emission standards to new stationary and mobile sources ▪ Introduced pollution control measures for major existing stationary sources
1991 Protocol Concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes	▪ Offered three options for emission reduction targets
1994 Protocol on Further Reduction of Sulphur Emissions	▪ Included further measures for the reduction of sulphur emissions ▪ Precautionary measures to anticipate, prevent and reduce air pollutants ▪ Guidelines for annual reporting provisions for technology transfers
1998 Protocol on Heavy Metals	▪ Reduce emissions of cadmium, lead and mercury ▪ Aimed to reduce metals below 1990 levels ▪ Annual reporting and provisions for technology transfers
1998 Protocol on Persistent Organic Pollutants	▪ Eventual elimination of 16 substances ▪ Provisions for dealing with wastes of products that will be prohibited ▪ Obliges parties to reduce emissions of certain substances below their 1990 levels ▪ Limit values for incineration of waste
1999 Protocol to Abate Acidification, Eutrophication and Ground-Level Ozone	▪ Emission ceilings for sulphur, VOx, VOCs and ammonia by 2010

(Source: UN/ECE, 1998a; UN/ECE, 2002)

Appendix 2

STOCKHOLM CONVENTION ON PERSISTENT ORGANIC POLLUTANTS

The Parties to this Convention,

Recognizing that persistent organic pollutants possess toxic properties, resist degradation, bioaccumulate and are transported, through air, water and migratory species, across international boundaries and deposited far from their place of release, where they accumulate in terrestrial and aquatic ecosystems,

Aware of the health concerns, especially in developing countries, resulting from local exposure to persistent organic pollutants, in particular impacts upon women and, through them, upon future generations,

Acknowledging that the Arctic ecosystems and indigenous communities are particularly at risk because of the biomagnification of persistent organic pollutants and that contamination of their traditional foods is a public health issue,

Conscious of the need for global action on persistent organic pollutants,

Mindful of decision 19/13 C of 7 February 1997 of the Governing Council of the United Nations Environment Programme to initiate international action to protect human health and the environment
through measures which will reduce and/or eliminate emissions and discharges of persistent organic pollutants,

Recalling the pertinent provisions of the relevant international environmental conventions, especially the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal including the regional agreements developed within the framework of its Article 11,

Recalling also the pertinent provisions of the Rio Declaration on Environment and Development and Agenda 21,

Acknowledging that precaution underlies the concerns of all the Parties and is embedded within this Convention,

Recognizing that this Convention and other international agreements in the field of trade and the environment are mutually supportive,

Reaffirming that States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction,

Taking into account the circumstances and particular requirements of developing countries, in

particular the least developed among them, and countries with economies in transition, especially the need to strengthen their national capabilities for the management of chemicals, including through the transfer of technology, the provision of financial and technical assistance and the promotion of cooperation among the Parties,

Taking full account of the Programme of Action for the Sustainable Development of Small Island Developing States, adopted in Barbados on 6 May 1994,

Noting the respective capabilities of developed and developing countries, as well as the common but differentiated responsibilities of States as set forth in Principle 7 of the Rio Declaration on Environment and Development,

Recognizing the important contribution that the private sector and non-governmental organizations
can make to achieving the reduction and/or elimination of emissions and discharges of persistent organic
pollutants,

Underlining the importance of manufacturers of persistent organic pollutants taking responsibility for
reducing adverse effects caused by their products and for providing information to users, Governments and
the public on the hazardous properties of those chemicals,

Conscious of the need to take measures to prevent adverse effects caused by persistent organic pollutants at all stages of their life cycle,

Reaffirming Principle 16 of the Rio Declaration on Environment and Development which states that
national authorities should endeavour to promote the internalization of environmental costs and the use of
economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of
pollution, with due regard to the public interest and without distorting international trade and investment,

Encouraging Parties not having regulatory and assessment schemes for pesticides and industrial chemicals to develop such schemes,

Recognizing the importance of developing and using environmentally sound alternative processes and
chemicals,

Determined to protect human health and the environment from the harmful impacts of persistent organic pollutants,

Have agreed as follows:

Article 1

Objective

Mindful of the precautionary approach as set forth in Principle 15 of the Rio Declaration on Environment and Development, the objective of this Convention is to protect human health and the environment from persistent organic pollutants.

Article 2

Definitions

For the purposes of this Convention:

(a) "Party" means a State or regional economic integration organization that has consented to be bound by this Convention and for which the Convention is in force;

(b) "Regional economic integration organization" means an organization constituted by sovereign States of a given region to which its member States have transferred competence in respect of matters governed by this Convention and which has been duly authorized, in accordance with its internal procedures, to sign, ratify, accept, approve or accede to this Convention;

(c) "Parties present and voting" means Parties present and casting an affirmative or negative vote.

Article 3

Measures to reduce or eliminate releases from intentional production and use

1. Each Party shall:

(a) Prohibit and/or take the legal and administrative measures necessary to eliminate:

(i) Its production and use of the chemicals listed in Annex A subject to the provisions of that Annex; and

(ii) Its import and export of the chemicals listed in Annex A in accordance with the provisions of paragraph 2; and

(b) Restrict its production and use of the chemicals listed in Annex B in accordance with the provisions of that Annex.

2. Each Party shall take measures to ensure:

(a) That a chemical listed in Annex A or Annex B is imported only:

(i) For the purpose of environmentally sound disposal as set forth in paragraph 1 (d) of Article 6; or

(ii) For a use or purpose which is permitted for that Party under Annex A or Annex B;

(b) That a chemical listed in Annex A for which any production or use specific exemption is in effect or a chemical listed in Annex B for which any production or use specific exemption or acceptable purpose is in effect, taking into account any relevant provisions in existing international prior informed consent instruments, is exported only:

(i) For the purpose of environmentally sound disposal as set forth in paragraph 1 (d) of Article 6;

(ii) To a Party which is permitted to use that chemical under Annex A or Annex B; or

(iii) To a State not Party to this Convention which has provided an annual certification to the exporting Party. Such certification shall specify the intended use of the chemical and include a statement that, with respect to that chemical, the importing State is committed to:

a. Protect human health and the environment by taking the necessary measures to minimize or prevent releases;

b. Comply with the provisions of paragraph 1 of Article 6; and

c. Comply, where appropriate, with the provisions of paragraph 2 of Part II of Annex B.

The certification shall also include any appropriate supporting documentation, such as legislation, regulatory instruments, or administrative or policy guidelines. The exporting Party shall transmit the certification to the Secretariat within sixty days of receipt.

(c) That a chemical listed in Annex A, for which production and use specific exemptions are no longer in effect for any Party, is not exported from it except for the purpose of environmentally sound disposal as set forth in paragraph 1 (d) of Article 6;

(d) For the purposes of this paragraph, the term "State not Party to this Convention" shall include, with respect to a particular chemical, a State or regional economic integration organization that has not agreed to be bound by the Convention with respect to that chemical.

3. Each Party that has one or more regulatory and assessment schemes for new pesticides or new industrial chemicals shall take measures to regulate with the aim of preventing the production and use of new pesticides or new industrial chemicals which, taking into consideration the criteria in paragraph 1 of Annex D, exhibit the characteristics of persistent organic pollutants.

4. Each Party that has one or more regulatory and assessment schemes for pesticides or industrial

chemicals shall, where appropriate, take into consideration within these schemes the criteria in paragraph 1 of Annex D when conducting assessments of pesticides or industrial chemicals currently in use.

5. Except as otherwise provided in this Convention, paragraphs 1 and 2 shall not apply to quantities of a chemical to be used for laboratory-scale research or as a reference standard.

6. Any Party that has a specific exemption in accordance with Annex A or a specific exemption or an acceptable purpose in accordance with Annex B shall take appropriate measures to ensure that any production or use under such exemption or purpose is carried out in a manner that prevents or minimizes human exposure and release into the environment. For exempted uses or acceptable purposes that involve intentional release into the environment under conditions of normal use, such release shall be to the minimum extent necessary, taking into account any applicable standards and guidelines.

Article 4

Register of specific exemptions

1. A Register is hereby established for the purpose of identifying the Parties that have specific exemptions listed in Annex A or Annex B. It shall not identify Parties that make use of the provisions in Annex A or Annex B that may be exercised by all Parties. The Register shall be maintained by the Secretariat and shall be available to the public.

2. The Register shall include:

(a) A list of the types of specific exemptions reproduced from Annex A and Annex B;

(b) A list of the Parties that have a specific exemption listed under Annex A or Annex B; and

(c) A list of the expiry dates for each registered specific exemption.

3. Any State may, on becoming a Party, by means of a notification in writing to the Secretariat, register for one or more types of specific exemptions listed in Annex A or Annex B.

4. Unless an earlier date is indicated in the Register by a Party, or an extension is granted pursuant to paragraph 7, all registrations of specific exemptions shall expire five years after the date of entry into force of this Convention with respect to a particular chemical.

5. At its first meeting, the Conference of the Parties shall decide upon its review process for the entries in the Register.

6. Prior to a review of an entry in the Register, the Party concerned shall submit a report to the Secretariat justifying its continuing need for registration of that exemption. The report shall be circulated by the Secretariat to all Parties. The review of a registration shall be carried out on the basis of all available information. Thereupon, the Conference of the Parties may make such recommendations to the Party concerned as it deems appropriate.

