WQ-10

MINNESOTA POLLUTION CONTROL AGENCY
Division of Water Quality
June 24, 1975

Status Memorandum on PCB Problem in Minnesota

Introduction

The following is an update memo regarding the polychlorinated biphenyl (PCB) problem in surface waters of the State and specifically the Lake Pepin region of the Mississippi River.

Inter-Agency Task Force

The Inter-Agency Task Force on PCB's was formed on May 23, 1975 with the following agencies having representation: Minnesota Department of Natural Resources, Minnesota Department of Health, Minnesota Department of Agriculture, Minnesota Pollution Control Agency, Wisconsin Department of Natural Resources, U.S. Environmental Protection Agency, and U.S. Food and Drug Administration. In addition to the above agencies listed, the Agency staff has asked that representatives from the Metropolitan Waste Control Commission and U.S. Fish and Wildlife Service also participate on the Task Force.

The Task Force has held two additional meetings since May 23rd (June 2nd and June 18th, 1975). These meetings have resulted in the development of an action team to investigate and identify the extent of the PCB problem in the Mississippi River below the Twin Cities Metropolitan Area and the source(s) which may be contributors.

The Task Force is presently compiling the results of a Quality Assurance Program involving seven (7) laboratories conducting fish flesh analyses on species from Lake Pepin. Also during this same period, the Minnesota and Wisconsin departments of natural resources have been collecting representative fish species from this segment of the Mississippi River as well as the major tributaries.

MONS 048072

The Task Force in their investigations to identify source(s) will be looking at the following suspected general categories: municipal and industrial wastewater effluents, stack-air emissions, storm sewer outlets, landfill and dump leachates, and other unknown and possibly ubiquitous sources.

Surface Water PCB Concentrations

The Agency as part of its routine water quality monitoring program has identified significant concentrations of PCB's (as Aroclor 1254) within the Mississippi River in 1975. Also, both Minnesota and Wisconsin's departments of natural resources have reported levels in fish which have been in excess of the U.S. Food and Drug Administration (U.S.F.D.A.) "Action Limit" of 5 parts per million. The staff has included a memorandum identified as Attachment A for your information in this regard.

The high levels of PCB's in the fish tissue have resulted in the enforcement of the "Action Limit" by the USFDA and subsequently a temporary ceasing of commercial fishing operations within the Lake Pepin area. This economic hardship has been reflected in a loss of jobs and profits to these companies as well as a reduction in tourism.

PCB Problem Elsewhere

It is worthwhile to note that this particular problem has not been limited to the Minnesota-Wisconsin Mississippi River waters. For your information, the staff has included a copy of the Lake Michigan Toxic Substances Committee Report, Conclusions, May 22, 1975, listed as Attachment B. Particular attention is warranted to conclusions C and F which reflect a similar situation occurring in Lake Michigan in respect to Lake Pepin.

Of equally significant concern are the effects from PCB's which have been occurring in the waterfowl of Lake Ontario. Again for your information, the staff has included a draft copy of a portion of Appendix A, Annual Report of the Water Quality Objectives Subcommittee to the Implementation Committee and Great Lakes Water Quality Board, June-1975, Draft of May 16, 1975 listed as Attachment C. This report will be presented to the International Joint Commission during the week of July 28, 1975. Your attention is directed to pages IV-19 through IV-21 which explains the effects of high PCB's in fish resulting in severe reproductive failures observed in herring gulls (fish eating waterfowl) colonies of Lake Ontario.

Within Lake Superior, the Great Lakes Environmental Contaminant Survey (GLECS) which is conducted yearly by Michigan's Departments of Natural Resources and Agriculture, the U.S. Food and Drug Administration - Detroit Region, and the Great Lakes Fishery Laboratory have determined, as a result of PCB analyses of trout, that a pattern of elevated residues exists much in the same sense as observed in Lake Michigan. The staff has included that report: Contaminants in Upper Great Lakes Fishes, Wayne A. Willford, U.S. Fish and Wildlife Service, March, 1975 for your information (Attachment F).

Recommendation

The effects of recent high levels of PCB's observed in the Mississippi River have resulted in concentrations in the fish tissues greater than the current USFDA "Action Limit" of 5 parts per million. An economic loss has already resulted to the commercial fishery and tourism industries of the Lake Pepin area due to PCB's. As the Agency staff continues to investigate and identify sources contributing to this problem (See Attachment E), it is appropriate to recommend that the Agency Board adopt a resolution which would control the source of these compounds.

MONS 048074

It is recommended that the resolution, if adopted, be presented to Representative Lionell Van Deerlin, Chairman, House Subcommittee on Consumer Protection and Finance, and Senator John V. Tunney, Chairman, Senate Special Subcommittee on Science, Technology, and Commerce, and the Minnesota Congressional delegation. The proposed resolution has been included as Attachment A.

MONS 048075

ATTACHMENT A

MINNESOTA POLLUTION CONTROL AGENCY
Division of Water Quality
June 24, 1975

Resolution

WHEREAS, *the Agency is charged with the administration and enforcement of all laws relating to the pollution of any waters of the state as given in Minnesota statutes of 1971, Chapter 115.03, and;*

WHEREAS, *no sewage, industrial waste or other wastes shall be discharged into any of the interstate or intrastate waters classified as fisheries and recreation so as to cause any material change in any other substances or characteristics which may impair the quality of interstate or intrastate waters or the aquatic biota in any manner render them unsuitable or objectionable for fishing, fish culture or recreational uses as per Minnesota Pollution Control Agency regulations WPC 14 and 15, (1973 Supplement), and;*

WHEREAS, *significant concentrations of persistent organic compounds known as polychlorinated biphenyls (PCBs) have been identified within the Mississippi River near the border areas of Minnesota-Wisconsin known as Lake Pepin, and;*

WHEREAS, *the United States Food and Drug Administration has enforced the "Action Limit" of five (5) parts per million total PCBs on several shipments of commercially caught rough fish from the Lake Pepin area resulting in voluntary disposal of the fish by the industry, and;*

WHEREAS, *as a result of the above, commercial fishing operations have temporarily been ceased in the Lake Pepin area, and;*

WHEREAS, on May 27, 1975 Dr. Warren R. Lawson, Minnesota Commissioner of Health advised the public to limit consumption to no more than one meal per week of fish taken from the Mississippi River from the Minneapolis-St. Paul metropolitan area and lower Lake Pepin, and;

WHEREAS, and as a result of the above actions significant environmental effects on the aquatic life and economics of commercial and sports fisheries as well as tourism have occurred, and;

WHEREAS, the Great Lakes Environmental Contaminant Survey (GLECS) conducted yearly by Michigan's Departments of Natural Resources and Agriculture, the U.S. Food and Drug Administration - Detroit Region, and the Great Lakes Fishery Laboratory has determined that Lake Superior lake trout collected near Isle Royale are showing a pattern of elevated PCB residues similar to Lake Michigan.

NOW THEREFORE BE IT RESOLVED, that the Minnesota Pollution Control Agency Board hereby supports a ban on the sale and use of PCBs, except in those cases where its use is judged by the United States Environmental Protection Agency and the states to be essential.

ATTACHMENT B

MINNESOTA POLLUTION CONTROL AGENCY
Division of Water Quality
May 20, 1975

Status Memorandum on Polychlorinated Biphenyl Problem in the Mississippi River

Introduction

Polychlorinated biphenyls (PCB's) have been used in the United States and elsewhere over the past 40 years. The principal uses for PCB fluids are in the electrical industry. Because of their dielectric properties, they are widely used in various products such as capacitors and transformers where insulation or superior cooling is needed.

Another large use of PCB's had been in carbonless duplicating paper. This use has been discontinued. There is a strong suspicion that PCB's may be contained within inks used in the printing industry.

Recently, adequate data has been accumulated which indicates that PCB's are now widely dispersed throughout the environment.

PCB's are synthetic (man-made) chemicals which do not occur naturally within the environment. Monsanto Corporation, St. Louis, Missouri is the sole manufacturer of PCB's. It is reported that Monsanto has voluntarily taken actions to reduce the production of PCB and to limit its distribution to industries.

Toxicology

Studies have been completed that demonstrate accumulation factors of up to 75,000 in whole organisms. This concept deplicts the uptake of PCB

residues from extremely low environmental concentrations. PCB's like many of the organic insecticides, are fat soluble, and are stored in the lipids of animals. Like insecticides, they are chemically stable, and tend to be concentrated (to an extent) at exceedingly higher levels as they pass through the various members of the food chain.

Current Situation

May 7, 1975

The staff was contacted on May 7, 1975 by the U.S. Food and Drug Administration regarding their confiscation of a shipment of carp from a commercial fisherman from Wisconsin. The fish were taken from Lake Pepin and the flesh when analyzed by the Food and Drug Administration from selected samples exceeded the FDA "Action Limit" of 5 ppm PCB. An estimated 20,000 pounds of carp filets were disposed of due to these concentrations of PCB. Because of the action by the Food and Drug Administration as well as a study completed by the Wisconsin Department of Natural Resources on concentrations of PCB within fish flesh, the staff felt that considerable effort should be implemented to find the source of these compounds within the Mississippi River. The following data summary of the Wisconsin study illustrates the levels of PCB found within selected fish from the Mississippi River.

