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DSW 362257

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CONTAMINANTS IN GREAT LAKES FISH

STAFF REPORT

JUNE 1975

by

John L. Hesse

MICHIGAN WATER RESOURCES COMMISSION
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION BRANCH
BUREAU OF WATER MANAGEMENT

DSW 362258

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DSW 362259

CONTAMINANTS IN GREAT LAKES FISH

STAFF REPORT

JUNE, 1975

SUMMARY

1. DDT in Lake Michigan fish continues to decline and is now above the 5 ppm FDA guideline only in large lake trout.

2. Mercury levels have dropped below the 0.5 FDA guideline in most Lake St. Clair area fish but remain above the limit in walleye.

3. Dieldrin, which has averaged just below the 0.3 ppm FDA guideline in Lake Michigan lake trout and chubs for years, was over the limit in five of six recent shipments of chubs seized by FDA. Dieldrin and aldrin production has recently been suspended by EPA.

4. Levels of polychlorinated biphenyls in Great Lakes fish have not declined. Large salmon and trout species remain well over the 5.0 ppm FDA guideline.

   a. FDA has recently taken seizure action against a few shipments of Lake Michigan fish.

   b. A new Lake Michigan Toxic Substances Committee was formed to assess the PCB situation and to make recommendations to EPA.

   c. Adverse PCB effects, primarily reproductive failure, have been documented in northern pike, fish-eating birds, and in mink fed Lake Michigan salmon.

   d. PCB monitoring shows PCB contamination to be ubiquitous at low levels difficult to trace back to sources of input.

   e. PCB disposal methods are inadequate and improper disposal practices are common.

   f. PCB's are present at significant concentrations even in snowfall.

   g. Lake Michigan Toxic Substances Committee recommendations to EPA stressed the need to search for safe alternatives for PCB uses and the implementation of a nationwide ban on PCB sale, distribution and use.

   h. Other recommendations were for States to implement extensive educational programs for safe use and handling of PCB's during the interim period leading to a ban. Trend analysis of contamination levels should be continued.

DDT AND MERCURY

In April, 1974 Michigan DNR officials reported (DNR Commission Meeting, April 11, 1974) the very pleasant news that DDT and mercury contaminant levels in Great Lakes' fish were rapidly declining. These downward trends are continuing (Figures 1 and 2) and can be attributed to control measures implemented by our State agencies. In 1969 the Michigan Department of Agriculture issued a total ban on sale of DDT products in Michigan and following the discovery of high mercury levels in the Lake St. Clair area fish, DNR identified and halted the major mercury discharges.

DDT is now above the 5 ppm guideline only in large lake trout of Lake Michigan and some areas of Lake Superior. Mercury, while having declined sharply in most species in the Lake St. Clair area, remains above 0.5 ppm in walleyes from Lake St. Clair, southern Lake Huron and Lake Erie. Recent surveys also show somewhat elevated mercury levels in lake trout of Isle Royale area of Lake Superior.

DIELDRIN

Two contaminants continue to plague certain Great Lakes fish species without showing evidence of declines. These are dieldrin and polychlorinated biphenyls (PCB's).

Although never receiving as much publicity or concern as DDT, dieldrin has been a nagging problem in Great Lakes fishes (particularly in Lake Michigan) for as long as DDT. The U. S. Fish and Wildlife Service Ann Arbor Laboratory data (Figure 3) indicate that residues of this insecticide have routinely averaged just below the FDA guideline of 0.3 ppm in Lake Michigan chubs and

lake trout. Michigan Department of Agriculture and Great Lakes Environmental Contaminant Survey (GLECS) data verify that Lake Michigan chubs have had dieldrin concentrations approaching, but not averaging, more than the 0.3 ppm limit.

In April 1975 the Food and Drug Administration collected "market check" samples of chubs from nine Lake Michigan commercial fishermen at various ports. Five (ranging from 0.31 to 0.39 ppm) of these nine composite samples measured over the allowable guideline. The average for the nine samples was 0.31 ppm. Since the date those tests were conducted, FDA has seized 6 interstate shipments of chubs leaving Michigan. Five of those have tested over the limit and have been ordered destroyed. This marks the first time in Michigan waters that legal action has been taken because of this contaminant in fish.

