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ABSTRACT

In this secondary school unit, students investigate the health effects and methods for controlling polychlorinated biphenyls (PCBs). The teacher's manual contains a materials list, objectives, teaching strategies, supplementary information on PCBs, and answers to questions included in the accompanying student workbook. Activities presented include a teacher demonstration of dilution, a study of PCBs in Lake Erie white bass, and a simulation centered around policies for regulating the use of contaminated fish. (Author/WB)

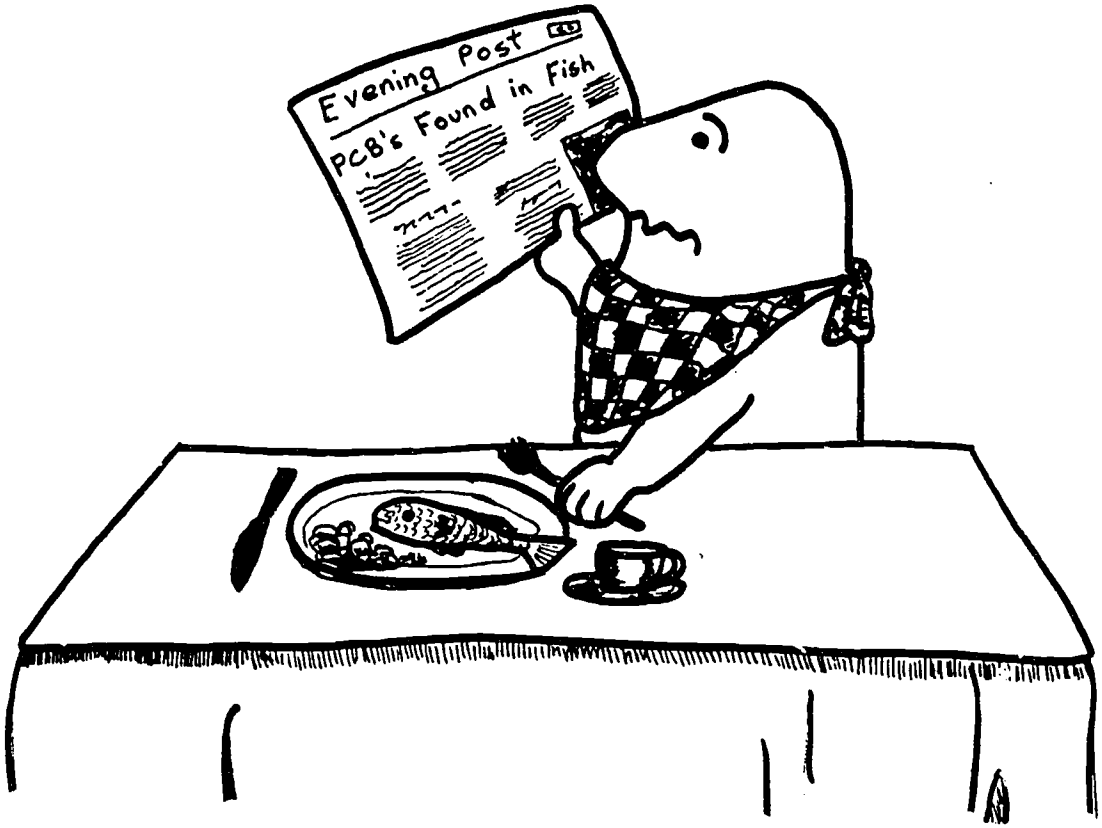
EP-23

OEAGLS-Oceanic Education Activities for Great Lakes Schools

PCBs IN FISH: A PROBLEM?

by

Victor J. Mayer and Amy J. White-Predieri,
The Ohio State University
and
Stephanie Ihle, Upper Arlington Public Schools



Ohio Sea Grant Program
Charles E. Herdendorf, Program Director
Victor J. Mayer, Principal Investigator

OEAGLS Investigation #19
Completed March, 1981

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PCBs IN FISH: A PROBLEM?

INTRODUCTION

During the summer of 1978, New York State closed down many of the fishing areas on Lake Ontario. This was done to reduce the chance that people would catch fish containing PCBs and eat them. What are PCBs? How did they get into the water of Lake Ontario? Are they found in Lake Erie? How are they harmful to us? What can be done if they do enter our food chain?

OBJECTIVES

When you have completed this investigation you will:

1. Know how PCBs and other dangerous materials enter the environment,
2. Understand the degree of danger in eating fish that contain PCBs,
3. Know what can be done to reduce the danger of eating harmful amounts of PCBs,
4. Understand the possible effects of different ways of controlling PCBs upon the fish and sports industries, and
5. Realize the difficulties in taking action to lessen the threat of PCBs.

ACTIVITY A

WHAT ARE PCBs?

The PCB story is a classic one on how we have knowingly created a threat to our health and that of animals that share our planet. This happened while providing something that improved our living standard. PCB is produced from petroleum. It is very useful as insulating material. It will not burst into flame at high temperatures, and so is used in electrical transformers and capacitors. It has also been used in a variety of consumer products. These latter uses have been banned since 1971.

The tragic effect of this chemical on human life was revealed in an event in Japan in 1968. Four people died from a mysterious disease. More than 1,000 others suffered symptoms such as stillbirths, miscarriages, skin disease, nervous disorders, hearing loss and discharge from the eyes. The one thing that all of these people had in common was that they had eaten rice oil prepared at the same plant. This plant had used PCB as a coolant in pipes that circulated through the hot rice oil. The pipes had developed leaks, discharging the PCB into the oil, which was then eaten by those that developed the disease. In some patients, the symptoms continued for three years after eating the rice oil.

PCBs and many other dangerous materials are found in very tiny, but often deadly, amounts in water and body tissue. The amount is expressed in parts of the material per million parts of the substance in which it is found. For example, the PCBs found in the rice oil in Japan were in a concentration of 2000 parts of the PCBs to one million parts of the oil.

PROCEDURE

STEP 1

To begin this investigation, your teacher will place one drop of a colored material, probably ink, in a 10 ml graduated cylinder. Then your teacher will add nine drops (parts) of water.

1. How many parts (drops) of ink are in the cylinder?

   _____

2. How many parts (drops) of water are in the cylinder?

   _____

3. How many total parts (drops) of solution are in the cylinder?

   _____

Since your teacher has 10 drops of solution that has one drop of ink in it, the concentration of solution is described as one part ink per 10 of solution. This ratio can be written 1 part ink:10 parts solution or 1 part ink/10 part solution.

4. Look carefully at the graduated cylinder. What is the volume of the solution?

   _____

Keep a record of all the data from Step I in the data cl

DATA CHART

	I	II	III	IV	V final step
PARTS					
VOLUME (ml)					

STEP II

In Step I we had a 1 part ink in 10 parts solution. Now we want to dilute the ink in solution by adding more water. The concentration of ink will be reduced because more water will be added.

In Step II we want to dilute the solution 10 times.

5. What volume of solution is ten times greater than the original volume of solution?

_____

6. How many parts (drops) were in the original solution?

_____

7. How many parts (drops) were added to dilute this solution 10 times?

_____

8. Now, what is the total number of parts (drops) in the solution?

_____

Add this data to Step II in the data chart.

STEP III

Remember, PCBs are measured in ppm, or parts per million. Our original drop of ink is now diluted to 1 part per 1 hundred. Let's keep diluting this solution until the ink is diluted to 1 part per million.

9. What volume in milliliters would be ten times greater than the volume we've obtained in Step II?

_____

Our 10 ml graduated cylinder is too small to hold this volume so the teacher must transfer our solution into a larger 100 ml graduated cylinder. Then the teacher will add water to dilute the solution to the volume you have calculated in question 9. Instead of counting drops as in Step II, you can calculate the number of drops (parts) of total solution using the equation:

20 drops (parts) = 1 milliliter

10. How many total parts (drops) of solution are in our newly diluted solution?

_____

Record the data from Step III dilution in data chart.

STEP IV

11. If we dilute the new solution 10 more times, what volume (in milliliters) of solution would we have?

_____

12. What volume in liters would be equal to the number of milliliters in question 11?

_____

13. Using the equation 20 drops (parts) = 1 ml, how many total drops (parts) of solution are contained in the volume obtained in question 11?

_____

Your teacher will make the dilution to the volume you calculated in question 11. A liter vessel must be used to hold the solution since the 100 ml graduated cylinder is too small. Tabulate your results for Step IV in the data chart.

STEP V

14. How many more tenfold dilutions are necessary to dilute the ink to one part per million?

_____. Explain how you arrived at this answer.

15. What volume (in liters) of solution is necessary to perform each of these dilutions?

_____

_____

16. How many gallons of solution is needed to dilute the ink to a concentration of 1:1,000,000?

_____HINT: 1 liter = .264 gallons.

As your teacher carries out the dilutions you've determined above, fill in the rest of the data chart.

17. At what concentration were you no longer able to see the ink?

PCBs are thought to enter bodies of water such as Lake Erie through the air as a result of burning plastic objects containing the chemical; from direct dumping of liquid waste from industries using PCBs in their industrial processes; and from water running through solid waste disposal sites where transformers or other PCB containing materials have been dumped. Fish will take up the PCB from the water through their gills or through the food they eat. The PCBs are then concentrated in the tissue, especially the fatty tissue, of the fish's body. See Figure one.

