Mercury levels detected in fish from rivers of the Crow Reservation, Montana

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INTRODUCTION

We have several reasons for being concerned about mercury contamination of local fish. In a major survey of fish mercury levels conducted by the EPA, the walleye in Big Horn Reservoir on the Reservation had some of the highest levels in the country. The coal burning power plant in nearby Colstrip is the major source of atmospheric mercury pollution in the state of Montana, and additional power plants are located in Billings and Hardin, MT. Atmospheric deposition of mercury to land and water surfaces leads to conversion of elemental mercury into methylmercury (MeHg) in aquatic ecosystems. Methylmercury is biomagnified up the aquatic food chain, by a factor of 10 million in top predators. Humans, birds and mammals eating contaminated fish have the highest levels of exposure. In the US, 8% of women of child-bearing age are considered to be at risk due to high blood MeHg levels; 410,000 children per year are exposed to levels in womb associated with neurological impairment.

On the Crow Reservation some of the natives regularly eat local fish. The two major rivers are the Little Bighorn and Bighorn, the smaller tributaries are Pryor Creek, Lodge Grass Creek and Soap Creek. Fish are also consumed from Willow Creek Reservoir. Our project, a collaboration among Little Big Horn College, the Crow Tribe, the Indian Health Service Hospital, the Crow Water & Wastewater Authority, Montana State University Bozeman and the US Fish & Wildlife Service, collected the first available data on fish mercury levels from most of these water bodies.

MAP OF THE CROW RESERVATION

Figure 1 Crow Reservation

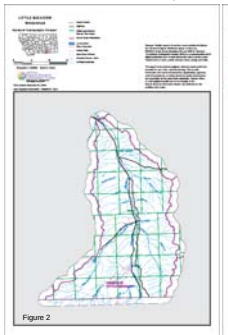

Figure 2 Little Bighorn Watershed

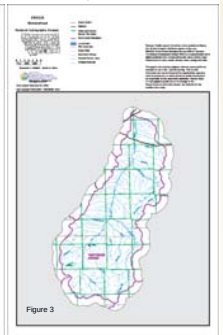

Figure 3 Pryor Watershed

METHODS

Fish were harvested from multiple sites along the Little Big Horn River and Pryor Creek by electrofishing in July 2008. At Willow Creek Dam the fish were caught by setting a net overnight. Fish were filleted, and muscle tissue samples taken. The tissue samples were packaged in aluminum foil, and sample sites/fish descriptions recorded. Samples were frozen and stored on ice for transport to Montana State University for analysis.

A Nippon Instruments Mercury Analyzer (model MA2000 with attached sample changer) was used for this study. Mineral fillers (additives M and B) provided by Nippon Instruments were used for loading samples in ceramic boats/dishes prior to analysis. The manufacturer's instructions were followed for sample preparation.

A water blank and a set of standards was prepared for each set of samples run. Six standards were prepared over a range from 0 ng to 20.0 ng mercury. To prepare liquid standards, the ceramic boats are filled 1/3 with Additive B. Water or mercury standards were dispensed evenly on top of the additive using a micropipette. The boats are then filled with another 1/3 volume of Additive B. The final 1/3 volume of each boat was then filled with Additive M. Metal spatulas were used to fill the boats and nitrile gloves were worn for protection. The six boats with standards were put in the sample chambers with forceps.

Fish samples were cut with a clean razor (wiped with tissue soaked in ethanol) and placed on labeled weighing paper. Each sample was prepared and analyzed in duplicate. The size of the samples were cut to give a sample mass of between 50 and 100 mg. The paper was first weighed by itself so that the paper weight could be subtracted from the total weight to give sample weight. After recording the weights, the sample names/descriptions and their correlating weights were entered into the mercury analyzer's computer program spreadsheet.

To prepare the ceramic boats containing the weighed fish tissue samples, the boats were first filled with 1/4 volume Additive M. The tissue sample was carefully placed on top of this first layer of additive, followed by another 1/4 volume/layer of Additive M, a 1/4 volume/layer of Additive B, and finally, a 1/4 volume of Additive M. A metal spatula was used to fill the boats, and nitrile gloves were worn for protection.

The boats with solid samples were put into the sample loader part of the analyzer according to the corresponding slot number from the spreadsheet. The MA2000 was operated following the manufacturer's instructions.