The insecticide aldrin is chemically related to dieldrin in that it breaks down in the environment to form dieldrin. It is important to note that on August 4, 1974, EPA suspended any further production of these two chemicals except for three minor uses (termite control, root dip for non-edible crops, and moth proofing). Existing stocks will be allowed to be used according to current label restrictions until supplies are depleted. In the past 2 - 3 years use has already declined in the Lake Michigan basin since these chemicals were placed into restricted use categories by Wisconsin and Michigan and extension agents have been recommending alternatives for many uses.

POLYCHLORINATED BIPHENYLS

Polychlorinated biphenyls (PCB's) represent a serious problem in the Great Lakes which needs to be discussed at considerable length. The remainder of this report deals with the PCB situation.

PCB's are a group of compounds used in the past in a diverse number of industrial compounds and processes. Some of the larger uses have been as

fire-resistant hydraulic fluids and heat transfer fluids, insulation in electrical transformers and capacitors, as plasticizers, and specialty inks in certain paper products.

Active monitoring by DNR's Bureau of Water Management staff of Michigan's tributary streams to the Great Lakes identified dozens of industries discharging elevated PCB concentrations to surface waters. Major point sources of loss were halted through voluntary actions of industries involved switching to replacement compounds. Monsanto Chemical Company, the sole U. S. producer of PCB's, also voluntarily claimed discontinuance of PCB sales for uses in open industrial systems where losses were believed most likely to occur. This included uses as hydraulic fluids and heat transfer systems which DNR surveys identified as being the two largest sources of losses. Because of these actions and observed declines of DDT and mercury following control programs, DNR staff were encouraged until recently that PCB fish contamination levels would also soon begin to decline.

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Lake Michigan Fish Contamination Levels - PCB's

Trend analysis data for PCB's in Lake Michigan chubs and lake trout through 1974 is now available from the U. S. Fish and Wildlife Service Ann Arbor Laboratory (Figure 4). Data from chubs, which are considered to be the most reliable index fish because of better sampling design, shows no significant change over the period of 1972 to 1974. The concentrations in lake trout are alarming because of what now appears to be an increase in concentrations over the three year period. The Great Lakes Environmental Contaminant Survey (GLECS) data for Lake Michigan lake trout do not indicate any increase in concentrations over the same period but neither is there any evidence of a decline. It should be noted that the GLECS program, designed for screening for hotspots in relation to current FDA contaminant guidelines, uses fish fillets for analysis rather than whole fish utilized by the USF & W trend analysis program.

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Recent Food & Drug Administration Actions

The U. S. Food and Drug Administration has recently taken seizure action on several Lake Michigan fish shipments on the basis of PCB concentrations exceeding the current FDA guideline of 5 parts per million (ppm). These seizures came in the wake of several press releases quoting Don Healton, Great Lakes Regional Director of FDA, as reporting that Lake Michigan chubs, coho salmon, and lake trout contain "dangerously high" levels of PCB's and that interstate shipments will be halted if significantly high levels are found in 1975. At a presentation to the Governor's Great Lakes Regional Pesticide Council in January, Healton advised that a recent legal decision now gives FDA the authority to act on the excessive PCB levels. The legal decision he referred to was a reversal by the Circuit Court of Appeals over a previous District Court decision in the case of U. S. vs. Vita Food Products of Illinois. This case involved chubs which had been seized because of excessive DDT levels. The Appeals Court supported FDA that DDT in fish can be considered as a food additive, that the 5 ppm limit was reasonable, and that the standard AOAC analytical methodology used in this case was adequate. FDA believes that the courts will follow this precedent in future cases involving PCB's, so they moved ahead.