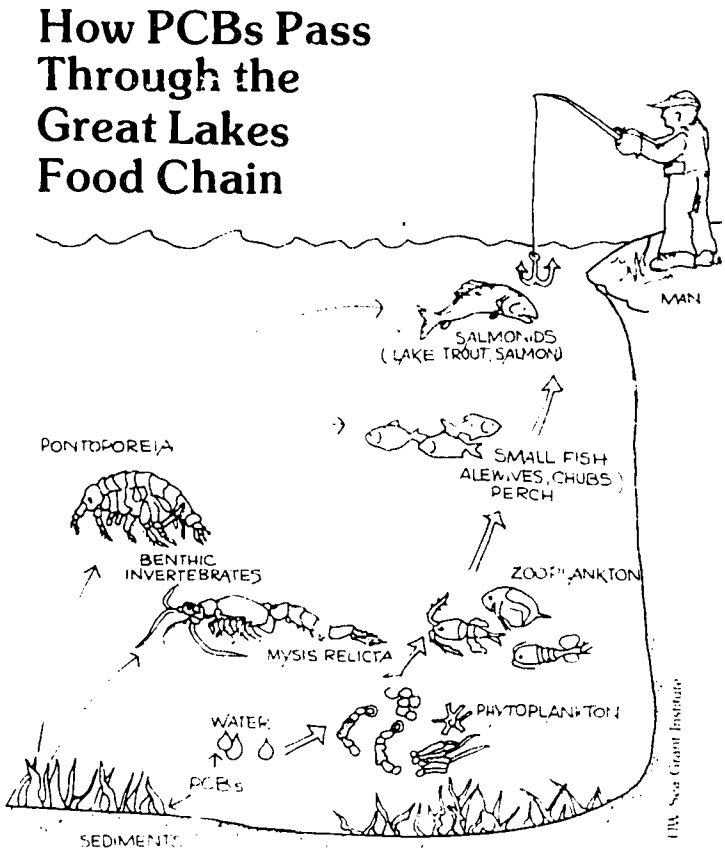


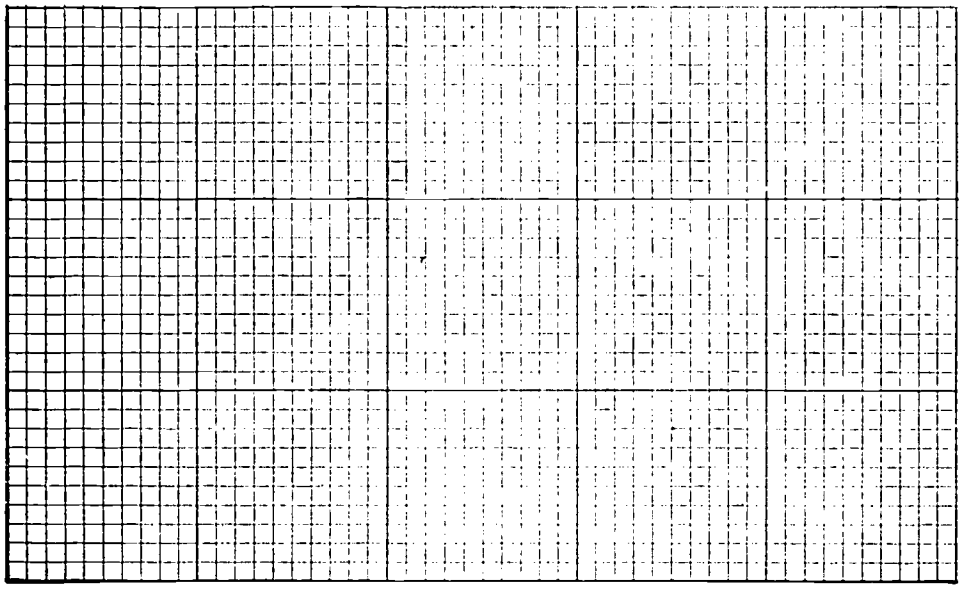
Figure 1. How PCBs get to man.

Are PCBs found in fish from Lake Erie? In 1979, the Ohio Department of Natural Resources measured the PCB concentration in white bass, collected at six different places on Lake Erie. Figure 2 has the data that was obtained.

Size	Bono	Port Clinton	Sandusky Bay	East Harbor	Cedar Point	Lorain
8-8.9"	0.72	0.78	1.4	0.68	0.37	0.46
9-9.9"	0.56	2.0	0.61	0.46	0.84	0.80
10-10.9"	0.96	2.3	0.42	0.93	0.88	1.0
11-11.9"	1.4	0.97	1.2	1.0	1.3	1.0
12-12.9"	1.9	1.6	1.2	1.5	1.0	1.4
13-13.9"	1.7	----	1.8	2.6	2.4	----

Figure 2. Concentration of PCBs in White Bass taken from Lake Erie in 1979.

18. In the space below, construct a bar graph of the data from East Harbor.



19. How is fish size related to PCB content?

_____

_____

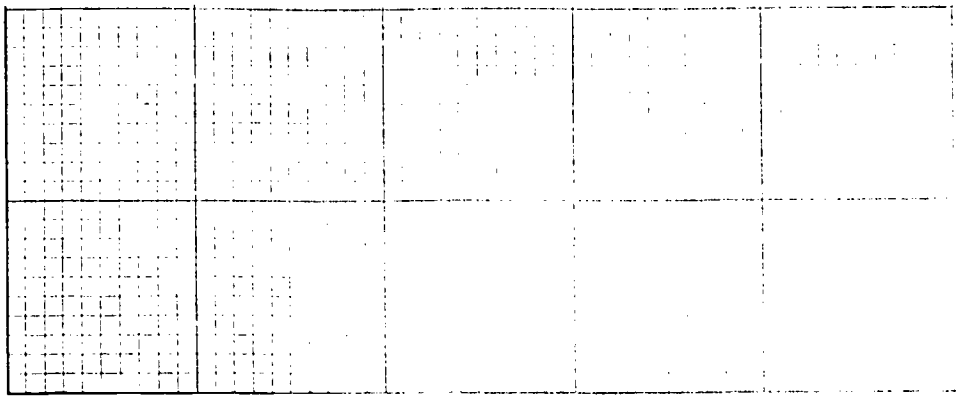
20. What could cause this relationship?

_____

_____

_____

21. Construct another graph with the data from Bono.



22. Do you see the same relationship?

_____

23. Now examine the data from the other sites. Does the relationship seem to hold for fish taken at each of the sites?

_____

24. Locate each of the sites on a map of Ohio. Is the concentration of PCB in the fish related to the site at which they are obtained? Which site seems to have fish with the highest concentration?

_____

_____

_____

PCBs are found in Lake Erie fish--but are they dangerous? The Food and Drug Administration, using information from the occurrence of PCB poisoning in Japan and from studies of laboratory animals, has established a standard of 5 ppm of PCB's this standard remained in effect in 1981. The FDA has proposed lowering it to 2 ppm as the maximum allowable concentration in fish used for human consumption. The white bass is an important food and sports fish.

25. What would you recommend to a fellow sportsfisher about eating white bass caught on a fishing trip to Lake Erie?

_____

_____

ACTIVITY B

HOW CAN THE PUBLIC HEALTH BE PROTECTED?

MATERIALS

Set of role descriptions

PROCEDURE

In 1978 it was determined that certain species of fish from Lake Ontario contained PCBs at a level that might be dangerous to the health of people eating them. The New York Department of Health considered several policies for reducing the health hazard. In this activity, you will play the role of a member of an interest group or an expert concerned with the PCB problem. You are attending a hearing that the Department of Health might have held to gain information so that it could select one of the policies to implement. Your teacher and two students will serve as the board conducting the hearings for the department. At the end of the hearings, the board will vote on a policy which will then be enforced throughout the state.

Your teacher will assign each member of the class to one of the following roles:

Experts (one student for each role):

Officer of the New York Department of Environmental Conservation

Scientist from the Federal Food and Drug Administration

Interest Groups (two or more students per group)

The Sports Fishers of New York

The New York Association of Commercial Fishers

The Marina Operators Association of New York

Association for the Protection of the Health of New York Citizens

Association of [illegible] Municipal and State Public Officials

The Department is considering the following policies:

I. Close Lake Ontario to any fishing.

II. Restrict the taking of fish to only those species that are contaminated with PCBs in concentrations above 5 ppm.

III. Restrict fish takes to only the smaller and therefore, less contaminated of the affected species of fish.

IV. Close only those areas of the lake in which fish are found to have concentrations of PCBs above the 5 ppm.

V. Develop and broadcast an advisory that tells the maximum amounts of fish that can be eaten without danger to health; and describes ways to reduce the amount of PCBs from fish.

VI. Take no action.

Following is the sequence to be followed:

1. Teacher will assign students their roles, and hand out role descriptions.

2. Students will have time to study their roles and to do any additional background research that they may find necessary.

3. Those students assigned to an interest group will meet with their groups to discuss the positions that they plan to take, and to nominate a spokesperson. The experts will meet with the Department of Health hearing board to discuss the information that they plan to present at the hearing.

4. The hearing will be held and the following rules followed:

   a. The experts will present prepared remarks to the board.

   b. Each interest group will have no more than five minutes to present a prepared statement.

   c. Only members of the board may ask questions, and they must be directed at the presenter immediately following the presentation.

   d. When all presentations have been made, board members may ask additional questions of any of the presenters.

   e. Board members meet to decide on one of the policies.

