PART 3

LEVEL 1 MODELS

Appendix 3.4.1 Derivation of a Hypothetical Lake Michigan Lake Trout Fish Consumption Criteria for PCBs

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The hypothetical fish consumption criteria that we derived for Lake Michigan lake trout has not been officially adopted by any Federal, State, or local authorities. We proceeded to calculate this target concentration because we could not find any other polychlorinated biphenyl (PCB) consumption concentrations for Lake Michigan lake trout that we could readily relate to our model-predicted concentrations in whole fish. This fish consumption criteria was used in our hypothetical PCB forecast scenarios for Lake Michigan found elsewhere in this report.

A reduction factor to convert whole fish PCB concentrations to fillet PCB concentrations was needed for the comparison of model output data to fish consumption advisories. The data gathered for the Lake Michigan Mass Balance Project (LMMBP) for lake trout PCB concentrations was based on the whole body of the fish, less the stomachs. Available consumption advisories are based on the edible portion of the fish (Great Lakes Sport Fish Advisory Task Force, 1993). The edible portion refers to a fillet which includes all flesh from the back of the head to the tail, including the skin and fatty belly flap. The Health Protection Value for this fillet portion has been established at 0.05 µg PCBs/(kg/day) and is sufficient to keep cancer incidence at less than 1 per 10,000. Using a standard of 225 meals per year, the amount of PCBs allowable in the edible portion for a 70 kg individual is 0.05 ppm. The derivation of this figure is described in the Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory (Great Lakes Sport Fish Advisory Task Force, 1993).

Research was necessary to determine if PCBs are concentrated equally in the fillet and whole body of lake trout. If it was determined that PCBs are concentrated either higher or lower in the fillet than in the whole fish, then the target level of 0.05 ppm would have to be adjusted accordingly.

Limited research was performed on Lake Michigan lake trout in this regard. Relevant research was done on Lake Superior lake trout (Miller and Schram, 2000) and Lake Michigan rainbow trout and coho salmon (Amrhein *et al.*, 1999), but nothing was found that specifically looked at Lake Michigan lake trout. Amrhein *et al.* (1999) found whole fish:fillet derived

ratios of 2.47 for rainbow trout, and 2.7 for coho salmon, but it was uncertain as to whether the ratio would be similar for lake trout. Miller and Schram (2000) found a whole fish:fillet ratio for siscowet lake trout of 2.5, but the lipid content of siscowet and Lake Michigan lake trout are vastly different. A data set of lean lake trout from Lake Superior was provided by the Michigan Department of Environmental Quality (MDEQ) which had PCB concentrations for both whole fish and fillets (Day, 1997). The fish in the data set provided were nearly identical in length, weight, and lipid content, so we believed that they would be sufficient to use in our comparison to the Lake Michigan data set (Table A3.4.1).

Statistical analysis of the MDEQ data set resulted in a whole fish:fillet ratio of 1.525; that is, PCB levels were found to be 1.525 times higher in the whole fish than in the fillets. Based upon this calculation, we concluded that a factor of 1.5 would be justified in converting the target level of 0.05 ppm PCBs for fillets to 0.075 ppm PCBs as the new target level for comparison of our model output for whole fish. Further examination of the MDEQ data set revealed that the whole fish:fillet PCB ratio was closely related to the whole fish:fillet lipid ratio. A ratio of 1.50 was found for the lipid concentrations and is shown in Figure A.3.4.1. The result was not surprising as it is known that PCBs are concentrated in the lipids.

Further research was initiated to validate the factor of 1.5 for lake trout in light of the work of Amrhein *et al*. (1999). Coho salmon and rainbow trout were both found to have much higher ratios, which if used for lake trout, would raise the target level for a fish consumption advisory to 1.25 ppm of PCBs, or even higher. To add validity to the factor we had calculated, a review of several common Great Lakes sport fish was conducted. Because the PCB ratio in question was shown in Figure 3.4.1 to be closely related to lipid concentrations, a comparison was made between eight Great Lakes sport fish using additional data. The lake trout from the MDEQ data set and the rainbow trout and coho salmon from Amrhein *et al*. (1999) were compared with five additional species of fish from the Fox River and Green Bay. The additional species examined were carp, walleye, northern pike, smallmouth bass, and yellow perch (Fox River Model Evaluation Workgroup, 1999). It was found that as whole fish lipid concentrations decreased, that the relative ratio of whole fish:fillet PCBs increased (Figure 3.4.2). It can be reasoned that fish with higher lipid contents store more lipids in the fillet portion than comparatively less fatty fish, which store most of their lipids in the viscera and head which are not included in the edible portion. Because Lake Michigan lake trout have higher lipid contents than the rainbow trout and coho salmon studied by Amrhein *et al*. (1999), they will also have a relatively lower whole fish:fillet PCBs ratio.