Formation of a New Lake Michigan Toxic Substances Committee

Following publicity created by Food & Drug Administration statements and actions, EPA Region V officials reviewed the current PCB situation with State and Federal representatives on March 24, and concluded that control over the PCB contamination problem in the Lake Michigan basin was inadequate. A new Lake Michigan Toxic Substances Committee was formed with representation from the States of Michigan, Indiana, Illinois, and Wisconsin, the U. S. Fish and Wildlife Great Lakes Laboratory, EPA Regional officials, and was to be chaired

by Dr. Donald Mount, Director of the Duluth National Water Quality Laboratory. The charge of the Committee was to assess the current status of PCB information, the seriousness of the problem in Lake Michigan, and to make recommendations to Francis Mayo, EPA Regional Director.

Summary of May 21 - 22 Lake Michigan Toxic Substances Committee Meeting

1. New Toxicological Data on Primates

Dr. J. R. Allen, University of Wisconsin Medical School, presented results of PCB feeding studies using Rhesus monkeys fed diets containing 2.5 to 300 ppm of PCB Arocior 1248*. These studies document adverse effects on primates at exposure levels much lower than has been documented for other mammalian test species.

2. PCB Effects on Great Lakes Biota

A serious situation exists with respect to populations of fish-eating birds in the Great Lakes area. Severe reproductive failure has been identified in herring gull colonies around Lake Ontario (IJC Water Quality Objectives Report, May 1975). There is a positive correlation between early embryonic mortality and PCB contamination (Gilbertson and Fox, 1975). The major effect on young birds is to produce symptoms of chick edema disease. The symptoms are subcutaneous pericardial and abdominal edema, p phyria, liver necrosis and high mortality (Gilbertson, 1974; Gilbertson and Hale, 1974; Gilbertson and Fox, 1975). Michigan officials have observed unnaturally high mortalities of gulls in recent years from Saginaw Bay and Grand Traverse Bay. Analysis of the liver and brain of a dead Herring Gull from Grand Traverse Bay in 1973 showed the presence of 2600 ppm of Arocior 1254.

* Monsanto Chemical Company trade name

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Researchers at Michigan State University have documented reproductive failure of commercially raised mink fed Lake Michigan salmon containing concentrations of PCB's as low as 2 ppm (Ringer, et al., 1972). In another study reproduction was eliminated in mink fed a beef diet containing 0.64 ppm Aroclor 1254 (Platonow and Karstad, 1973).

PCB contamination has very recently been associated with reproductive failures in fish. Michigan Bureau of Water Management staff documented PCB contamination in eggs of spawning adult northern pike as the probable cause of high fry mortality in the early stages of development (Waybrant, 1974). Hatching and survival studies currently underway at the Wolf Lake Fish Hatchery and tissue analysis of adults and egg samples from corresponding lots will hopefully better define this problem.

3. Watershed and Point Source Monitoring Efforts

A review was made of the PCB monitoring efforts conducted by each of the Lake Michigan states. Michigan and Wisconsin agencies, having the majority of the Lake Michigan watershed within their boundaries, had conducted by far the most extensive PCB sampling programs.

Michigan Bureau of Water Management has analyzed approximately 900 industrial and 350 municipal discharge samples. While several dozen industrial effluents have been identified at levels in excess of 1 µg/l and corrective action has been taken on many, the majority of industrial dischargos contain PCB's at lower levels difficult to trace back to a particular use or process. Surveys of approximately 60 municipal wastewater treatment plant (WWTP) effluents have shown WWTP's to be major point sources of PCB discharge to surface waters. WWTP effluents have averaged approximately 0.5 µg/l. Some success has been

achieved at finding industrial contributors within municipal WWTP's collection systems where WWTP effluents measure 1 µg/l or higher. Most large discharges identified, both industrial and municipal, have not been in the Lake Michigan basin but rather in watersheds draining to Lake Huron, Lake St. Clair and Lake Erie.

Surveys in Wisconsin, Indiana and Illinois have identified only a few major PCB sources. Wisconsin has taken action against approximately 12 industries.

The consensus of the State representatives is that PCB discharges in the Lake Michigan basin are small but diffuse and difficult to trace by current monitoring techniques.

