

# PRELIMINARY PCDF AND PCDD TISSUE BASED ASSESSMENT OF BELTED KINGFISHER (*CERYLE ALCYON*)



## RESIDING IN THE TITTABAWASSEE RIVER FLOODPLAIN, MI, USA

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### ABSTRACT

The belted kingfisher (*Ceryle alcyon*) was selected as a receptor species in an ecological risk assessment being performed on the Tittabawassee River, Michigan, USA. The high trophic status of the kingfisher, along with its strong site fidelity, territoriality, and limited foraging range, make it an ideal receptor species to investigate compounds possessing bioaccumulative potential. The target study area, which includes 38 km of the river from the upstream boundary at the city of Midland, MI to the confluence of the Tittabawassee and Shiawassee Rivers, has previously been shown to contain elevated concentrations of polychlorinated dibenzofurans (PCDFs) and polychlorinated dibenzo-*p*-dioxins (PCDDs) in soils, sediments, and biota. Kingfisher eggs and nestlings were collected from nests in both reference and target areas. Concentrations of the seventeen 2,3,7,8 substituted PCDD/Fs were quantified in eggs and whole-body nestling homogenates and normalized to 2,3,7,8 dibenzo-*p*-dioxin using WHO avian TEFs. Total TEQs in nestlings collected from the reference area was 7.5-8.3 ng/kg, ww (n=2) and ranged from 3.3x10<sup>-1</sup>-1.4x10<sup>2</sup> ng/kg, ww (n=4) in the target area. On a TEQ basis, 2,3,7,8-TCDF and 2,3,4,7,8-TCDF were the predominant congeners contributing to approximately 90% of the total TEQ attributable to dioxins and furans.

### INTRODUCTION

- Around the turn of the century, dibenzofurans, dioxins and other contaminants were released into the Tittabawassee River near Midland, MI.
- Mean PCDF/D concentrations in soils and sediments downstream of Midland, MI were 10- to 20- fold greater than those collected from an upstream reference area.
- Belted kingfisher (*Ceryle alcyon*) selected as a receptor species due to its presence on site, high trophic status, territoriality, site fidelity, and limited foraging range.

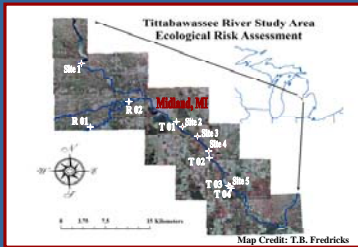


Figure 1. Target area consists of 38 km of river, stretching from the city of Midland, MI to the confluence of the Tittabawassee and Shiawassee Rivers. Reference areas include the Tittabawassee River upstream of Midland, along with the Chippewa and Pine Rivers.

### METHODS AND MATERIALS

- Kingfisher nest chambers were located along the Tittabawassee River and associated reference areas May through July, 2005.
- Nests were accessed by excavating the ground behind the nest and installing an access door.
- One nestling was collected from each nest and euthanized through cervical dislocation. Each was given a unique field identification label, placed in an I-Chem jar, and stored at -20°C.
- Feathers, legs, and beak were removed prior to the preparation of the whole-body homogenate.
- Analyses of the seventeen 2,3,7,8 substituted PCDF/D congener concentrations were conducted at AgriQuality Limited (Lower Hutt, New Zealand) using EPA method 8290.
- All TEQ values based on avian World Health Organization TCDD equivalent factors [1]

### RESULTS AND DISCUSSION

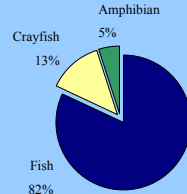


Figure 2. Site-specific dietary composition

Table 1. 95% UCL TEQs in dietary items (ng/kg) collected from Tittabawassee River. Sites with n=1, actual value reported(\*). Target values expressed as a range from all target sites.

	Reference	Target
Sediment	1.92	82.2 – 2570
Amphibian	1.36	39.8 – 506
Crayfish	0.45	55.3* – 422*
Forage fish	0.92	130* – 272

Table 2. Potential average daily dose (ADD<sub>POT</sub>) (ng/kg body weight/day) [2] calculated from 95% UCL TEQs (ng/kg ww) in dietary items collected from Tittabawassee River.

