PCDD, PCDF, and EOCl Bioaccumulation in a Northern Canadian River System

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Abiotic and biotic compartments in a Northern Canadian river system [Figure 1] have been analyzed for polychlorinated dibenzo-p-dioxins [PCDDs], polychlorinated dibenzofurans [PCDFs], and extractable organic chlorine [EOCl]. PCDDs/PCDFs were analyzed using methods stipulated by the United States Environmental Protection Agency[1] and Environment Canada[2]. Both methods stipulate the use of capillary gas chromatography/high resolution mass spectrometry [10,000 resolution]. EOCl was analyzed using a modification of the method of Martinsen et al.[3]. Briefly, the modification included the use of methyl-t-butylether : cyclohexane [1:1] as extraction solvent; furthermore, 2,4,6-tribromophenol was added to all samples as a surrogate. Iodine in toluene was added to all extracts [2.0 mL] to serve as a volume correction surrogate because, extracts were removed from precleaned cryogenic vials after neutron activation analysis and transferred to glass scintillation vials prior to gamma counting.

The water column and both deposited and suspended sediments were analyzed as were invertebrates and several fish species. The organic carbon contents of sediments and the lipid levels of biota were also analyzed for most samples. These initial data suggest that PCDDs, PCDFs, and EOCl may be primarily transported in suspended sediments. Analysis of suspended sediments reveal levels of 2378-TCDD to be < 0.12 - 50 pg/g and 2378-TCDF to be < 0.12 - 150 pg/g. The available data support food chain transfer from filter feeding macroinvertebrates to particular fish species such as the mountain whitefish [*Prosopium williamsoni*]. Analyses of invertebrates revealed 2378-TCDD ranged from <0.20 - 4.8 pg/g, and 2378-TCDF ranged from <0.20 - 29 pg/g.

Analyses of mountain whitefish [*Prosopium williamsoni*], revealed 2378-TCDD ranged from 0.30 - 130 pg/g, and 2378-TCDF ranged from 0.1 - 430 pg/g. Analyses of other benthic-feeding species such as longnose sucker [*Catostomus catostomus*][2378-TCDD, <0.60 - 3.0 pg/g; 2378-TCDF, <0.40 - 29 pg/g] and piscivorous species such as northern pike [*Esox lacius*][2378-TCDD <0.59 pg/g; 2378-TCDF, 4.6 pg/g] show that biaccumulation is limited. EOCl for mountain whitefish [*Prosopium williamsoni*] ranged

from <0.50 - 42 μg/g; for longnose sucker [*Catostomus catostomus*] the range was <0.50 - 22 μg/g and for northern pike [*Esox lacius*] the range was 0.50 - 1.3 μg/g. EOCl is reported on a tissue weight basis.

These data suggest that simple, generalized bioconcentration factors from the water column for compounds such as PCDDs are insufficient. We suggest that regulatory risk assessments should employ site specific models based on the particular characteristis of the individual ecosystem.

References

1. US-EPA. Method 1613: Tetra- through Octa- Chlorinated Dioxins and Furans by Isotope Dilution HRGC-HRMS. Washington, D.C.: United States Environmental Protection Agency, 1991.

2. Environment Canada. Reference Method for the Determination of Polychlorinated Dibenzo-para-Dioxins [PCDDs] and Polychlorinated Dibenzofurans [PCDFs] in Pulp and Paper Mill Effluents. Ottawa, Ontario: Environment Canada Report EPS 1/RM/19, 1991.

3. Martinsen, K., Kringstad, A., G.E. Carlberg. Methods for Determination of Sum Parameters and Characterization of Organochlorine Compounds in Spent Bleach Liquors from Pulp Mills and Water, Sediment and Biological Samples from Receiving Waters. *Water Sci. Technol.* 1988; 20: 13-24.

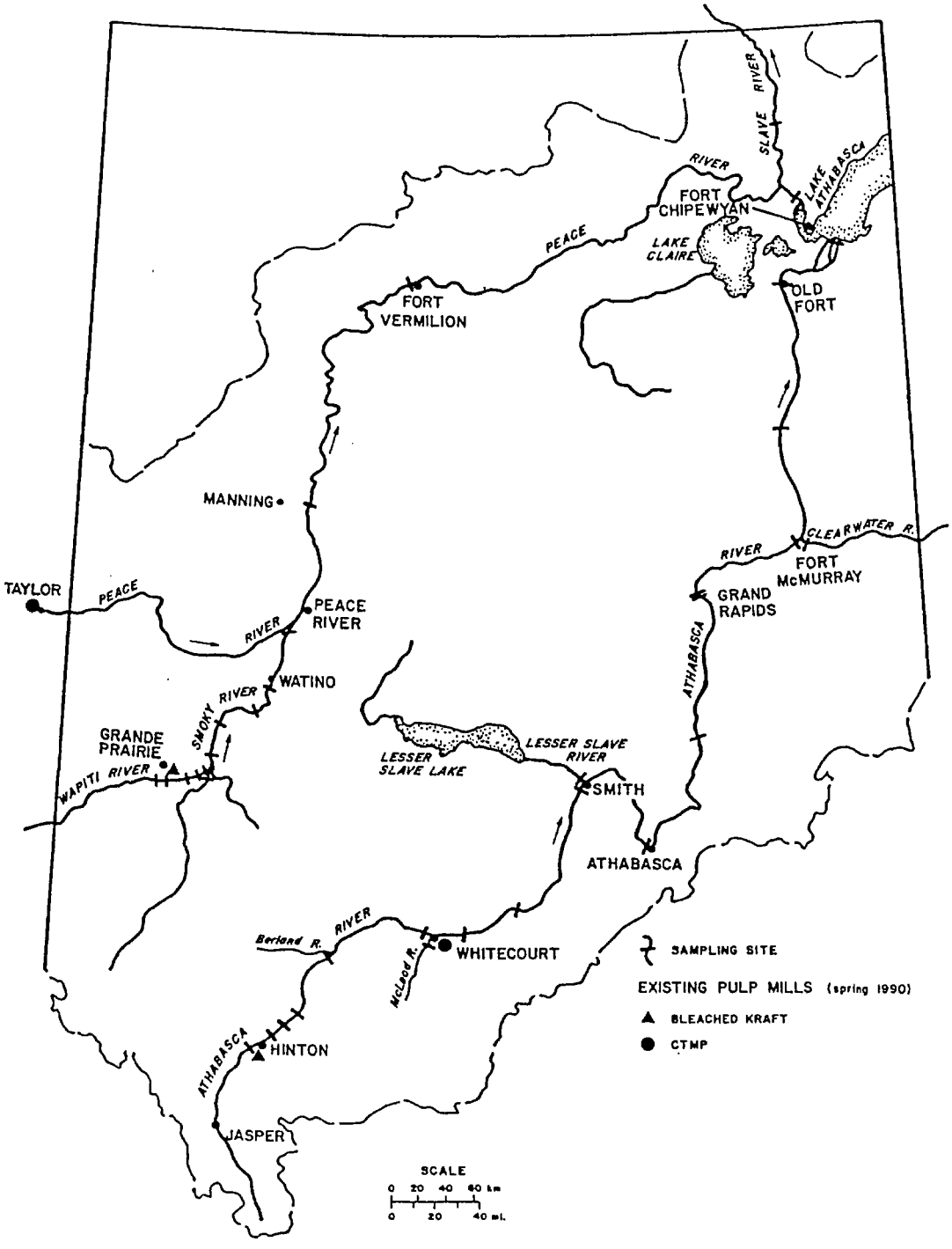

Figure 1. Sampling sites