7. The Conference of the Parties may, upon request from the Party concerned, decide to extend the expiry date of a specific exemption for a period of up to five years. In making its decision, the Conference of the Parties shall take due account of the special circumstances of the developing country Parties and Parties with economies in transition.

8. A Party may, at any time, withdraw an entry from the Register for a specific exemption upon written notification to the Secretariat. The withdrawal shall take effect on the date specified in the notification.

9. When there are no longer any Parties registered for a particular type of specific exemption, no new registrations may be made with respect to it.

Article 5

Measures to reduce or eliminate releases from unintentional production

Each Party shall at a minimum take the following measures to reduce the total releases derived from anthropogenic sources of each of the chemicals listed in Annex C, with the goal of their continuing minimization and, where feasible, ultimate elimination:

(a) Develop an action plan or, where appropriate, a regional or subregional action plan within two years of the date of entry into force of this Convention for it, and subsequently implement it as part of its implementation plan specified in Article 7, designed to identify, characterize and address the release of the chemicals listed in Annex C and to facilitate implementation of subparagraphs (b) to (e). The action plan shall include the following elements:

(i) An evaluation of current and projected releases, including the development and maintenance of source inventories and release estimates, taking into consideration the source categories identified in Annex C;

(ii) An evaluation of the efficacy of the laws and policies of the Party relating to the management of such releases;

(iii) Strategies to meet the obligations of this paragraph, taking into account the evaluations in (i) and (ii);

(iv) Steps to promote education and training with regard to, and awareness of, those strategies;

(v) A review every five years of those strategies and of their success in meeting the obligations of this paragraph; such reviews shall be included in reports submitted pursuant to Article 15;

(vi) A schedule for implementation of the action plan, including for the strategies and measures identified therein;

(b) Promote the application of available, feasible and practical measures that can expeditiously achieve a realistic and meaningful level of release reduction or source elimination;

(c) Promote the development and, where it deems appropriate, require the use of substitute or modified materials, products and processes to prevent the formation and release of the chemicals listed in Annex C, taking into consideration the general guidance on prevention and release reduction measures in Annex C and guidelines to be adopted by decision of the Conference of the Parties;

(d) Promote and, in accordance with the implementation schedule of its action plan, require the use of best available techniques for new sources within source categories which a Party has identified as warranting such action in its action plan, with a particular initial focus on source categories identified in Part II of Annex C. In any case, the requirement to use best available techniques for new sources in the categories listed in Part II of that Annex shall be phased in as soon as practicable but no later than four years after the entry into force of the Convention for that Party. For the identified categories, Parties shall promote the use of best environmental practices. When applying best available techniques and best environmental practices, Parties should take into consideration the general guidance on prevention and release reduction measures in that Annex and guidelines on best available techniques and best environmental practices to be adopted by decision of the Conference of the Parties;

(e) Promote, in accordance with its action plan, the use of best available techniques and best environmental practices:

(i) For existing sources, within the source categories listed in Part II of Annex C and within source categories such as those in Part III of that Annex; and

(ii) For new sources, within source categories such as those listed in Part III of Annex C which a Party has not addressed under subparagraph

(d). When applying best available techniques and best environmental practices, Parties should take into consideration the general guidance on prevention and release reduction measures in Annex C and guidelines on best available techniques and best environmental practices to be adopted by decision of the Conference of the Parties;

(f) For the purposes of this paragraph and Annex C:

(i) "Best available techniques" means the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for release limitations designed to prevent and, where that is not practicable, generally to reduce releases of chemicals listed in Part I of Annex C and their impact on the environment as a whole. In this regard:

(ii) "Techniques" includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned;

(iii) "Available" techniques means those techniques that are accessible to the operator and that are developed on a scale that allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages; and

(iv) "Best" means most effective in achieving a high general level of protection of the environment as a whole;

(v) "Best environmental practices" means the application of the most appropriate combination of environmental control measures and strategies;

(vi) "New source" means any source of which the construction or substantial modification is commenced at least one year after the date of:

a. Entry into force of this Convention for the Party concerned; or

b. Entry into force for the Party concerned of an amendment to Annex C where the source becomes subject to the provisions of this Convention only by virtue of that amendment.

(g) Release limit values or performance standards may be used by a Party to fulfill its commitments for best available techniques under this paragraph.

Article 6

Measures to reduce or eliminate releases from stockpiles and wastes

1. In order to ensure that stockpiles consisting of or containing chemicals listed either in Annex A or Annex B and wastes, including products and articles upon becoming wastes, consisting of, containing or contaminated with a chemical listed in Annex A, B or C, are managed in a manner protective of human health and the environment, each Party shall:

(a) Develop appropriate strategies for identifying:

(i) Stockpiles consisting of or containing chemicals listed either in Annex A or Annex B; and

(ii) Products and articles in use and wastes consisting of, containing or contaminated with a chemical listed in Annex A, B or C;

(b) Identify, to the extent practicable, stockpiles consisting of or containing chemicals listed either in Annex A or Annex B on the basis of the strategies referred to in subparagraph (a);

(c) Manage stockpiles, as appropriate, in a safe, efficient and environmentally sound manner. Stockpiles of chemicals listed either in Annex A or Annex B, after they are no longer allowed to be used according to any specific exemption specified in Annex A or any specific exemption or acceptable purpose specified in Annex B, except stockpiles which are allowed to be exported according to paragraph 2 of

Article 3, shall be deemed to be waste and shall be managed in accordance with subparagraph (d);

(d) Take appropriate measures so that such wastes, including products and articles upon becoming wastes, are:

(i) Handled, collected, transported and stored in an environmentally sound manner;

(ii) Disposed of in such a way that the persistent organic pollutant content is destroyed or irreversibly transformed so that they do not exhibit the characteristics of persistent organic pollutants or otherwise disposed of in an environmentally sound manner when destruction or irreversible transformation does not represent the environmentally preferable option or the persistent organic pollutant content is low, taking into account international rules, standards, and guidelines, including those that may be developed pursuant to paragraph 2, and relevant global and regional regimes governing the management of hazardous wastes;

(iii) Not permitted to be subjected to disposal operations that may lead to recovery, recycling, reclamation, direct reuse or alternative uses of persistent organic pollutants; and

(iv) Not transported across international boundaries without taking into account relevant international rules, standards and guidelines;

(e) Endeavour to develop appropriate strategies for identifying sites contaminated by chemicals listed in Annex A, B or C; if remediation of those sites is undertaken it shall be performed in an environmentally sound manner.

2. The Conference of the Parties shall cooperate closely with the appropriate bodies of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal to, inter alia:

(a) Establish levels of destruction and irreversible transformation necessary to ensure that the characteristics of persistent organic pollutants as specified in paragraph 1 of Annex D are not exhibited;

(b) Determine what they consider to be the methods that constitute environmentally sound disposal referred to above; and

(c) Work to establish, as appropriate, the concentration levels of the chemicals listed in Annexes A, B and C in order to define the low persistent organic pollutant content referred to in paragraph 1 (d)(ii).

Article 7

Implementation plans

1. Each Party shall:

(a) Develop and endeavour to implement a plan for the implementation of its obligations under this Convention;

(b) Transmit its implementation plan to the Conference of the Parties within two years of the date on which this Convention enters into force for it; and

(c) Review and update, as appropriate, its implementation plan on a periodic basis and in a manner to be specified by a decision of the Conference of the Parties.

2. The Parties shall, where appropriate, cooperate directly or through global, regional and subregional organizations, and consult their national stakeholders, including women's groups and groups involved in the health of children, in order to facilitate the development, implementation and updating of their implementation plans.

3. The Parties shall endeavour to utilize and, where necessary, establish the means to integrate national implementation plans for persistent organic pollutants in their sustainable development strategies where appropriate.

Article 8

Listing of chemicals in Annexes A, B and C

1. A Party may submit a proposal to the Secretariat for listing a chemical in Annexes A, B and/or C. The proposal shall contain the information specified in Annex D. In developing a proposal, a Party may be assisted by other Parties and/or by the Secretariat.

2. The Secretariat shall verify whether the proposal contains the information specified in Annex D. If the Secretariat is satisfied that the proposal contains the information so specified, it shall forward the proposal to the Persistent Organic Pollutants Review Committee.

3. The Committee shall examine the proposal and apply the screening criteria specified in Annex D in a flexible and transparent way, taking all information provided into account in an integrative and balanced manner.

4. If the Committee decides that:

(a) It is satisfied that the screening criteria have been fulfilled, it shall, through the Secretariat, make the proposal and the evaluation of the Committee available to all Parties and observers and invite them to submit the information specified in Annex E; or

(b) It is not satisfied that the screening criteria have been fulfilled, it shall, through the Secretariat, inform all Parties and observers and make the proposal and the evaluation of the Committee available to all Parties and the proposal shall be set aside.

