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1980 Annual Report

A perspective on the problem of hazardous substances in the Great Lakes Basin Ecosystem

Summary
Introduction

The Great Lakes basin ecosystem encompasses an area of nearly three-quarters of a million square kilometres (three hundred thousand square miles). It is inhabited by nearly forty million people with a high per capita use of technology and energy. Although the basin is of relatively recent origin in terms of glaciation, plants and animals inhabiting the basin are the product of several billion years of ecological and biospheric history.

Over the past century - particularly the past 40 years - synthetic industrial chemicals have been produced in and imported into this ecosystem in exponentially increasing amounts. Many of these chemicals are new to the biosphere. Others have been added at hitherto unknown rates. Some are highly resistant to destruction. They have spread throughout the basin ecosystem and in some cases have entered human food chains. Some of these substances may be toxic.

Toxicity, a property of hazardous polluting substances, is the ability to produce adverse effects in living organisms when they are exposed to the substances through ingestion, inhalation, contact, or injection. As yet there is no instrument that can measure toxicity; it can only be determined by the response of an organism. Therefore, the concerns about toxicity are strictly biological in origin.
The toxicity of a substance is not a discrete property but a relative one. High toxicity has meaning only when one substance is compared to another. All elements, chemicals, and mixtures of chemicals produce toxicity at some exposure and time. To compare toxicities one must fix either the amount of the toxicant or the period of exposure. For example, both table salt and arsenic are toxic. However, salt is considered less toxic than arsenic because more is needed for a fixed exposure time or exposure over a longer period of time is needed for a fixed amount to produce toxic effects. For some substances there is a threshold dose or exposure below which no adverse effects occur, regardless of the length of exposure. Other chemicals are believed to have no safe threshold; no amount may be safe.

Beginning about 1970 public concern became more pronounced about the occurrence of chemicals - some of which are hazardous substances - in air, soil, and water throughout the continent. Prior to this period the use of various pesticides, especially the chlorinated hydrocarbon insecticides, were the major concern. Several bans on pesticide use and seizures of food products occurred as a result of concentrations being discovered which exceeded administrative guidelines or were at levels thought to be unsafe. Rachel Carson's book *Silent Spring* did much to arouse public reaction.

Several events have occurred to increase the degree of this public concern. The use of chemicals in commerce
increased drastically as the standard of living and economic conditions improved. The development of modern plastics and new adhesives, paints, coatings and synthetic materials contributed to the increased use of chemicals. In industries, such as agriculture, the use of chemicals increasingly replaced manual labor as more capital intensive technologies were adopted.

Analytical capabilities improved dramatically with the development of gas chromatography and mass spectroscopy. The positive identification of complex organic chemicals became easier, and detection limits were lowered making it possible to measure many chemicals at concentrations much lower than previously detectable in water and air. The public, aware of environmental contamination, was willing to support monitoring and control programs. During this same period, the role of chemicals as a possible cause of cancer was widely heralded; public concern was further heightened. Legislation followed that required more stringent testing before large-scale production of new chemicals and more controls on their release into commerce.

Some hazardous substances have become dispersed over large areas; PCBs and DDT have been dispersed globally. Others are found only near the point of release. In large lakes particularly, long periods of time may be required before the concentrations in the lake reach equilibrium with the loadings. Such lag times require new and innovative monitoring strategies.
Leaching from solid waste disposal sites has recently been recognized as a significant source of hazardous substances in the environment. This is especially true for many older sites which were improperly located or poorly designed and operated. Love Canal is a well known example of such a site.

Controlling hazardous substances is fundamentally different from controlling the more conventional pollutants, such as biochemical oxygen demand (BOD) or phosphorus, in one respect, there is a large number of hazardous substances and little knowledge of their locations, quantities, adverse impacts, or persistence.

The Science Advisory Board's 1980 Annual Report discusses the problems of hazardous substances in the Great Lakes basin ecosystem in the context of their biological effects, human health effects, transport and fate, sources and control alternatives, and presents a plan for attacking the problems. The Appendix provides much of the detailed background information used in developing the report.
II THE COMMISSION SHOULD URGE JURISDICTIONS TO RECOVER HAZARDOUS SUBSTANCES FOR REUSE AND EMPLOY TREATMENT TECHNOLOGIES THAT DESTROY, RATHER THAN MERELY REMOVE, CONTAMINANTS FROM WASTE DISCHARGES.