A telephone survey of 39 Michigan industries reporting PCB usage on Critical Materials reports in 1974 confirmed that usage is diverse with the continued presence of PCB's in a wide variety of products and processes. A total of 20 different products being used by these 39 plants were identified as containing PCB's. This clearly points out that the restrictions against PCB sales initiated by Monsanto Chemical Company for any uses other than transformer and capacitor dielectric fluids have been ineffective. It is probable that many other industries are also using PCB-containing products but are totally unaware of the presence of PCB's.

Another aspect of the problem is that PCB residues have been detected in fish and wildlife from remote undeveloped localities suggesting that aerial transport may play a significant role in PCB distribution. Wisconsin DNR analyzed snowfall samples in five municipal areas and found PCB concentrations averaging approximately 0.2 µg/l. Considering total dry fallout, rainfall and snowfall, it appears that atmospheric contributions of PCB's to Lake Michigan could be very significant.

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4. Disposal of PCB Wastes

PCB's require special incineration conditions to achieve destruction. Monsanto Chemical Company advises that temperatures must be at least 2000 °F with a retention time of 4 seconds. Scrubbers must be used to remove HCl which is a combustion product. Before any incinerator is cleared for PCB destruction, tests should be conducted on emissions to determine if destruction is complete.

No incinerators in Michigan have been cleared for routine PCB disposal. The same situation exists in other Lake Michigan states. The recommendation has been and continues to be for industries to return waste PCB liquids to Monsanto Chemical Company for destruction. Monsanto operates a high temperature incinerator at its W. G. Krummrich Plant at Sauget, Illinois. The cost to industry for PCB disposal includes $.05 per pound and $8.00 per drum service charge plus shipping expenses.

It appears that because of the high cost of sending PCB's back to Monsanto, very few industries are using this approach. Surveys indicate that many industries add PCB's to other waste oils and dispose of them through waste haulers. Other practices apparently being used include use of PCB fluids for dust control on roadways and parking lots, long term storage in drums on plant property, and burning in unapproved incinerators and boilers. All of these can lead to further environmental contamination.

Landfills are generally not considered as a safe method of disposal of PCB's because of their long persistance and potential for leaching into surface waters. Disposal of liquids is forbidden in Michigan landfills.

5. Recommendations to EPA Regional Administrator

In light of considerable environmental damage and economic impact of PCB contamination, an absence of any apparent decline in environmental concentrations with current control methods, the ubiquitous nature of usage, the general lack

of adequate disposal facilities, and the indication that atmospheric transport and deposition is also significant, the Lake Michigan Toxic Substances Committee has submitted the following recommendations to Francis Mayo, EPA Region V Regional Administrator:

a. Environmentally safe alternatives for all PCB uses should be explored immediately.

b. EPA should push for a nation-wide ban on the sale, distribution and use of PCB's.

c. During the interim period leading to a ban, individual states should implement extensive educational programs to minimize environmental hazards of PCB usage and disposal methods. States should also continue efforts to identify sources of PCB losses to the environment and take corrective actions.

d. Trend analysis programs for Great Lakes fish contamination levels should be continued for evaluation purposes.

e. EPA should urge financial support of additional studies on PCB effects on primates with an emphasis on relating the significance of results to potential hazards to humans concerning PCB's through the food chain.