5. Any Party may resubmit a proposal to the Committee that has been set aside by the Committee pursuant to paragraph 4. The resubmission may include any concerns of the Party as well as a justification for additional consideration by the Committee. If, following this procedure, the Committee again sets the proposal aside, the Party may challenge the decision of the Committee and the Conference of the Parties shall consider the matter at its next session. The

Conference of the Parties may decide, based on the screening criteria in Annex D and taking into account the evaluation of the Committee and any additional information provided by any Party or observer, that the proposal should proceed.

6. Where the Committee has decided that the screening criteria have been fulfilled, or the Conference of the Parties has decided that the proposal should proceed, the Committee shall further review the proposal, taking into account any relevant additional information received, and shall prepare a draft risk profile in accordance with Annex E. It shall, through the Secretariat, make that draft available to all Parties and observers, collect technical comments from them and, taking those comments into account, complete the risk profile.

7. If, on the basis of the risk profile conducted in accordance with Annex E, the Committee decides:

(a) That the chemical is likely as a result of its long-range environmental transport to lead to significant adverse human health and/or environmental effects such that global action is warranted, the proposal shall proceed. Lack of full scientific certainty shall not prevent the proposal from proceeding. The Committee shall, through the Secretariat, invite information from all Parties and observers relating to the considerations specified in Annex F. It shall then prepare a risk management evaluation that includes an analysis of possible control measures for the chemical in accordance with that Annex; or

(b) That the proposal should not proceed, it shall, through the Secretariat, make the risk profile available to all Parties and observers and set the proposal aside.

8. For any proposal set aside pursuant to paragraph 7 (b), a Party may request the Conference of the Parties to consider instructing the Committee to invite additional information from the proposing Party and other Parties during a period not to exceed one year. After that period and on the basis of any information received, the Committee shall reconsider the proposal pursuant to paragraph 6 with a priority to be decided by the Conference of the Parties. If, following this procedure, the Committee again sets the proposal aside, the Party may challenge the decision of the Committee and the Conference of the Parties shall consider the matter at its next session. The Conference of the Parties may decide, based on the risk profile prepared in accordance with Annex E and taking into account the evaluation of the Committee and any additional information provided by any Party or observer, that the proposal should proceed. If the Conference of the Parties decides that the proposal shall proceed, the Committee shall then prepare the risk management evaluation.

9. The Committee shall, based on the risk profile referred to in paragraph 6 and the risk management evaluation referred to in paragraph 7 (a) or paragraph 8, recommend whether the chemical should be considered by the Conference of the Parties for listing in Annexes A, B and/or C. The Conference of the Parties, taking due account of the recommendations of the Committee, including any scientific uncertainty, shall decide, in a precautionary manner, whether to list the chemical, and specify its related control measures, in Annexes A, B and/or C.

Article 9

Information exchange

1. Each Party shall facilitate or undertake the exchange of information relevant to:

(a) The reduction or elimination of the production, use and release of persistent organic pollutants; and

(b) Alternatives to persistent organic pollutants, including information relating to t heir risks as well as to their economic and social costs.

2. The Parties shall exchange the information referred to in paragraph 1 directly or through the Secretariat.

3. Each Party shall designate a national focal point for the exchange of such information.

4. The Secretariat shall serve as a clearing-house mechanism for information on persistent organic pollutants, including information provided by Parties, intergovernmental organizations and nongovernmental organizations.

5. For the purposes of this Convention, information on health and safety of humans and the environment shall not be regarded as confidential. Parties that exchange other information pursuant to this Convention shall protect any confidential information as mutually agreed.

Article 10

Public information, awareness and education

1. Each Party shall, within its capabilities, promote and facilitate:

(a) Awareness among its policy and decision makers with regard to persistent organic pollutants;

(b) Provision to the public of all available information on persistent organic pollutants, taking into account paragraph 5 of Article 9;

(c) Development and implementation, especially for women, children and the least educated, of educational and public awareness programmes on persistent organic pollutants, as well as on their health and environmental effects and on their alternatives;

(d) Public participation in addressing persistent organic pollutants and their health and environmental effects and in developing adequate responses, including opportunities for providing input at the national level regarding implementation of this Convention;

(e) Training of workers, scientists, educators and technical and managerial personnel;

(f) Development and exchange of educational and public awareness materials at the national and international levels; and

(g) Development and implementation of education and training programmes at the national and international levels.

2. Each Party shall, within its capabilities, ensure that the public has access to the public information referred to in paragraph 1 and that the information is kept up-to-date.

3. Each Party shall, within its capabilities, encourage industry and professional users to promote and facilitate the provision of the information referred to in paragraph 1 at the national level and, as appropriate, subregional, regional and global levels.

4. In providing information on persistent organic pollutants and their alternatives, Parties may use safety data sheets, reports, mass media and other means of communication, and may establish information centers at national and regional levels.

5. Each Party shall give sympathetic consideration to developing mechanisms, such as pollutant release and transfer registers, for the collection and dissemination of information on estimates of the annual quantities of the chemicals listed in Annex A, B or C that are released or disposed of.

Article 11

Research, development and monitoring

1. The Parties shall, within their capabilities, at the national and international levels, encourage and/or undertake appropriate research, development, monitoring and cooperation pertaining to persistent organic pollutants and, where relevant, to their alternatives and to candidate persistent organic pollutants, including on their:

(a) Sources and releases into the environment;

(b) Presence, levels and trends in humans and the environment;

(c) Environmental transport, fate and transformation;

(d) Effects on human health and the environment;

(e) Socio-economic and cultural impacts;

(f) Release reduction and/or elimination; and

(g) Harmonized methodologies for making inventories of generating sources and analytical techniques for the measurement of releases.

2. In undertaking action under paragraph 1, the Parties shall, within their capabilities:

(a) Support and further develop, as appropriate, international programmes, networks and organizations aimed at defining, conducting, assessing and financing research, data collection and monitoring, taking into account the need to minimize duplication of effort;

(b) Support national and international efforts to strengthen national scientific and technical research capabilities, particularly in developing countries and countries

with economies in transition, and to promote access to, and the exchange of, data and analyses;

(c) Take into account the concerns and needs, particularly in the field of financial and technical resources, of developing countries and countries with economies in transition and cooperate in improving their capability to participate in the efforts referred to in subparagraphs (a) and (b);

(d) Undertake research work geared towards alleviating the effects of persistent organic pollutants on reproductive health;

(e) Make the results of their research, development and monitoring activities referred to in this paragraph accessible to the public on a timely and regular basis; and

(f) Encourage and/or undertake cooperation with regard to storage and maintenance of information generated from research, development and monitoring.

Article 12

Technical assistance

1. The Parties recognize that rendering of timely and appropriate technical assistance in response to requests from developing country Parties and Parties with economies in transition is essential to the successful implementation of this Convention.

2. The Parties shall cooperate to provide timely and appropriate technical assistance to developing country Parties and Parties with economies in transition, to assist them, taking into account their particular needs, to develop and strengthen their capacity to implement their obligations under this Convention.

3. In this regard, technical assistance to be provided by developed country Parties, and other Parties in accordance with their capabilities, shall include, as appropriate and as mutually agreed, technical assistance for capacity-building relating to implementation of the obligations under this Convention. Further guidance in this regard shall be provided by the Conference of the Parties.

4. The Parties shall establish, as appropriate, arrangements for the purpose of providing technical assistance and promoting the transfer of technology to developing country Parties and Parties with economies in transition relating to the implementation of this Convention. These arrangements shall include regional and subregional centres for capacity-building and transfer of technology to assist developing country Parties and Parties with economies in transition to fulfill their obligations under this Convention. Further guidance in this regard shall be provided by the Conference of the Parties.

5. The Parties shall, in the context of this Article, take full account of the specific needs and special situation of least developed countries and small island developing states in their actions with regard to technical assistance.

Article 13

Financial resources and mechanisms

1. Each Party undertakes to provide, within its capabilities, financial support and incentives in respect of those national activities that are intended to achieve the objective of this Convention in accordance with its national plans, priorities and programmes.

2. The developed country Parties shall provide new and additional financial resources to enable developing country Parties and Parties with economies in transition to meet the agreed full incremental costs of implementing measures which fulfill their obligations under this Convention as agreed between a recipient Party and an entity participating in the mechanism described in paragraph 6. Other Parties may also on a voluntary basis and in accordance with their capabilities provide such financial resources. Contributions from other sources should also be encouraged. The implementation of these commitments shall take into account the need for adequacy, predictability, the timely flow of funds and the importance of burden sharing among the contributing Parties.

3. Developed country Parties, and other Parties in accordance with their capabilities and in accordance with their national plans, priorities and programmes, may also provide and developing country Parties and Parties with economies in transition avail themselves of financial resources to assist in their implementation of this Convention through other bilateral, regional and multilateral sources or channels.

4. The extent to which the developing country Parties will effectively implement their commitments under this Convention will depend on the effective implementation by developed country Parties of their commitments under this Convention relating to financial resources, technical assistance and technology transfer. The fact that sustainable economic and social development and eradication of poverty are the first and overriding priorities of the developing country Parties will be taken fully into account, giving due consideration to the need for the protection of human health and the environment.

5. The Parties shall take full account of the specific needs and special situation of the least developed countries and the small island developing states in their actions with regard to funding.

