



# Sport fish consumption by the general population from a waterway contaminated with PCDDs and PCDFs

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## Introduction

The University of Michigan Dioxin Exposure Study (UMDES) was designed to determine whether residents living on contaminated soils and participating in activities in a contaminated region have higher serum concentrations of polychlorinated dibenzo-*p*-dioxins (PCDDs) and dibenzofurans (PCDFs) than residents of Michigan in areas with no unusual source of dioxin-like compounds. This short paper focuses specifically on sport fish consumption from the waterways immediately downstream of the Midland, MI Dow Chemical Facility: the Tittabawassee River, Saginaw River, and Saginaw Bay (TRSRB). Monitoring of fish caught from the area indicate that the fish are measurably accumulating PCDDs and PCDFs in their tissues. As consumption of foodstuffs is thought to be the primary route of human exposure to dioxin-like compounds, and sport fish consumption is common in this population, there is a probable pathway for human exposure.

## Methods

All population data are from the UMDES. Stepwise linear regression methods were used to test the significance of the fish consumption variables with the previously tested study variables (i.e. age, BMI, smoking, breastfeeding, occupation, game consumption, etc.). A threshold of  $p < 0.05$  was set for selection and retention of variables in the stepwise regression. Population weighting was incorporated in all regression modeling. Serum results are lipid adjusted and population weighted; total dioxin concentration (TEQ) was calculated using the World Health Organization's 2005 toxic equivalency factor (TEF) weighting system. Observations below the limit of detection were substituted with  $LOD/\sqrt{2}$ . Serum concentrations were first natural log transformed before statistical testing.

Fish concentration data for PCDDs and PCDFs from the Tittabawassee River is available through the Fish Contaminant Monitoring Program (FCMP) on the Michigan Department of Environmental Quality website (MDEQ), <http://www.deq.state.mi.us/fcmp/>

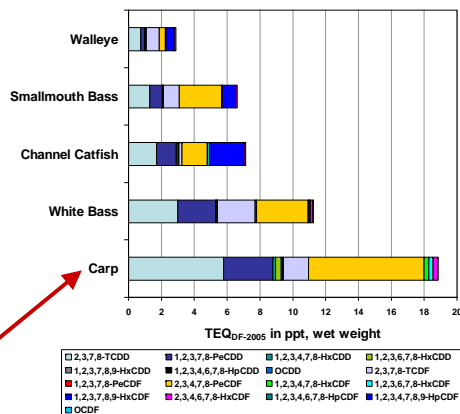
## Results & Conclusions

Figure 1: The Study Area



Monitoring of fish caught from downstream the Dow Chemical Facility over the past five years indicate that the fish are measurably accumulating PCDDs and PCDFs in their tissues with benthic species such as carp or catfish being more contaminated (3 - 40 ppt  $TEQ_{DF-2005}$ , wet weight) while migratory species such as walleye are less contaminated (1.5 - 5 ppt  $TEQ_{DF-2005}$ , wet weight).

Figure 2: Median  $TEQ_{DF-2005}$  and PCDD/PCDF Contributions for Fish Caught from the Tittabawassee River (2003 MDEQ)

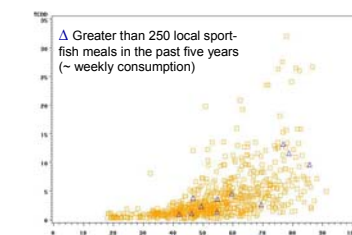
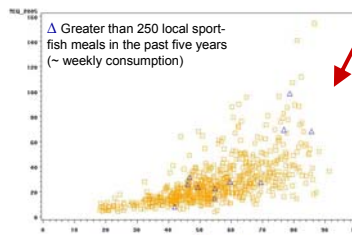


Within this population, 19.7% of residents have consumed sport-caught fish from the Tittabawassee River, Saginaw River, and/or Saginaw Bay within the past five years. Walleye and/or perch are the dominant sport species consumed from the contaminated area (87% of local fishers have consumed), followed by Catfish, Bullhead, Carp and/or Suckers (29% of local fishers have consumed).

Table 1: Population Past Five Years Sport Fish Consumption Habits from Tittabawassee and Saginaw Rivers, Saginaw Bay

Species	Percent of population who have consumed listed species	Number of local sport fish meals among consumers (median, 90 <sup>th</sup> %ile, max)
Any fish	19.7	25, 140, 1040
Walleye, Perch	17.2	15, 60, 1040
Catfish, Bullhead, Carp, Suckers	5.8	10, 25, 145
Pike, Pickerel, Muskellunge	1.7	25, 360, 360
Bass	1.3	20, 20, 20
Panfish	3.0	15, 25, 660
Steelhead, Trout, Salmon	2.7	15, 60, 200
Other	0.5	5, 5, 150

Figure 3: Serum Concentrations of Total TEQ, TCDD and 4-PentaCDF by Age and Frequent Local Sport Fish Consumption



Plots of weekly, local sport-fish consumers do not show obvious elevations in serum congener concentrations. Of the regression models run with the fish consumption variables, there were only significant, stable associations within two congener models: walleye and/or perch consumption from the Tittabawassee River, Saginaw River, and/or Saginaw Bay was *inversely* associated with serum 2,3,4,7,8-pentaCDF concentration ( $\beta = -0.0005$ ) and 'Other' fish consumption from the TRSRB was *inversely* associated with total serum TEQ ( $\beta = -0.0022$ ).

The primary hypothesis behind this analysis was that fish caught from a contaminated waterbody would lead to an increase in the contaminant levels of the population consuming them. Despite the contamination present in the local fish, we find little association of population serum levels with past five years sport fish consumption from these waterbodies. Possible explanations of this result include the lower TEQ concentrations in the primary fish species consumed (walleye/perch), distinction of general population vs. frequent sport fishers, and/or variable misspecification.

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