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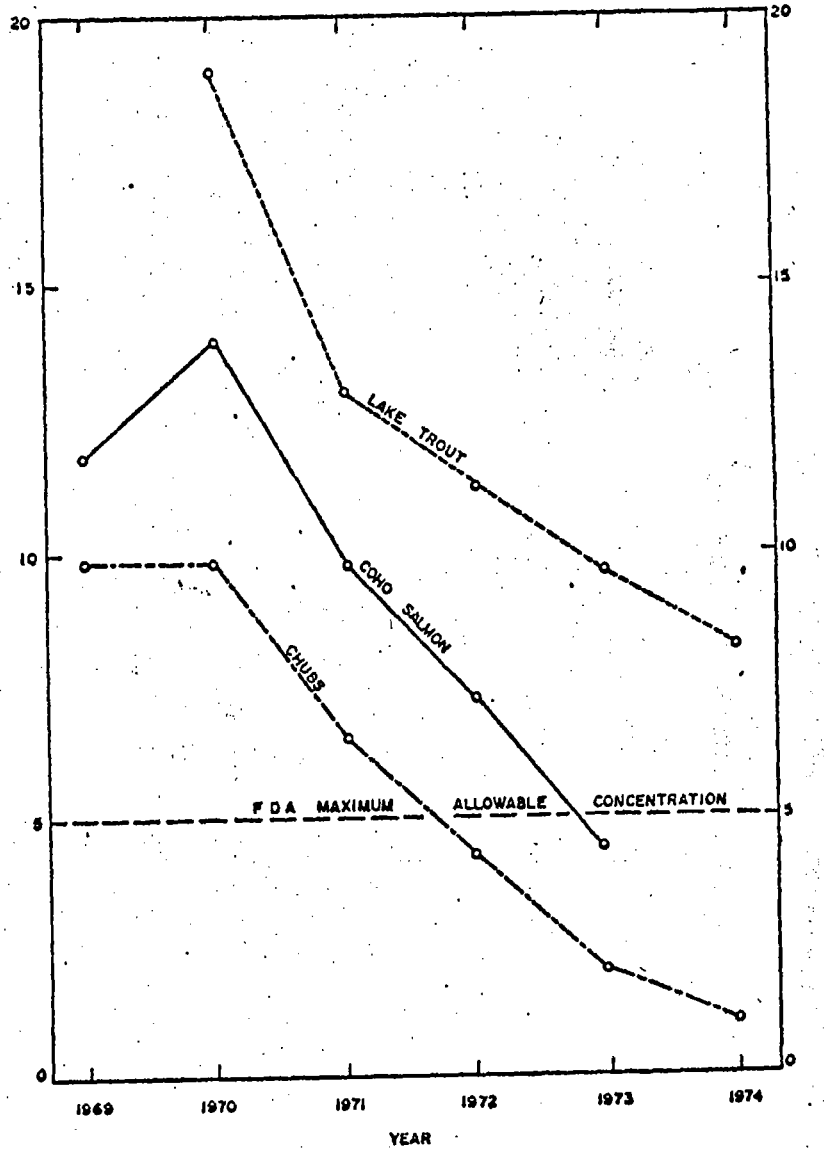
FIGURE 1
TRENDS IN DDT LEVELS
LAKE MICHIGAN FISH



DATA SOURCE : WAYNE WILLFORD
GREAT LAKES FISHERY LABORATORY
U.S. FISH & WILDLIFE SERVICE
ANN ARBOR, MICHIGAN

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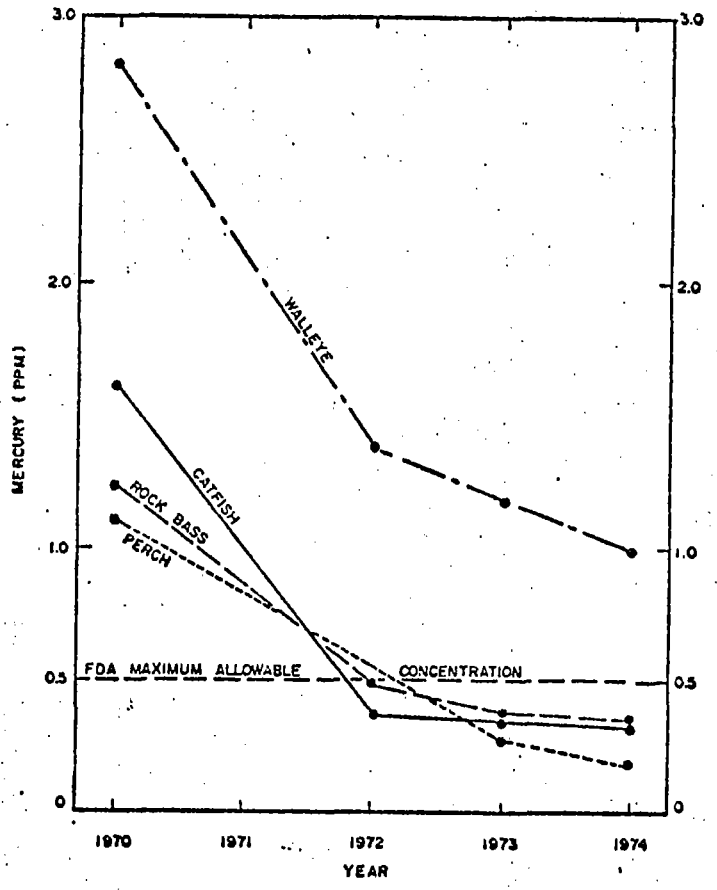
FIGURE 2