6. A mechanism for the provision of adequate and sustainable financial resources to developing country Parties and Parties with economies in transition on a grant or concessional basis to assist in their implementation of the Convention is hereby defined. The mechanism shall function under the authority, as appropriate, and guidance of, and be accountable to the Conference of the Parties for the purposes of this Convention. Its operation shall be entrusted to one or more entities, including existing international entities, as may be decided upon by the Conference of the Parties. The mechanism may also include other entities providing multilateral, regional and bilateral financial and technical assistance. Contributions to the mechanism shall be additional to other financial transfers to developing country Parties and Parties with economies in transition as reflected in, and in accordance with, paragraph 2.

7. Pursuant to the objectives of this Convention and paragraph 6, the Conference of the Parties shall at its first meeting adopt appropriate guidance to be provided to the mechanism and shall agree with the entity or entities participating in the financial mechanism upon arrangements to give effect thereto. The guidance shall address, inter alia:

(a) The determination of the policy, strategy and programme priorities, as well as clear and detailed criteria and guidelines regarding eligibility for access to and utilization of financial resources including monitoring and evaluation on a regular basis of such utilization;

(b) The provision by the entity or entities of regular reports to the Conference of the Parties on adequacy and sustainability of funding for activities relevant to the implementation of this Convention;

(c) The promotion of multiple-source funding approaches, mechanisms and arrangements;

(d) The modalities for the determination in a predictable and identifiable manner of the amount of funding necessary and available for the implementation of this Convention, keeping in mind that the phasing out of persistent organic pollutants might require sustained funding, and the conditions under which that amount shall be periodically reviewed; and

(e) The modalities for the provision to interested Parties of assistance with needs assessment, information on available sources of funds and on funding patterns in order to facilitate coordination among them.

8. The Conference of the Parties shall review, not later than its second meeting and thereafter on a regular basis, the effectiveness of the mechanism established under this Article, its ability to address the changing needs of the developing country Parties and Parties with economies in transition, the criteria and guidance referred to in paragraph 7, the level of funding as well as the effectiveness of the performance of the institutional entities entrusted to operate the financial mechanism. It shall, based on such review, take appropriate action, if necessary, to improve the effectiveness of the mechanism, including by means of recommendations and guidance on measures to ensure adequate and sustainable funding to meet the needs of the Parties.

Article 14

Interim financial arrangements

The institutional structure of the Global Environment Facility, operated in accordance with the Instrument for the Establishment of the Restructured Global Environment Facility, shall, on an interim basis, be the principal entity entrusted with the operations of the financial mechanism referred to in Article 13, for the period between the date of entry into force of this Convention and the first meeting of the Conference of the Parties, or until such time as the Conference of the Parties decides which institutional structure will be designated in accordance with Article 13. The institutional structure of the Global Environment Facility should fulfill this function through operational measures related specifically to persistent organic pollutants taking into account that new arrangements for this area may be needed.

Article 15

Reporting

1. Each Party shall report to the Conference of the Parties on the measures it has taken to implement the provisions of this Convention and on the effectiveness of such measures in meeting the objectives of the Convention.

2. Each Party shall provide to the Secretariat:

(a) Statistical data on its total quantities of production, import and export of each of the chemicals listed in Annex A and Annex B or a reasonable estimate of such data; and

(b) To the extent practicable, a list of the States from which it has imported each such substance and the States to which it has exported each such substance.

3. Such reporting shall be at periodic intervals and in a format to be decided by the Conference of the Parties at its first meeting.

Article 16

Effectiveness evaluation.

1. Commencing four years after the date of entry into force of this Convention, and periodically thereafter at intervals to be decided by the Conference of the Parties, the Conference shall evaluate the effectiveness of this Convention.

2. In order to facilitate such evaluation, the Conference of the Parties shall, at its first meeting, initiate the establishment of arrangements to provide itself with comparable monitoring data on the presence of the chemicals listed in Annexes A, B and C as well as their regional and global environmental transport. These arrangements:

(a) Should be implemented by the Parties on a regional basis when appropriate, in accordance with their technical and financial capabilities, using existing monitoring programmes and mechanisms to the extent possible and promoting harmonization of approaches;

(b) May be supplemented where necessary, taking into account the differences between regions and their capabilities to implement monitoring activities; and

(c) Shall include reports to the Conference of the Parties on the results of the monitoring activities on a regional and global basis at intervals to be specified by the Conference of the Parties.

3. The evaluation described in paragraph 1 shall be conducted on the basis of available scientific, environmental, technical and economic information, including:

(a) Reports and other monitoring information provided pursuant to paragraph 2;

(b) National reports submitted pursuant to Article 15; and

(c) Non-compliance information provided pursuant to the procedures established under Article 17.

Article 17

Non-compliance

The Conference of the Parties shall, as soon as practicable, develop and approve procedures and institutional mechanisms for determining non-compliance with the provisions of this Convention and for the treatment of Parties found to be in non-compliance.

Article 18

Settlement of disputes

1. Parties shall settle any dispute between them concerning the interpretation or application of this Convention through negotiation or other peaceful means of their own choice.

2. When ratifying, accepting, approving or acceding to the Convention, or at any time thereafter, a Party that is not a regional economic integration organization may declare in a written instrument submitted to the depositary that, with respect to any dispute concerning the interpretation or application of the Convention, it recognizes one or both of the following means of dispute settlement as compulsory in relation to any Party accepting the same obligation:

(a) Arbitration in accordance with procedures to be adopted by the Conference of the Parties in an annex as soon as practicable;

(b) Submission of the dispute to the International Court of Justice.

3. A Party that is a regional economic integration organization may make a declaration with like effect in relation to arbitration in accordance with the procedure referred to in paragraph 2 (a).

4. A declaration made pursuant to paragraph 2 or paragraph 3 shall remain in force until it expires in accordance with its terms or until three months after written notice of its revocation has been deposited with
the depositary.

5. The expiry of a declaration, a notice of revocation or a new declaration shall not in any way affect proceedings pending before an arbitral tribunal or the International Court of Justice unless the parties to the dispute otherwise agree.

6. If the parties to a dispute have not accepted the same or any procedure pursuant to paragraph 2, and if they have not been able to settle their dispute within twelve months following notification by one party to another that a dispute exists between them, the dispute shall be submitted to a conciliation commission at the request of any party to the dispute. The conciliation commission shall render a report with recommendations. Additional procedures relating to the conciliation commission shall be included in an annex to be adopted by the Conference of the Parties no later than at its second meeting.

Article 19

Conference of the Parties

1. A Conference of the Parties is hereby established.

2. The first meeting of the Conference of the Parties shall be convened by the Executive Director of the United Nations Environment Programme no later than one year after the entry into force of this Convention. Thereafter, ordinary meetings of the Conference of the Parties shall be held at regular intervals to be decided by the Conference.

3. Extraordinary meetings of the Conference of the Parties shall be held at such other times as may be deemed necessary by the Conference, or at the written request of any Party provided that it is supported by at least one third of the Parties.

4. The Conference of the Parties shall by consensus agree upon and adopt at its first meeting rules of procedure and financial rules for itself and any subsidiary bodies, as well as financial provisions governing the functioning of the Secretariat.

5. The Conference of the Parties shall keep under continuous review and evaluation the implementation of this Convention. It shall perform the functions assigned to it by the Convention and, to this end, shall:

(a) Establish, further to the requirements of paragraph 6, such subsidiary bodies as it considers necessary for the implementation of the Convention;

(b) Cooperate, where appropriate, with competent international organizations and intergovernmental and non-governmental bodies; and

(c) Regularly review all information made available to the Parties pursuant to Article 15, including consideration of the effectiveness of paragraph 2 (b) (iii) of Article 3;

(d) Consider and undertake any additional action that may be required for the achievement of the objectives of the Convention.

6. The Conference of the Parties shall, at its first meeting, establish a subsidiary body to be called the Persistent Organic Pollutants Review Committee for the purposes of performing the functions assigned to that Committee by this Convention. In this regard:

(a) The members of the Persistent Organic Pollutants Review Committee shall be appointed by the Conference of the Parties. Membership of the Committee shall consist of government-designated experts in chemical assessment or management. The members of the Committee shall be appointed on the basis of equitable geographical distribution;

(b) The Conference of the Parties shall decide on the terms of reference, organization and operation of the Committee; and

(c) The Committee shall make every effort to adopt its recommendations by consensus. If all efforts at consensus have been exhausted, and no consensus reached, such recommendation shall as a last resort be adopted by a two-thirds majority vote of the members present and voting.

7. The Conference of the Parties shall, at its third meeting, evaluate the continued need for the procedure contained in paragraph 2 (b) of Article 3, including consideration of its effectiveness.

8. The United Nations, its specialized agencies and the International Atomic Energy Agency, as well as any State not Party to this Convention, may be represented at meetings of the Conference of the Parties as observers. Any body or agency, whether national or international, governmental or non-governmental, qualified in matters covered by the Convention, and which

has informed the Secretariat of its wish to be represented at a meeting of the Conference of the Parties as an observer may be admitted unless at least one third of the Parties present object. The admission and participation of observers shall be subject to the rules of procedure adopted by the Conference of the Parties.