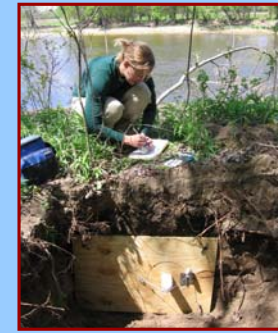
	ADD <sub>POT</sub>
Site 1 (Reference)	0.46
Site 2 (Target)	59.66
Site 3 (Target)	83.03
Site 4 (Target)	120.02
Site 5 (Target)	166.00

$$ADD_{POT} \text{ (ng / kg BW / day)} = \sum_k \frac{C_k \times FR_k \times NIR_k}{NIR} \times 10^{-6}$$

NIR = 0.50 kg / kg BW / day

Table 3. TEQs (ng/kg ww) in whole-body kingfisher nestling homogenates collected from Tittabawassee River study area.

Nest Site	TEQs
R 01	8.49
R 02	7.48
T 01	54.5
T 02	62.0
T 03	142
T 04	32.8



Completed nest chamber excavation with access door installed for future visits to the nest.

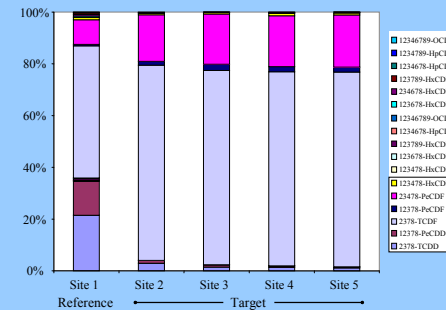


Figure 3. Seventeen 2,3,7,8 substituted PCDF/D congener profile of dietary items collected from sites on the Tittabawassee River. Site locations are shown on Figure 1. Based on WHO<sub>AVIAN</sub> TEQ (1/2 DL).

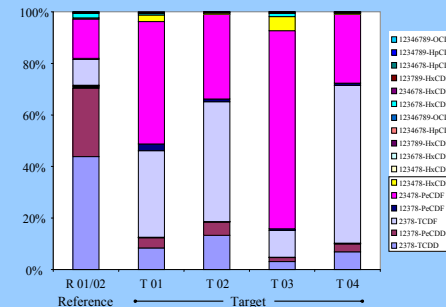
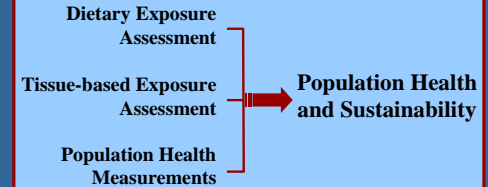


Figure 4. Seventeen 2,3,7,8 substituted PCDF/D congener profile of whole-body kingfisher nestling homogenates from nestlings collected in the Tittabawassee River study area. Nest locations are shown on Figure 1. Based on WHO<sub>AVIAN</sub> TEQ (1/2 DL).



### MULTIPLE LINES OF EVIDENCE



### CONCLUSIONS

- Site-specific dietary composition calculated for the Tittabawassee River floodplain is similar to those of other ecosystems in the Midwest [3,4].
- TEQs in sediment and dietary items from the target area of the Tittabawassee River are approximately 30x – 1300x greater than those from the reference area.
- Approximately 90% of the TEQs in dietary items and kingfisher nestling tissue from the target area can be attributed to 2,3,7,8-TCDF and 2,3,4,7,8-PeCDF.
- ADDs in the reference area are least 130x less than those calculated for the target area, which increase with a downstream trend.
- TEQs in kingfisher nestling tissues from the target area are approximately 4x – 18x greater than those from the reference area.
- The shift from a predominance of 2,3,7,8-TCDF in dietary items to 2,3,4,7,8-PeCDF in kingfisher nestlings has also been observed in mammalian tissues collected onsite, and is likely due to metabolism.
- All data presented are from one year of sampling and should be considered preliminary
- Future research will include analysis of eggs (n=68) and additional nestlings (n=7)

### REFERENCES

1. Van den Berg, M., et al. (1998) *Environ Health Perspect* 106:775-79.
2. USEPA (1993) *Wildlife Exposure Handbook*
3. Salyer, J.C., Lagler, K.F. (1946) *Trans Am Fish Soc* 76:97-117.
4. Davis, W.J. (1982) *Auk* 99:353-362.

### ACKNOWLEDGEMENTS

- The hard work and dedication of all the members of our field and laboratory research teams made this research possible.
- Personnel at Entrix, Inc. (East Lansing office) for assistance with data management.
- I would like to thank the Michigan State University Museum for access to their Vertebrate Paleontology Collection.
- Funding was provided through an unrestricted grant from The Dow Chemical Company to Michigan State University.