River Mile - 811 (Below Hastings, Mn.)

No.	Species	Average PCB level	Median PCB level
7	Walleye (1970)	30.1 ppm	28.1 ppm
8	Walleye (1973)	9.0 ppm	9.0 ppm
7	Carp (1970)	12.8 ppm	10.7 ppm
8	Carp (1973)	8.4 ppm	8.1 ppm

MONS 048079

River Mile - 765 (At Pepin, Wisconsin)

No.	Species	Average PCB level	Median PCB level
13	Walleye (1970)	32.4 ppm	25.4 ppm

River Mile - 765 (At Pepin, Wisconsin) cont.

No.	Species	Average PCB level	Median PCB level
7	Walleye (1973)	21.8 ppm	25.4 ppm
5	Carp (1970)	16.2 ppm	16.7 ppm
7	Carp (1973)	7.7 ppm	7.4 ppm

River Mile - 758 (At Wabasha, Mn.)

No.	Species	Average PCB level	Median PCB level
5	Walleye (1970)	7.7 ppm	8.6 ppm
5	Walleye (1973)	5.9 ppm	5.8 ppm
5	Carp (1970)	31.7 ppm	34.8 ppm
7	Carp (1973)	7.8 ppm	8.0 ppm

After looking at the above data, attention is warranted to the median values which more accurately reflect the concentrations that could be expected to be found within the flesh. It is apparent that a significant reduction in the levels of PCB's has occurred during the period from 1970 to 1973 except for walleyes at River Mile - 765 (Lake Pepin) and 758 (Lake Pepin). The Wisconsin study is in disagreement with work completed by the Minnesota Department of Natural Resources from the same reach of the Mississippi River. With this in mind the staff felt that additional studies should be completed to delineate whether the concentrations within the fish have in fact gone up or have decreased or remained the same.

May 16, 1975

Because of the problem indicated previously regarding the Wisconsin and Minnesota Department of Natural Resources studies on the concentrations of PCB's within the fish of the Mississippi River the staff felt that additional fish should be collected from the river and analyzed for PCB levels. With this in mind, fish were collected by the Lake City Area District of the Department of Natural Resources on the 16th of

May. A total of 25 fish were collected and fileted with three separate samples being obtained from each filet. Plans have been made to split the filet samples between the following three laboratories: Minnesota Department of Health, Minnesota Department of Natural Resources, and U.S. EPA Central Regional Laboratory, Chicago. will Conc. varying in fish body. So split will not [illegible] to [illegible]

Also on the 16th the staff received the latest update of water quality data for PCB's in the Mississippi River from the routine monitoring program. Following is the data from those stations that we currently have on file.

Date	Station	Concentration
3-18-75	UM-840 (Below Wabasha St. Bridge)	25.5 ppb
3-18-75	UM-826 (Above Grey Cloud Island)	35.4 ppb
3-18-75	UM-815 (Lock & Dam #2, Hastings)	20.1 ppb
3-5-75	UM-738 (Lock & Dam #5)	8.1 ppb
3-5-75	UM-698 (Bridge on U.S. 14, LaCrosse)	11.4 ppb
4-2-75	UM-738 (Lock & Dam #5)	6.8 ppb
4-2-75	UM-698 (Bridge, etc.)	12.2 ppb

It should be pointed out that these concentrations are the highest values that the staff has observed in any surface water of the state to this date. Because these values are exceedingly high for surface waters the staff recognized the seriousness of the situation and felt that a more extensive sampling of the river should take place with possible split samples being sent to the U.S. EPA Central Regional Laboratory to ascertain the confirmation as to the presence of these levels of PCB's.

May 19, 1975

Due to the serious nature of this problem, the staff felt that all interested parties should be brought together to discuss all aspects of this particular problem. With this in mind the staff has scheduled a meeting for Friday, May 23 at the Agency at 10:00 a.m. The meeting will involve state agencies from both Minnesota and Wisconsin and federal agencies

MONS 048081

River Mile - 765 (At Pepin, Wisconsin) cont.

No.	Species	Average PCB level	Median PCB level
7	Walleye (1973)	21.8 ppm	25.4 ppm
5	Carp (1970)	16.2 ppm	16.7 ppm
7	Carp (1973)	7.7 ppm	7.4 ppm

River Mile - 758 (At Wabasha, Mn.)

No.	Species	Average PCB level	Median PCB level
5	Walleye (1970)	7.7 ppm	8.6 ppm
5	Walleye (1973)	5.9 ppm	5.8 ppm
5	Carp (1970)	31.7 ppm	34.8 ppm
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After looking at the above data, attention is warranted to the median values which more accurately reflect the concentrations that could be expected to be found within the flesh. It is apparent that a significant reduction in the levels of PCB's has occurred during the period from 1970 to 1973 except for walleyes at River Mile - 765 (Lake Pepin) and 758 (Lake Pepin). The Wisconsin study is in disagreement with work completed by the Minnesota Department of Natural Resources from the same reach of the Mississippi River. With this in mind the staff felt that additional studies should be completed to delineate whether the concentrations within the fish have in fact gone up or have decreased or remained the same.

May 16, 1975

Because of the problem indicated previously regarding the Wisconsin and Minnesota Department of Natural Resources studies on the concentrations of PCB's within the fish of the Mississippi River the staff felt that additional fish should be collected from the river and analyzed for PCB levels. With this in mind, fish were collected by the Lake City Area District of the Department of Natural Resources on the 16th of

that also have an interest in this matter.

It is hoped that the following items can be accomplished at this meeting.

1) Present all existing background data on PCB's in the Mississippi River.

2) Discuss proposed additional sampling of the Mississippi River and major tributaries.

3) Discuss possible effluent sources of PCB's to the Mississippi River.

Following this meeting and additional work on this problem to identify the source of the PCB's the staff will present to the Agency Board a complete review of this situation at the June Agency Board meeting.

Joel G. Schilling, Head
Lake Surveys Sub-Unit
Section of Surface & Groundwaters
Division of Water Quality

Attachments

STATE OF MINNESOTA JGS

DEPARTMENT Pollution Control Agency

Office Memorandum

TO : Barry C. Schade, Assistant Director
Division of Water Quality

DATE: May 12, 1975

FROM : Joel G. Schilling, Head
Lake Survey Sub-Unit

THROUGH: John F. McGuire, P.E.
Chief, Surface & Groundwater Section

SUBJECT: PCB problem in the Mississippi River

The staff has been recently made aware of the fact that the levels of PCB's in fish flesh within the Mississippi River (Lake Pepin) are exceeding the USFDA "Action Limit" of 5 ppm.

Mr. Schilling received a call from Mr. Mike Morehead, U.S. Food and Drug Administration on Wednesday, May 7, 1975 to report that their agency had confiscated a shipment of carp from a commercial fisherman from Wisconsin. The fish were taken from Lake Pepin and the flesh, when analysed from selected samples, exceeded the FDA "Action Limit" of 5 ppm PCB. The specific polychlorinated biphenyl found was Aroclor #1254.

This particular situation presents further concern to the staff in that certain questions on this matter need to be answered very soon. As you may be aware, this was a rather hot item in 1972. Dr. Jere Hossier had done some work on this problem as shown within a memo of April 1, 1972 to the Agency Board. That memo had included a study with an accompanying letter from Wisconsin Department of Natural Resources regarding fish collection and analysis for PCB's from the Mississippi River. The Wisconsin study had indicated high levels of PCB's in the fish taken in 1970 (data revealed levels as much as 10 times the FDA limit of 5 ppm). We have recently received an update (to 1973) to the Wisconsin study which has added to the concern on this matter. The following data summary of Wisconsin study reveals this problem.

River Mile - 811 (Below Hastings, Mn.)

No.	Species		Average PCB level	Median PCB level
4	Walleye	(1970)	30.1 ppm	28.1 ppm
5	Walleye	(1973)	9.0 ppm	9.0 ppm
7	Carp	(1970)	12.8 ppm	10.7 ppm
8	Carp	(1973)	8.4 ppm	8.1 ppm

River Mile - 765 (At Pepin, Wisconsin)

No.	Species		Average PCB level	Median PCB level
13	Walleye		32.4 ppm	25.4 ppm
7	Walleye	(1973)	21.8 ppm	25.7 ppm
5	Carp	(1970)	16.2 ppm	16.7 ppm
7	Carp	(1973)	7.7 ppm	7.4 ppm

MONS 048084

River Mile - 758 (At Wabasha, Mn.)

No.	Species	Average PCB level	Median PCB level
3	Walleye (1970)	7.7 ppm	8.6 ppm
5	Walleye (1973)	5.9 ppm	5.8 ppm
5	Carp (1970)	31.7 ppm	34.8 ppm
7	Carp (1973)	7.8 ppm	8.0 ppm

Attention is warranted to the median values which more accurately reflect the concentrations that could be expected to be found within the fish flesh. It is apparent that a significant reduction in the levels of PCB's has occurred during the interim from 1970 to 1973 except for walleyes at River Mile - 765 (Lake Pepin) and 758 (Lake Pepin). Why the levels of PCB's in the walleyes from Lake Pepin has remained relatively unchanged is not presently known. A number of possibilities exist which could be explored.