Article 20

Secretariat

1. A Secretariat is hereby established.

2. The functions of the Secretariat shall be:

(a) To make arrangements for meetings of the Conference of the Parties and its subsidiary bodies and to provide them with services as required;

(b) To facilitate assistance to the Parties, particularly developing country Parties and Parties with economies in transition, on request, in the implementation of this Convention;

(c) To ensure the necessary coordination with the secretariats of other relevant international bodies;

(d) To prepare and make available to the Parties periodic reports based on information received pursuant to Article 15 and other available information;

(e) To enter, under the overall guidance of the Conference of the Parties, into such administrative and contractual arrangements as may be required for the effective discharge of its functions; and

(f) To perform the other secretariat functions specified in this Convention and such other functions as may be determined by the Conference of the Parties.

3. The secretariat functions for this Convention shall be performed by the Executive Director of the United Nations Environment Programme, unless the Conference of the Parties decides, by a three-fourths majority of the Parties present and voting, to entrust the secretariat functions to one or more other international organizations.

Article 21

Amendments to the Convention

1. Amendments to this Convention may be proposed by any Party.

2. Amendments to this Convention shall be adopted at a meeting of the Conference of the Parties. The text of any proposed amendment shall be communicated to the Parties by the Secretariat at least six months before the meeting at which it is proposed for adoption. The Secretariat shall also communicate proposed amendments to the signatories to this Convention and, for information, to the depositary.

3. The Parties shall make every effort to reach agreement on any proposed amendment to this Convention by consensus. If all efforts at consensus have been exhausted, and no agreement

reached, the amendment shall as a last resort be adopted by a three-fourths majority vote of the Parties present and voting.

4. he amendment shall be communicated by the depositary to all Parties for ratification, acceptance or approval.

5. Ratification, acceptance or approval of an amendment shall be notified to the depositary in writing. An amendment adopted in accordance with paragraph 3 shall enter into force for the Parties having accepted it on the ninetieth day after the date of deposit of instruments of ratification, acceptance or approval by at least three-fourths of the Parties. Thereafter, the amendment shall enter into force for any other Party on the ninetieth day after the date on which that Party deposits its instrument of ratification, acceptance or approval of the amendment.

Article 22

Adoption and amendment of annexes

1. Annexes to this Convention shall form an integral part thereof and, unless expressly provided otherwise, a reference to this Convention constitutes at the same time a reference to any annexes thereto.

2. Any additional annexes shall be restricted to procedural, scientific, technical or administrative matters.

3. The following procedure shall apply to the proposal, adoption and entry into force of additional annexes to this Convention:

(a) Additional annexes shall be proposed and adopted according to the procedure laid down in paragraphs 1, 2 and 3 of Article 21;

(b) Any Party that is unable to accept an additional annex shall so notify the depositary, in writing, within one year from the date of communication by the depositary of the adoption of the additional annex. The depositary shall without delay notify all Parties of any such notification received. A Party may at any time withdraw a previous notification of non-acceptance in respect of any additional annex, and the annex shall thereupon enter into force for that Party subject to subparagraph (c); and

(c) On the expiry of one year from the date of the communication by the depositary of the adoption of an additional annex, the annex shall enter into force for all Parties that have not submitted a notification in accordance with the provisions of subparagraph (b).

4. The proposal, adoption and entry into force of amendments to Annex A, B or C shall be subject to the same procedures as for the proposal, adoption and entry into force of additional annexes to this Convention, except that an amendment to Annex A, B or C shall not enter into force with respect to any Party that has made a declaration with respect to amendment to those Annexes in accordance with paragraph 4 of Article 25, in which case any such amendment shall enter into force for such a Party on the ninetieth day after the date of deposit with the depositary of its instrument of ratification, acceptance, approval or accession with respect to such amendment.

5. The following procedure shall apply to the proposal, adoption and entry into force of an amendment to Annex D, E or F:

(a) Amendments shall be proposed according to the procedure in paragraphs 1 and 2 of Article 21;

(b) The Parties shall take decisions on an amendment to Annex D, E or F by consensus; and

(c) A decision to amend Annex D, E or F shall forthwith be communicated to the Parties by the depositary. The amendment shall enter into force for all Parties on a date to be specified in the decision.

6. If an additional annex or an amendment to an annex is related to an amendment to this Convention, the additional annex or amendment shall not enter into force until such time as the amendment to the Convention enters into force.

Article 23

Right to vote

1. Each Party to this Convention shall have one vote, except as provided for in paragraph 2.

2. A regional economic integration organization, on matters within its competence, shall exercise its right to vote with a number of votes equal to the number of its member States that are Parties to this Convention. Such an organization shall not exercise its right to vote if any of its member States exercises its right to vote, and vice versa.

Article 24

Signature

This Convention shall be open for signature at Stockholm by all States and regional economic integration organizations on 23 May 2001, and at the United Nations Headquarters in New York from 24 May 2001 to 22 May 2002.

Article 25

Ratification, acceptance, approval or accession

1. This Convention shall be subject to ratification, acceptance or approval by States and by regional economic integration organizations. It shall be open for accession by States and by regional economic integration organizations from the day after the date on which the Convention is closed for signature. Instruments of ratification, acceptance, approval or accession shall be deposited with the depositary.

2. Any regional economic integration organization that becomes a Party to this Convention without any of its member States being a Party shall be bound by all the obligations under the Convention. In the case of such organizations, one or more of whose member States is a Party to this Convention, the organization and its member States shall decide on their respective

responsibilities for the performance of their obligations under the Convention. In such cases, the organization and the member States shall not be entitled to exercise rights under the Convention concurrently.

3. In its instrument of ratification, acceptance, approval or accession, a regional economic integration organization shall declare the extent of its competence in respect of the matters governed by this Convention. Any such organization shall also inform the depositary, who shall in turn inform the Parties, of any relevant modification in the extent of its competence.

4. In its instrument of ratification, acceptance, approval or accession, any Party may declare that, with respect to it, any amendment to Annex A, B or C shall enter into force only upon the deposit of its instrument of ratification, acceptance, approval or accession with respect thereto.

Article 26

Entry into force

1. This Convention shall enter into force on the ninetieth day after the date of deposit of the fiftieth instrument of ratification, acceptance, approval or accession.

2. For each State or regional economic integration organization that ratifies, accepts or approves this Convention or accedes thereto after the deposit of the fiftieth instrument of ratification, acceptance, approval or accession, the Convention shall enter into force on the ninetieth day after the date of deposit by such State or regional economic integration organization of its instrument of ratification, acceptance, approval or accession.

3. For the purpose of paragraphs 1 and 2, any instrument deposited by a regional economic integration organization shall not be counted as additional to those deposited by member States of that organization.

Article 27

Reservations

No reservations may be made to this Convention.

Article 28

Withdrawal

1. At any time after three years from the date on which this Convention has entered into force for a Party, that Party may withdraw from the Convention by giving written notification to the depositary.

2. Any such withdrawal shall take effect upon the expiry of one year from the date of receipt by the depositary of the notification of withdrawal, or on such later date as may be specified in the notification of withdrawal.

Article 29

Depositary

The Secretary-General of the United Nations shall be the depositary of this Convention.

Article 30

Authentic texts

The original of this Convention, of which the Arabic, Chinese, English, French, Russian and Spanish texts are equally authentic, shall be deposited with the Secretary-General of the United Nations. IN WITNESS WHEREOF the undersigned, being duly authorized to that effect, have signed this Convention. Done at Stockholm on this twenty-second day of May, two thousand and one.

Annex A

ELIMINATION

Part I

Chemical	Activity	Specific Exemptions
Aldrin* CAS No: 309-00-2	Production	None
	Use	Local ectoparasiticide Insecticide
Chlordane* CAS No: 57-74-9	Production	As allowed for the Parties listed in the Register
	Use	Local ectoparasiticide Insecticide Termiticide Termiticide in buildings and dams Termiticide in roads Additive in plywood adhesives
Dieldrin* CAS No: 60-57-1	Production	None
	Use	In agricultural operations
Endrin* CAS No: 72-20-8	Production	None
	Use	None
Heptachlor* CAS No: 76-44-8	Production	None
	Use	Termiticide Termiticide in structures of houses Termiticide (subterranean) Wood treatment In use in underground cable boxes
Hexachlorobenzene CAS No: 118-74-1	Production	As allowed for the Parties listed in the Register
	Use	Intermediate Solvent in pesticide Closed system site limited intermediate
Mirex* CAS No: 2385-85-5	Production	As allowed for the Parties listed in the Register
	Use	Termiticide
Toxaphene* CAS No: 8001-35-2	Production	None
	Use	None
Polychlorinated Biphenyls (PCB)*	Production	None
	Use	Articles in use in accordance with the provisions of Part II of this Annex

Notes:

(i) Except as otherwise specified in this Convention, quantities of a chemical occurring as unintentional trace contaminants in products and articles shall not be considered to be listed in this Annex;

(ii) This note shall not be considered as a production and use specific exemption for purposes of paragraph 2 of Article 3. Quantities of a chemical occurring as constituents of articles manufactured or already in use before or on the date of entry into force of the relevant obligation with respect to that chemical, shall not be considered as listed in this Annex, provided that a Party has notified the Secretariat that a particular type of article remains in use within that Party. The Secretariat shall make such notifications publicly available;