REVIEW QUESTIONS

1. How do PCBs get into water? Into fish?

2. How dangerous is it to eat fish from Lake Erie? Why?

3. List ways in which the threat of PCBs to human health can be reduced.

4. How would banning the taking of fish from Lake Erie affect the economy of towns along the lake?

5. Which of the policies discussed in Activity B would be most difficult to enforce? Why?

6. Which policy would you support? State your reasons.

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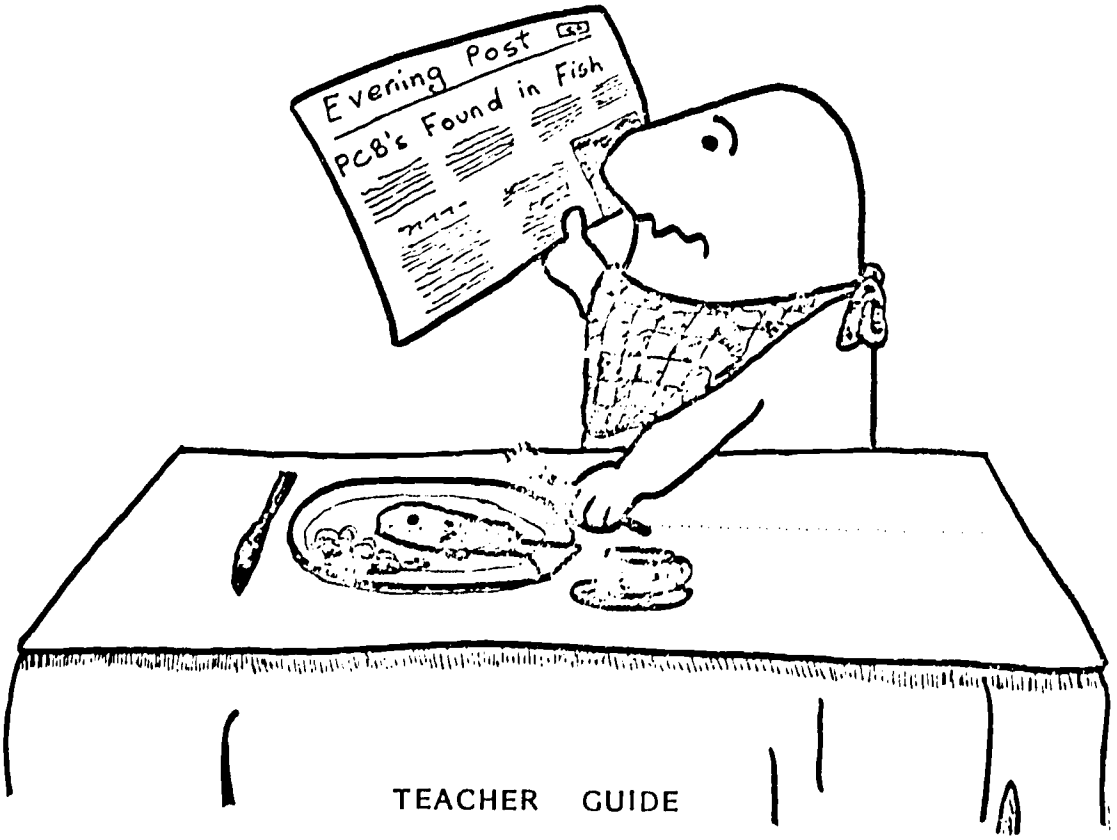

TEACHER GUIDE

Ohio Sea Grant Program
Charles E. Herdendorf, Program Director
Victor J. Mayer, Principal Investigator

OEAGLS Investigation #19
Completed March, 1981

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TITLE

PCBs IN FISH: A PROBLEM?

OVERVIEW

In this investigation students determine the extent of dilution necessary for a substance to have a concentration of a few parts per million. They learn about the effects of PCBs contained in fish on the health of fish consumers, how PCBs get into water and what variables affect their concentration in fish found in Lake Erie. In the second part of the investigation, students participate in a role playing simulation. They represent various experts from government and interest groups; they attempt to determine a policy regulating the use of contaminated fish from Lake Ontario.

PREREQUISITE STUDENT BACKGROUND

Students should be able to construct bar graphs and to do basic multiplication and division. They should also be somewhat familiar with the concept of solution.

MATERIALS

Demonstration: India ink, two eyedroppers, graduated cylinders: 10 ml, 100 ml, and 1000 ml (or a liter vessel), two ten gallon aquariums or one 15 to 20 gallon aquarium. Map of Ohio (could be a state road map).

OBJECTIVES

When the students have completed this investigation they will:

1. Know how PCBs and other dangerous materials enter the environment,
2. Understand the degree of danger in eating fish that contain PCBs,
3. Know what can be done to reduce the danger of eating harmful amounts of PCBs,
4. Understand the possible effects of different ways of controlling PCBs upon the fish and sports industries, and
5. Realize the difficulties in taking action to lessen the threat of PCBs.

SUGGESTED APPROACH

The first part of Activity A is written as a teacher demonstration. The first part (through Step II) could be conducted as a student lab if sufficient equipment were available. The section of Activity A dealing with PCB concentration in Lake Erie white bass could be completed as a homework assignment. If so, then that activity could be completed in one class period.

ROCEDURE

Keywords: solution, dilution (dilute), concentration

Concentrations of substances in solution are expressed as parts of the substance to the total parts of the solution. Therefore, if there were a solution of one part of ink and nine parts of water, the concentration would be expressed as one part in ten. Discuss this with your students as you begin the activity.

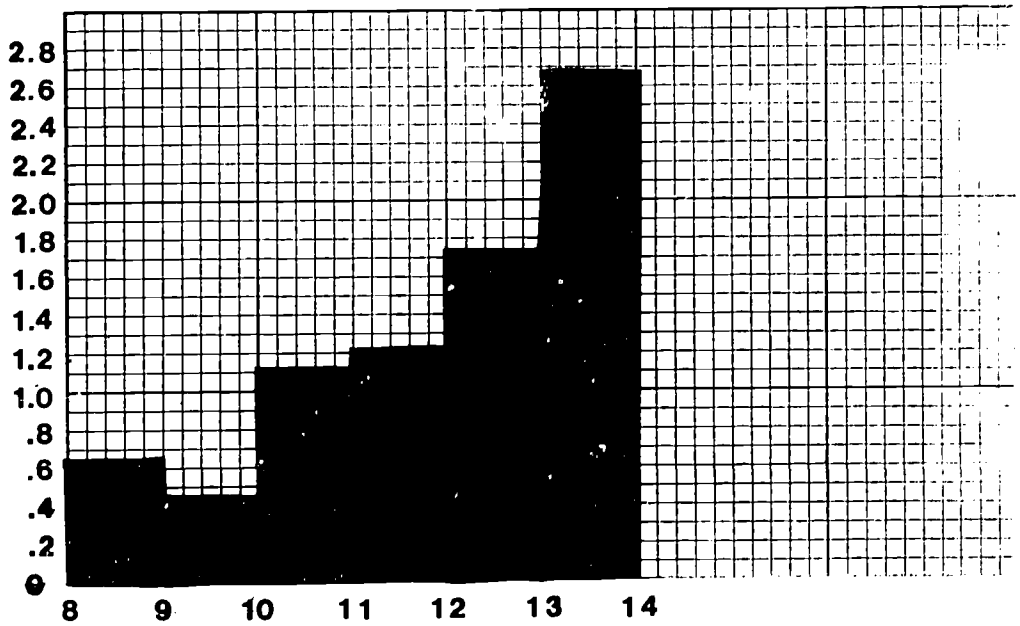
Answers to questions:

1. 1
2. 9
3. 10
4. ½ ml. (There are 20 drops to a milliliter.) At each step of the dilution, hold the vessel containing the solution in front of a white sheet of paper, and ask the class whether they can still see the ink.
5. 5 ml
6. 10
7. 90
8. 100
9. 50 ml
10. 1000
11. 500 ml
12. 0.5 liters
13. 10,000
14. Two additional dilutions. One dilution will take it to 100,000 drops and the second to 1,000,000 drops.
15. For the first dilution you will end up with 5000 ml or 5 liters of solution and for the second, 50,000 ml or 50 liters of solution.
16. 13.2 gal.
17. After a concentration of 1:1000 has been reached, students will find it difficult to see any indication of the presence of the ink.

	I	II	III	IV	V final step
PARTS	1:10	1:100	1:1000	1/ 10,000	1/ 1,000,000
VOLUME (ml)	1/2 ml	5 ml	50 ml	500 ml	50,000 ml

You might want to bring out some other comparisons of what one part per million means. For example: it is one minute in two years; one second in 11.6 days, one penny in $10,000, and one ounce of chocolate in 8,000 gallons of ice cream.

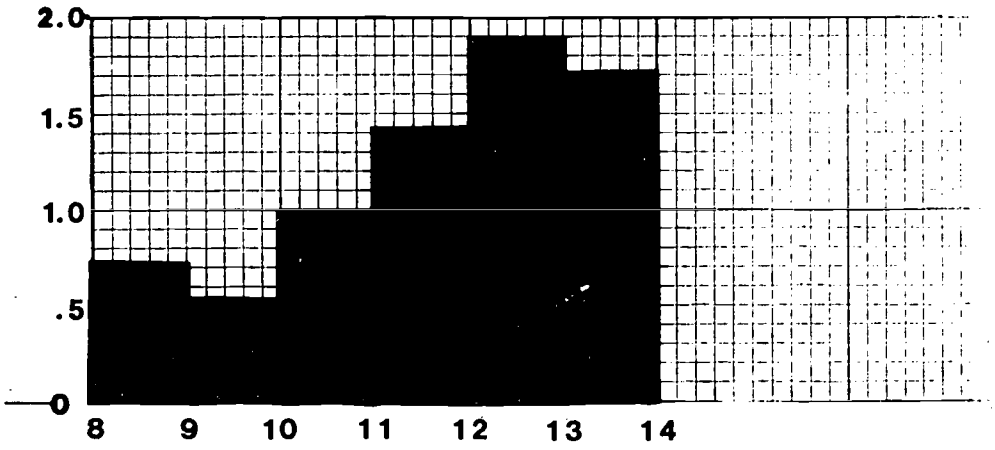
18.



19. The concentration of PCBs increases as the fish increase in size.

20. This is probably true because the larger fish are older, and therefore have had more time to concentrate PCBs in their fatty tissues.

21.



22. The relationship, though not as strong, is still present at Bono.

23. The relationship seems to hold at each site.

24. The concentrations do differ according to the sites at which the fish were obtained. This may be due to local sources of contamination such as industrial wastes or industrial dump sites on the adjacent land.

25. There may be a range of student answers on this question. The data, though sketchy, really suggest that there should not be any problems in consuming white bass that have been taken from Lake Erie, since even the recommended standards were only slightly exceeded in two locations.

ACTIVITY B

HOW CAN THE PUBLIC HEALTH BE PROTECTED?

PROCEDURE

Assign roles at least a day or two before you plan to start the simulation. Duplicate enough of the role descriptions so that each member of a role group can have the one pertaining to his/her role. Have the students study the descriptions prior to the day that the simulation will be conducted. Also have them read the student guide for Activity B, especially the five policies that will be considered during the simulation. These policies should also be written on the chalk board where they can be referred to by the students during the simulation.

APPENDIX

Following are the descriptions of each role. In addition some of the roles have supplementary background material.

Experts:

1. Scientist from the Federal Government and Drug Administration - excerpt from Federal Registar.
2. Officer of New York Department of Environmental Conservation - 'Fish Filleting Guide'.

Interest Groups:

1. Association for the Protection of the Health of New York Citizens.
2. Association of Local, Municipal and State Public Officials.
3. Marina Operators Association of New York - "PCBs in Fish: The Worst May Be Over".
4. Sports Fishers of New York - Article from Sandusky Register.
5. The New York Association of Commercial Fishers - Article from Columbus Dispatch.