Of particular concern is the role of the Division in this matter to date. The staff has been closely monitoring this problem from the standpoint of the waste sources which might be contributing to this problem. The work done previously in 1972 was aimed chiefly at the 3M - Chemolite plant in Cottage Grove as the source of PCB's. The data which is being summarized to date seems to indicate that 3M is not presently the main source of these compounds. This would directly correlate with the reduction in fish flesh levels found below Hastings, Minnesota. However, Foot Tanning Company, Red Wing, Minnesota had the highest levels of PCB's in their effluent during the surveys of 1972. For some reason, no follow-up composite sampling of Foot Tanning was undertaken as was the case at Chemolite.

It is quite apparent that follow-up studies of this problem should be carried out. The staff of the Special Investigations Unit of this Section would be willing to coordinate additional study with the assistance of the Facilities Section to identify point sources which might be contributing to this problem. However, authority to act in this area previously resided in the Division of Special Services. We therefore request that you seek clarification to determine who has this responsibility.

STATE OF MINNESOTA

DEPARTMENT Pollution Control Agency

Office Memorandum

TO : Barry C. Schade
Acting Director
Division of Water Quality

DATE: May 16, 1975

FROM : Joel C. Schilling, Head
Lake Survey Sub-Unit
through: John F. McGuire, P.E.
Chief, Surface & Groundwater Section

SUBJECT: Update to PCB Problem on the Mississippi River (No. 2).

The following is an update to the first memo developed on this problem dated May 12, 1975.

An extensive conversation with Mr. Chuck Burrows, Chief, Section of Fisheries, Minnesota Dept. of Natural Resources on May 15 involved the matter of fish collection and subsequent lab analysis for PCB's in fish flesh from Lake Pepin species. This particular problem stems from a noticeable discrepency between data on PCB concentration in fish from studies completed by Wisconsin Dept. of Natural Resources and Minnesota Dept. of Natural Resources (reference is made to a letter from Commissioner Herbst to Mr. Merritt, dated May 13 on this matter). We agreed that fish collection would take place on May 16 in Lake Pepin conducted by the Dept. of Natural Resources Lake City Area District both game and rough fish species. Plans have been made to split the fillets between the following three laboratories: Minnesota Dept. of Health, Minnesota Dept. of Natural Resources, and USEPA Central Regional Lab Chicago. A more detailed memo will outline this situation later.

We discussed briefly the matter regarding a public announcement about the consumption of fish by the public. There is a problem here with the lack of adequate data concerning the human health effects from the consumption of these compounds. We arrived at no conclusion on this matter because of DNR's concern about the data discussed previously. It was indicated that Mr. Burrows would probably contact the Health Dept. for their advice on this matter.

The following is the latest update of Water Quality data on PCB's in the Mississippi River from the routine monitoring program.

Date	Station	Concentration
3-18-75	UM-840(Below Wabasha St. Bridge)	25.5 ppb
3-18-75	UM-826(Above Grey Cloud Island)	35.4 ppb
3-18-75	UM-815(Lock & Dam #2, Hastings)	20.1 ppb
3-5-75	UM-738(Lock & Dam #5)	8.1 ppb
3-5-75	UM-698(Bridge on U.S. 14, LaCrosse)	11.4 ppb
4-2-75	UM-738(Lock & Dam #5)	6.8 ppb
4-2-75	UM-698(Bridge, etc.)	12.2 ppb

MONS 048086

It should be pointed out that these concentrations are the highest values the staff has observed in any surface water of the state to date. Because these values are exceedingly high for surface waters the staff feels that a more extensive sampling of the River should take place with split samples sent to USEPA Central Regional Laboratory for confirmation as to the presence of these concentrations.

Staff members of the Section of Surface and Groundwaters conducted a field survey on May 15, 1975 to attempt to identify possible sources of PCB's to the Mississippi River. Effluent samples were obtained from the Red Wing Municipal Wastewater Treatment Plant and the S.B. Foot Tanning Co. Also, tributary samples were obtained from the Cannon River at its confluence with the Mississippi River.

STATE OF MINNESOTA

DEPARTMENT Pollution Control Agency

Office Memorandum

TO : Barry C. Schade, Assistant Director
Division of Water Quality

DATE: May 19, 1975

FROM : Joel G. Schilling, Head
Lake Surveys Sub-Unit

THROUGH: John F. McGuire, P.E.
Chief, Section of Surface & Groundwaters

SUBJECT: Update Memo to PCB problem in the Mississippi River (No. 3)

The following is a current update of the PCB problem in the Mississippi River.

Mr. Schilling, on May 16, 1975, participated in the acquisition of fish samples from the head of Lake Pepin, Mississippi River for analysis of PCB's. The collection of fish was accomplished by the Minnesota Department of Natural Resources, Lake City area district. A total of 25 fish were collected and filleted for packaging and subsequent shipment to 3 analytical laboratories. Mr. Schilling supervised these operations and transported the filets back to Minneapolis for storage until they're transferred to the laboratories on Monday, May 19. The three laboratories which will be conducting the analysis on the fish flesh specimens will be the Minnesota Department of Health, Minnesota Department of Natural Resources and the U.S. EPA Central Regional Laboratory in Chicago. Each laboratory will be receiving 15 total fish specimens. The remaining ten specimens will be kept in storage here in the Agency for later analysis.

Mr. Schilling received a request for attendence at a meeting on the 27th of May in Wabasha, Minnesota at 7:30 p.m. to participate in a discussion with commercial fishermen in the Lake Pepin area with regard to the PCB problem in the Mississippi River. The request was made by Mr. Dan McGuinness from the Southeast Planning Commission, 149 Main Street, Wabasha, Minnesota. Mr. Schilling indicated that the Agency would request that Mr. McGuinness ask personnel from the Minnesota Department of Natural Resources to also attend this meeting.

An additional meeting has been set up [redacted] on May 23rd at 10:00 a.m. here at the Agency to discuss with all participating and interested parties the PCB problem in the Mississippi River. The meeting will involve state agencies from both Minnesota and Wisconsin and federal agencies that also have an interest in this matter.

The staff proposes to conduct additional field surveys the week of May 19-23 on possible sources of PCB's to the Mississippi River. This will involve both effluents and tributaries to the Mississippi to determine the exact source of these compounds.

MONS 048088

Lake Michigan Toxic Substances Committee
May 22, 1975

Conclusions

A. The effect level of PCB's in primates reproduction is recently documented as less than 2.5 ppm and is much lower than has been observed in standard test mammals (rats).

B. As a result of recent court decisions the FDA is now enforcing the 5 ppm residue maximum in fish intended for human consumption and is likely to review the 5 ppm maximum allowable based on recent primate toxicological evidence.

What is he referring to?

C. The concentrations of PCB's in Lake Michigan fish are probably not decreasing and Salmonids, particularly larger specimens, currently achieved the 5 ppm maximum allowable level.

D. Reported efforts by the manufacturer to restrict distribution and efforts by the agencies to restrict discharges have not resulted in PCB reductions in the lake.

E. It is probable that wastewater sources of PCB's to Lake Michigan are ubiquitous and at or below detectable levels.

F. An economic loss has already resulted to the commercial fishery as a result of PCB contamination. A much larger economic loss to the commercial and sport fishing industry is imminent in light of current FDA food recommendations and enforcement actions.

G. Non-wastewater PCB's are probably still reaching the environment from incineration, land disposal, and careless dumping.

MONS 048089

H. The presence of PCB's in many processes and many products, continues to be widespread in spite of Monsanto Chemical Company policy to restrict sale for closed systems. Taken ?

I. For many if not for all uses, PCB's can be eliminated or replaced by alternative chemicals.

ATTACHMENT D

DRAFT OF MAY 16, 1975

RECEIVED
MAY 29 1975
MINN. POLLUTION
CONTROL AGENCY

APPENDIX A

ANNUAL REPORT OF THE WATER QUALITY OBJECTIVES SUBCOMMITTEE TO THE IMPLEMENTATION COMMITTEE AND GREAT LAKES WATER QUALITY BOARD

WATER QUALITY OBJECTIVES FOR THE GREAT LAKES

JUNE 1975

MONS 048091

TOXIC SUBSTANCES - PERSISTENT COMPOUNDS

PERSISTENT ORGANIC CONTAMINANTS

WE SHOULD IDENTIFY WHO WE ARE ORGANIZATION

RECOMMENDATION

It is recommended that the following numerical objectives for persistent organic contaminants be adopted to replace the existing interim objectve in Annex I, paragraph 2 (c) of the Water Quality Agreement:

Persistent organic contaminants should nowhere in the Great Lakes system exceed the water and tissue concentrations specified below for the protection of aquatic organisms and consumers of fish.