Treatment of water and air discharges does not ensure that substances of concern will not harm the ecosystem, unless they are destroyed during treatment. In many technologies for air and water treatment, the substances being removed are concentrated in sludges which then may be disposed of as solid waste. The Water Quality Board in its 1978 Annual Report advised the Commission that waste treatment techniques which destroy chemicals rather than concentrate them in sludges will substantially reduce solid waste generation. Similarly, treatment technologies which do not produce large volumes of chemical sludge are highly desirable. Some substances such as heavy metals will remain intact and should be reused if possible, but will usually require careful disposal probably as solid waste. Every effort should be made to keep such substances to a minimum in all discharges.

III THE COMMISSION SHOULD ENCOURAGE DISCHARGERS TO SEEK WAYS TO REDUCE THE USE OR LOSS OF HAZARDOUS SUBSTANCES THAT MAY FIND THEIR WAY INTO AIR OR WATER EFFLUENTS.

While the economic benefits of wise chemical use will probably be recognized
eventually by the industrial sector, pressure from regulatory agencies could speed such recognition. To the extent that better use can lessen the amount of treatment needed, society will benefit. Although preventing hazardous substances from occurring in waste seems obvious, the past losses of mercury from chlor-alkali facilities illustrates the need for closer scrutiny in all industrial processes.

IV THE COMMISSION SHOULD URGE THE JURISDICTIONS TO IDENTIFY AND INFORM POPULATIONS IN THE BASIN WHICH MAY HAVE HIGHER THAN AVERAGE EXPOSURE TO HAZARDOUS SUBSTANCES AS A RESULT OF THEIR DIETARY HABITS OR LIVING CONDITIONS, AND THAT THE JURISDICTIONS EXPAND THEIR EFFORTS TO IDENTIFY ANY CAUSE AND EFFECT HUMAN HEALTH RELATIONSHIPS ASSOCIATED WITH THE CONSUMPTION OF GREAT LAKES FISH AND WILDLIFE.

Because various small groups in the Great Lakes population eat quantities of fish in amounts well above average, because residues in sport fish are less well monitored, and because many desired sport fish have high lipid contents, the exposure of these populations is above average. Therefore, acceptable residue concentrations based on average consumption may not be sufficiently protective. Residues in sport fish are currently regulated differently in various jurisdictions and usually only by public advisories, which are not mandatory. While the consequences of such increased exposure
are not known, these populations should be informed of their high exposure. Monitoring of the residues they consume should be at least as intensive as they are for the average population. The Water Quality Board has recommended that common risk assessment procedures be developed by the jurisdictions. Initial effort concentrated on an identifiable sub-population would be easier than considering the entire population of the Basin because these groups are smaller. Such efforts will be especially significant for protecting high exposure groups.

The Commission request that appropriate agencies in Canada and the United States review the human health toxicity information on those hazardous substances which form residues in Great Lakes fish and wildlife, and establish tolerance levels for those substances as they are identified.

Substances that are not food additives or pesticides are not uniformly measured or controlled. Acceptable residue limits for such substances in fish do not currently exist. Through a binational effort and pooling of agency resources, interim levels could be established and used for regulatory actions. These actions would provide a basis to judge the importance of residues found in fish used for food and would aid in establishing estimated risks to residents of the basin. Both the Water Quality Board and the Science Advisory Board in previous reports, have emphasized the need for knowing the significance of
chemical residues on human health. Resources to accomplish this goal have not been forthcoming. An alternative is to use existing data and expertise to make best judgements of acceptable intakes. The Commission should urge that a sound regulatory basis be developed that will enable defensible and valid limits to be set for the protection of the Great Lakes basin ecosystem.

VI THE COMMISSION SHOULD STRONGLY URGE GOVERNMENTS TO ESTABLISH PROGRAMS TO DEVELOP ROUTINE FATE AND EFFECTS INFORMATION NEEDED FOR PREDICTIVE HAZARD ASSESSMENT.

