



PCDF and PCDD concentrations in great horned owls (*Bubo virginianus*) inhabiting the Tittabawassee River floodplain in central Michigan



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ABSTRACT

The great horned owl (*Bubo virginianus*) is a long-lived top predator that maintains its territory year-round. Because of its potential for accumulating contaminants, the great horned owl (GHO) has been chosen as an indicator species to determine the impacts of polychlorinated dibenzofuran (PCDF) and polychlorinated dibenzo-p-dioxin (PCDD) on terrestrial wildlife species along the Tittabawassee River in central Michigan, USA. The Tittabawassee River contains elevated levels of PCDFs and PCDDs in sediments, floodplain soils, and fish downstream of Midland, MI. From 2005 through 2006, plasma was collected from 31 nestlings and 14 adult resident GHOs. The plasma was analyzed for PCDF and PCDD concentrations as part of an on-going wildlife study conducted in support of an ecological risk assessment of the Tittabawassee River

INTRODUCTION

The Tittabawassee River floodplain in Midland, MI, is contaminated with elevated levels of PCDFs and PCDDs. The Aquatic Toxicology Laboratory at Michigan State University is examining the impact of this contamination on resident great horned owl (*Bubo virginianus*) populations. As tertiary predators and year-round residents, great horned owls have the potential to be exposed to high levels of bioaccumulative contaminants. To determine the owls' PCDF and PCDD accumulation we have sampled plasma from nestlings and adults in the Tittabawassee River floodplain.



Table 1. Mean avian TEQ concentrations (ng/L) for GHO plasma in the Tittabawassee River floodplain

	Upstream	Downstream
Nestlings	0.78 (0.50) N=5	3.40 (2.24) N=14
Adults	3.42 (1.46) N=5	11.53 (11.09) N=9

METHODS

- GHO territories were located via call-response surveys.
- Artificial nesting platforms were installed in known GHO territories
- Blood was drawn from nestling GHOs ~6wks post-hatch by accessing the nests and lowering nestlings to the ground.
- Adult GHOs were caught in mist-nets by using a plastic decoy great horned owl and broadcasting a territorial GHO call.
- After collection, blood was stored in a heparinized Vacutainer.
- Within 2 hours after collection blood was spun down in a centrifuge and plasma decanted for analysis.
- Chemical extraction followed EPA method 3540C and 3541.
- Congener-specific PCDF/D analysis was conducted with GC/high resolution MS following EPA method 8290
- Results are corrected based on recoveries and non-detect congeners = 1/2 detection limit.
- Great horned owl plasma concentrations are estimated based on avian-specific World Health Organization (WHO_{Avian}) TCDD equivalency factors

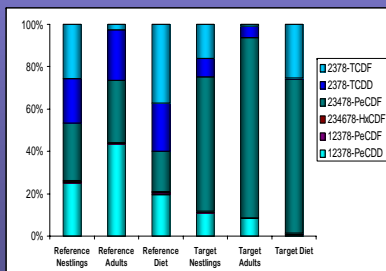


Chart 1. Congener profiles of GHO nestlings, adults, and dietary items

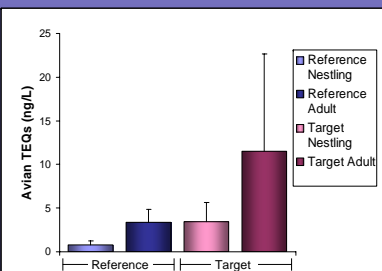


Chart 2. Mean avian TEQ concentrations (ng/L) in GHO plasma

RESULTS AND DISCUSSION

UPSTREAM VS DOWNSTREAM

Great horned owl plasma PCDF/D concentrations downstream (target area) of Midland, MI, are higher than those upstream (reference area) (Table 1). It is interesting to note, however, that adult and nestling plasma concentrations are significantly different (one-sided student t-test, $p < 0.05$), and nestling PCDF/D concentrations in the target area are nearly identical to adult concentrations in the reference area, despite having different congener profiles (Charts 1 and 2). This is likely due to the duration of exposure, growth dilution, and metabolic differences between nestlings and adults. Great horned owls have been known to survive for over 28 years in the wild, during which time even background concentrations of bioaccumulative compounds such as furans and dioxins can result in elevated tissue concentrations. In addition, nestling great horned owls are growing at a fast pace; the PCDF/D plasma concentrations are naturally diluted as the nestling's mass increases.

CONGENER PROFILES

There are distinct differences in congener profiles for target and reference owls. In the reference areas the primary congeners are 1,2,3,7,8-PCDD, 2,3,4,7,8-PCDF, and 2,3,7,8-TCDD. In contrast, the primary congener in the target area is 2,3,4,7,8-PCDF. These profiles are consistent with samples in different matrices in the floodplain, including the great horned owls' dietary items (Chart 1). The match in congener profile between diet and plasma indicates the owls' exposure can be attributed to their feeding habits.

GREAT HORNED OWLS REPRESENTATIVE OF CONTAMINATION

These data indicate that the great horned owls of the Tittabawassee River floodplain provide representative samples of the nature and extent of PCDF/D exposure in the terrestrial ecosystem: PCDF/D concentrations in both nestling and adult owls are consistently higher downstream of Midland, MI; congener profiles are consistent within sites and different between sites; and the plasma congener profiles are aligned with dietary congener profiles derived from the site-specific GHO dietary composition. In addition, the owl PCDF/D plasma concentrations are similar to plasma concentrations found in great blue herons foraging along the Tittabawassee River (range = 2-20 ngTEQ/L). The slightly higher concentrations in owl plasma are most likely attributed to the movement of the contaminants into floodplain soils and sediments.

CONCLUSIONS

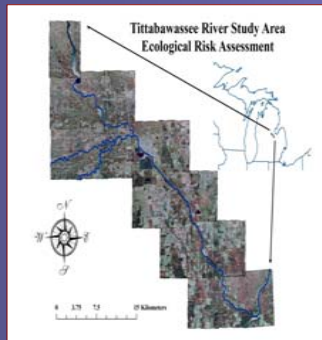
- Great horned owls downstream of Midland, MI are being exposed to elevated concentrations of PCDFs/Ds.
- Congener profiles are consistent between adults, nestlings, and dietary items for each site.
- Upstream and downstream congener profiles do not match, indicating different sources of exposure.
- The concentration and congener consistency within sites and matrices indicate the great horned owls in this study provide representative data of the extent of terrestrial exposure to the contamination in the Tittabawassee River floodplain.

REFERENCES

Coefield, S.J. "Great Horned Owl Site-specific Dietary Exposure to PCDF/Ds in the Tittabawassee River Floodplain in central Michigan." 28th Annual Society of Environmental Toxicology and Chemistry Meeting, November 11 15, 2007, Milwaukee, Wisconsin.

Nero RW. New great horned owl longevity record. *The Blue Jay* 1992;50:91-2.

Seston, R.M. "Preliminary PCDF and PCDD tissue-based assessment of great blue heron (*Ardea herodias*) residing in the Tittabawassee River floodplain, MI, USA." 28th Annual Society of Environmental Toxicology and Chemistry Meeting, November 11 15, 2007, Milwaukee, Wisconsin.



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