Compounds	Specified concentrations: Water (ug/l)	Tissue ug/g
Phthalate esters		
Dibutyl phthalate	*4.0*	*U⁴*
Di-(2- ethylhexyl phthalate	*0.6*	*U⁴*
Other phthalate esters	*0.2‡*	*U⁴*
Total P.C.B.'s	*U⁴*	*0.1*
Total D.D.T./D.D.E.	*.003‡*	*1.0*
Total Aldrin/Dieldrin	*.001‡*	*0.3†*
Total Heptachlor/Heptachlor epoxide	*.001‡*	*0.3†*
Endrin	*.002‡*	*0.3†*
Toxaphene	*.008*	*U⁴*
Chlordane	*.060*	*U⁴*
Lindane	*.010*	*0.3†*
Methoxychlor	*.040*	*U⁴*

U⁴ - undetermined at present

‡ - recommended quantification limit

† - based upon U.S.F.D.A. guidelines for edible portions of fish.

For other organic contaminants, the concentrations of which are not specified but which can be demonstrated to be persistent and are likely to be toxic, it is recommended that the concentrations of such compounds in water or aquatic organisms be limited to the detection level as determined by the best scientific methodology available at the time.

Note: Such a compound for which concentrations cannot be specified is Mirex, a rationale for which appears along with those for compounds specified above.

Note: Where waters are found to be contaminated as defined by exceeding the appropriate objective, all reasonable and practicable measures should be taken by the regulating agencies to reduce the input of the persistent organic contaminant to any part of the Great Lakes system.

EXISTING OBJECTIVE:

The recommended numerical objectives are intended to replace the existing interim objective in Annex 1, paragraph 2 (c) of the Agreement which states:

"Persistent Organic Contaminants. Persistent pest control products and other persistent organic contaminants that are toxic or harmful to human, animal or aquatic life should be substantially absent in the waters."

RATIONALE

Introduction

MONS 048093

Synthetic organic contaminants entering surface waters may be broadly divided into persistent and non-persistent compounds. The distinction is important since the organic

contaminants known to present the greatest hazard to human, animal and aquatic life are those which are resistant to degradation and which are thus available for dispersion in the environment and for incorporation into biological tissues. Concentrations of persistent organic contaminants in the aquatic environment seldom achieve acutely-toxic proportions except in localized situations due to accident or misuse. Of much greater concern are effects due to long-term exposure at sub-lethal levels and bio-concentration of residues resulting in tissue accumulations of increasing magnitude with each higher level in the aquatic food chain. For these reasons it is necessary to consider persistent contaminants separately from those which are readily decomposed to non-toxic constituents.

Persistent organic contaminants are, according to the Canada-U.S. Agreement, to be "substantially absent" from Great Lakes waters. While the Water Quality Objectives Subcommittee would like to interpret this as completely absent from the aquatic ecoysystem, it is constrained by the need to justify selected levels based upon protection of all potential uses. Consequently, it recommends levels based upon (1)protection of all aspects of aquatic life and human health as measured by water and tissue levels, (2) quantification limits for water concentrations, and (3) drinking water and food standards when these levels are limiting. Recreational effects of persistent organic compounds in water, with the possible exception of oil (covered under a separate objective), do not present any limitations to the introduction of such material into the water system. Agricultural use levels also are not likely to provide adequate protection for aquatic life.

PERSISTENCE

A persistent compound is defined as one which either (a) by itself or as its transformation product, has a half-life for degradation under natural environmental conditions of more than eight weeks, or, (b) by itself or as its transformation product, on entering surface waters may bioconcentrate in the biota of the receiving system.

Persistence is the property of chemical compounds, measured in units of time, which describes their ability to resist structural alteration under specific physical and chemical conditions. Under similar environmental conditions, different compounds exhibit different persistences depending on their molecular configuration. No standard test of persistence has yet been developed and, consequently, the term lacks precise definition. This is reflected in the common practice of arbitrarily classifying environmental contaminants as persistent when their presence can be demonstrated in different substrates several days or weeks after release.

The development of a standard test of persistence is a desirable precursor to the introduction of an objective for persistent contaminants in water. However, such a test cannot be arbitrarily selected, will require careful research and evaluation, and must be generally acceptable to the scientific community before its application for regulatory purposes. Whereas such research should be stimulated at the earliest opportunity, there is no possibility that an acceptable test for 'persistence' can be developed for incorporation into the impending revision of the U.S.-Canada Agreement on the Great Lakes' Water Quality. Thus, if the word 'persistence' is to appear in the objectives it must include the present broad meaning indicated in (a) of the above definition.

A laboratory study of eight organochlorine, ten organophosphorus and seven carbamate compounds showed marked differences

MONS 048095

in persistence in river water over an eight week period (Eichelberger and Lichtenberg, 1971). The results indicated, however, that 50% or more of the initial concentrations (10 ug/l) of all major environmental contaminants studied remained at the termination of the study. Thus a half-life of eight weeks would appear to be a reasonable criterion for the separation of persistent and non-persistent compounds in water.

In keeping with the intent of the objectives that persistent organic contaminants be substantially absent, the definition has been modified to include the property of bioconcentration potential so as to provide for the distinct possibility that levels in tissue may accumulate from water concentrations below those which can be detected. This effect is provided for in part (b) of the definition.

While the problem of bioconcentration is real and is the reason for the inclusion of tissue levels in the objectives, bioconcentration factors are not standardized, sometimes combining dietary and direct water uptake, and sometimes being acquired from systems considerably above the solubility of the compound under examination. As a consequence of these, and other difficulties in determining this factor, no defensible objective can presently be made based primarily upon this influence. It is hoped that future work in this area may allow the situation to change.

Aquatic Life

Body burdens of persistent organic contaminants in aquatic biota and those of their predators may become limiting for species survival. Most of such compounds are classified by organic chemists as "non-polar" and as such they are very insoluble and are liable to occur predominantly as adsorbed

material on the particulate load. From there it may be ingested along with the particulates, thus entering the food chain, or it may be deposited in the sediment from where it can enter via benthic organism. Fish may also absorb these compounds directly through the gills. In higher trophic organisms, the persistent material usually ends up in the liver or in the adipose tissue due to its preferential solubility in fats and oils over that in aqueous fluides. In many cases, bioconcentration occurs as well since the material then may not readily be excreted by the organism. As a consequence of these considerations, sediments, plankton, fish tissue and predators of fish are probably better indicators of the presence of persistent organic contaminants than is water. Predators are of concern since avian and other non-aquatic predators feed on aquatic life and their body burdens may accumulate to toxic levels as a result. Since fish are the food source of concern for these predators, levels are largely set for fish tissue, but where it can be shown that detrimental effects occur in the predators the tissue level objective should be extended to include the predators.

The dynamics of adsorption also give rise to increased levels of persistent organic contaminants in the sediments. However, sediments are prone to movements over large distances through current action and additionally, present technology does not permit the determination of their deposition rates on a useful time scale for these monitoring purposes. Hence, they presently can only give indications of the presence of the contaminants but cannot easily be related to detrimental effects. It is recommended that studies be undertaken into such sampling methods as would permit the use of sediment levels for measuring contamination but for the present, criteria are not recommended for this compartment of the ecosystem.

Specific recommendations have been made for those cases where significant studies have determined "safe" levels for representative fish and invertebrate species by chronic toxicity experiments. In cases where subtle and deleterious effects were noted at the lowest chronic dose level (e.g. a partial reduction in hatchability of eggs), an arbitrary safety factory of 0.2 was applied to estimate the "safe" level. In cases where the acute toxicity studies indicated that some species of fish were more sensitive than those actually investigated, an experimentally determined application factor for fish for the compound in question was utilized to estimate a "safe" level for the more sensitive species of fish. Data for invertebrate studies were handled in the same fashion.

When chronic field studies were available which documented water concentrations and used intensive ecological analyses, these were given greater weight than laboratory studies. Concentration factors for pesticides from water to aquatic life were found to be too variable (often greater than an order of magnitude) to utilize meaningfully in the establishment of water quality criteria. Therefore, body burdens of various persistent chemicals in fish were utilized directly, when appropriate information existed. Protection of wildlife which consumes aquatic life, is based on chronic feeding studies of sensitive species and calls for restrictions on body burdens.

It is the intent of the Agreement to protect boundary waters of the Great Lakes System as a raw public water supply which will produce a safe drinking water after treatment. In addition, the use of fish for human consumption should be protected. Existing standards for most of the toxic persistent

organic contaminants are inadequate to protect aquatic life. Protection of fish as a resource is provided by guidelines of the U.S.F.D.A. for three persistent organics. (See recommendations). As new standards related to raw water supplies or drinking water which are lower than recommended water concentrations are developed and adopted by Canadian or U.S. federal agencies. They should be adopted as part of the specific objectives, as should new edible tissue guidelines from U.S. Food and Drug Administration or the Canadian Food and Drug Directorate.

