

PCDF and PCDD congener concentrations in cavity nesting duck eggs

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ABSTRACT

Cavity nesting duck eggs collected in the Tittabawassee and Chippewa 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). Twenty nest boxes were placed upstream of which 11 (55%) were occupied, and 34 nest boxes were placed downstream of Midland of which 21 (62%) were occupied throughout the breeding season. Fresh and addled eggs were collected from 2 reference sites upstream and 5 target sites downstream of Midland in 2005. Seventeen 2,3,7,8 (PCDF/PCDD) congeners were measured and converted to TEQs using avian WHO TEF values. Concentrations of TEQs in wood duck and hooded merganser eggs ranged from 3.12-684 ng/kg wet weight downstream of Midland. PCDF and PCDD congener profiles were compared across species and locations, and to soil/sediment and possible dietary items. Avian TEQs were primarily (>90%) composed of 2,3,7,8-TCDF and 2,3,4,7,8-TCDF for downstream sites, which is similar to co-located soil, sediment, and invertebrate concentrations.

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: wood duck (*Aix sponsa*) and hooded merganser (*Lophodytes cucullatus*)

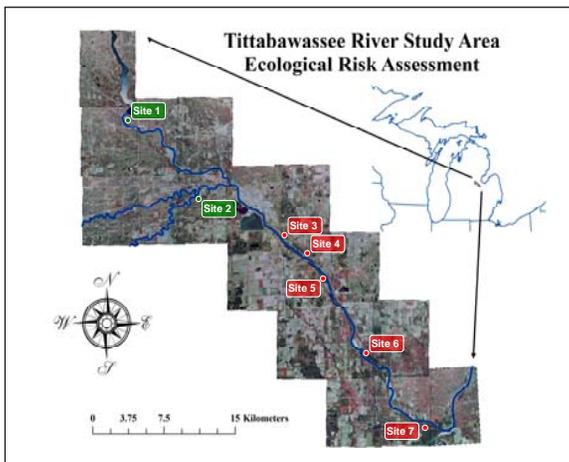


Fig. 1. Tittabawassee River study area in Midland Co, Michigan USA. Upstream reference sites (1 & 2) and downstream target sites (3-7) are indicated, all study sites were located within the Tittabawassee, Chippewa, and Pine River 100-yr floodplains.

METHODS & MATERIALS

- In 2004, 52 nest boxes placed at 2 reference sites (n=20) and 5 target sites (n=34)
- Egg samples collected April-May 2005
 - 1 fresh egg/nest was collected
 - Addled eggs were sampled from abandoned or depredated nests
- Processed eggs were lyophilized
 - Concentrations are based on wet weight
- Chemical extraction followed EPA method 3540C & 3541
- Chemical analyses followed EPA method 8290
- Results are corrected based on recoveries and non-detect congeners = ½ detection limit
- TEQ concentrations are based on avian-specific World Health Organization (WHO_{Avian}) TCDD equivalency factors [2]



RESULTS & DISCUSSION

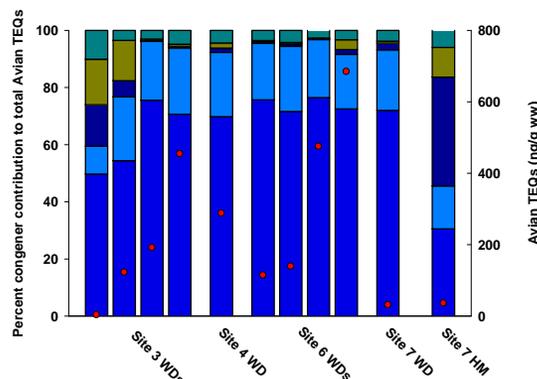
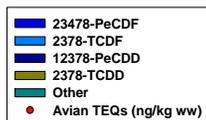
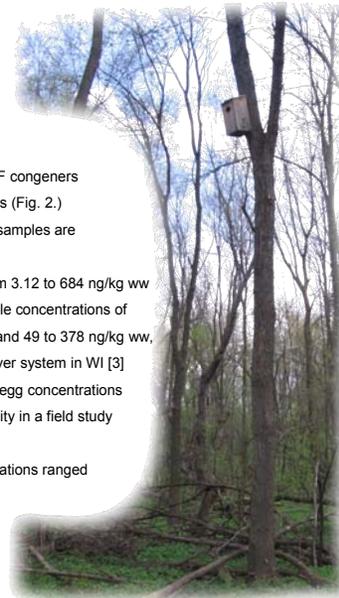


Fig. 2. Cavity nesting waterfowl individual egg congener profiles and total TEQs (ng/kg ww) collected in the Tittabawassee River floodplain (WD – wood duck, HM – hooded merganser).



- 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 (Fig. 2.)
- Congener profiles for 3 of 11 target area egg samples are similar to reference area food web profiles
- TEQ concentrations at target sites ranged from 3.12 to 684 ng/kg ww
- Wood duck and hooded merganser egg sample concentrations of 2,3,7,8-TCDD ranged from ND to 6 ng/kg ww and 49 to 378 ng/kg ww, respectively, collected from a contaminated river system in WI [3]
- White and Hoffman [4] implicated dioxin TEQ egg concentrations of > 20-50 ng/kg ww with decreased productivity in a field study of wood ducks in Arkansas
 - TEQ concentrations at the reference locations ranged from ND to 5.8 ng/kg ww



CONCLUSIONS

- Target area WHO_{Avian} TEQ concentrations are comparable to other field collected wood duck egg samples
- Some egg TEQ concentrations were similar to those implicated in White and Hoffman [4] as causing decreased productivity
- 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=27) samples for concentrations of PCDF/IDs from the study area

LITERATURE CITED

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