SCIENTIST FROM THE FEDERAL FOOD AND DRUG ADMINISTRATION (FDA)

Polychlorinated biphenyls (PCBs) are virtually indestructible man-made pollutants now found in food and water sources. For almost 50 years, this toxic chemical has been used in motor fuels, detergents, nylon, pesticides, plastics, paints and varnishes, adhesives, lubricants, printing inks, fluorescent light starters, waterproofing and fireproofing materials, and other products. Each year, millions of pounds of PCBs have been dumped into rivers and waterways through industrial waste disposal and accidental spills, leaked into the soil from trash in dumps and landfills, and carried into the air from burning of waste and vapor escaping from paints and varnishes. PCBs are chemically stable and not easily broken down. Complete destruction requires temperatures above 1,200 degrees Farenheit. Once PCBs are incorporated into fish, animals and other foodstuffs, they cannot be eliminated by processing.

Recently, production and distribution of PCBs has been halted, except for use as insulating fluid in closed electrical systems. Even so, it is estimated that 450 million pounds of PCBs exist in the environment and 750 million pounds of PCBs are still in industrial and domestic use.

The effects of PCB contamination in humans was discovered in 1968 in Japan when some people ate rice oil containing PCBs that had leaked from a heat exchange unit at the oil processing plant. Many people developed severe symptoms of weakness, numbness of limbs, dark coloring of skin, swelling of eyelids, and disturbances in liver function. Babies born to mothers who had eaten the oil had skin discolorations. Recent laboratory studies have shown that monkeys fed PCBs developed reproductive problems, liver disease, acne, eye inflammations, weight loss, and loss of hair. Liver tumors or liver damage has also been produced in test animals such as chickens, rabbits, quail, mice, and rats which have eaten PCBs.

The U.S. Department of Agriculture and the FDA have been routinely inspecting fresh fruits and vegetables, dairy products, eggs, grains, fish, animal feeds and processed foods for high concentrations of PCBs. Maximum tolerance levels of PCBs in foods have been established by the FDA to provide a margin of safety for the public:

5.0 ppm in the edible portions of fish and shellfish
"an order lowering the standard to 2 ppm has been stayed by court order"

1.5 ppm in milk and dairy products

3.0 ppm in poultry

0.3 ppm in eggs

0.2 ppm in finished animal feed

2.0 ppm in animal feed components of animal origin

0.2 ppm in infant and junior foods.

Other FDA regulations concern the use of PCBs in equipment and machinery employed in food and animal feed production and food packaging and storage materials. These are necessary since there have been cases of PCB contamination of various foodstuffs from herbicides, paper wrappers and cartons, and transfer fluid leakage.

PCBs pose a great threat to fresh water fish because it is extremely difficult to eliminate the PCBs already present in waterways. PCBs also tend to accumulate in the fatty tissue and flesh of fish and other animals that eat them. Freshwater fish most affected with PCBs include: coho, chinook, steelhead trout, striped and smallmouth bass, carp, eel, rockbass, catefish, adewife and lake trout. Fish from Lake Ontario and Lake Michigan have been found to contain a high level of PCB contamination. A two-year study, funded by FDA, revealed that people who eat Lake Michigan fish have more PCBs in their blood than people who do not; however, no adverse health effects could be identified in this study. Long range effects on human health has not yet been determined.

Additional information is included in the excerpt from the February 26, 1976, issue of the Federal Register.

Food and Drug Administration

[Docket No. 76N-0048]

POLYCHLORINATED BIPHENYLS (PCB's) IN CERTAIN FRESHWATER FISH

Statement of Policy

The Food and Drug Administration is stating its policy in regard to the contamination of freshwater fish with polychlorinated biphenyls (PCB's).

Although PCB's may not intentionally be added to food in any quantity, they are, at times, unavoidably present in certain foods as a result of environmental contamination. The Commissioner of Food and Drugs promulgated a regulation under § 122.10(a) (21 CFR 122.10 (a)) in the FEDERAL REGISTER of July 6, 1973 (38 FR 18096) that established limits on the amount of PCB's that may lawfully be present in food as the result of such contamination. Among other things, the regulation set a temporary tolerance for fish of 5 parts per million (ppm) PCB's. Since the July 1973 temporary tolerances were established, additional toxicological data on PCB's have become available. These recently developed data have raised concern that PCB's may be more toxic than previously thought. The need to lower the temporary tolerances in light of these data, particularly the tolerance for fish, is under active consideration. Contemporaneously, sampling programs conducted by Federal and State authorities reveal that PCB's continue to be a significant contaminant of some species of freshwater fish taken from certain rivers and lakes in the United States.

The Commissioner believes that the present situation warrants a statement of the policy of FDA regarding the problem of PCB contamination of freshwater fish and the steps FDA has taken, or may initiate, to deal with the problem. Furthermore, the New York State Department of Environmental Conservation has requested guidance from FDA as to what action, if any, is necessary at this time to protect the public health in light of the recurrence of PCB levels in excess of the 5 ppm temporary tolerance in fish taken from certain waters in New York State. This notice responds to the request from the New York State authorities for guidance and discusses the PCB-in-fish problem generally.

BACKGROUND

PCB's are a class of toxic industrial chemicals that are highly stable, heat resistant, and nonflammable. Prior to 1971, PCB's were used in a variety of applications, primarily because of their excellent chemical and thermal stability. It has been estimated that approximately 40 percent of the PCB's used in the United States prior to 1971 went into applications that resulted in loss into the environment. These applications included use as plasticizers, pesticide extenders, microencapsulation of dyes for carbonless copy paper, and as components of hydraulic fluids and lubricants, surface coatings, inks, sealants, and adhesives. The bulk of the remaining 60 percent use of PCB's was in electrical transformers and capacitors (Ref. 1).

By late 1971, it was apparent that the unique physical and chemical properties of PCB's and their widespread, uncontrolled industrial application had led to their becoming a persistent and ubiquitous environmental contaminant. In 1971, the Monsanto Corp., the sole United States producer of PCB's, restricted sales for use only in closed-system electrical application, e.g., transformers and capacitors. PCB use in the United States today is principally limited to such closed systems, which minimizes but does not eliminate the loss of PCB's into the environment (Ref. 2).

One consequence of the contamination of the environment with PCB's was the indirect contamination of certain foods, principally those of animal origin. Although only limited information on the toxicity of PCB's was available in late 1971 to 1972, there were sufficient data for the Commissioner to conclude that PCB's were a poisonous or deleterious substance, and that their presence in food posed a potentially serious health hazard. As a first step to limit human exposure to PCB's from dietary sources, FDA issued a notice of proposed rule making in the FEDERAL REGISTER of March 18, 1972 (37 FR 5705), indicating the agency's intentions under section 406 of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 346) to restrict the level of PCB's that could lawfully be present in food. Temporary tolerances for PCB's in fish, milk, dairy products, eggs, poultry, animal feed and feed ingredients, and infant and junior foods became effective in the final regulation of July 6, 1973. These tolerances are listed in § 122.10(a). An action level is also in effect for PCB's in paper food-packaging materials.

In setting the temporary tolerances for PCB's, the Commissioner took into account the extent to which a limit on PCB consumption was necessary for the protection of the public health, other ways in which the consumer might be exposed to PCB's or other poisonous or deleterious substances, and the extent to which PCB contamination of food cannot be avoided. Numerous safety factors were used to assure that the temporary tolerances provided an adequate safety margin for the consumer as long as exposure to PCB's was sporadic and diminished with the passage of time.

Surveillance data gathered by FDA and the U.S. Department of Agriculture subsequent to the effective date of the temporary tolerances (Ref. 3) have shown that, with the exception of certain freshwater fish, the presence of PCB's in those individual foods subject to the tolerances continues to be sporadic, and that there has been an overall and substantial decline in frequency and levels. These data further show that the average daily dietary intake of PCB's is quite low and well within the margin of safety.

PCB CONTAMINATION OF FISH

The Commissioner stresses that most fish intended for human consumption come from salt waters. Sampling programs of FDA reveal that these fish are largely uncontaminated with PCB's (Ref. 3). Fish collected from commercial establishments contained an average of less than 0.2 ppm PCB's substantially below levels that would pose a risk to health. However, considerably higher levels of PCB's are being detected in various species of freshwater fish—particularly sportsfish, e.g., coho and chinook salmon, lake trout—from several areas in the United States. FDA is currently developing information to determine the exact extent of the problem.

The jurisdiction of FDA extends only to food in interstate commerce. For this reason, the agency cannot control directly sportsfishing or the consumption of PCB-contaminated fish, unless such fish are being sold or shipped in interstate commerce. Nonetheless, the Commissioner is concerned about the public health implications for sportsfishermen and others who may regularly consume fish that are caught from PCB-contaminated waters.

PCB CONTAMINATION OF FISH IN CERTAIN NEW YORK STATE WATERS

On October 9, 1975, the New York Department of Environmental Conservation formally sought the support of FDA with respect to specific actions it contemplated to limit the consumption of PCB-contaminated fish. This request by the Department was based on its finding that various fish species caught in the Hudson River and two species of salmon caught in Lake Ontario contained levels of PCB's well in excess of the FDA tolerance of 5 ppm. Specifically, the New York Department of Environmental Conservation was considering the following actions:

1. Banning all commercial fishing in the Hudson River;

2. Advising the public not to consume fish from the Hudson River and salmon from Lake Ontario; and

3. Seizing any Hudson River fish in intrastate commerce that contain PCB's in excess of the 5 ppm temporary tolerance.

On October 20, 1975, the New York Department of Environmental Conservation was informed that FDA would initiate seizure of interstate shipments of fish found to exceed the temporary tolerance and would support the State in taking similar action against intrastate shipments. The State was also advised that FDA would need to evaluate fully the results of surveys of fish taken from the Hudson River and Lake Ontario before it could determine the appropriateness of the other suggested actions. At that time, surveys were still being conducted by the State and by FDA. Subsequently, data from these surveys were submitted and have been evaluated by FDA (Ref. 4).

