FINAL REPORT TO THE
MEADOWLANDS ENVIRONMENTAL RESEARCH INSTITUTE

EVALUATION OF THE FORM OF SPECIATION OF MERCURY IN HACKENSACK MEADOWLANDS WHITE PERCH

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EXECUTIVE SUMMARY:

As a result of a recent project in the Hackensack Meadowlands, the "Aquatic Animal Assessment and Inventory", it was determined that white perch were probably unsafe for human consumption because of mercury and PCB contamination. This project was specifically for achieving more accurate data and understanding of the mercury problem. We proposed to re-assess this issue by analyzing another 12 fish from the archived collection for methylmercury, because only 8 fish had been analyzed so far (and methylmercury is much more toxic than inorganic mercury). Since this fish species is sought by local fishers, it is important that the state agencies responsible for protecting the citizenry have appropriate information on which to base their decisions. Since the first 8 samples were from late autumn, we used June and July fish for this follow-up analysis. The results were that <u>all</u> the Hg in the white perch was found to be methylated in these warm-weather collected fish. This is the first report of seasonal differences in methylation of Hg in fish. Furthermore, since we previously found higher levels of total Hg in warmer months, this accentuates the prediction of greater health risk to recreational fishers who have more activity during the warmer months.

INTRODUCTION:

During 2001-2003, personnel of the Meadowlands Environmental Research Institute (MERI), along with investigators from Rutgers University and the University of Medicine & Dentistry of New Jersey (UMDNJ), in a multi-faceted project, the "Aquatic Animal Assessment and Inventory", demonstrated that there is a healthy population of the white perch (*Morone americana*) in the Hackensack Meadowlands (HM). The UMDNJ part of the project involved analyzing the fish for toxic contaminants: a suite of trace metals including mercury (Hg). These were anticipated to be problematical because of the existence of a Superfund site with very high Hg contamination. The results of the analysis showed that there were substantial numbers of white perch in which the Hg level exceeded the FDA/EPA guideline for consumption of more than one meal per month (Weis, 2005). Furthermore, the Hg levels were higher in larger fish - those that would be likely to be kept by fishers - and higher during the summer months - when more people are out fishing in the HM. However, there were some uncertainties that needed to be cleared up.

The most toxic species of Hg found in aquatic organisms is the monomethylated form, methylmercury (meHg). The FDA/EPA guideline (USEPA, 1999) for Hg was determined using a risk assumption based on the then available information that virtually all the Hg in fish is meHg

(Bloom, 1992). However, the 8 white perch that we had analyzed for meHg had much less of their total Hg methylated, just 18.1 ± 9.7%. This is low. Kannen et al (1998) analyzed Hg speciation in a large number of Florida fish species and found that meHg could be anywhere from 20% to 100% of the total Hg, but with most species having >80% (as anticipated in the federal consumption guidelines.) More relevant to this proposal, white perch in the Chesapeake were found to have 28 ± 14% methylation (Mason, 2004), a value which is significantly different from ours ($t = 2.327$, $P < 0.05$). [It should be noted, however, that Mason (2004) found site differences in percent of methylation of Hg. We, however, did not find significant differences for total Hg among our several collection sites (Weis, 2005).] If most of the Hg in white perch is inorganic, then much of it would not be biologically available (Wallace et al, 2003), and thus not so much of a health risk. But the possibility of lifting a ban on white perch consumption should not be made on the basis of analysis of only 8 fish.

OBJECTIVES/RATIONALE:

We proposed to have *more white perch analyzed for meHg* so that there would be a significant amount of samples in our database, originally only 8 fish. Better data (i.e., a more significant data-base for the meHg, would allow MERI to have a more meaningful interaction with state officials responsible for decisions vis-á-vis health advisories related to fish consumption. Better data would also give us a stronger paper to write for publication.

METHODS:

MeHg analysis was done by a contract laboratory, as before. The lab is at the University of Manitoba, Winnipeg. Their work includes QA/QC. We thus had 12 more fish analyses added to our database, and these were selected from a warmer part of the year than the mid-October collection analyzed previously, in order to represent the peak of the fishing season. Our role included sample preparation from archived material, data processing, and writing up the results. Twelve fish samples were prepared from June and July collections and delivered on dry ice to Winnepeg by courier service. There, the samples were prepared according to Bloom (1992) for analysis by cold vapor atomic fluorescence spectrophotometry. The certified reference material (CRM) used was NRC-Canada DORM-2.

RESULTS:

All of the Hg was in monomethyl form, i.e., meHg. Specifically, 110 ± 13.2 was methylated. (The greater than 100% finding is probably a result of different methods being used for total Hg and for meHg.) This was a radical difference from previous measurements, showing an apparent seasonal difference of 100% vs. 18%. Both sets of analyses had appropriate CRM returns as part of their QA/QC. Because of the radical and unexpected difference, both I and the contract lab manager carefully went over the calculations. The results were thus verified.

DISCUSSION:

This appears to be the first reporting of seasonal differences in methylation of Hg in fish. This increase in methylation is in addition to the greater amount of total Hg that we had already reported (Weis, 2005). The reasons for higher mercury in fish during the warmer months may represent the higher food intake at this time. Depuration occurs at a rate that, like any physiological activity or chemical reaction, is temperature-dependent. Nevertheless, it still continues during the winter, a time when food is scarce to non-existent, so that a fish will show a

net loss of Hg during that time. Changes in Hg burden in relation to season were previously reported in HMD mummichogs (Weis et al, 1986).

Kannan et al (1998) studied total mercury and methylmercury in water, sediment, and fish from South Florida estuaries and found among the many fish species studied that the percentage of methylated Hg varied from 20 to 100%. Mason (2004) analyzed several game fish species from numerous sites within the Chesapeake Bay system and found that white perch averaged 28% methylated form of Hg; no reporting of collection dates was made, however. MeHg is bioaccumulated mostly (>85%) from the diet (Hall et al, 1997). Furthermore, meHg is associated more with the hypoxic interface of estuarine systems (Mason et al, 1993), and hypoxia is more likely to occur in the summer. These last two relationships (diet, which is greater in the warmer months, and hypoxia) would explain the greater uptake of Hg in the summer, and why this Hg is much more in methylated form at this time.

CONCLUSION:

We previously reported higher levels of total Hg in warmer months, a time associated with more recreational fishing activity. This finding of total methylation of fish Hg accentuates the prediction of greater health risk to recreational fishers.

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