Chapter 3
Persistent Toxic Substances

The problems of persistent toxic substances (PTS) dominate three annexes of the Agreement: Annex 12 (Persistent Toxic Substances), Annex 14 (Contaminated Sediment), and Annex 15 (Airborne Toxic Substances). The primary response of the Parties to persistent toxic substances is the Great Lakes Binational Toxics Strategy, which is discussed in Section 3.4.

3.1 Annex 12 - Persistent Toxic Substances

Annex 12 addresses definitions, general principles, programs, monitoring, early warning system, human health, research, and reporting. This annex embraces the philosophy of zero discharge and the goal of virtual elimination, and the Parties have achieved considerable success in controlling direct, point source discharges of toxic chemicals to the lakes. The Commission finds, however, that there are two remaining significant challenges to the virtual elimination of persistent toxic substances. The first is the historic burden of toxic chemicals in contaminated sediment; the second is the ongoing problem of airborne pollutants. The Parties' Great Lakes Binational Toxics Strategy does not adequately address either of these two remaining challenges.

The Commission's assessment of progress under Annex 12 examines the threat to human health, the early warning system, new and previously unidentified chemicals, chemical mixtures, and the general principles of the annex.

Threat to Human Health

The Parties have made progress in identifying the problems related to persistent toxic substances, most of which have human health implications. This work includes an increased understanding of the neurological, developmental, and trans-generational effects of some persistent toxic substances.

One of the main ways humans are exposed to persistent toxic substances in the Great Lakes basin is through consuming Great Lakes fish. Existing evidence demonstrates that the consumption of contaminated Great Lakes fish prior to and during pregnancy is associated with decreased birth weight and deficits in cognitive function in infants and children. Great Lakes fish contain many neurotoxins, including PCBs and methyl mercury, which can also produce interactive effects. These substances accumulate in the tissues of women and are transferred to the fetus during pregnancy and to infants during breast-feeding. Developing fetuses and nursing infants receive higher doses of toxic substances than at any other time in their lives. The subpopulations at greatest risk include First Nation and tribe members, sport fish anglers, and certain population groups who eat large quantities of Great Lakes fish. These facts raise the policy question of how best to protect human health, particularly for the more vulnerable sectors of the Great Lakes community.

A widely used governmental mechanism for addressing this policy question is the issuance of fish consumption advisories based on the current state of knowledge. The Great Lakes states have made significant advances in harmonizing their fish consumption advisories, taking into account the variation in concentrations of substances in different-sized fish of various species caught at different locations. Ontario advisories are based upon different sampling protocols from those used by the states and therefore sometimes provide different advice to consumers. The states of Ohio and Indiana both advise expectant and nursing mothers and children that "it is best to prevent exposure to fish contaminants in the first place" (Indiana State Department of Health and; Ohio Department of Health 2000). Fish consumption advisories assess risk and are not a guarantee of safety; and, there is always a danger that the advisory does not reflect the latest research. Over the past thirty years, fish advisories have generally become more restrictive as knowledge increased and more sensitive endpoints were reported from human health research.

"I'm concerned about a new strategy of lowering toxics body burdens by warning people 'repeatedly and emphatically' the fish are poisoned. . . Fish and wildlife will not be protected under this strategy."

Mary Sinclair
National Sierra Club

The Commission has some very serious concerns about the injury to human health from exposures to contaminants in Great Lakes fish. The Commission is most interested in how the Parties can reduce exposures of susceptible subpopulations until ongoing programs achieve acceptable concentrations of persistent toxic substances in fish tissue. The Commission commends the states of Ohio and Indiana for adopting a precautionary approach in recognizing the particular dangers of these chemicals to the development of embryos, fetuses, infants, and