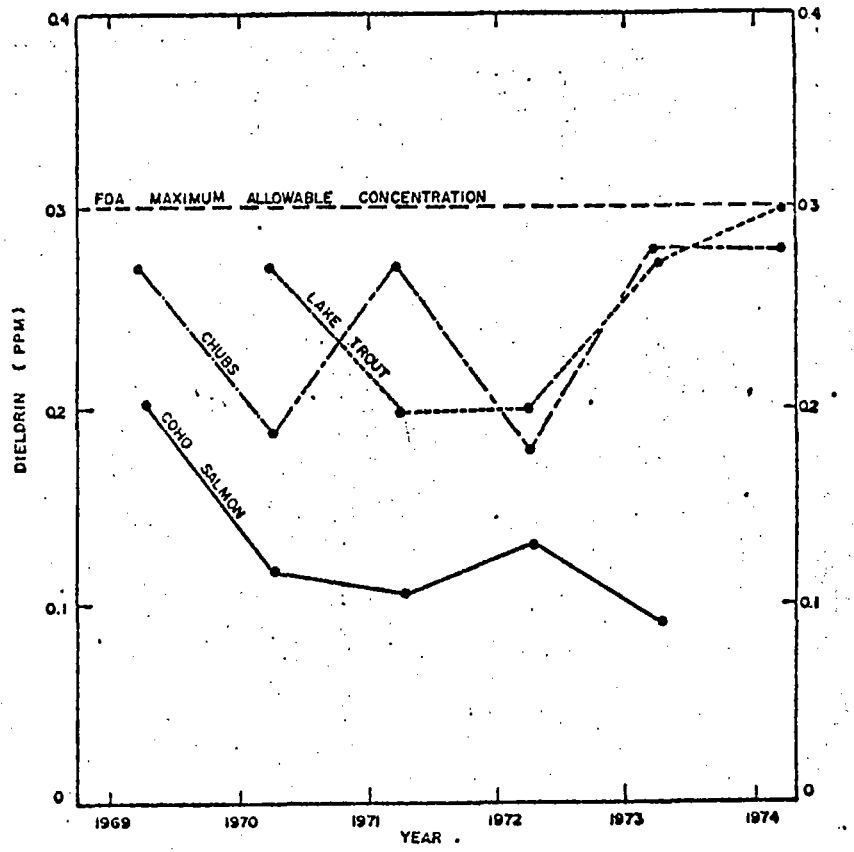
TRENDS IN MERCURY LEVELS
LAKE ST. CLAIR FISH



DATA SOURCE : WAYNE WILLFORD
GREAT LAKES FISHERY LABORATORY
U.S. FISH & WILDLIFE SERVICE
ANN ARBOR, MICHIGAN

FIGURE 3

TRENDS IN DIELDRIN LEVELS
LAKE MICHIGAN FISH



DATA SOURCE : WAYNE WILLFORD
GREAT LAKES FISHERY LABORATORY
U.S. FISH & WILDLIFE SERVICE
ANN ARBOR, MICHIGAN

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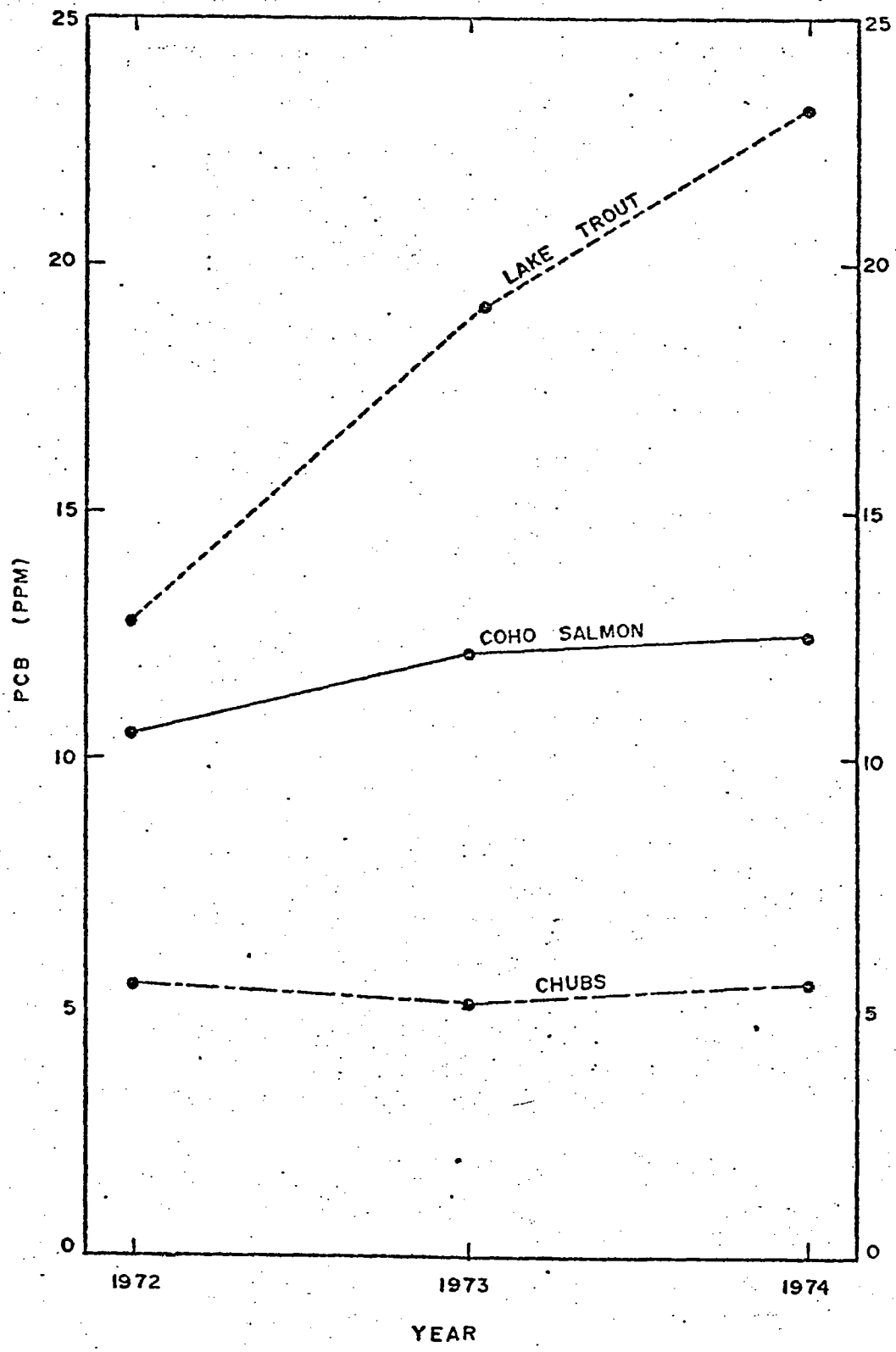
FIGURE 4

TRENDS IN PCB LEVELS
LAKE MICHIGAN FISH



NOTE: METHODS UTILIZED DIFFER FROM STANDARD CONSUMER PROTECTION PROGRAM TECHNIQUES AND GENERALLY RESULT IN SOMEWHAT HIGHER MEASURED VALUES. THIS DATA SHOULD ONLY BE USED FOR TREND ANALYSIS PURPOSES.

DATA SOURCE: WAYNE WILLFORD
GREAT LAKES FISHERY LABORATORY
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ANN ARBOR, MICHIGAN

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