References

Amrhein, J.F., C.A. Stow, and C. Wible. 1999. Whole-Fish Versus Fillet Polychlorinated Biphenyl Concentrations: An Analysis Using Classification and Regression Tree Models. Environ. Toxicol. Chem., 18(8):1817-1823.

Day, R. 1997. Michigan Fish Contaminant Monitoring Program Annual Report. Surveillance Water Quality Division, Michigan Department of Environmental Quality, Surface Water Quality Division, Lansing, Michigan. Report Number MI/DEQ/SWQ-97-125.

Fox River Model Evaluation Workgroup. 1999. Analysis of Bioaccumulation in the Fox River. Technical Memorandum Document, Number 8600B6A.001 1001 0299 DN08, 24 pp.

Table A3.4.1. Comparison of the LMMBP Lake Trout to MDEQ Lake Superior Lake Trout

	Length (cm)	Weight (g)	Whole Fish PCBs	Lipid (%)
Lake Superior (MDEQ)	58.1	1519	0.24075	15.63
Lake Michigan (LMMBP)	57.83	1943.34	2.03646	16.07

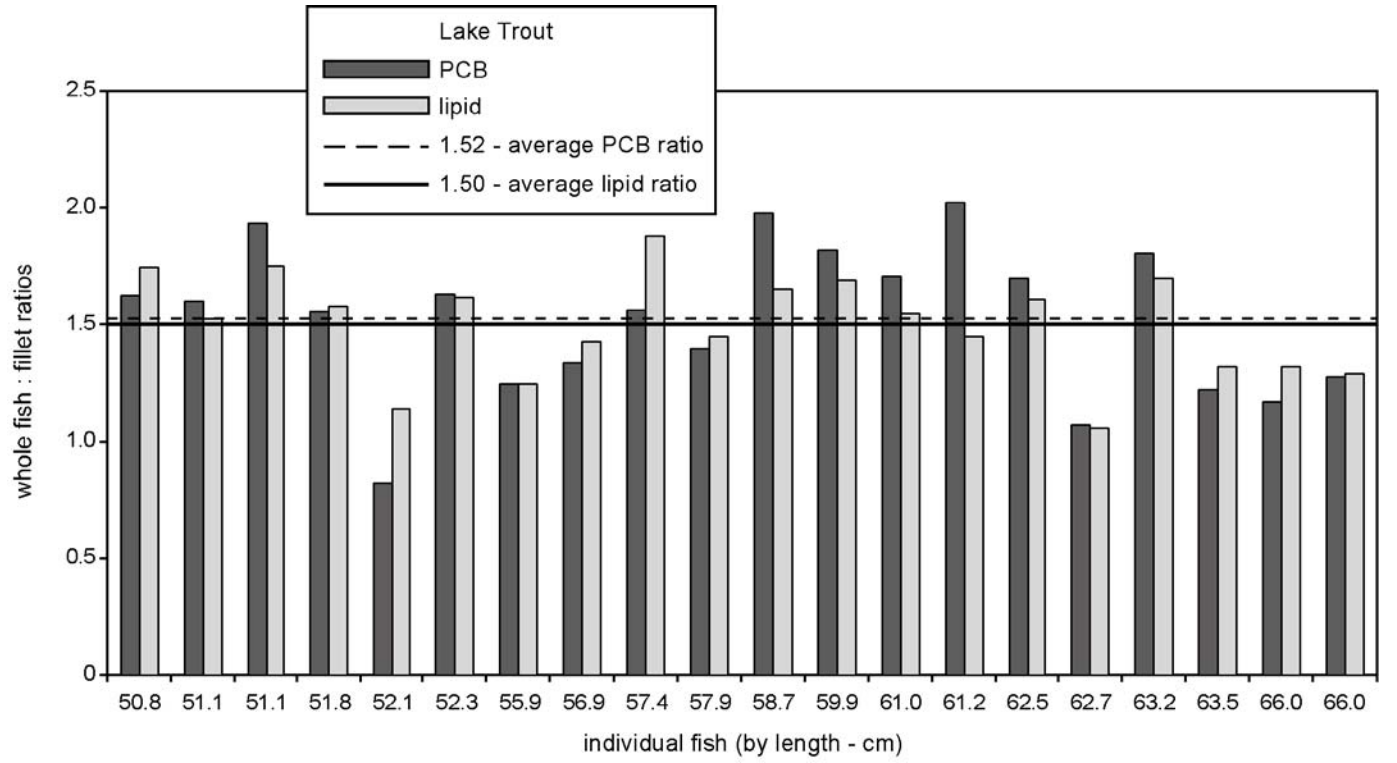

Figure A3.4.1. Whole fish to edible portion of fish PCBs and lipid ratios for lake trout.