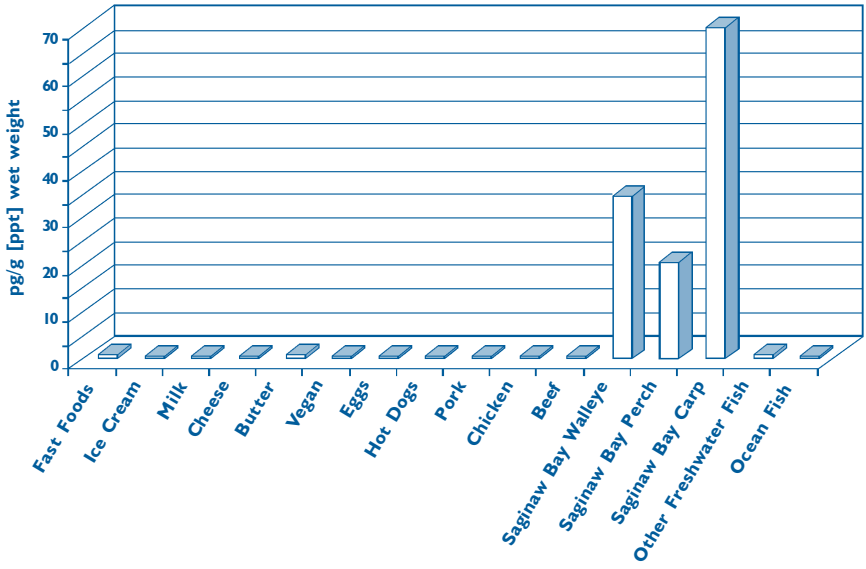
children. The Commission sees the need for a straightforward statement consistent with the recommendations of Ohio and Indiana that, for women of childbearing age and for children, it is best to prevent exposure to fish contaminants in the first place. The Commission is also concerned that advisories are not effectively distributed to women.

In the Commission's view, fish consumption advisories can only be an interim solution. They have been shown to have limited effectiveness among anglers, and, for First Nations and tribes, fishing is an integral component of culture and treaty rights. The long-term solution is clearly the restoration of the chemical integrity of the Great Lakes ecosystem to minimize exposure and subsequent bioaccumulation of persistent toxic substances in the tissue of fish. The Commission is asking its advisors to give further consideration to this matter over the next two years.

Figure 1 shows the dioxin-like activity of fish from Saginaw Bay compared to other foods. Appendix B illustrates the body of scientific knowledge to support a policy initiative in this area. The studies encompass the extent of human exposure to persistent toxic substances through consumption of fish and the subsequent effects of the substances.

Figure 1

Dioxin-Like Activity in Great Lakes Fish from Saginaw Bay Relative to Other Foods Sampled at Supermarkets throughout the U.S.



Adapted from Schecter et al. 1997; Schecter and Li, 1997; Giesy et al. 1997

THE COMMISSION RECOMMENDS THAT:

Governments should require that:

(i) sport fish consumption advisories state plainly that eating Great Lakes sport fish may lead to birth anomalies and other serious health problems for children and women of child-bearing age. These advisories should be addressed and distributed directly to women, in addition to their general distribution,

(ii) consumption advisories clearly identify fish to be totally avoided in light of the precautionary approach, and preparation methods for any that may be consumed, and

(iii) consumption advisories are supported by culturally appropriate community education programs directed to those who are likely to consume these fish.

Early Warning System

Another concern about Annex 12 relates to the reliability of models used to predict the ecosystem consequences of various loading rates of different persistent toxic substances. Computer simulations to identify the sources of these substances and their dispersal, fate, and distribution have advanced in the last few years.

In addition to simply estimating concentrations of chemical residues, the newer models incorporate monitoring data and consider indicators such as those based on fish, plants and nutrients. The modeling has been based on the physical and chemical properties of the molecules but requires monitoring data to confirm the predictions regarding the environmental fate and distribution of these substances. Furthermore, data deficiencies in discharge and emissions inventories, and inadequate information on chemical processes, increase the predictive uncertainty of the models. Models have proved adequate for planning research and monitoring, and have helped to elucidate source-receptor relationships to estimate the loading rates. Perhaps most important, the models point to the origin of loadings and indicate what actions need to be taken.

There is also very limited information indicating how much of a pollutant comes from a particular pathway and the relative importance of different sources to the loading contributions from a specific pathway. For example, there are limited measurements of dioxin in the Great Lakes atmosphere, and the air emissions inventories in both the United States and Canada are imperfect. As a result, scientists are unable to model atmospheric deposition of dioxin accurately. Dioxin is a sentinel toxic chemical for monitoring because it is detectable in trace quantities. Furthermore, an understanding of the relative importance of local, regional, national, continental, and global sources of certain persistent toxic substances is

needed to make scientifically supportable policy decisions, particularly in planning and implementing remedial measures. There is a clear need for the Governments to increase their efforts to obtain this information. Without this information, it is unlikely that Agreement goals to reduce the loadings of persistent toxic substances can be effectively achieved by the Parties.