(iii) This note, which does not apply to a chemical that has an asterisk following its name in the Chemical column in Part I of this Annex, shall not be considered as a production and use specific exemption for purposes of paragraph 2 of Article 3. Given that no significant quantities of the chemical are expected to reach humans and the environment during the production and use of a closed-system site-limited intermediate, a Party, upon notification to the Secretariat, may allow the production and use of quantities of a chemical listed in this Annex as a closed-system site-limited intermediate that is chemically transformed in the manufacture of other chemicals that, taking into consideration the criteria in paragraph 1 of Annex D, do not exhibit the characteristics of persistent organic pollutants. This notification shall include information on total production and use of such chemical or a reasonable estimate of such information and information regarding the nature of the closed-system site-limited process including the amount of any non-transformed and unintentional trace contamination of the persistent organic pollutant-starting material in the final product. This procedure applies except as otherwise specified in this Annex. The Secretariat shall make such notifications available to the Conference of the Parties and to the public. Such production or use shall not be considered a production or use specific exemption. Such production and use shall cease after a ten-year period, unless the Party concerned submits a new notification to the Secretariat, in which case the period will be extended for an additional ten years unless the Conference of the Parties, after a review of the production and use decides otherwise. The notification procedure can be repeated;

(iv) All the specific exemptions in this Annex may be exercised by Parties that have registered exemptions in respect of them in accordance with Article 4 with the exception of the use of polychlorinated biphenyls in articles in use in accordance with the provisions of Part II of this Annex, which may be exercised by all Parties.

Part II

Polychlorinated biphenyls

Each Party shall:

(a) With regard to the elimination of the use of polychlorinated biphenyls in equipment (e.g. transformers, capacitors or other receptacles containing liquid stocks) by 2025, subject to review by the Conference of the Parties, take action in accordance with the following priorities:

(i) Make determined efforts to identify, label and remove from use equipment containing greater than 10 per cent polychlorinated biphenyls and volumes greater than 5 litres;

(ii) Make determined efforts to identify, label and remove from use equipment containing greater than 0.05 per cent polychlorinated biphenyls and volumes greater than 5 litres;

(iii) Endeavour to identify and remove from use equipment containing greater than 0.005 percent polychlorinated biphenyls and volumes greater than 0.05 litres;

(b) Consistent with the priorities in subparagraph (a), promote the following measures to reduce exposures and risk to control the use of polychlorinated biphenyls:

(i) Use only in intact and non-leaking equipment and only in areas where the risk from environmental release can be minimised and quickly remedied;

(ii) Not use in equipment in areas associated with the production or processing of food or feed;

(iii) When used in populated areas, including schools and hospitals, all reasonable measures to protect from electrical failure which could result in a fire, and regular inspection of equipment for leaks;

(c) Notwithstanding paragraph 2 of Article 3, ensure that equipment containing polychlorinated biphenyls, as described in subparagraph (a), shall not be exported or imported except for the purpose of environmentally sound waste management;

(d) Except for maintenance and servicing operations, not allow recovery for the purpose of reuse in other equipment of liquids with polychlorinated biphenyls content above 0.005 per cent;

(e) Make determined efforts designed to lead to environmentally sound waste management of liquids containing polychlorinated biphenyls and equipment contaminated with polychlorinated biphenyls having a polychlorinated biphenyls content above 0.005 per cent, in accordance with paragraph 1 of Article 6, as soon as possible but no later than 2028, subject to review by the Conference of the Parties;

(f) In lieu of note (ii) in Part I of this Annex, endeavour to identify other articles containing more than 0.005 per cent polychlorinated biphenyls (e.g. cable-sheaths, cured caulk and painted objects) and manage them in accordance with paragraph 1 of Article 6;

(g) Provide a report every five years on progress in eliminating polychlorinated biphenyls and submit it to the Conference of the Parties pursuant to Article 15;

(h) The reports described in subparagraph (g) shall, as appropriate, be considered by the Conference of the Parties in its reviews relating to polychlorinated biphenyls. The Conference of the Parties shall review progress towards elimination of polychlorinated biphenyls at five year intervals or other period, as appropriate, taking into account such reports.

Annex B

RESTRICTION

Part I

Chemical	Activity	Acceptable purpose or specific exemption
DDT (1,1,1-trichloro-2,2-bis (4-chlorophenyl)ethane) CAS No: 50-29-3	Production	Acceptable purpose: Disease vector control use in accordance with Part II of this Annex Specific exemption: Intermediate in production of dicofol Intermediate
	Use	Acceptable purpose: Disease vector control in accordance with Part II of this Annex Specific exemption: Production of dicofol Intermediate

Notes:

(i) Except as otherwise specified in this Convention, quantities of a chemical occurring as unintentional trace contaminants in products and articles shall not be considered to be listed in this Annex;

(ii) This note shall not be considered as a production and use acceptable purpose or specific exemption for purposes of paragraph 2 of Article 3. Quantities of a chemical occurring as constituents of articles manufactured or already in use before or on the date of entry into force of the relevant obligation with respect to that chemical, shall not be considered as listed in this Annex, provided that a Party has notified the Secretariat that a particular type of article remains in use within that Party. The Secretariat shall make such notifications publicly available;

(iii) This note shall not be considered as a production and use specific exemption for purposes of paragraph 2 of Article 3. Given that no significant quantities of the chemical are expected to reach humans and the environment during the production and use of a closed-system site-limited intermediate, a Party, upon notification to the Secretariat, may allow the production and use of quantities of a chemical listed in this Annex as a closed-system site-limited intermediate that is chemically transformed in the manufacture of other chemicals that, taking into consideration the criteria in paragraph 1 of Annex D, do not exhibit the characteristics of persistent organic pollutants. This notification shall include information on total production and use of such chemical or a reasonable estimate of such information and information regarding the nature of the closed-system site-limited process including the amount of any non-transformed and unintentional trace contamination of the persistent organic pollutant-starting material in the final product. This procedure applies except as otherwise specified in this Annex. The Secretariat shall make such notifications available to the Conference of the Parties and to the public. Such production or use shall not be considered a production or use specific exemption. Such production and use shall cease after a ten year period, unless the Party concerned submits a new notification to the Secretariat, in which case the period will be extended for an additional ten years unless the Conference of the Parties, after a review of the production and use decides otherwise. The notification procedure can be repeated;

(iv) All the specific exemptions in this Annex may be exercised by Parties that have registered in respect of them in accordance with Article 4.

Part II

DDT (1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane)

1. The production and use of DDT shall be eliminated except for Parties that have notified the Secretariat of their intention to produce and/or use it. A DDT Register is hereby established and shall be available to the public. The Secretariat shall maintain the DDT Register.

2. Each Party that produces and/or uses DDT shall restrict such production and/or use for disease vector control in accordance with the World Health Organization recommendations and guidelines on the use of DDT and when locally safe, effective and affordable alternatives are not available to the Party in question.

3. In the event that a Party not listed in the DDT Register determines that it requires DDT for disease vector control, it shall notify the Secretariat as soon as possible in order to have its name added forthwith to the DDT Register. It shall at the same time notify the World Health Organization.

4. Every three years, each Party that uses DDT shall provide to the Secretariat and the World Health Organization information on the amount used, the conditions of such use and its relevance to that Party's disease management strategy, in a format to be decided by the Conference of the Parties in consultation with the World Health Organization.

5. With the goal of reducing and ultimately eliminating the use of DDT, the Conference of the Parties shall encourage:

(a) Each Party using DDT to develop and implement an action plan as part of the implementation plan specified in Article 7. That action plan shall include:

(i) Development of regulatory and other mechanisms to ensure that DDT use is restricted to disease vector control;

(ii) Implementation of suitable alternative products, methods and strategies, including resistance management strategies to ensure the continuing effectiveness of these alternatives;

(iii) Measures to strengthen health care and to reduce the incidence of the disease.

(b) The Parties, within their capabilities, to promote research and development of safe alternative chemical and non-chemical products, methods and strategies for Parties using DDT, relevant to the conditions of those countries and with the goal of decreasing the human and economic burden of disease. Factors to be promoted when considering alternatives or combinations of alternatives shall include the human health risks and environmental implications of such alternatives. Viable alternatives to DDT shall pose less risk to human health and the environment, be suitable for disease control based on conditions in the Parties in question and be supported with monitoring data.

6. Commencing at its first meeting, and at least every three years thereafter, the Conference of the Parties shall, in consultation with the World Health Organization, evaluate the continued need for DDT for disease vector control on the basis of available scientific, technical, environmental and economic information, including:

(a) The production and use of DDT and the conditions set out in paragraph 2;

(b) The availability, suitability and implementation of the alternatives to DDT; and

(c) Progress in strengthening the capacity of countries to transfer safely to reliance on such alternatives.

7. A Party may, at any time, withdraw its name from the DDT Registry upon written notification to the Secretariat. The withdrawal shall take effect on the date specified in the notification.