The samples from the Hudson River included 17 species of fish collected from 18 points on the Hudson River between Glens Falls and Alpine, with 13 samples being collected at Glens Falls and 68 samples below Glens Falls. In summary, this evaluation showed that 53 out of the 68 samples of fish collected at or below Fort Edward (approximately 7 miles below Glens Falls) contained PCB's in excess of 5 ppm. The average level of PCB contamination in these 68 samples was 31.3 ppm. In contrast, only trace levels were found in the 13 samples obtained at Glens Falls. A high proportion of finfish and eels from all sampling points below Glens Falls contained PCB levels in excess of 5 ppm. The Fort Edward sampling point had the highest levels for the species examined, with individual samples ranging from 20.1 to 178 ppm.

Twenty-eight of the 33 samples of coho and chinook salmon from Lake Ontario exceeded 5 ppm, with a range from 2.1 ppm to 24.6 ppm. Of the 4 samples of lake trout tested, results were in the range of 10 to 15 ppm. All other species of fish sampled from Lake Ontario were at 5 ppm or less PCB's.

As a result of these findings, the Commissioner has concluded that fish caught in the Hudson River south of Fort Edward are likely to contain excessive levels of PCB's. Similarly, coho and chinook salmon caught in Lake Ontario are likely to contain excessive levels of PCB's. Since there are no data on current levels of PCB's in shad caught in the Hudson River, FDA is unable to make any conclusions about PCB contamination of that fish at this time. However, data obtained by the State of New York for past years, while limited, indicate that shad may contain relatively low levels of PCB's. There are insufficient samples to make any valid conclusions about lake trout caught in Lake Ontario at this time.

The scientific evidence described in the preamble to the July 6, 1973 FDA final regulations on PCB's and in more recent statements by agency officials (Refs. 5 and 6) supports the conclusion that frequent consumption of fish containing PCB's above 5 ppm poses a risk to public health. Therefore, on February 11, 1976 the Commissioner advised the State of New York that FDA fully supports the remaining proposals of the Department of Environmental Conservation. Specifically, the Commissioner concurs with the State of New York in its proposals to:

1. Ban commercial fishing, except for shad, from the Hudson River at or south of Fort Edward.

2. Advise sportsfishermen and other persons not affected by the ban to restrict their intake of fish caught from these waters and to restrict their intake of salmon caught from Lake Ontario.

When implemented these actions will effectively eliminate the possibility that commercial fish contaminated with PCB's will enter interstate or intrastate commerce from these waters. An advisory to sportsfishermen and others who consume fish caught from these waters is essential to alert them to the potential hazard of consuming such fish, and is necessary since a ban on commercial fishing does not directly protect such individuals. Should additional regulatory actions become necessary in the future, FDA will promptly take all appropriate steps, consistent with its statutory authority, to protect the public from PCB-contaminated fish. Additionally, the State of New York plans to monitor closely the 1976 spring run of shad to determine what additional action may be required for this species of Hudson River fish.

The presence of significant levels of PCB's in freshwater fish is caused by the continued industrial discharge and disposal of PCB's into the environment. The Commissioner emphasizes that the contamination of fish with PCB's will persist unless controls are initiated to curtail pollution of the environment with PCB's. The Commissioner has, therefore, assured the Environmental Protection Agency (EPA) that the full scientific resources of FDA continue to be available to assist in that agency's efforts to control PCB discharges. Similarly, FDA has provided, and will continue to provide, the full range of its scientific expertise in support of individual State actions aimed at controlling industrial pollution of the environment with PCB's (Refs. 5 and 6).

Status of Temporary Tolerances For PCB's in Food

The preamble to the regulations on PCB's in the July 6, 1973 Federal Register states that FDA will periodically review and evaluate the appropriateness of the temporary tolerances for PCB's. On November 21, 1975, it was announced (Ref. 7) at the National Conference on PCB's sponsored by EPA that FDA had initiated such a review. The scope of this review includes an in-depth evaluation of recent scientific reports on various aspects of the toxicity of PCB's. These reports were formally presented at the National Conference on PCB's (Ref. 8). The purpose of the FDA evaluation will be to determine if the information contained in these reports indicates that a reassessment of the temporary tolerances is warranted. As part of its current activities, the agency is also gathering and reviewing data from different sources on the extent to which PCB's occur in fish and other foods. This information is needed since section 406 of the act requires an assessment of the impact on both human health and the food supply that would result from any lowering of the current temporary tolerances.

Additionally, on November 21, 1975 the Environmental Defense Fund and the National Resources Defense Council petitioned FDA to reduce gradually all the temporary tolerances for PCB's in food to zero. This petition and supporting information will be given full consideration and are included in the current review activities of the agency.

If, on the basis of these reviews, lowering any of the temporary tolerances is warranted, the Commissioner will issue a proposal to amend the existing PCB regulations in the Federal Register, and allow time for public comment prior to implementing any revision.

References

A copy of each reference document is on file with the Hearing Clerk, Food and Drug Administration, Rm. 4-65, 5600 Fishers Lane, Rockville, MD 20852, and may be seen during working hours, Monday through Friday.

1. World Health Organization, International Agency for Research on Cancer, "IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man," Vol. 7, 1974.

2. Statement by Russell R. Train, Administrator, Environmental Protection Agency, at a Press Conference on PCB's, Monday, December 22, 1975, Washington, DC.

3. "Levels of PCB's in the U.S. Food Supply," C. F. Jelinek and P. E. Cornelliussen, Bureau of Foods, Food and Drug Administration, November 25, 1975.

4. "Polychlorinated Biphenyls Residues in Fish from Lake Ontario and the Hudson River," Bureau of Foods, Food and Drug Administration, December 17, 1975.

5. Testimony of Albert C. Kolbye, Bureau of Foods, Food and Drug Administration, before the Department of Environmental Conservation, State of New York, October 17, 1975.

6. Testimony of Henry Roberts, Minneapolis District Office, Food and Drug Administration, before the Department of Natural Resources, State of Wisconsin, August 28, 1975.

7. "FDA Regulation of PCB's in Food," John R. Wessel, Office of the Associate Commissioner for Compliance, Food and Drug Administration, November 21, 1975.

8. "Health Effects and Human Exposure," Session I of the National Conference on PCB's, November 19 through 21, 1975, Chicago, Illinois.

Dated: February 12, 1976.

A. M. Schmidt,
Commissioner of Food and Drugs.

[FR Doc.76-4666 Filed 2-23-76;2:36 pm]

The Department is responsible for the enforcement of all laws and regulations relating to fishing on Lake Ontario. Its budget for these activities comes from fees for the licenses it issues to commercial and sports fishers. These revenues are also used for stocking fish in many of the waters of New York State. Although the Department is part of the executive branch of the state government, it is sensitive to the concerns of state legislators, since they are responsible for approving any increases in the Department budget.

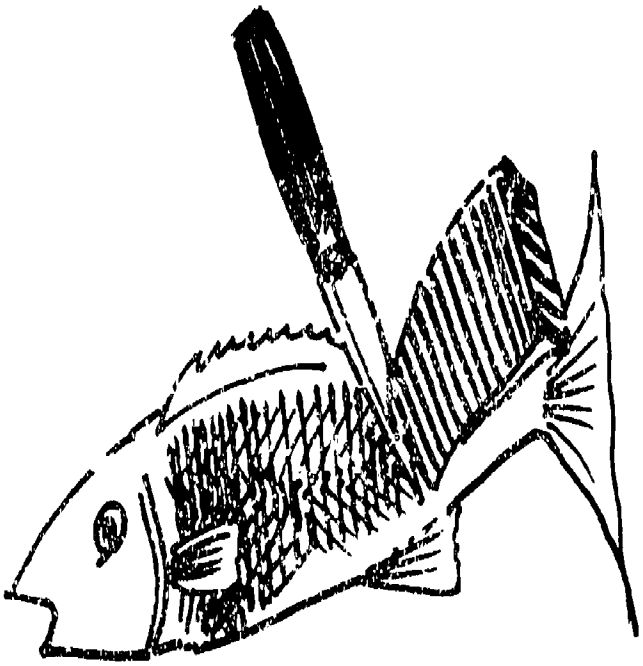
The Federal Food and Drug Administration (FDA) has issued maximum standards for PCB content in milk, poultry, eggs, animal feed and fish. FDA recommends 2.0 ppm in fish as the maximum tolerance limit. The enforcement of this standard has been stayed by court order. Tests in 1979 have shown that all species of fish in Lake Ontario contain some PCBs; however, only salmon, trout, white bass, and channel catfish contain concentrations of PCBs above the 2.0 ppm level. Generally the older and larger the fish, the higher the PCB contamination. Many of the young of the fish species mentioned above have less than the 2.0 ppm level. Also, the Department has found that the amount of contamination varies according to the area of the lake in which the fish were caught; only in certain bays do the fish exceed the 2.0 ppm level. The Department intends to test Lake Ontario fish monthly for PCB levels.

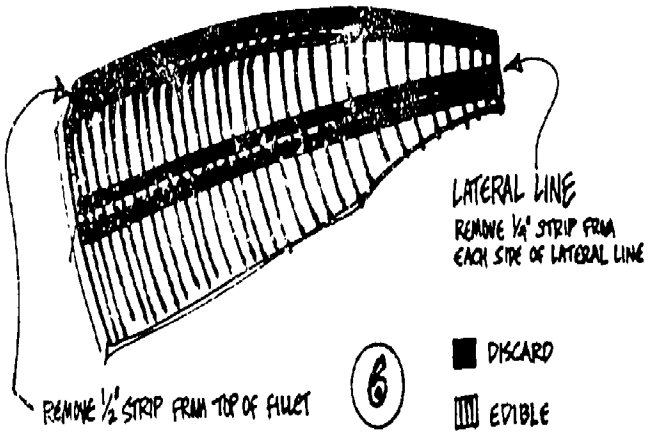
It is important that fishers are advised of the PCB contamination in fish. The Department intends to print a warning on the fishing licenses of the sport fishers. It cautions them to eat no more than one meal per week of contaminated species. Besides advising fishers of the PCB danger, the general public should be protected from eating contaminated fish caught by commercial fishers. Pregnant women and younger children are especially susceptible to the side effects of high PCB concentrations. The Fish Filleting Guide is one effort of the Department to inform the public of ways in which to reduce PCB content of fish.

Any regulation enacted by the health department which calls for strict regulations on species or size of fish caught commercially in Lake Ontario will cause difficulty in enforcement by the Department. Depending on the amount of additional enforcement needed, the Department may not be able to fund it for at least two years. It operates on a fixed budget which is developed and appropriated two years ahead of time.