New Chemicals and Previously Unidentified Chemicals

Another aspect of an early warning system is the ability to identify chemicals new to commerce and previously unidentified chemicals that may cause future environmental problems. For example, although scientists can chemically extract chlorinated hydrocarbon residue from the tissue of Great Lakes fish and birds, they can only identify about 30 percent of the material they find. Several halogenated compounds as well as antibiotic and other pharmaceutical residues in Great Lakes samples remain unidentified. The presence of brominated diphenyl ethers, chlorinated paraffins and naphthalenes, and PCB metabolites in the tissue of a variety of species, ranging from snapping turtles and herring gulls to polar bears and humans, remains a mystery. Retrospective analysis of tissue samples from Great Lakes species deposited in specimen banks since the early 1970s may help to ascertain the source of these chemicals.

Human and other biotic communities are most often exposed to a "chemical soup" or mixture; only very rarely are they exposed to a single chemical.

Chemical Mixtures

The question of chemical mixtures is also important. Human and other biotic communities are most often exposed to a "chemical soup" or mixture; only very rarely are they exposed to a single chemical. Many of these chemicals interact with each other externally in the environment or internally once inside the organism. How mixtures of chemicals affect exposed biota remains relatively unknown. Some chemicals behave either synergistically or antagonistically. In the absence of information on a specific mixture or combination, many regulatory agencies use a procedure first suggested by the U.S. National Academy of Sciences (1974) in which effects are assumed to be additive. This "default position" has withstood the test of time (over 25 years) and existing evidence often supports this position. However, this observation offers little comfort because of the multiplicity of combinations and permutations among chemicals in the environment.

"With a number of organic pollutants which cause effects such as immunosuppression and hormone disruption, research is showing that mixtures can have an additive or synergistic effect. It appears that the fetus is most at risk to the effects of these types of pollutant. Under these circumstances classical risk assessment ceases to be of use and it becomes difficult or impossible to predict effects. Society does not really possess the intellectual, regulatory or legal instruments to approach such problems currently. However the mantra of "There is no evidence" - to justify the continuation of the current bulk global production of persistent bioaccumulative toxic substances - simply will not do. . . . Future generations will not thank us for failing to take a precautionary approach during our temporary stewardship of the environment which they will have to inherit"

Dr. Vyvyan Howard
Synergistic Effects of Chemical Mixtures -
Can We Rely on Traditional Toxicology
The Ecologist, Vol. 27, No.5 (1997)

The Parties should undertake research on the theoretical aspects of the chemical and physical properties of known substances that could produce synergistic or antagonistic effects when in mixtures. The Parties have used dioxin "equivalents" to evaluate mixtures of PCB isomers, dioxin, and furans, and the technique offers possibilities for evaluating the risk and effects of other chemical mixtures. The effects of mixtures is an area of research that the Commission believes will offer considerable help to the Parties as they work on identifying persistent toxic substances and their effects.

General Principles

Annex 12 refers to "General Principles." The first encompasses the well-known Agreement concepts of virtual elimination and zero discharge. The second principle, rehabilitation, acknowledges that virtual elimination and zero discharge are necessary, but not sufficient, to achieve Agreement goals. Rehabilitation recognizes the importance of addressing persistent toxic substances that are already present in the ecosystem and are causing adverse effects. Rehabilitation is generally achieved through remediation under the RAPs and LaMPs and cannot be addressed by the Parties' emphasis on pollution prevention policies and programs. In its Seventh Biennial Report (1994), the Commission endorsed the work of its Virtual Elimination Task Force in the consideration of persistent toxic substances under Annex 12. At that time, the Commission noted that zero discharge means absolutely no release of chemicals, not merely "below the level of detection" of

available analytical instrumentation. The Task Force also recognized the need to apply certain concepts, notably reverse onus, and a precautionary approach. These two ideas mean respectively that "a chemical is presumed harmful unless proven otherwise" and that "when there is a serious risk of environmental damage, even though scientific certainty has not been established, it is prudent to take (cost-effective) measures to reduce or eliminate the risk" (IJC 1993).

The Commission welcomes the addition of the concept of virtual elimination to the Canadian legislative framework. Canada has led in this regard by being one of the first countries in the world to incorporate the concept into federal policy and now into the revised Canadian Environmental Protection Act (CEPA). CEPA's effectiveness will depend, however, on how it is implemented and on the accompanying regulations which, for example, will need to define "persistence." The Commission prefers adoption of a definition consistent with the Agreement. Given the Commission's interpretation of the term "zero discharge" as literally zero discharge, the Commission will take a special interest in how Environment Canada sets the Levels of Quantification in the CEPA regulations, in conjunction with provisions in other sections of CEPA that can be used to ban the manufacture, import, export, and use of designated persistent toxic substances.

3.2 Annex 14 - Contaminated Sediment

The persistent toxic substances found in contaminated sediment are the dominant issue in the Areas of Concern. Annex 14 requires that the information obtained through research and studies under this annex guide the development of RAPs and LaMPs.