QUANTIFICATION LIMITS

The water quality objectives proposed for persistent organic contaminants have been based on the intent expressed within the existing Agreemtn which is that such materials should be "substantially absent" within the boundary waters of the Great Lakes. The assumed philosophy, which is perpetuated here, is that danger exists in allowing persistent materials of unknown fate or biological significance to be added to surface waters within arbitrarily established limits because there is no assurance that bioconcentration will not occur and reach unacceptable levels. Corrective action may come too late to offset serious enviornmental consequences. Therefore, the philosophy of substantial absence of these substances is endorsed. In a practical sence, this is that concentration which is below that which can be quantified. That such quantification limits should be the objective for compounds without "safe levels is indicated in the preceeding, but it should be particularly so for proven carcinogens. In a survey of some ten laboratories in the Great Lakes region which are currently doing routine determinations of pesticides and other persistent organic contaminants, the following means and ranges of quantification limits were reported.

Table 1 - Persistent Organic Contaminants Quantification Limits.

Compound	Mean ug/l	Range ug/l	Recommended quantification limit ug/l
Lindane	.004	.001-.010	.001
Heptachlor	.004	.001-.010	.001
Heptachlor Epoxide	.004	.001-.010	.001
pp'-DDD	.012	.001-.050	.002
pp'-DDE	.011	.001-.050	.002
pp'-DDT	.011	.001-.125	.003
op'-DDT	.014	.001-.045	.003
Aldrin	.004	.001-.010	.001
Dieldrin	.008	.001-.025	.001
Endrin	.008	.001-.020	.002
Chlordane	.005	.002-.010	.002
Total PCB	.035#	.020-.100#	.010
pp' Methoxychlor	.020	.010-.050	.010
Phthalate esters	.6	.1 -1.5	.2

does not include a single high value of 1.5 ug/l.
◊ the mean of the lowest three values reported.

The third column is the mean of the lowest three quantification limits reported. Since it is desired to provide incentive to the development of more sensitive procedures, and not to condone insensitive determinations, it is these means which are recommended. They are employed, where appropriate, for specification of concentrations for which experimental data are not available to produce "safe" water levels but where there are data to establish "safe" tissue levels.

MONS 048100

Where an organic compound can be demonstrated to be persistent and likely to be toxic and for which data are unavailable to establish either "safe" water or tissue concentrations, it is recommended that its concentration in water or aquatic organisms be limited to the detection level as determined by the best sciontific methodology available at the time.

These quantification and detection limits, however, should not be accepted as permanent substitutes for experimentally determined "safe" concentration - rather it is intended that they should stimulate research on safety evaluations and analytical methods, plus provide a mechanism for action in the case of newly observed contaminants.

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MONS 048101

PERSISTENT ORGANIC CONTAMINANTS

POLYCHLORINATED BIPHENYLS

RECOMMENDATION

It is recommended that the following new objective for polychlorinated biphenyls be adopted:

The concentration of total polychlorinated biphenyls in fish tissues (whole fish, calculated on a wet weight basis), should not exceed 0.1 micrograms per gram for the protection of fish consuming birds and mammals.

Note: The Subcommittee expresses concern that a water concentration objective for this ubiquitous contaminant is unavailable. Based upon poorly defined bio-concentration factors it may be concluded that PCB's in water should not exceed 0.001 micrograms per litre. However, this level may not be adequate to provide protection to certain predators, and could presently not be enforced because of insufficiently sensitive quantification limits.

RATIONALE

Introduction

In North America polychlorinated biphenyls (PCB's) are manufactured solely by the Monsanto Chemical Company and are distributed under the trade name AROCLOR^{R}. Each Aroclor is a mixture of various isomers of which 210 may occur in theory, the actual number of isomers formed chemically is probably closer to 100. In addition, a significant percentage of these isomers has been predicted to exist in pairs of optically active forms (Kaiser, 1974).

Polychlorinated biphenyls are now known to constitute the third most widely distributed pollutants on Earth, exceeded only by the chlorinated insecticides DDT and dieldrin. Similar to the latter compounds, PCB residues are found in the fat deposits of numerous warm and cold-blooded animals including Man. Their persistance is generally considered to be greater than most chlorinated insecticides. In the aquatic environment, PCB's have been detected in water, sediments, invertebrates, fish and waterfowl with highest levels being recorded in predatory organisms high in the food chain. While greater quantities are found in areas close to heavy industrialization, substantial residues have been detected in fish from undeveloped localities suggesting that aerial transport may play a significant role in their distribution.

PCB's In Great Lakes Waters

Contamination of the Great Lakes by PCB's has been, and continues to be, extensive. Fifty-seven per cent of water samples from 30 major tributaries analyzed by Michigan Water Resources Commission (1971) contained detectable concentrations of PCB (0.01 ug/l). Mean values determined for Michigan tributaries of Lakes Michigan, Huron, Superior, St. Clair and Erie were .023 ug/l, .228 ug/l, .010 ug/l, .081 ug/l, and .186 ug/l total PCB respectively. The Canada Centre for Inland Waters examined open waters of Lakes Ontario and Erie during 1971 and measurable quantities were found in 60 percent and 63 percent of the samples respectively. Summaries of data from the three basins in each lake are presented in the Report of the IJC Boards to the IJC (1972). The highest mean value was 0.062 ug/l for bottom waters of Lake Ontario (western region), while the lowest was .012 ug/l for

the surface of Lake Ontario (eastern region). Lakewide means for surface and bottom samples were .030 µg/l and .032 µg/l respectively for Lake Ontario, and .027 µg/l and .025 µg/l for Lake Erie. Samples taken from Hamilton Harbour (Lake Ontario) by the Ontario Ministry of Environment in 1972 showed ranges of PCB's in water of .035 -.095 µg/l and 0.2 - 10.1 µg/g in sediments (Berg et al., 1974)

PCB's In Biota

Fish contamination is also widespread. The U.S. Food and Drug Administration guideline of 5 µg /g in edible tissue has been exceeded in numerous species in Lake Michigan including lake trout, coho salmon, chinook salmon and chub. In Lake Huron, walleye, whitefish, and catfish are above the tolerance level and likewise smelt and coho salmon in Lake Ontario. PCB concentrations in Lake Erie fish are generally below 5 µg/g with the exception of white bass (Report of the IJC Boards to the IJC, 1972). Recent analyses by the Ontario Ministry of the Environment on fish from the St. Clair River revealed muscle concentrations of 4.3 - 12.3 µg/g in white bass, 0.1 - 6.8 µg/g in pike, 0.1 - 2.8 in white suckers and 1.5 - 4.7 µg/g in coho salmon. Perch from Lake St. Clair showed levels of 0.1 - 0.25 µg/g and in the same area walleye contained 0.2 - 3.0 µg/g (Berg et al., 1974).

A serious situation exists with respect to populations of fish eating birds in the vicinity of the lower Great Lakes. Severe reproductive failure has been identified in herring gull colonies around Lake Ontario. While eggshell thinning has been correlated with DDE content of the eggs there is a positive correlation between early embryonic

mortality and PCB contamination (Gilbertson and Fox, 1975). Geometric means for PCB's in eggs of four fish-eating bird species are given below (National Research Council Canada, Associate Committee on Scientific Criteria for Environmental Quality, 1974).

PCB RESIDUES IN BIRDS EGGS (ug/g, dry weight basis)

Location	Herring gull	Ring-billed gull	Common tern	Double-crested cormorant
Lake Nipigon				77.5(52)
Lake Huron	368(5)	113(2)	81.7(8)	140.0(55)
Detroit River	520(2)			
Lake Erie	300(6)	243(4)	156(15)	63.7(18)
Hamilton Harbour			258(71)	
Lake Ontario	565(16)	379(4)	268(20)	114(7)

The major effect of PCB's on young birds is to produce symptoms of chick edema disease. The symptoms are subcutaneous pericardial and abdominal edema, prophyria, liver necrosis and high mortality (Gilbertson, 1974; Gilbertson and Hale, 1974; Gilbertson and Fox, 1975). In herring gull chicks from Lake Ontario colonies poor hatching success is associated with these forms of edema, increased porphyrin synthesis but not liver necrosis. These signs were associated with levels of PCB's of over 900 ug/g on a dry matter basis in the liver - amongst the highest levels in the world. Less severe signs were seen in Lake Erie chicks at about 600 ug/g, but were not completely absent in a control group from outside the Great

Lakes at about 35 ug/g. Clearly, even the Lake Erie group is contaminated by more than an order of magnitude above these.

In summary there can be little doubt that the existing state of PCB contamination in the Great Lakes system is excessive. Of particular concern must be the higher forms of life in which the process of bioconcentration causes the greatest residues to be accumulated. At present, there are insufficient data to estimate water concentrations of PCB's which will assure protection of predatory fish, fish eating birds and other predators; this will require greater understanding of the correlation of dietary intakes and bioconcentration factors.