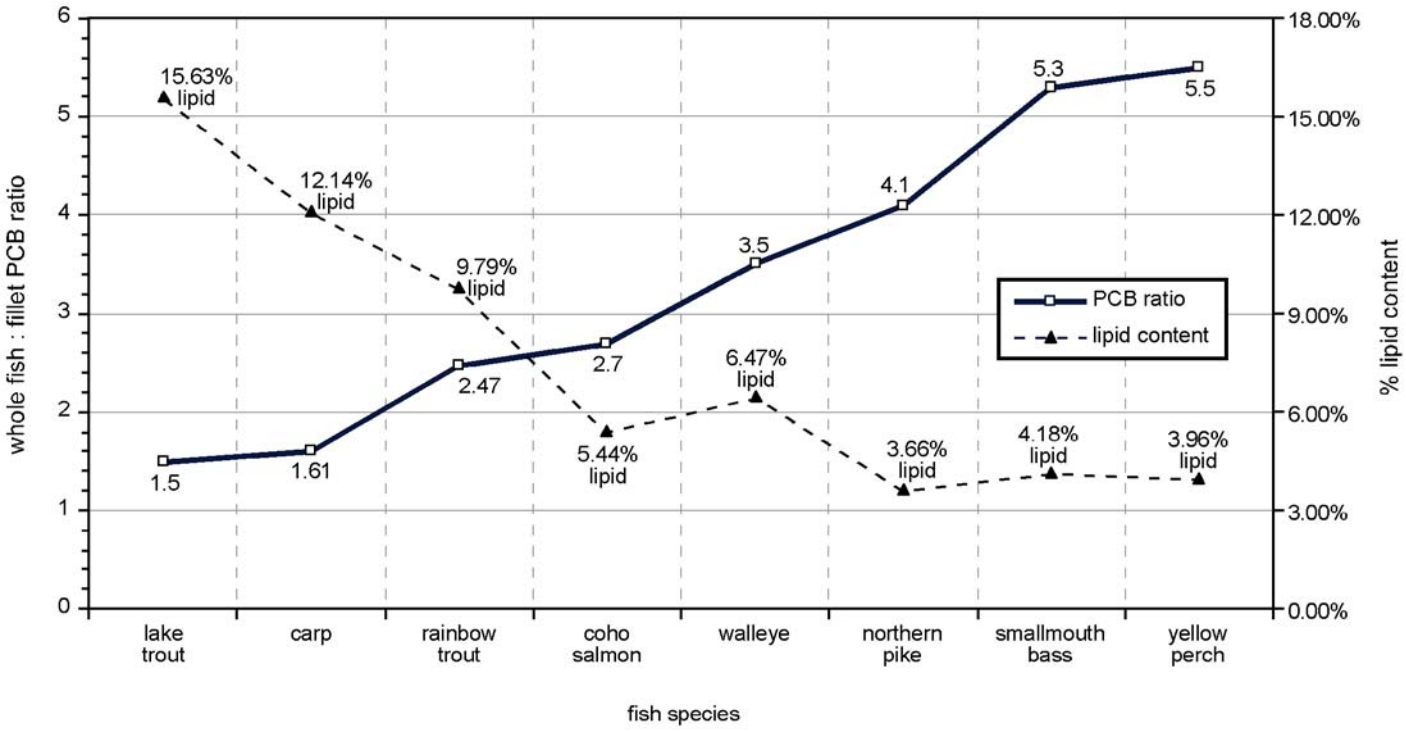

Figure A3.4.2. Comparison of whole fish to fillet PCB ratios and lipid content for various fish species.

Great Lakes Sport Fish Advisory Task Force. 1993. Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory. 86 pp.

Miller, M.A. and S.T. Schram. 2000. Growth and Contaminant Dynamics of Lake Superior Lake Trout. J. Great Lakes Res., 26(1):102-111.