

ASSESSMENT OF BELTED KINGFISHER (*CERYLE ALCYON*) DIETARY EXPOSURE TO PCDFs AND PCDDs IN THE TITTABAWASSEE RIVER, MI



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ABSTRACT

A site-specific dietary assessment of belted kingfishers residing in the Tittabawassee River floodplain was conducted. The target study area includes 38 km stretch of the Michigan river that previous studies have shown to contain elevated concentrations of polychlorinated dibenzofurans (PCDFs) and polychlorinated dibenzo-*p*-dioxins (PCDDs) in soils, sediments, and biota. Dietary exposure was estimated using site-specific concentrations of representative dietary items, which were determined by both site-specific and literature-based dietary compositions. Site-specific dietary composition was determined through identification of prey remains collected from kingfisher nests within the study site. Concentrations of the seventeen 2,3,7,8 substituted PCDFs and PCDDs were quantified in select dietary items and normalized to 2,3,7,8 dibenzo-*p*-dioxin using WHO avian TEFs. Total TEQs in prey items ranged from 3.8×10^{-1} - 1.5 (n=3) and 1.2×10^1 - 4.0×10^2 (n=8) ng/kg ww for crayfish upstream and downstream, respectively, and from 9.0×10^{-1} - 1.1×10^1 (n=2) and 1.3×10^2 - 4.0×10^2 (n=4) ng/kg ww for forage fish (<25cm) upstream and downstream, respectively. Dietary exposure, based on both literature and site-specific dietary compositions, as well as resulting hazard quotients for belted kingfisher are presented.

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.

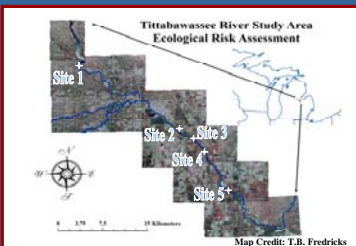


Figure 1. Target area consists of 38 km of river, stretching from the city of Midland, MI to the confluence of the Tittabawassee and Shiawassee Rivers. Reference areas include the Tittabawassee River upstream of Midland, along with the Chippewa and Pine Rivers.

METHODS AND MATERIALS

- Prey remains were collected from kingfisher nest chambers located along the Tittabawassee River and associated reference areas May through July, 2005.
- Prey remains were sorted to taxonomic class. Distinguishable elements of fish were used for identification to taxonomic family.
- Estimates of individuals were determined by counting the most numerous element for each class of prey identified. If this was a paired element, the total was halved to give an estimate of the minimum number of individuals.
- Analyses of the seventeen 2,3,7,8 substituted PCDF/D congener concentrations were conducted at AgriQuality Limited (Lower Hunt, New Zealand) using EPA method 8290.
- All TEQ values based on avian World Health Organization TCDD equivalent factors [1]

RESULTS AND DISCUSSION

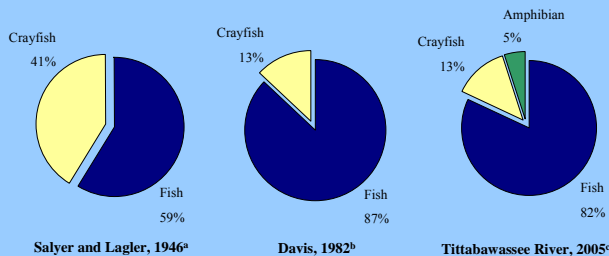
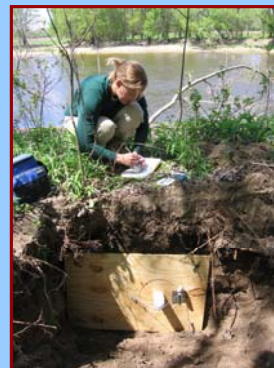


Figure 2. Composition of literature-based and site-specific kingfisher diets.

- Salyer and Lagler [2] based dietary composition on % wet volume of prey items recovered in stomach contents. Study took place in Michigan.
- Davis [3] based dietary composition on prey item occurrence, determined through observation of items brought to nest. Study took place in Ohio.
- Tittabawassee River dietary composition based on prey item occurrence, determined through identification and enumeration of prey remain skeletal items recovered from kingfisher nest chambers



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



Prey remains in an excavated kingfisher nest chamber.

- Prey remains identified in the nest include:
 - Fish – Operculum, pharyngeal arches, dentary, otoliths, and cleithrum
 - Crayfish – Chelipeds
 - Amphibian – Pelvis, femur
- Identified fish families include:
 - Cyprinidae (minnows and carps)
 - Ictaluridae (catfish)
 - Percidae (perch and darters)
 - Catostomidae (suckers)

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

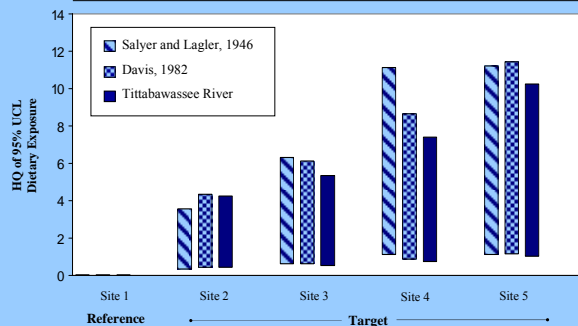
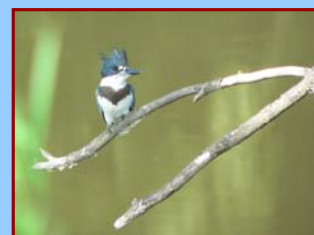


Figure 3. Comparison of literature-derived and site-specific dietary based HQs at the reference and target areas of the Tittabawassee River Study Area. The range in values represents the spread between the NOAEL and LOAEL. HQs were calculated using 14 ng/kg bw/day NOAEL and 140 ng/kg bw/day LOAEL TRV, adopted from a ring-necked pheasant study [4]. Location of the sites are marked on Figure 1.



Juvenile male kingfisher on feeding perch.

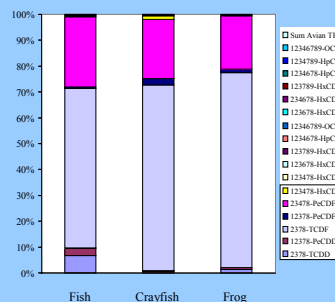


Figure 4. Seventeen 2,3,7,8 substituted PCDF/D congener profile of dietary items collected from Site 4 on the Tittabawassee River. Based on WHO_{AVIAN} TEQ (1/2 DL).

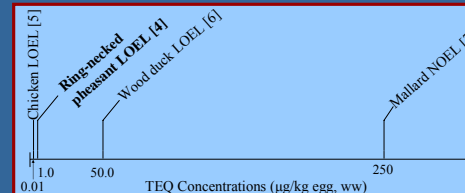


Figure 5. Relative species TEQ sensitivity to cause adverse effects.

CONCLUSIONS

- Dietary composition variations did not have a large impact on HQ.
- Approximately 90% of the TEQs in dietary items from the Tittabawassee River can be attributed to 2,3,7,8-TCDF and 2,3,4,7,8-PeCDF.
- Dietary composition of belted kingfisher on the Tittabawassee River was similar to dietary compositions determined on other rivers in the Midwest.
- Present sample size led to the use of 95% UCL dietary exposure data in the calculation of HQs for a conservative estimate of risk.
- Although some of the HQs are greater than 1, it is not certain that belted kingfisher along the Tittabawassee River are experiencing adverse effects.
- These are first-year data from a multi-year study that is utilizing a multiple lines of evidence approach, including dietary and tissue-based assessments and population health assessment.

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