Effects of PCB's On Biota

PCB's are toxic to aquatic life by direct exposure and are hazardous also to consumers of contaminated fish. Reproduction of midges and Daphnia magna was reduced at 0.45 ug/l (Aroclor 1254) and 1.3 ug/l respectively (Nebeker and Puglisi, 1974). The highest concentration of Aroclor 1248 having no effect on the fathead minnow was about 0.3 ug/l (National Water Quality Laboratory, 1974), a concentration which resulted in tissue residues of about 90 ug/g or 18 times the guideline for human consumption recommended by U.S. and Canadian federal health authorities. This indicates a bioconcentration factor for fathead minnows of approximately 3×10^5. The factor for bluegills with Aroclors 1248 and 1254 has been estimated at 7.1×10^4 (Stalling and Mayer, Jr., 1972) while large Lake Michigan coho salmon have mean tissue levels of about 15 ug/g (Veith, 1973) which is 1.5×10^6 times greater than the maximum open water concentration of around 0.010 ug/l (Lake Michigan Toxic Substances Committee Report).

Two ug/g PCB's in fish flesh has been shown to prevent survival of newborn commercial ranch mink (Ringer et al., 1972) while reproduction was eliminated in mink fed a beef diet containing 0.64 ug/g Aroclor 1254 (Platonow and Karstad, 1973). While this is not a subtle effect, it is the lowest dietary concentration observed to produce a deleterious biological effect. The safety factor of 0.2 applied to this results in the recommended tissue level of 0.1 ug/g.

The recommendation for PCB's is designed to protect the aquatic biota as well as the consumer of aquatic life. A conservative bioconcentration factor of 10^5 could be used to calculate a water concentration for total PCB's which should prevent tissue levels greater than 0.1 ug/g. This would result in a PCB concentration in water of less than 0.001 ug/l, a concentration which would be beyond the present routine analytical sensitivities and therefore impossible to monitor or enforce. It is therefore recommended that the regulatory agencies undertake fish and bird monitoring programs to determine compliance with the recommendation regarding tissue levels.

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MONS 048108

ATTACHMENT E

MINNESOTA POLLUTION CONTROL AGENCY
Division of Water Quality

Proposed Polychlorinated Biphenyls Sampling Program
June 16, 1975

The objectives of the polychlorinated biphenyl (PCB) field sampling program are to determine the source or sources of PCB's to the Mississippi River and to determine the extent of the problem. To accomplish these objectives the field sampling program will include surface water sampling, bottom sediment sampling, fish flesh sampling, WTP sludge sampling, air sampling, and point source discharge sampling. The location of the study area is that segment of the Mississippi River from Elk River, Minnesota to Lock and Dam No. 4 near Alma, Wisconsin (Figure 1). The study segment was divided into sub-segments in order to delineate specific problem areas and facilitate data analyses (Figure 2, Table 1).

A surface water sample will be taken in each of the sub-segments at two-week intervals. Water samples will be collected in 250 ml hexane-rinsed glass bottles which have glass stoppers. Direct bottle sampling should be used whenever possible. Composite or split samples will not be used because the low levels of PCB's may be altered by adsorption to the sample container walls.

Up to 2 or 3 bottom sediment samples will be taken in each of the sub-segments (Figure 2, Table 1). Samples will be collected by either a stationary core sampler or a Shipeck grab sampler. The sediment samples will be transferred to either a hexane-rinsed glass bottle with a glass stopper or all metal cap or to aluminum foil. The first sediment sampling trip should identify critical sub-segments which may require additional sampling in the future.

Fish flesh samples will be taken in all sub-segments where it is reasonably possible (Figure 2, Table 1). Fish will be collected by boom shocking or any other suitable equipment. Two species of sport fish and two species of rough fish will be included in each sample. Five individuals of each species will be collected to make a total fish sample of twenty individuals. The species of sport fish which may be used are walleye, sauger, white base, channel catfish and small-mouth bass. Rough fish species which may be used are carp, buffalo, gizzard shad, and freshwater drum. Fish removed from the river for the sample should be large enough to be considered of edible size by sport fishermen. Only the edible fish fillet should be used for the PCB analyses. Frequency of sampling and areas or sub-segments for specific intensive sampling will be determined after the initial sampling trip.

Sludge samples will be taken at the major wastewater treatment plants in the study area which burn or incinerate the sewage sludge. If high levels of PCB's are found in the sludge, air sampling of the incinerators may be necessary to determine if these are major sources.

Point source discharge sampling will be conducted on all known or suspected sources of PCB's. The exact procedures or frequency of sampling will be determined for each discharger. Possible methods of sampling may include grab sampling once every two weeks or over a 24 hour period.

TABLE 1

Description of Sub-Segment
and Sampling Areas for PCB Investigations

A. St. Croix River

1. Taylors Falls to Stillwater
2. Stillwater to Prescott, Wisconsin

B. Minnesota River

1. Jordan to Shakopee
2. Shakopee to confluence with Mississippi River

C. Mississippi River

1. Elk River to Coon Rapids Dam (Mile 866)
2. Coon Rapids (866) to St. Anthony Falls (Mile 854)
3. St. Anthony Falls (Mile 854) to Lock and Dam #1 (Mile 848)
4. Lock and Dam #1 (848) to Wabasha St. Bridge (Mile 840)
5. Wabasha St. Bridge (Mile 840) to Rock Island RR Bridge (Mile 830)
6. Rock Island RR Bridge (Mile 830) to Lock and Dam #2 (Mile 815)
7. Lock and Dam #2 (Mile 815) to Lock and Dam #3 (Mile 797)
8. Lock and Dam #3 (Mile 797) to Pepin (Mile 765)
9. Pepin (Mile 765) to Lock and Dam #4 (Mile 753)

