

Passerine egg concentrations of PCDF and PCDD congeners as part of a site-specific risk assessment on the Tittabawassee River



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INTRODUCTION

- Site located in Midland Co, Michigan, USA on the Tittabawassee River (Fig. 1.)
- Elevated concentrations of PCDFs and PCDDs downstream of Midland, MI [1]
- Upstream ("reference") and downstream ("target") sites identified
- Receptor species of interest: tree swallow (*Tachycineta bicolor*), house wren (*Troglodytes aedon*), and eastern bluebird (*Sialia sialis*)

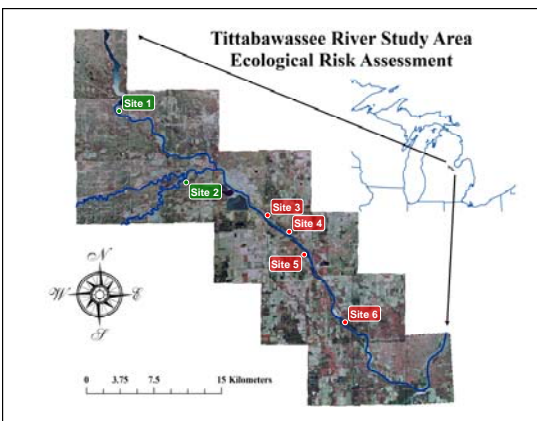


Fig. 1. Tittabawassee River study area in Midland Co, Michigan, USA. Upstream reference sites (1 & 2) and downstream target sites (3-6) are indicated, all study sites were located within the Tittabawassee, Chippewa, and Pine River 100-yr floodplains.

METHODS & MATERIALS

- In 2004, 202 nest boxes placed at 2 reference sites ($n=69$) and 4 target sites ($n=133$)
- Egg samples collected April-August 2005
 - Fresh eggs collected within 4 days of incubation
 - Addled eggs salvaged opportunistically



- Processed eggs were lyophilized
 - Concentrations are based on mass at laying minus the shell
- Chemical extraction followed EPA method 3540C & 3541
- Chemical analyses followed EPA method 8290
- Results are corrected based on recoveries and non-detect congeners = $\frac{1}{2}$ detection limit
- TEQ concentrations are based on avian-specific World Health Organization (WHO_{Avian}) TCDD equivalency factors [2]

ABSTRACT

Egg concentrations of passerine birds nesting in the Tittabawassee, Chippewa and Pine River floodplains near Midland, Michigan, were examined due to the presence of polychlorinated dibenzofurans (PCDFs) and dibenzo-p-dioxins (PCDDs) in both the terrestrial and aquatic food webs. Historical chemical production around the turn of the century is a possible source of the PCDF/PCDD compounds currently occurring downstream of Midland. Mean concentrations of PCDF/PCDDs in soil and sediment were 10- to 20-fold greater downstream (target sites) of Midland compared to upstream (reference sites). Based on life history, site presence and availability of on and off site historical data, tree swallow, eastern bluebird, and house wren were chosen as passerine receptor species of interest. In 2005, over 200 nest boxes were monitored upstream ($n=69$) and downstream ($n=133$) of Midland as one part of a large scale site-specific ecological risk assessment of the Tittabawassee River floodplain. Fresh eggs were collected and addled eggs were opportunistically salvaged from nest boxes for contaminant analyses. Seventeen 2,3,7,8 (PCDF/PCDD) congeners were measured in individual passerine eggs and converted to toxic equivalents (TEQs) using avian WHO TEF values. Concentrations of TEQs in eastern bluebird, house wren, tree swallow eggs ranged from 8.83-99.7 ($n=3$), 16.2-19.2 ($n=2$), and 122-291 ($n=3$) ng/kg wet weight (ww) upstream of Midland while downstream concentrations of TEQs ranged from 31.0-1050 ($n=10$), 122-2290 ($n=12$), and 15.1-450 ($n=8$) ng/kg ww, respectively. PCDF and PCDD avian TEQ congener profiles were compared across species between reference and target locations.

RESULTS & DISCUSSION

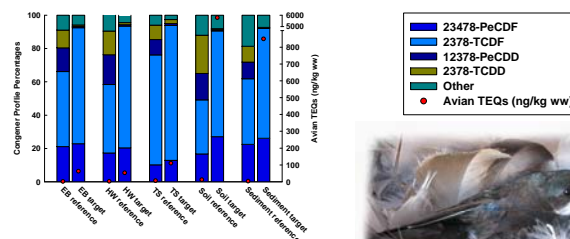


Fig. 2. Congener profiles and total avian TEQs (ng/kg ww) for dietary items (by species, combined across sites), and soil and sediment collected in the Tittabawassee River floodplain.

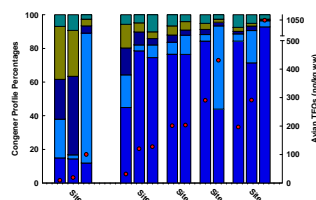


Fig. 3. Eastern bluebird individual egg congener profiles and total avian TEQs (ng/kg ww) collected in the Tittabawassee River floodplain.

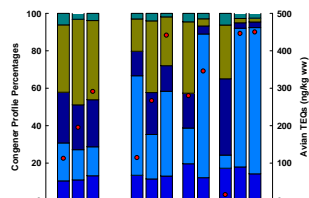


Fig. 4. House wren individual egg congener profiles and total avian TEQs (ng/kg ww) collected in the Tittabawassee River floodplain.

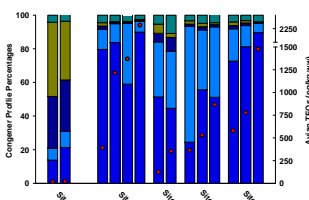


Table 1. Passerine egg avian TEQ concentrations (ng/kg ww) from both addled and fresh eggs collected in 2005.

Species	Upstream	Downstream
	mean \pm SD (range)	mean \pm SD (range)
Eastern bluebird	42.4 \pm 49.9 (8.83-99.7) $n=3$	293 \pm 286 (31.0-1050) $n=10$
House wren	17.7 \pm 2.12 (16.2-19.2) $n=2$	859 \pm 623 (122-2290) $n=12$
Tree swallow	199 \pm 89.5 (122-291) $n=3$	295 \pm 162 (15.1-450) $n=8$

- WHO_{Avian} TEQs are made up of 80-90% PCDF congeners (2,3,4,7,8-PeCDF/2,3,7,8-TCDF) at target sites (Figs. 2-5.)
- Congener profiles at reference sites (1+2) include higher percentages of PCDD congeners (Figs. 2-5.)
- Dietary based congener profiles for each species were similar (Fig. 2.)
- TEQ concentrations at target sites ranged from 15.1 to 2300 pg/g ww (Table. 1.)
- Custer *et al.* [3] implicated average dioxin TEQ concentrations of 500 to 1,100 pg/g ww (primarily 2,3,7,8-TCDD) in reduced hatching success in a field study of tree swallows in Rhode Island, USA
 - TEQ concentrations at the reference locations averaged 52 and 94 pg/g ww

CONCLUSIONS

- Some egg TEQ concentrations were similar to those implicated in Custer *et al.* [3] as causing reduced hatching success
- House wren eggs have 2-3x higher TEQ concentrations compared to the other species
- Possible congener profile differences between species needs to be further evaluated
- All data presented are from one year of data collection and should be considered preliminary
- Future research will include analysis of additional egg ($n=87$) samples, and both nesting ($n=124$) and adult ($n=66$) samples for concentrations of PCDF/Ds from the study area

LITERATURE CITED

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