A copy of the Fish Filleting Guide accompanies this role description.

5. Remove the fillet and repeat steps 2 through 5 for the other side.





6. Trim the two fillets as follows.
   A. remove 1/2" strip from the top of the fillet and discard.
   B. remove 1/2" strip (1/4" from each side of the lateral line) along the entire length of the fillet and discard.
7. The four fillets are now ready to be cooked.

FW-P116(4/78)

REDUCING TOXICS

FISH FILLETING GUIDE

Fishing is a sport enjoyed by millions of men, women and children in New York State.

The full use and enjoyment of New York's outstanding freshwater fishery resources have been marred by contaminants found in some fish species taken from certain waters.

According to the New York State Health Department, although the total biologic impact on humans of frequent eating of chemically contaminated fish is unknown, certain of these chemicals, mirex included, produce cancer and other pathologic conditions in laboratory animals and the chemicals are transmitted to the animals' offspring through mammalian milk.

HEALTH ADVISORY

The State Health Department has advised the public that eating Lake Ontario fish may pose a hazard to health and has urged that pregnant women and nursing mothers as well as infants and young children eat **no** fish from Lake Ontario.

The Health Department's general advisory that persons limit themselves to no more than one meal per week of fish from any water in the State is still in effect.

As a general rule, the larger and older the fish, the higher the concentration of contaminant in its flesh. Thus, smaller fish are generally safer to eat than larger fish.

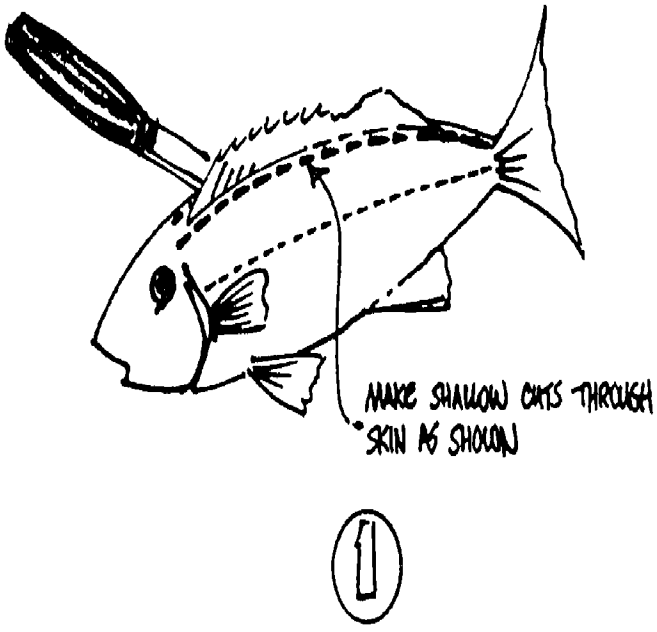
Research conducted by the Department of Environmental Conservation shows that careful trimming of fish can reduce levels of chemical contaminants by 45 to 60 percent.

We recommend that the trimming and filleting guidelines contained in this folder be followed.

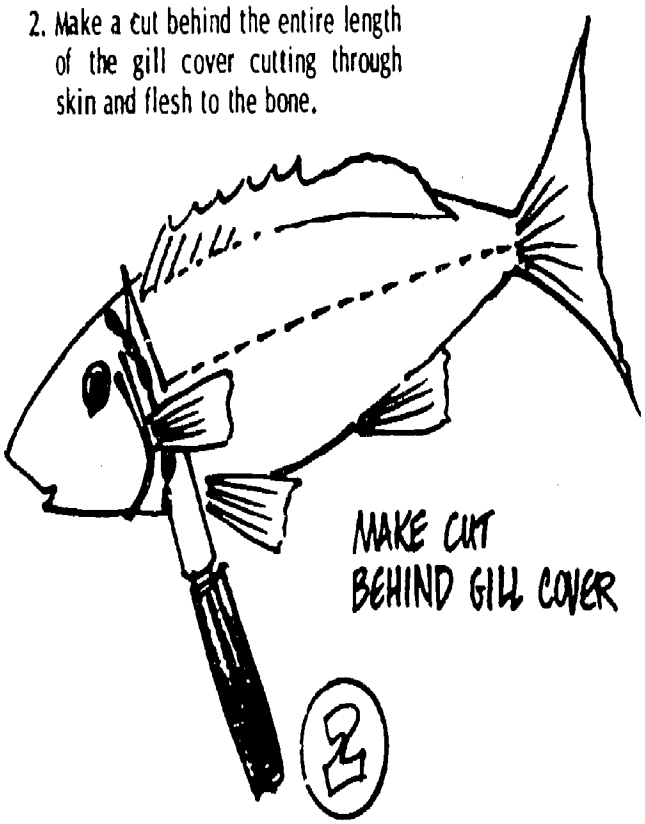
New York State
Department of Environmental Conservation

The following trimming procedure will reduce organochlorine contaminants in freshwater fish:

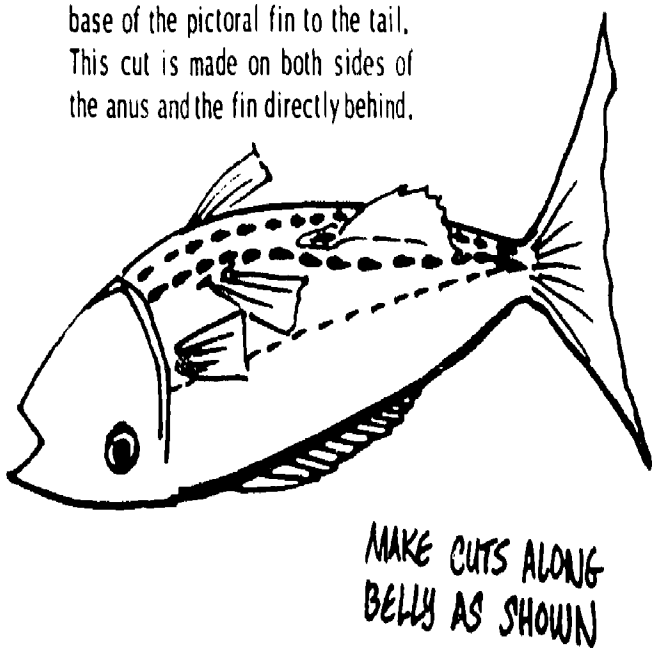
1. Make a shallow cut through the skin (on either side of the dorsal fin) from base of the head to the tail.

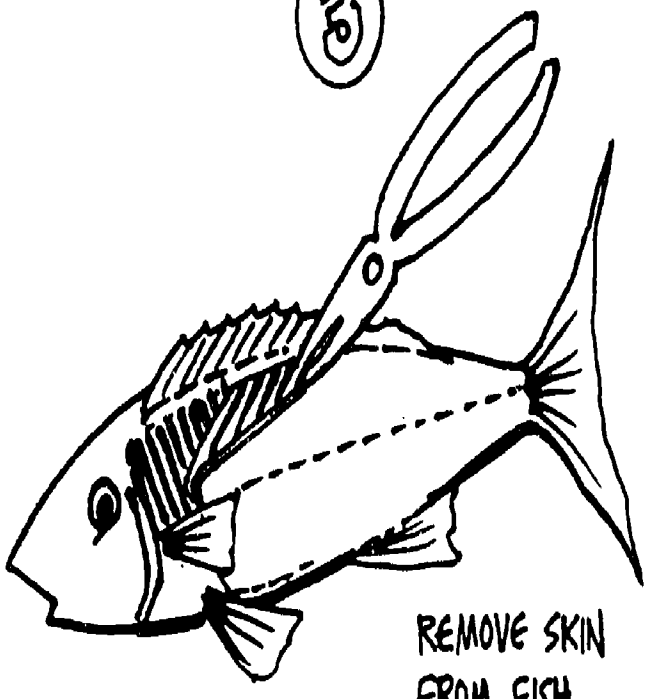


2. Make a cut behind the entire length of the gill cover cutting through skin and flesh to the bone.



3. Make a cut along the belly from the base of the pictoral fin to the tail. This cut is made on both sides of the anus and the fin directly behind.





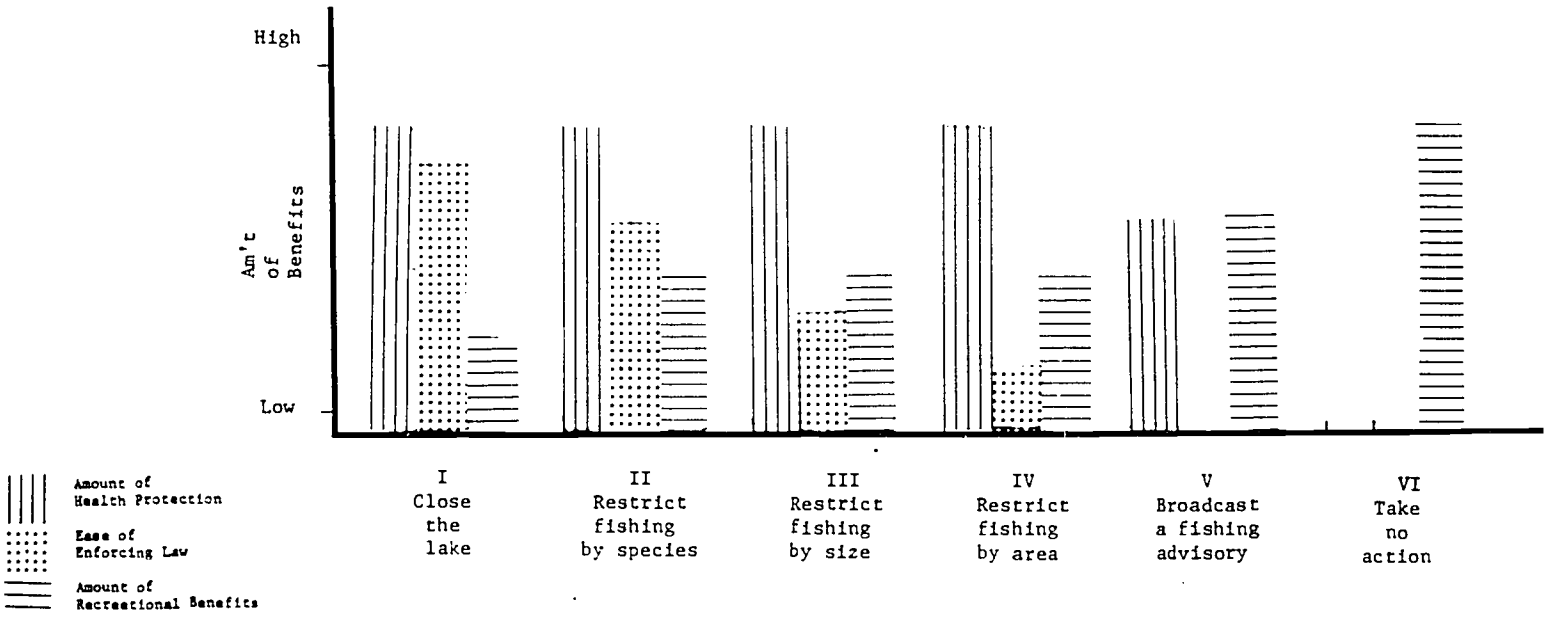
4. Grasp the skin at the base of the head (preferably with pliers) and pull towards the tail removing both the skin and belly meat. If belly meat does not come off with skin, trim it off. Discard this trimmed material along with the skin.