In 1973 the Water Quality Board advised the Commission that there was a need for data on the level and effects of various contaminants, with special emphasis on the environmental significance of PCB levels in the biota, in order to evaluate the human health implications. In addition, both the Science Advisory and Water Quality Boards in previous reports have stressed to the Commission the importance of developing fate and effects information. However, very little additional work has been initiated. The generation of such data is routine work and should not be done by research organizations, which are not efficient in routine data production. They should use their resources to develop better methods for data production and a better knowledge of what data are most needed. Routine data generation is not the responsibility of any agency. This fact may explain why little has been done. Because such data are so important to
regulations, funding outside existing research budgets should be requested to develop the required data.

VII THE COMMISSION SHOULD CENTRALIZE AN INFORMATION SYSTEM TO COLLECT, STORE, SORT, AND DISPENSE DATA NEEDED BY THE JURISDICTIONS FOR CONTROL OF HAZARDOUS SUBSTANCES.

Much of the data needed for the control of hazardous substances, such as toxicity, persistence, and bioconcentration potential must be generated or gathered from diverse sources. Each jurisdiction will need such data as a basis for its control actions. Furthermore, each jurisdiction will be concerned with a number of substances. A single organized assembly of this data at a central location will be far more cost effective than many individual efforts. The Science Advisory Board in its 1978 Annual Report recommended a centralized system. The Water Quality Board has repeatedly stressed the need for information of this nature. Little progress has been made in developing a common data bank accessible to all. The Commission should take a more aggressive role in assisting the jurisdictions to gain access to this data.

VIII THE COMMISSION SHOULD RECOMMEND RESEARCH FOR DEVELOPING METHODS TO DETERMINE NET BENEFIT AS A NECESSARY CONSIDERATION IN FUTURE DECISION MAKING IN THE GREAT LAKES BASIN ECOSYSTEM.
Many pollution abatement procedures, such as chemical precipitation of phosphorus and operation of air scrubbers, require the use of chemicals and fossil fuels. The extraction and conversion of fossil fuels produces impacts on various parts of the ecosystem. Likewise, the production of chemicals and the disposal of sludge after treatment can cause adverse impacts. Often these secondary effects occur in locations outside the Great Lakes basin ecosystem. When these impacts exceed the benefit of the abatement steps, the net environmental result is negative and the abatement probably should not be implemented. Careful environmental assessments are needed to identify when this point is reached. The ecosystem approach adopted by the Commission requires that all control programs within the basin result in net environmental benefit. At present there are no methods available to determine net environmental benefit, but they are needed to guide decision making.
The Commission should recommend research for developing methods to determine net benefit as a necessary consideration in future decision making in the Great Lakes Basin ecosystem.
Additional Information

The Appendix to the Science Advisory Board Report includes the following reports:

A. Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem - S. J. Eisenreich, B.B. Looney, and J.D. Thornton, Department of Civil and Mineral Engineering, University of Minnesota, Minneapolis, Minnesota.


D. Toxics in Municipal and Industrial Wastewaters - D.F. Bishop, Municipal Environmental Research Laboratories, U.S. Environmental Protection Agency, Cincinnati, Ohio.

Addition Information

The Appendix to the Science Advisory Board Report includes the following reports:

1. Assessment of Airborne Inorganic Contaminants in the Great Lakes
   By: E. A. Allen and M. A. Hall, Jr., President of the American Water Resources Association, Detroit, Michigan.

2. Sources and Control of Discharge of Pollutants - H. N. Cohen
   By: E. L. Harriman, Air Resources Branch, Ontario, Canada.


The 1960 Science Advisory Board Advisory on Hazardous Substances to the Great Lakes and Their Basins is also available from the IDC Great Lakes Office in Ontario, Canada, MB 013.
Other Board Activities

In addition to the problem of hazardous substances, the Board also considered problems related to eutrophication, new and revised water quality objectives, and human health effects of Great Lakes water quality. The following committee and task force reports have been completed:


These reports are available from the IJC Great Lakes Regional Office, 100 Ouellette Avenue, Windsor, Ontario, Canada, N9A 6T3.