RESULTS

Fish species and size, location & date collected	n	Mean (Hg in ppm)
Shorthead RedHorse 8-12" LBHRiver @ Reno Creek 073008	9	0.231
Shorthead Redhorse 8-12" LBHRiver below dam 072908	5	0.230
Shorthead RedHorse 12-16" LBHRiver @ Spear Siding 073008	6	0.212
White Sucker 4-8" LBHRiver @ Spear Siding 073008	1	0.085
White Sucker 8-12" LBHRiver @ Spear Siding 073008	3	0.158
White Sucker 12-16" LBHRiver @ Spear Siding 073008	4	0.297
Mtn Whitefish 8-12" LBHRiver @ Speer Siding 073008	1	0.025
Mtn Whitefish 12-16" LBHRiver @ Speer Siding 073008	1	0.067
Mtn Whitefish 4-8" LBHR @ Little Horn Ranch 073108	3	0.073
Mtn Whitefish 12-16"" LBHR @ Little Horn Ranch 073108	5	0.091
Channel Catfish 4-8" LBHRiver @ Reno Crk 073008	1	0.051
Channel Catfish 4-8" LBHRiver just below Dam 072908	1	0.077
Channel Catfish 8-12" LBHRiver just below Dam 072908	10	0.126
Channel Catfish 12-16" LBHRiver just below Dam 072908	10	0.133
Channel Catfish 20-24" LBHRiver just below Dam 072908	1	0.152

Fish species and size, location & date collected	n	Mean (Hg in ppm)
Brown trout 8-12" LBHRiver @ Spear Siding 073008	5	0.096
Brown trout 12-16" LBHRiver @ Spear Siding 073008	4	0.073
Brown trout 12-16" Willow Creek Reservoir 072908	5	0.334
Brown trout 16-20" Willow Creek Reservoir 072908	3	0.338
Brown Trout 4-8" LBHRiver @ Little Horn Ranch 073108	5	0.027
Brown Trout 8-12" LBHRiver @ Little Horn Ranch 073108	6	0.065
Brown Trout 12-16" LBHRiver @ Little Horn Ranch 073108	5	0.133
Brown Trout 16-20" LBHRiver @ Little Horn Ranch 073108	1	0.210
Rainbow Trout 8-12" Willow Creek Reservoir 072908	1	0.008
Rainbow Trout 12-16" Willow Creek Reservoir 072908	3	0.207
Rainbow Trout 4-8" Pryor Creek @ Gap 073108	5	0.000
Rainbow Trout 8-12" Pryor Creek @ Gap 073108	4	0.003
Brook Trout 4-8" Pryor Creek @ Gap 073108	5	0.001
Brook Trout 8-12" Pryor Creek @ Gap 073108	5	0.002
Smallmouth Bass 4-8" LBHRiver just below Dam 072908	3	0.059
Smallmouth Bass 8-12" LBHRiver just below Dam 072908	1	0.234

Summer 2008 Electrofishing Crew (L to R): Micah White Clay, Crescentia Cummins, Julian Goes Ahead, Antone Lopez, Glenn Boltz, Robbin Wagner, Audrey Plenty Hoops and Jarvis Gust. (Missing: Justin Hugs, Sara Plaggemeyer, Mari Eggers and Ada Iron).

Deep water under the bridge on the Little Big Horn River was a challenge. L to R: Julian Goes Ahead, Micah White Clay, Crescentia Cummins, Glenn Boltz, Jarvis Gust.

DISCUSSION

Consumption guidelines state that people at higher risk should not consume more than one serving per month of any fish with methylmercury levels in the range of 0.170 – 0.650 ppm. In this higher risk group are women of childbearing age, nursing mothers, and children six and under. All other people should not eat more than one serving per week of such fish (dphhs.mt.gov/fish2005).

Edible fish in our survey which are contaminated at this level include (a) brown trout 12" and larger from Willow Creek Reservoir, and 16" and larger from the Little Big Horn River; (b) rainbow trout 12" and larger from Willow Creek Reservoir; and (c) small mouth bass 8" and larger from Little Big Horn River. Some of the channel catfish 12" and larger from the Little Big Horn River also were similarly contaminated. Smaller trout, catfish and small mouth bass were less contaminated and therefore a safer choice for consumption.

The larger brown and rainbow trout in Willow Creek Reservoir are of particular concern since the Reservoir is a popular fishing area. This Reservoir is located in the foothills of the Big Horn Mountains; it seems likely that the major source of contamination is aerial deposition.

CONCLUSIONS

Having coal burning power plants close to the Crow Reservation has caused concern. Not very many people eat fish on the Reservation, but the ones that do eat fish eat a lot of fish. The fish in Willow Creek Reservoir had higher concentrations of methylmercury. The fish caught upriver in Pryor Creek had the lowest concentrations. We found levels in some fish that would warrant an advisory to limit consumption.

FUTURE WORK

Public education will be an important aspect of this work, and is planned for this spring prior to the beginning of the fishing season. As we only tested fish fillets, further testing will be needed if people are also eating fish skin or other parts of the fish. A survey is being conducted to determine how much fish people are eating, and of which species.

REFERENCES

Montana Department of Public Health and Human Services 2005 Montana Sport Fish Consumption Guidelines.
http://www.dphhs.mt.gov/fish2005
http://nris.state.mt.gov
http://www.stopthecoalplant.org

Little Big Horn College Project Coordinator Cummins and intern Lopez teach water quality monitoring to local school children.

ACKNOWLEDGMENTS

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