D. Crow River

At confluence with Mississippi River

E. Rum River

At confluence with Mississippi River

F. Vermillion River

At confluence with Mississippi River

G. Cannon River

At confluence with Mississippi River

H. Rush River

At confluence with Mississippi River

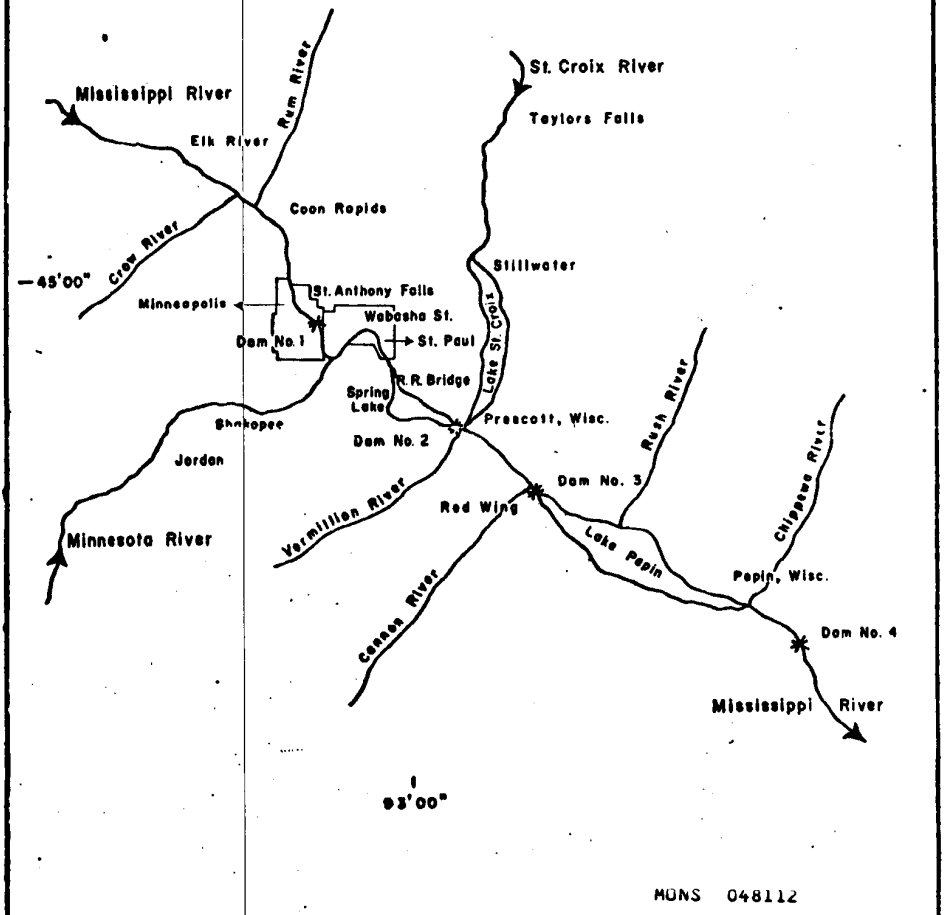
I. Chippewa River

At confluence with Mississippi River

MONS 048111

Figure I

DELINEATION OF PCB STUDY AREA

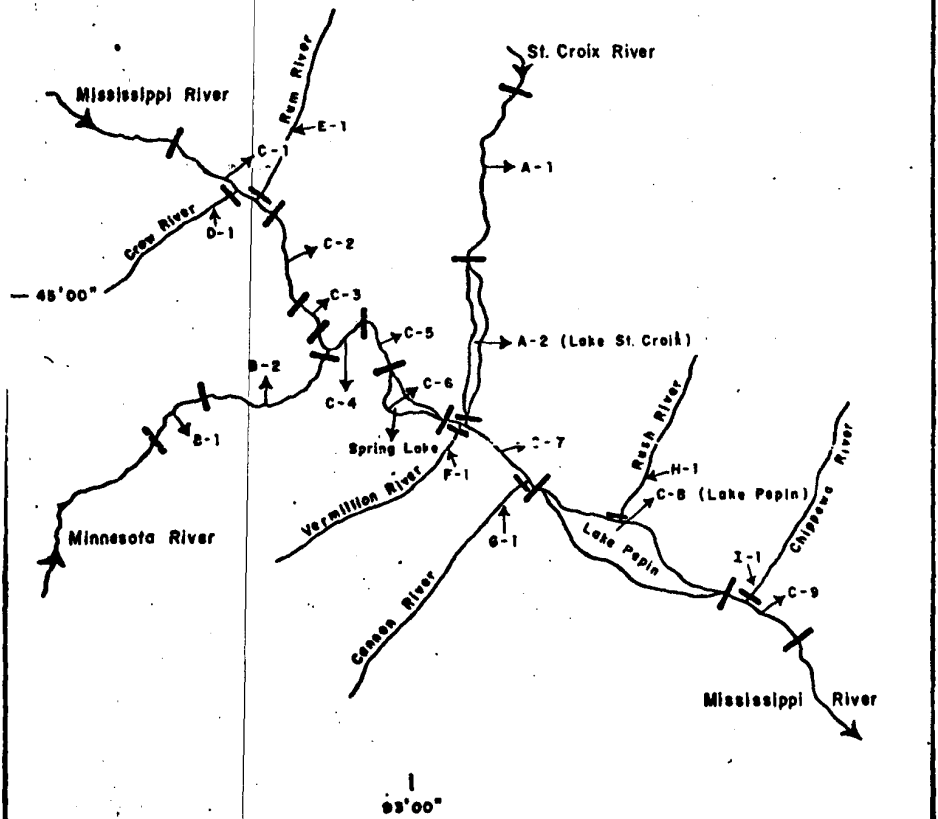


MONS 048112

MINN. POLLUTION CONTROL AGENCY
DIV. OF WATER QUALITY
JUNE, 1975

Figure II

DELINEATION OF SUB-SEGMENT AREAS FOR PCB INVESTIGATIONS



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DIV. OF WATER QUALITY
JUNE, 1975

ATTACHMENT F

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Contaminants in Upper Great Lakes Fishes[1/]

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At a recent meeting (January 30) of the Governor's Great Lakes Regional Interdisciplinary Pesticide Council, Mr. Donald C. Healton, Regional Director, U. S. Food and Drug Administration, Chicago, announced that future interstate shipments of Lake Michigan chubs, lake trout, or salmon will be subject to seizure because of contamination by polychlorinated biphenyls (PCB's). Mr. Healton's statement has resurfaced past concerns and questions about the status and trends of PCB's and other contaminants in Great Lakes fishes, and the implications of these contaminants in future management decisions on fisheries. The issue is further confused by reports over the past year or two that problems associated with contaminants in the Great Lakes were rapidly declining in importance. Because of the Great Lakes Fishery Laboratory's (GLFL) past and current program of contaminant monitoring, together with our participation in several interagency studies on contaminants in fish, I have been asked to review the current status of "problem" contaminants in the Great Lakes and discuss what successes or failures we have observed in the control of these contaminants.

The four fishery contaminants of major concern over the past 5 to 10 years have been DDT, dieldrin, mercury, and PCB's. For the purposes of this presentation, it would be most convenient for me to discuss each of these four contaminants individually in the chronological order of their recognition as a problem. Source material for my discussion will be data obtained by the GLFL and the Great Lakes Environmental Contaminant Survey (GLECS). GLECS is a cooperative program of fish sampling and analysis conducted yearly by Michigan's Departments of Natural Resources and Agriculture, the U. S. Food and Drug Administration--Detroit Region, and the Great Lakes Fishery Laboratory.

DDT

Several investigators, including Dr. Robert Reinert of the GLFL, identified DDT and its metabolites as a contaminant of Great Lakes fishes in the mid 1960's. Dr. Reinert also soon determined that, although present in fishes from each of the Great Lakes, DDT contamination was particularly severe in those from Lake Michigan where residues in several species exceeded the FDA guideline of 5.0 ppm. This information contributed ultimately to a decision by the States (1969-70) and eventually

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Upper Great Lakes Committee Meetings
Milwaukee, Wisconsin 53203
March 25-26, 1975

MONS 048114

by the Federal government (1972) to ban the use of DDT. We feel that the reduction in residues that followed the 1969-70 ban of DDT in the Lake Michigan watershed will eventually be considered as a classic example of the impact of legislative controls in a large aquatic system. Within 2 years of the ban, we were able to detect a significant decline of DDT residues in fish taken at our index stations on Lake Michigan (Table 1). And now, only 5 years after the ban, DDT in bloaters is down 87% from the high in 1969-70 and is no longer considered a problem in bloaters or coho salmon, and is fast approaching this status in lake trout. Thus controls do work--and even fish, which are considered the slowest indicators of change, show such a rapid response to the elimination of contaminant sources that even the most optimistic of us in the business were surprised.

DDT was never considered to be a particular problem in Lake Superior fish, but somewhat elevated levels (2.8-7.4 ppm) of this contaminant were observed in larger lake trout from the lake during the mid 1960's. Recent collections (1973) of lake trout from Lake Superior as part of CLECS show that "elevated" levels of DDT still exist in certain areas. Large fish taken from near Isle Royale contain DDT residues in excess of the FDA guidelines (Table 2). Residues are considerably lower, however, in fish collected to the southeast or southwest of this central region. Although the data are limited, there is some indication that perhaps DDT residues have not really declined much in Lake Superior since the mid 1960's. If true, it is possible that the oligotrophic nature of the lake may have resulted in a different behavior of the compound or else the sources of DDT to the lake were not eliminated as rapidly as in Lake Michigan.

Dieldrin

Although never receiving as much publicity or concern as DDT, dieldrin has been a nagging problem in Great Lakes fishes (particularly Lake Michigan) for as long as DDT. Residues of this insecticide have routinely averaged just below the FDA guideline of 0.3 ppm in Lake Michigan fish sampled as part of our monitoring program (Table 1). In addition, we have observed no decline in dieldrin residues since the 1960's. This type of information again contributed ultimately to the EPA ban on dieldrin in 1974. We would hope that this ban will shortly result in declines of dieldrin residues in Lake Michigan fish.

Mercury

Mercury was first reported by Canadian investigators as a contaminant of Lake St. Clair fishes in early 1970. Within 1 to 2 years of this announcement, mercury had been found to exceed the FDA guideline of 0.5 ppm in at least one species of fish from each of the Great

Lakes except Lake Michigan, and appropriate fishing restrictions or warnings were issued for each of the affected lakes. Even in Lake Michigan, we found that large walleyes and an occasional very large lake trout exceeded the Guideline. The presence of mercury in fish from each of the lakes, combined with the results of studies of mercury in museum fish, soon made it apparent that elevated background levels of mercury were common to the Great Lakes, and that the existence of a few point sources, as in Lake St. Clair, were sufficient to cause problems in practically all of the lakes.

Based on characteristic background levels of mercury in Great Lakes fishes and the known persistence of mercury in the environment, the best scientific judgement in 1971 was that even with the elimination of known sources of mercury, a severe problem would continue to exist in Lake St. Clair for tens of years. Well--so much for science. In late 1970, the alleged major source of mercury to Lake St. Clair was eliminated, and by 1972 the levels of mercury residues in our monitoring samples of rock bass, channel catfish, and probably yellow perch had fallen precipitously to below 0.5 ppm (Table 3). Mercury concentrations in walleyes had also declined more than 50% by 1972, and the decline is continuing yet today, though at a much lower rate. Again, as with DDT in Lake Michigan, the elimination of sources brought about an almost immediate decline of residues in fish to the surprise, and possible chagrin, of several investigators including myself.

In defense of science, it must be realized that mercury still is, and will continue to be, a problem in the Great Lakes. Walleyes in Lake St. Clair remain above 1 ppm and it is possible that the larger fish may never get below 0.5 ppm because of the apparent natural background of mercury in the Great Lakes. Lake trout in Lake Superior also contain excessive amounts of mercury, particularly in the area of Isle Royale (Table 2). This is probably related to the past problems with mercury in Thunder Bay and hopefully will improve in the near future. Recent (1973) samples of walleyes from southern Lake Huron contained average mercury concentrations of 0.9 ppm, and samples of walleyes from Lakes Ontario and Erie (1974) show continued high levels, with most fish of about 500 mm or larger exceeding 0.5 ppm. There are, however, some indications of a decline in average residues in Lake Erie walleyes.

PCB's

PCB's are by no means a recently recognized problem in Great Lakes fish. Their presence in Lake Michigan fish has been known since the late 1960's and initial actions to reduce PCB losses to water were taken by EPA and the Monsanto Chemical Company in 1971. The recent actions are primarily the result of a strengthening by court decisions

of FDA's ability to enforce their Guideline of 5.0 ppm.