Sediment remediation is a large-scale, high-cost problem throughout the Great Lakes basin. Beginning with the 1975 final report of the IJC International Working Group on the Abatement and Control of Pollution from Dredging Activities, the Commission has sponsored numerous technical workshops and received extensive advice from expert committees. In 1999, the Great Lakes Water Quality Board's Sediment Priority Action Committee (SedPAC) identified obstacles to sediment remediation and developed data interpretation tools to support sediment management decisions. In addition, SedPAC offered several recommendations to improve ecological assessment and monitoring programs to enhance recovery forecasting and benefit measurement.

The policy and program requirements needed to support a binational program for the management of contaminated sediment are clearly articulated under Annex 14.

They include comprehensive problem definition, development of common assessment methodologies, review of contaminated sediment classification practices, establishment of compatible criteria for sediment quality classification, development of biological indicators, development of a standard approach and management procedures, cooperative technology assessment, design and implementation of demonstration projects at selected Areas of Concern, and establishment of measures for long-term disposal and beneficial reuse of contaminated sediment.

The Commission notes that the Parties have accomplished some of the elements required in Annex 14. For example, the U.S. and Canada adopted similar classification practices and compatible criteria for remediating contaminated sediment. However, the emphasis on site-specific characteristics in each AOC has resulted in wide variations in remediation practices. This was evident when the Commission compared remediation projects in the Black River in the United States and Hamilton Harbour in Canada. There were significant differences in the final levels of polycyclic aromatic hydrocarbons (PAHs) in these two AOCs. In the Black River, sediment removal resulted in final PAH concentrations in the remaining sediment ranging between 6 and 37 mg/kg. As a result, Black River fish show significantly fewer tumors than previously noted. (Ohio Environmental Protection Agency 1999) In contrast, the Randle Reef Project in Hamilton Harbour proposes a final PAH concentration of 700 mg/kg. This level is well above the objectives achieved for the Black River and the lowest effect levels based on Canadian guidelines.

Therefore, it is recommended:

"Much greater emphasis be placed on post-project monitoring of the effectiveness of sediment remediation (i.e. assessment of effectiveness relative to restoration of uses with appropriate quality assurance and quality control)."

Great Lakes Water Quality Board
1997-99 Priorities Report, IJC 1999d

That the PAH level allowed for the Randle Reef project is considerably higher than the upper limit of the range for the Black River is inconsistent from both a scientific and policy perspective. PAHs are established carcinogens and, as demonstrated by remediation efforts in the Black River, minimizing their allowable residue in biota and environmental media advances the goal of restoration.

The situation of the Hamilton Harbour AOC is more complex than that of the Black River because, in addition to PAHs, fish consumption advisories are in place in Hamilton Harbour for PCBs, mercury, and mirex. There also are documented sources of dioxin in air emissions from the Stelco sintering plant. The Commission is concerned that the proposal to incinerate pretreated contaminated

sediments in the same sintering plant could lead to the production and release of more dioxins. These conditions provide a good example of the problem of chemical mixtures. A more holistic analysis, utilizing the precautionary approach applied to human health concerns for multiple bioaccumulative chemicals, would assist in this case. As recommended by the Great Lakes Water Quality Board, this situation would also benefit from close post-project monitoring.

Natural Recovery

Although SedPAC noted the need to consider natural recovery as a viable cleanup option, the issue is potentially contentious. Natural recovery can take as few as five years, for example, to eliminate kepone in the James River, Virginia, or well over 10,000 years to eliminate substances such as radioactive waste. This range of recovery time warns of the need for a careful analysis of the approaches being considered. It would also be important for an effective public outreach effort to determine that a cleanup that could take several generations would be acceptable to a well-informed public.

"How clean is clean enough? And on what timetable?"

Rebecca Katers
Clean Water Action Council
Green Bay, WI

Current Status

The Commission has summarized progress related to sediment remediation in Areas of Concern. Clearly, the problem remains significant. Less than 2.4 percent of known contaminated sediment by volume in U.S. AOCs is remediated while, in Canada, the amount is only 0.2 percent (See Figures 2 and 3). The Parties have adopted some elements of Annex 14 (Contaminated Sediment) and are cooperating with respect to technology programs. However, they have not developed standard approaches, agreed management procedures, and long-term measures related to disposal and sediment reuse as required by the Agreement. The Commission concludes that the initiatives related to both RAPs (Annex 2) and contaminated sediment (Annex 14) require a long-term, binational effort and program that reflects the magnitude of the contaminated sediment challenge.