ASSOCIATION OF LOCAL, MUNICIPAL AND STATE PUBLIC OFFICIALS

Membership of this organization includes local and state elected officials. Mayors, county commissioners and state legislators make up the most powerful groups within the organization. The Association has a responsibility first to its membership: to lobby for bills and regulations that the membership agrees best serve their voters and themselves. Because the people they represent have different interests and needs, they are frequently in conflict, making it difficult for the Association to develop single, coherent positions on issues. For instance, health interest groups such as the American Cancer Society want benefits for the consumer that provide high health protection. Business groups dealing in recreation, such as hotel owners, restaurant operators and marina operators don't want policies that would cut into their business, such as restrictions on fishing. The public officials know how important income from recreation is to New York and they don't want any policies that would give New York a bad name and thereby discourage people from spending their vacations there.

Because they are responsible for law enforcement, public officials realize that any regulations resulting from policies must be enforceable to be effective. Yet they don't want to burden enforcement agencies with programs that will require a great deal of money and additional staff.

With these points in mind, examine the graph below. It shows the relative amount of health protection, ease of law enforcement and recreational benefits to society of each of the policies that are under consideration.



MARINA OPERATORS ASSOCIATION OF NEW YORK

Marina owners and operators earn their living from recreation activities near Lake Ontario. A big source of income is from the charter boat business. Many anglers cannot afford to own a boat, and do not have the experience necessary to safely operate a boat on the lakes, but they can still enjoy the relaxation and challenge of fishing by chartering a boat for a day. Marinas often rent space to charter boat operators. A marina is important to those who own their own boats, too. If the owner has no room to store a boat, or doesn't want to tow the boat to the lake every time it is used, the owner will rent a space for the boat at a marina. If fishing is restricted in Lake Ontario, boat owners will take their boats to other lakes where there are no restrictions. There would be many empty marinas on Lake Ontario if this happened, and some would be forced to close. Another major source of income comes from selling tackle and bait to fishers.

Lake Ontario marinas employ many workers and are important to the economy of lake towns. Restricted fishing would hurt marina business and force many to close. Instead, the Department of Health should use marinas as a valuable information source. They are the perfect location for distributing pamphlets and brochures on PCBs. Used this way, they could supply every angler with information on unsafe fish species, proper cooking techniques, and instructions for cleaning fish to reduce PCB content. In this way, the angler could decide on the basis of impartial information, whether to fish and how to handle the fish once it is caught.

Marina operators are very concerned about the anglers' health--after all, they keep the marinas in business! But restricting fishing wouldn't benefit anyone. Instead, they believe the angler should be allowed to make the decisions that bear on his/her recreation and health.

Additional information is provided in the article from The Great Lakes Communicator entitled PCBs In Fish: "The Worst May Be Over."

PCBs in Fish: 'The Worst May Be Over'

By Linda Weimer

If it weren't for the fish in the Great Lakes, polychlorinated biphenyls wouldn't be such a problem. Through the fish of the lakes, PCBs have made their presence felt.

Public alarm over the possible hazards of PCB contamination and federal standards restricting allowable PCB levels in fish products have affected both sport and commercial fishing.

In terms of economics, the Great Lakes commerical fishery has been hardest hit. Though not as robust as it once was, fishing is still a sizable industry. In a recent report for the Great Lakes Fishery Commission, the landed value of Great Lakes commerical fish was estimated at about $25 million a year.

"The total economic impact of the commercial fishery in Canada and the U.S. is about $160 million annually," estimates University of Wisconsin-Madison economist Richard Bishop, one of the report's authors.

The presence of PCBs has diminished that impact, says Bishop. He points to Wisconsin, which has the largest commercial fishery of any Great Lakes state. Last year, that fishery was valued at about $6 million, but would have been worth more if it weren't for PCBs.

A carp fishery that stood at three million pounds a few years ago recently fell to just 300,000 pounds and has since dwindled to practically nothing, according to Ron Poff, a biologist with Wisconsin's Department of Natural Resources. Carp, espcially in lower Green Bay and parts of the Mississippi River, exceed the federal Food and Drug Administration standard of 5 parts per million (ppm) PCBs.

Lake Michigan, particularly Green Bay, has been the area most affected by PCBs. The alewife fishery there has been nearly wiped out by the presence of these chemicals.

Though alewives are not sold for human consumption, they are used to make animal feed. The final product must not exceed 2 ppm of PCBs, a tough standard set by the Food and Drug Administration.

Poff says the decline in carp and alewife fisheries has diverted fisherman to species like perch, whitefish and chubs, putting more pressure on those populations and, perhaps in the long run, adversely affecting those fisheries as well.

If a Stricter Standard Is Adopted...

These commerical targets, which are far more valuable than the alewife or carp, are within a more lenient 5 ppm standard. Chubs average just below the 5 ppm mark in PCB content and though the larger whitefish are just above it, average whitefish catches meet the standard.

However, if the FDA were to lower the standard to 2 ppm — as it has proposed — perhaps a third to a half of Wisconsin's commercial catch would be affected, says Bishop. "Loss of the chub industry alone would mean a loss of about $800,000 a year."

Bishop says the PCB situation has not really harmed the economies of local communities because few fisherman have been affected by the loss of the carp and alewife fisheries. But, he added, if the standard is dropped to 2 ppm, fishing communities like those in Wisconsin's Door County would almost certainly feel the pinch.

The National Fisheries Institute has challenged and stalled the FDA's proposed changes in the PCB standard, arguing that the agency has underesimated the adverse economic impacts that would result from such a move.

While the FDA standard dictates what fish can and cannot be sold across state lines, it has no direct influence over sport fishing—a billion-dollar industry around the Great Lakes.

Although some anglers do think the PCB problem has reduced the quality of the fishing, Bishop doesn't think it has had a large adverse impact on sport fishing. "Recreational businesses associated with sport fishing seem healthy."

There may also be some good news for the state's commerical fishermen. There are indications that PCB levels in Lake Michigan are steadily declining. Where whitefish samples, taken in 1975, showed an average of 4.36 ppm PCBs, 1979 samples showed an average of only 1.72 ppm PCBs.

Poss says that levels in some Lake Michigan salmon were less than 5 ppm and that the Michigan Department of Natural Resources allowed a commercial firm to can more than a million pounds of fish.

Though the Great Lakes fisheries aren't yet out of the woods, there are some encouraging signs that the worst of the PCB problems may be over. □

Linda Weimer is associate director of the University of Wisconsin Sea Grant Institute.

SPORTS FISHERS OF NEW YORK
(Based on Ohio Data)

Sports fishers are a very large group of people with influence in the state legislature. There are over one million throughout the state, many of whom spend much of their fishing time on Lake Ontario. Overall, anglers spend over $60 million per year on fishing licenses, charter boats, fishing tackle, bait, hotel accomodations and meals while at Lake Ontario. This money supports many lake-town businesses. The license money helps to stock fish in the lake and supports enforcement of fishing laws on the lake and throughout the state. It is easy to see why sports fishers are a powerful group whose recreational dollars are important to New York State.

Many anglers are business people who like the relaxation and enjoyment that fishing provides. Because of their busy schedules, they don't have a lot of free time to devote to fishing and they are glad that there are no major restrictions on their fishing. Recreational freedom is important to them. Sports fishers also believe that restrictions on Lake Ontario fishing would violate their freedom of choice for eating fish. Most fishers say they are aware of the dangers of PCBs, but they know how to minimize these dangers. Many pamphlets are available that explain which species are affected, which sizes of fish are affected, and how to clean and cook fish to reduce the PCB content. Most anglers feel that this information is sufficient to control PCB problems.

Also, some people don't even eat the fish that they catch! Restrictions would be very unfair to those who fish just for the fun of it.

Additional information in article from Sandusky Register entitled "Chemical Tests Leave Some Fishermen Edgy."

Chemical tests leave some fishermen edgy

- SANDUSKY REGISTER — THURS., JULY 19, 1979

By BILL LAMMERS
Staff Writer

BAY VIEW — Most Lake Erie fishermen reacted Tuesday to news that white bass and channel catfish will not meet new federal and state chemical-pollution standards by promising not to eat the two varieties of fish or to cut back on their fishing altogether.

The *Register* polled anglers along the old Sandusky Bay Bridge (Ohio 269) Tuesday, in most cases informing them of the Ohio Department of Natural Resources test results, which said the two varieties are too high in content of PCB, a cancer-producing chemical, to pass federal regulation to become effective Aug. 28.

The test results also said three varieties of Lake Erie fish — walleye, yellow perch and coho salmon — were within safe limits.

"I don't know if I'd want to eat any," Jim Bryant, MacDonald, Ohio, said. "That's a shame, though.

"If it wouldn't make me stop, it'd make me slow down some," Bryant said. "I'd probably even stop fishing for white bass.

"I wouldn't say I would never eat another white bass again, but I'd sure look into what they're saying."

Although a study which says certain fish are not safe could induce panic among fishermen, Bryant said the testing will serve some good.

"That's a good thing they're coming out with reports like that," he said, "because it's been coming out that more and more things affect the fetus of an expectant mother."