Annex C

UNINTENTIONAL PRODUCTION

Part I: Persistent organic pollutants subject to the requirements of Article 5

This Annex applies to the following persistent organic pollutants when formed and released unintentionally from anthropogenic sources:

Chemical
Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/PCDF)
Hexachlorobenzene (HCB) (CAS No: 118-74-1)
Polychlorinated biphenyls (PCB)

Part II: Source categories

Polychlorinated dibenzo-p-dioxins and dibenzofurans, hexachlorobenzene and polychlorinated biphenyls are unintentionally formed and released from thermal processes involving organic matter and chlorine as a result of incomplete combustion or chemical reactions. The following industrial source categories have the potential for comparatively high formation and release of these chemicals to the environment:

(a) Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge;

(b) Cement kilns firing hazardous waste;

(c) Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching;

(d) The following thermal processes in the metallurgical industry:

(i) Secondary copper production;

(ii) Sinter plants in the iron and steel industry;

(iii) Secondary aluminium production;

(iv) Secondary zinc production.

Part III: Source categories

Polychlorinated dibenzo-p-dioxins and dibenzofurans, hexachlorobenzene and polychlorinated biphenyls may also be unintentionally formed and released from the following source categories, including:

(a) Open burning of waste, including burning of landfill sites;

(b) Thermal processes in the metallurgical industry not mentioned in Part II;

(c) Residential combustion sources;

(d) Fossil fuel-fired utility and industrial boilers;

(e) Firing installations for wood and other biomass fuels;

(f) Specific chemical production processes releasing unintentionally formed persistent organic pollutants, especially production of chlorophenols and chloranil;

(g) Crematoria;

(h) Motor vehicles, particularly those burning leaded gasoline;

(i) Destruction of animal carcasses;

(j) Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction);

(k) Shredder plants for the treatment of end of life vehicles;

(l) Smouldering of copper cables;

(m) Waste oil refineries.

Part IV: Definitions

1. For the purposes of this Annex:

(a) "Polychlorinated biphenyls" means aromatic compounds formed in such a manner that the hydrogen atoms on the biphenyl molecule (two benzene rings bonded together by a single carbon-carbon bond) may be replaced by up to ten chlorine atoms; and

(b) "Polychlorinated dibenzo-p-dioxins" and "polychlorinated dibenzofurans" are tricyclic, aromatic compounds formed by two benzene rings connected by two oxygen atoms in polychlorinated dibenzo-p-dioxins and by one oxygen atom and one carbon-carbon bond in polychlorinated dibenzofurans and the hydrogen atoms of which may be replaced by up to eight chlorine atoms.

2. In this Annex, the toxicity of polychlorinated dibenzo-p-dioxins and dibenzofurans is expressed using the concept of toxic equivalency which measures the relative dioxin-like toxic activity of different congeners of polychlorinated dibenzo-p-dioxins and dibenzofurans and coplanar polychlorinated biphenyls in comparison to 2,3,7,8-tetrachlorodibenzo-p-dioxin. The toxic equivalent factor values to be used for the purposes of this Convention shall be consistent with accepted international standards, commencing with the World Health Organization 1998 mammalian toxic equivalent factor values for polychlorinated dibenzo-pdioxins and dibenzofurans and coplanar polychlorinated biphenyls. Concentrations are expressed in toxic equivalents.

Part V: General guidance on best available techniques and best environmental practices

This Part provides general guidance to Parties on preventing or reducing releases of the chemicals listed in Part I.

A. General prevention measures relating to both best available techniques and best environmental practices

Priority should be given to the consideration of approaches to prevent the formation and release of the chemicals listed in Part I. Useful measures could include:

(a) The use of low-waste technology;

(b) The use of less hazardous substances;

(c) The promotion of the recovery and recycling of waste and of substances generated and used in a process;

(d) Replacement of feed materials which are persistent organic pollutants or where there is a direct link between the materials and releases of persistent organic pollutants from the source;

(e) Good housekeeping and preventive maintenance programmes;

(f) Improvements in waste management with the aim of the cessation of open and other uncontrolled burning of wastes, including the burning of landfill sites. When considering proposals to construct new waste disposal facilities, consideration should be given to alternatives such as activities to minimize the generation of municipal and medical waste, including resource recovery, reuse, recycling, waste separation and promoting products that generate less waste. Under this approach, public health concerns should be carefully considered;

(g) Minimization of these chemicals as contaminants in products;

(h) Avoiding elemental chlorine or chemicals generating elemental chlorine for bleaching.

B. Best available techniques

The concept of best available techniques is not aimed at the prescription of any specific technique or technology, but at taking into account the technical characteristics of the installation concerned, its geographical location and the local environmental conditions. Appropriate control techniques to reduce releases of the chemicals listed in Part I are in general the same. In determining best available techniques, special consideration should be given, generally or in specific cases, to the following factors, bearing in mind the likely costs and benefits of a measure and consideration of precaution and prevention:

(a) General considerations:

(i) The nature, effects and mass of the releases concerned: techniques may vary depending on source size;

(ii) The commissioning dates for new or existing installations;

(iii) The time needed to introduce the best available technique;

(iv) The consumption and nature of raw materials used in the process and its energy efficiency;

(v) The need to prevent or reduce to a minimum the overall impact of the releases to the environment and the risks to it;

(vi) The need to prevent accidents and to minimize their consequences for the environment;

(vii) The need to ensure occupational health and safety at workplaces;

(viii) Comparable processes, facilities or methods of operation which have been tried with success on an industrial scale;

(ix) Technological advances and changes in scientific knowledge and understanding.

(b) General release reduction measures: When considering proposals to construct new facilities or significantly modify existing facilities using processes that release chemicals listed in this Annex, priority consideration should be given to alternative processes, techniques or practices that have similar usefulness but which avoid the formation and release of such chemicals. In cases where such facilities will be constructed or significantly modified, in addition to the prevention measures outlined in section A of Part V the following reduction measures could also be considered in determining best available techniques:

(i) Use of improved methods for flue-gas cleaning such as thermal or catalytic oxidation, dust precipitation, or adsorption;

(ii) Treatment of residuals, wastewater, wastes and sewage sludge by, for example, thermal treatment or rendering them inert or chemical processes that detoxify them;

(iii) Process changes that lead to the reduction or elimination of releases, such as moving to closed systems;

(iv) Modification of process designs to improve combustion and prevent formation of the chemicals listed in this Annex, through the control of parameters such as incineration temperature or residence time.

C. Best environmental practices

The Conference of the Parties may develop guidance with regard to best environmental practices. 31

Annex D

INFORMATION REQUIREMENTS AND SCREENING CRITERIA

1. A Party submitting a proposal to list a chemical in Annexes A, B and/or C shall identify the chemical in the manner described in subparagraph (a) and provide the information on the chemical, and its transformation products where relevant, relating to the screening criteria set out in subparagraphs
(b) to (e):

(a) Chemical identity:

(i) Names, including trade name or names, commercial name or names and synonyms, Chemical Abstracts Service (CAS) Registry number, International Union of Pure and Applied Chemistry (IUPAC) name; and

(ii) Structure, including specification of isomers, where applicable, and the structure of the chemical class;

(b) Persistence:

(i) Evidence that the half-life of the chemical in water is greater than two months, or that its half-life in soil is greater than six months, or that its half-life in sediment is greater than six months; or

(ii) Evidence that the chemical is otherwise sufficiently persistent to justify its consideration within the scope of this Convention;

(c) Bio-accumulation:

(i) Evidence that the bio-concentration factor or bio-accumulation factor in aquatic species for the chemical is greater than 5,000 or, in the absence of such data, that the log Kow isvgreater than 5;

(ii) Evidence that a chemical presents other reasons for concern, such as high bio-accumulation in other species, high toxicity or ecotoxicity; or

(iii) Monitoring data in biota indicating that the bio-accumulation potential of the chemical is sufficient to justify its consideration within the scope of this Convention;

(d) Potential for long-range environmental transport:

(i) Measured levels of the chemical in locations distant from the sources of its release that are of potential concern;

(ii) Monitoring data showing that long-range environmental transport of the chemical, with the potential for transfer to a receiving environment, may have occurred via air, water or migratory species; or

(iii) Environmental fate properties and/or model results that demonstrate that the chemical has a potential for long-range environmental transport through air, water or migratory species, with the potential for transfer to a receiving environment in locations distant from the sources of its release. For a chemical that migrates significantly through the air, its half-life in air should be greater than two days; and

(e) Adverse effects:

(i) Evidence of adverse effects to human health or to the environment that justifies consideration of the chemical within the scope of this Convention; or

(ii) Toxicity or ecotoxicity data that indicate the potential for damage to human health or to the environment.

2. The proposing Party shall provide a statement of the reasons for concern including, where possible, a comparison of toxicity or ecotoxicity data with detected or predicted levels of a chemical resulting or anticipated from its long-range environmental transport, and a short statement indicating the need for global control.

3. The proposing Party shall, to the extent possible and taking into account its capabilities, provide additional information to support the review of the proposal referred to in paragraph 6 of Article 8. In developing such a proposal, a Party may draw on technical expertise from any source.