The GLFL has been routinely analyzing for PCB's in Lake Michigan fish since 1972. Average concentrations of PCB's in bloaters, lake trout, and coho salmon have consistently exceeded the FDA Guideline and, based on our samplings of bloaters, it would appear that residue levels have remained "static" since 1972. Analyses of lake trout performed as part of the GLECS confirm the presence of high PCB residues and indicate a pattern of greater contamination in the southern portion of the lake similar to that routinely observed over the years with DDT (Table 4). Recent reports of lake trout taken from southern Lake Michigan indicate that individual fish may contain as much as 40 to 60 ppm of PCB's. Our data and those of the GLECS show that average residues are considerably lower than that. But, regardless of whose data is used, FDA is correct in stating that Lake Michigan bloaters, lake trout, and salmon do not meet their Guideline. Size and origin of the fish are, of course, considerations in the marketability of any fish, and it is probable that residues in smaller bloaters and lake trout, particularly from the northern portion of the lake, would average below the Guideline.

The greatest concern from an environmental standpoint is the question of why we have not observed a reduction in PCB levels since the initiation of voluntary controls on their sales and use in 1971. One possible explanation is that PCB's behave differently in the environment than DDT or mercury. This may be technically true, but I do not feel it explains the complete absence of change. A more likely cause is that the controls imposed to date have failed to eliminate the major sources. The Michigan DNR has shown, for example, that elimination of PCB sources to the Saginaw River drainage resulted in an immediate reduction of residues in fish from the river. It would seem reasonable that after 3 years we would have observed at least a small decline in Lake Michigan if the sources were truly eliminated. One benefit of the recent "scare" will undoubtedly be a closer look by EPA at what the current sources of PCB's are in the Lake Michigan watershed.

As inferred earlier, PCB's are not peculiar to Lake Michigan alone. PCB analyses of Lake Superior lake trout as part of the GLECS have shown the same disconcerting pattern of elevated residues near Isle Royale as previously noted with DDT and mercury (Table 2). Because of the similarity in geographical distribution of mercury, DDT, and PCB residues in Lake Superior lake trout, it would appear that the Thunder Bay area was, and may still be, a major point source for these contaminants to the lake.

Future Contaminant "Problems"

A long list of additional potential contaminants including chlordane, hexachlorobenzene, phthalates, arsenic, cadmium, chromium, copper, and, most recently, mirex, have been found in Great Lakes fishes over the years by either the USFWS, EPA, State DNR's, or university

MGNS 048117

research groups. The mere presence of these lesser contaminants does not represent a problem as such, but it does suggest a strong need for continued surveillance of known or potential contaminants, and more aggressive regulatory controls on the loss of contaminants to the lakes. The problem of contaminants is a double-edged sword in that they affect not only the utilization of fishes but probably also play a subtle role in their growth, reproduction, survival, and long-term potential.

We at the GLFL will continue to monitor known or potential contaminant problems in the Great Lakes to the best of our ability. We will also continue to participate as much as possible in interagency programs attempting to define and control contaminant problems such as the GLECS, the Lake Michigan Toxic Substances Committee, the IJC Reference Group on Upper Lakes Pollution, and the National Pesticide Monitoring Program. Hopefully, we can contribute through these groups to a better coordination of contaminant research and monitoring programs in the future. Our ultimate goal is the elimination of problems before they become "crises" similar to those created by DDT, mercury, and PCB's. And finally, we are making every reasonable effort to improve our ability to evaluate what these contaminants mean in terms of possible toxicological effects on fish, and their adverse role, if any, in curtailing the productivity of Great Lakes fish stocks.

MONS 048118

Table 1.--Concentrations of pesticides and PCB's in fall collections of Lake Michigan bloaters and lake trout off Saugatuck, Michigan, and coho salmon from between Ludington and Frankfort, Michigan.

Species and year	Number of fish	Average length (mm)	Total DDT (ppm)[1/]	Dieldrin (ppm)[1/]	Total PCB's (ppm)[1/]
Bloaters					
1969	120	270	9.94 (0.33)	0.27 (0.01)	-
1970	28	263	9.87 (1.44)	0.19 (0.02)	-
1971	60[2/]	264	6.24 (1.13)	0.27 (0.06)	-
1972	120[3/]	255	4.33 (0.48)	0.18 (0.03)	5.66 (0.95)
1973	160[3/]	250	2.09 (0.26)	0.28 (0.02)	5.24 (0.37)
1974	110[3/]	257	1.33 (0.14)	0.28 (0.03)	5.57 (0.31)
Coho salmon					
1969	11	621	11.82 (2.69)	0.21 (0.02)	-
1970	13	651	14.03 (1.29)	0.12 (0.02)	-
1971	15	674	9.85 (1.41)	0.11 (0.01)	-
1972	10	693	7.17 (1.09)	0.13 (0.04)	10.93 (2.12)
1973	29	620	4.48 (0.34)	0.09 (0.01)	12.17 (0.77)
Lake trout					
1970	18	613	19.19 (3.27)	0.27 (0.05)	-
1971	20	579	13.00 (1.76)	0.20 (0.03)	-
1972	9	648	11.31 (3.26)	0.20 (0.06)	12.86 (4.75)
1973	30	602	9.96 (1.36)	0.27 (0.03)	18.93 (2.08)

1/Concentrations in whole fish, wet weight with 95% confidence interval in parentheses.

2/Composite samples, 5 fish/sample.

3/Composite samples, 10 fish/sample.

MONS 048119

TABLE 2.

SUMMARY OF 1973 GLEGS DATA

Prepared by the Michigan Department of Agriculture

LAKE TROUT

Zone	Size	Number	Total DDT's ppm	Total PCB's ppm	Hg ppm	Dieldrin ppm
LAKE SUPERIOR						
MS-1	<17"	4	2.1	2.4	.57	tr
	17-20"	1	2.4	2.9	.51	tr
	>20"	6	7.9±1.4	5.3± .9	.80±.30	.08±.05
MS-2	<17"	3	.3	.5	.18	tr
	17-20"	3	.9	1.8	.36	tr
	>20"	5	1.8± .6	4.2±1.8	.43±.17	.04
MS-3	<17"	12	.9± .7	1.6±1.4	.29±.12	.03
	17-20"	16	1.1± .7	1.9±1.3	.32±.15	.04
	>20"	19	3.3±1.4	4.7±2.2	.69±.27	.06
MS-4	17-20"	6	0.7± .3	1.0± .5	.25±.05	.01
	>20"	15	2.1±1.7	3.3±2.7	.48±.17	.03
MS-5	17-20"	4	.5	.8	.32	.02
	>20"	5	1.5± .2	1.8± .5	.30±.05	.03
MS-6	<17"	1	.6	.9	.21	.01
	17-20"	1	1.0	1.0	.26	.02
	>20"	6	1.4±.3	1.4± .2	.34±.04	.04

MONS 048120

Table 3.--Mercury concentrations in fillets of selected Lake St. Clair fishes collected in the fall of the year.

Species and year	Number of fish	Average length (mm)	Average weight (g)	Total mercury (ppm)[1]
Walleye				
1970	56	506	1214	2.83 (0.37)
1972	68	445	831	1.38 (0.16)
1973	77	485	1105	1.18 (0.10)
1974	60	501	1174	1.07 (0.10)
Rock bass				
1970	45	185	164	1.24 (0.27)
1972	40	174	121	0.49 (0.08)
1973	36	178	126	0.37 (0.07)
1974	50	209	211	0.37 (0.06)
Yellow perch				
1970	45	198	106	1.22 (0.17)
1973	45	191	91	0.31 (0.08)
1974	43	228	158	0.28 (0.04)
Channel catfish				
1970	15	538	1867	1.62 (0.45)
1972[2]	9	363	519	0.37 (0.19)
1973[2]	8	461	1023	0.35 (0.08)
1974[2]	20	490	1135	0.35 (0.04)

[1] Concentrations expressed as elemental mercury in wet weight of tissue with 95% confidence interval in parentheses.

[2] Whole fish.

MONS 048121

TABLE 4 . SUMMARY OF 1973 GLECS DATA

Prepared by the Michigan Department of Agriculture

LAKE TROUT

Zone	Number	Size	Total DDT's ppm	PCB's ppm	Hg ppm	Dieldrin ppm
LAKE MICHIGAN						
MM-1	1	<17"	1.6	2.2	.20	.02
	2	17-20"	2.2	3.6	.26	.02
MM-3	3	<17"	1.9	2.6	.16	.10
	3	17-20"	1.7	2.4	.21	.06
	3	>20"	6.2	10.6	.42	.14
MM-4	2	<17"	2.3	2.6	.23	.11
	1	17-20"	1.4	1.8	.20	.06
	3	>17"	5.8	8.5	.41	.09
MM-5	3	>17"	4.4	6.8	.36	.06
MM-6	1	17-20"	2.2	6.4	.71	.11
	5	>20"	4.1±2.8	6.3±3.6	.33±.11	.15
MM-7	3	>20"	7.6	11.2	.57	.24
MM-8	8	<17"	1.9	4.6	.19	.12
	9	>17"	7.2	12.1	.47	.26

MONS 048122