"It makes me think," said Bellevue resident [illegible] think we're eating a lot of cancer-causing stuff around. I'm more concerned about the stuff that's in our bacon and ham now."

On his first trip to the Sandusky-Port Clinton area, Ed Sperling of Cincinnati hasn't had much experience with Lake Erie fishing. With findings like Tuesday's ODNR tests, he's not likely to have any more.

> 'I wouldn't say I would never eat another white bass again, but I'd sure look into what they're saying.'
>
> — *one fisherman*

"I wouldn't eat any of them," he said. "It sure wouldn't be worth the risk of contaminating my family.

"I wouldn't want to stay here and fish and catch something I couldn't take home," he said.

Harry Lovett, Lorain, said he probably will not eat any catfish or white bass because of the results.

"I don't want no part of the stuff that's in them," he said. "I just might quit fishing for a while until they see if they clean up a little," Lovett said. "I don't want them if I can't eat them."

Two other fishermen on the bridge Tuesday who fish only for the sport said it probably would not affect their angling habits.

"I don't eat a lot of fish from out of here anyway," Don Sellers, Catawba Island, said. "We just give them away or something."

Sellers, however, doubted the accuracy of the testing.

"All the fish around here swim in the same water," he said. "How can one be safe and one be dangerous?

"If people are out fishing, they're going to eat what they catch," Sellers said.

"I don't catch very many anyway," Odus Townsend, Cleveland, said.

"I know a lot of people who do a lot of fishing and it won't affect them," he said. "Nowadays, we live in a world where everything you eat causes cancer, but I guess there are a lot of people who worry about that."

THE NEW YORK ASSOCIATION OF COMMERCIAL FISHERS

(This role is based on information from the fishing industry on the Ohio portion of Lake Erie. Lake Ontario does not have an important commercial fishery.)

Many of the fisheries on Lake Ontario have been owned by one family for many generations. The owners have fished all their lives and are dependent upon the fish for their livelihood. Most have either a grade school or high school education. The fisheries employ many additional people to catch and process the fish for eating. A restriction on commercial fishing would have a severe economic effect upon the owners and their employees. In fact, the fishery on the lake may have to close down completely causing a great deal of unemployment.

Fisheries are significant contributers to the State's economy. All of the fisheries on the Great Lakes contribute $95 million each year to the United States and Canadian economies. New York would lose millions of dollars if restrictions were placed on commercial fishing.

Businesses such as restaurants and grocery stores depend on Lake Ontario fishers to supply them with fresh and processed fish. They spend their dollars in New York, instead of buying expensive out-of-state fish. This benefits New York by keeping money in the State, and consumers by providing less expensive fish.

When consumers buy Lake Ontario fish, they are getting a great deal. Lake fish are just as tasty as ocean fish, they cost less than ocean fish, and a fish dinner is a healthy and nutritious meal. The National Marine Fisheries Service in Washington, D.C., reports that a serving of fish has less calories and more protein than an equal size serving of beef or pork. Consumers really benefit when they eat fish. Even though PCBs can accumulate in fish, there are effective ways to prepare fish so that they are safe to eat. Pamphlets are available from the New York Department of Fish and Wildlife that illustrate methods of trimming fat and procedures for cooking that can reduce PCB content 25-64 percent.

Additional information is included in the article from the Columbus Dispatch entitled "Fishing is Great."

FISHING IS GREAT by JOE IONNE with photos by Gordon Kuster Jr., from the Sunday Magazine of the Columbus Dispatch, October 28, 1979.

THE DAY WAS sunny with just a gentle wind as the 30-foot *Lyman* eased away from its dock on the Vermilion River and headed out towards Lake Erie.

Ray Full was at the controls of the big white wooden craft powered by twin 265s. Beyond the breakwater he pointed us to the northeast and pushed forward on the power control levers, lifting the bow, and we were on our way to see how Lake Erie boatmen garner food for our tables.

Full is president of the Kishman Fish Co. at Vermilion, one of the oldest commercial fish operations in Ohio, and he also operates fisheries at Sandusky and Conneaut. He went to work for the firm as an accountant after his discharge from the Army Air Corps at the end of World War II.

"My father was a lake fisherman, but he advised me not to get into the business," said Full, who today owns the 111-year-old fish company. "It was a job after getting out of the service, so I took it."

Beginning in March, as soon as the ice clears, and through November, the boatmen harvest the great crop of fish from Lake Erie. They live by their strength and wits on the lake's broad waters.

Full's boatmen, and others who live as they do on Lake Erie, are part of a great industry. They provide our tables with more fish than any other group of inland lake commercial fishermen.

Last year Ohio's commercial fishermen delivered more than 9.3 million pounds of fish to markets in the Midwest and East. That was nine percent more than the 8.5 million pounds they landed in 1977. The Ohio Division of Wildlife has forecast bigger harvests of yellow perch, white bass, channel catfish and some of the other species for 1979.

Although Lake Erie is next to the smallest of the Great Lakes, it produces more than 50 percent of the fish taken from all five of the Great Lakes, notes Jim Schoby of the Division of Wildlife, who was sitting up on the boat's flying bridge.

Why is Lake Erie blessed with all these fish?

Because it has better spawning conditions and habitat and an abundance of food, explains Schoby.

Another important thing is the fact that the lake is relatively shallow, he points out. This allows the water to clear up faster when it is polluted.

A concentration of population and industrial plants in its watershed made Lake Erie the most heavily polluted of the Great Lakes in the 1960s. That, plus the mercury scare of the early 1970s, played havoc, for a time, with the commercial fish industry.

Thanks to the great progress in cleaning up pollution in recent years, the fishermen are again lifting big catches from the clean waters of Lake Erie. "Industry cleaned up its act," Schoby observed

The biggest market for Lake Erie's tasty yellow perch — for fisheries on both the south (Ohio) and north (Ontario) shores — is Wisconsin, followed by Ohio and Chicago. Cleveland and Detroit are the big white bass markets.

A large percentage of a season's yellow perch catch goes to restaurants, hotels and clubs, and to community organizations planning big fish fries.

The wholesale price for the perch in September was $3.60 a pound. How, then, can some Ohio restaurants feature "all the perch you can eat for $2.79"?

"They're not serving Lake Erie perch," Full points out. "You're probably getting ocean perch, which sells for about $2 a pound less than Lake Erie perch."

The days of Lake Erie fishermen begin early. They go out anytime between 3 a.m. and 7 a.m., depending on how far they must travel to reach their nets.

Their faces are weatherbeaten, and their hands are calloused. Each day they must lift the big nets, gather the fish and return to port in the afternoon.

Lifting the big nets containing fish requires a lot of strength, skill and teamwork. Each boat has three to six crewmen, depending on its size, including the skipper.

Bob Newton, a crewman on Larry Davis' boat, shovels white bass onto the scales, while a fishery worker checks the weight.

The rougher the water, the harder it is to handle the nets. The skipper has to maneuver the craft like a nautical cowboy to get it into the right position alongside the trap net's marker buoy. A member of the crew snares the line with a large hook and pulls it aboard.

The line is secured around the boat's winch, and slowly one end of the net is lifted and dragged across the boat. The boatmen open two holes in the trap of the net and lift the captured fish aboard the boat with long dip nets. The trap is hanging just over the side of the boat. The men quickly toss the flopping fish into a sorting box.

Another crewman sorts the fish — yellow perch, white bass, catfish, drum, carp and so on — into other boxes. The noncommercial, like walleyes, and the undersized remain. These go back into the lake.

Not only is it illegal for Ohio's commercial fishermen to take walleyes, but they're also prohibited from catching such fish as blue pike, sauger, sturgeon, whitefish, burbot, trout and salmon from Lake Erie and its tributaries. However, all are legal for the sport angler, with, of course, bag and size limits.

When the trap net is emptied, it's replaced in the water — which is about 25 feet deep in this particular area — and the skipper heads the boat toward the next marker buoy.

The procedure is repeated until all the nets scheduled for that day have been lifted and emptied. State law says that set fishing gear can't be left unattended for more than five days.

The nets used by commercial fishermen today haven't changed much from those used during the Civil War, Full says. The fishermen build the nets themselves at a cost today of about $1,500 for the big trap nets, he explains.

Lake Erie's commercial fishermen also use gill nets. This net reminds one of a giant tennis net, about 120 feet long and six feet wide. Fish swim into its webbing and are trapped by their gills. Small fish can swim through. The gill net is emptied more frequently, sometimes within hours after being set.

By early afternoon the boatmen head for the south shore. (They're allowed to fish only in the lake's Ohio waters.) They go around the breakwater and up the Vermilion River the short distance to the big red Kishman fishhouse in downtown Vermilion.

Now the day's catch must be unloaded and weighed. Daily catches run anywhere from 200 to 5,000 pounds, Full says.

What becomes of the catch from this point is the task of the employees in the fishhouse. Machines can be used to dehead, scale and fillet the fish. But some are sliced and boned by hand by people like Milo Shepard, who has been filleting fish "off and on since 1935."

Four fast swipes with his razor-sharp knife, and Shepard tosses another fillet into the pan by his left hand. He and the others at the long table are paid 20 cents a pound for filleting the perch, he says.

All that tape on his fingers is for protection, not because he has been careless with the knife, Shepard explains, as he reaches for another pile of perch to cut.

Commercial fishing is a complicated and difficult business, Full says later over a plate of fresh and tasty Lake Erie perch at McGarvey's restaurant.

One must know where and when to set the nets and how deep to put them. But unless he has a certain feeling for the job he won't be successful. It's almost like a sixth sense.

There are other difficulties. The nets, which must be left in the lake to do their job, often are damaged accidentally by boaters and storms. And there is danger. Lake Erie is big, and venturing out on it before dawn six days a week in all kinds of weather becomes hazardous. Equipment can fail. In the summer, violent storms blow up without warning.

Other problems confront Ohio's commercial fishermen. The major one, Full feels, is the lack of new and bigger processing plants to compete with the giant and modern processing facility on the Canadian side at Wheatley, Ontario.

The five processing plants on the Ohio shore are quite antiquated, the veteran fisherman points out.

"There's plenty of demand for fish, and it's growing," Full says. "If we don't have a constant and dependable supply, the market will go elsewhere."