Annex E

INFORMATION REQUIREMENTS FOR THE RISK PROFILE

The purpose of the review is to evaluate whether the chemical is likely, as a result of its long-range environmental transport, to lead to significant adverse human health and/or environmental effects, such that global action is warranted. For this purpose, a risk profile shall be developed that further elaborates on, and evaluates, the information referred to in Annex D and includes, as far as possible, the following types of information:

(a) Sources, including as appropriate:

(i) Production data, including quantity and location;

(ii) Uses; and

(iii) Releases, such as discharges, losses and emissions;

(b) Hazard assessment for the endpoint or endpoints of concern, including a consideration of toxicological interactions involving multiple chemicals;

(c) Environmental fate, including data and information on the chemical and physical properties of a chemical as well as its persistence and how they are linked to its environmental transport, transfer within and between environmental compartments, degradation and transformation to other chemicals. A determination of the bio-concentration factor or bio-accumulation factor, based on measured values, shall be available, except when monitoring data are judged to meet this need;

(d) Monitoring data;

(e) Exposure in local areas and, in particular, as a result of long-range environmental transport, and including information regarding bio-availability;

(f) National and international risk evaluations, assessments or profiles and labelling information and hazard classifications, as available; and

(g) Status of the chemical under international conventions.

Annex F

INFORMATION ON SOCIO-ECONOMIC CONSIDERATIONS

An evaluation should be undertaken regarding possible control measures for chemicals under consideration for inclusion in this Convention, encompassing the full range of options, including management and elimination. For this purpose, relevant information should be provided relating to socioeconomic considerations associated with possible control measures to enable a decision to be taken by the Conference of the Parties. Such information should reflect due regard for the differing capabilities and conditions among the Parties and should include consideration of the following indicative list of items:

(a) Efficacy and efficiency of possible control measures in meeting risk reduction goals:

  (i) Technical feasibility; and

  (ii) Costs, including environmental and health costs;

(b) Alternatives (products and processes):

  (i) Technical feasibility;

  (ii) Costs, including environmental and health costs;

  (iii) Efficacy;

  (iv) Risk;

  (v) Availability; and

  (vi) Accessibility;

(c) Positive and/or negative impacts on society of implementing possible control measures:

  (i) Health, including public, environmental and occupational health;

  (ii) Agriculture, including aquaculture and forestry;

  (iii) Biota (biodiversity);

  (iv) Economic aspects;

  (v) Movement towards sustainable development; and

  (vi) Social costs;

(d) Waste and disposal implications (in particular, obsolete stocks of pesticides and clean-up of contaminated sites):

(i) Technical feasibility; and

(ii) Cost;

(e) Access to information and public education;

(f) Status of control and monitoring capacity; and

(g) Any national or regional control actions taken, including information on alternatives, and other relevant risk management information.

Appendix 3

Participants	Signatures	Ratifications
Albania	5 Dec 2001	
Algeria	5 Sep 2001	
Antigua and Barbuda	23 May 2001	10 Sep 2003
Argentina	23 May 2001	
Armenia	23 May 2001	26 Nov 2003
Australia	23 May 2001	
Austria	23 May 2001	27 Aug 2002
Bahamas	20 Mar 2002	
Bahrain	22 May 2002	
Bangladesh	23 May 2001	
Belgium	23 May 2001	
Belize	14 May 2002	
Benin	23 May 2001	
Bolivia	23 May 2001	3 Jun 2003
Bosnia and Herzegovina	23 May 2001	
Botswana		28 Oct 2002 a
Brazil	23 May 2001	
Brunei Darussalam	21 May 2002	
Bulgaria	23 May 2001	
Burkina Faso	23 May 2001	
Burundi	2 Apr 2002	
Cambodia	23 May 2001	
Cameroon	5 Oct 2001	
Canada	23 May 2001	23 May 2001
Central African Republic	9 May 2002	
Chad	16 May 2002	
Chile	23 May 2001	
China	23 May 2001	
Colombia	23 May 2001	
Comoros	23 May 2001	
Congo	4 Dec 2001	
Costa Rica	16 Apr 2002	
Côte d'Ivoire	23 May 2001	
Croatia	23 May 2001	
Cuba	23 May 2001	
Czech Republic	23 May 2001	6 Aug 2002
Democratic People's Republic of Korea		26 Aug 2002 a

Denmark	23 May 2001	
Djibouti	15 Nov 2001	
Dominica		8 Aug 2003 a
Dominican Republic	23 May 2001	
Ecuador	28 Aug 2001	
Egypt	17 May 2002	2 May 2003
El Salvador	30 Jul 2001	
Ethiopia	17 May 2002	9 Jan 2003
European Community	23 May 2001	
Fiji	14 Jun 2001	20 Jun 2001
Finland	23 May 2001	3 Sep 2002 A
France	23 May 2001	
Gabon	21 May 2002	
Gambia	23 May 2001	
Georgia	23 May 2001	
Germany	23 May 2001	25 Apr 2002
Ghana	23 May 2001	30 May 2003
Greece	23 May 2001	
Guatemala	29 Jan 2002	
Guinea	23 May 2001	
Guinea-Bissau	24 Apr 2002	
Haiti	23 May 2001	
Honduras	17 May 2002	
Hungary	23 May 2001	
Iceland	23 May 2001	29 May 2002
India	14 May 2002	
Indonesia	23 May 2001	
Iran (Islamic Republic of)	23 May 2001	
Ireland	23 May 2001	
Israel	30 Jul 2001	
Italy	23 May 2001	
Jamaica	23 May 2001	
Japan		30 Aug 2002 a
Jordan	18 Jan 2002	
Kazakhstan	23 May 2001	
Kenya	23 May 2001	
Kiribati	4 Apr 2002	
Kuwait	23 May 2001	
Kyrgyzstan	16 May 2002	
Lao People's Democratic	5 Mar 2002	

Republic		
Latvia	23 May 2001	
Lebanon	23 May 2001	3 Jan 2003
Lesotho	23 Jan 2002	23 Jan 2002
Liberia		23 May 2002 a
Liechtenstein	23 May 2001	
Lithuania	17 May 2002	
Luxembourg	23 May 2001	7 Feb 2003
Madagascar	24 Sep 2001	
Malawi	22 May 2002	
Malaysia	16 May 2002	
Mali	23 May 2001	5 Sep 2003
Malta	23 May 2001	
Marshall Islands		27 Jan 2003 a
Mauritania	8 Aug 2001	
Mauritius	23 May 2001	
Mexico	23 May 2001	10 Feb 2003
Micronesia (Federated States of)	31 Jul 2001	
Monaco	23 May 2001	
Mongolia	17 May 2002	
Morocco	23 May 2001	
Mozambique	23 May 2001	
Nauru	9 May 2002	9 May 2002
Nepal	5 Apr 2002	
Netherlands	23 May 2001	28 Jan 2002 A
New Zealand	23 May 2001	
Nicaragua	23 May 2001	
Niger	12 Oct 2001	
Nigeria	23 May 2001	
Niue	12 Mar 2002	
Norway	23 May 2001	11 Jul 2002
Oman	4 Mar 2002	
Pakistan	6 Dec 2001	
Palau	28 Mar 2002	
Panama	23 May 2001	5 Mar 2003
Papua New Guinea	23 May 2001	7 Oct 2003
Paraguay	12 Oct 2001	
Peru	23 May 2001	
Philippines	23 May 2001	

Poland	23 May 2001	
Portugal	23 May 2001	
Republic of Korea	4 Oct 2001	
Republic of Moldova	23 May 2001	
Romania	23 May 2001	
Russian Federation	22 May 2002	
Rwanda		5 Jun 2002 a
Saint Lucia		4 Oct 2002 a
Samoa	23 May 2001	4 Feb 2002
Sao Tome and Principe	3 Apr 2002	
Saudi Arabia	14 Mar 2002	
Senegal	23 May 2001	8 Oct 2003
Serbia and Montenegro	2 May 2002	
Seychelles	25 Mar 2002	
Sierra Leone		26 Sep 2003 a
Singapore	23 May 2001	
Slovakia	23 May 2001	5 Aug 2002
Slovenia	23 May 2001	
South Africa	23 May 2001	4 Sep 2002
Spain	23 May 2001	
Sri Lanka	5 Sep 2001	
Sudan	23 May 2001	
Suriname	22 May 2002	
Sweden	23 May 2001	8 May 2002
Switzerland	23 May 2001	30 Jul 2003
Syrian Arab Republic	15 Feb 2002	
Tajikistan	21 May 2002	
Thailand	22 May 2002	
The Former Yugoslav Republic of Macedonia	23 May 2001	
Togo	23 May 2001	
Tonga	21 May 2002	
Trinidad and Tobago		13 Dec 2002 a
Tunisia	23 May 2001	
Turkey	23 May 2001	
Ukraine	23 May 2001	
United Arab Emirates	23 May 2001	11 Jul 2002
United Kingdom of Great Britain and Northern Ireland	11 Dec 2001	
United Republic of Tanzania	23 May 2001	
United States of America	23 May 2001	

Uruguay	23 May 2001	
Vanuatu	21 May 2002	
Venezuela	23 May 2001	
Viet Nam	23 May 2001	22 Jul 2002
Yemen	5 Dec 2001	
Zambia	23 May 2001	
Zimbabwe	23 May 2001	