METHODOLOGY EMPLOYING BELTED KINGFISHER (*CERYLE ALCYON*) AS A RECEPTOR IN AN ECOLOGICAL RISK ASSESSMENT OF THE TITTABAWASSEE RIVER, MI, USA

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ABSTRACT

The life history characteristics of the belted kingfisher (*Ceryle alcyon*) make it an ideal receptor species to use in ecological risk assessments. The high trophic status of the kingfisher, along with site fidelity, territoriality, and limited foraging range, make it a model receptor species to investigate compounds possessing bioaccumulative potential. As such, the belted kingfisher has been selected as a receptor species in an ecological risk assessment being performed on the Tittabawassee River, Michigan, USA. Kingfishers offer a number of technical hurdles which needed be overcome in order for them to be an effective study species. Kingfishers burrow 1-2m into earthen banks to make their nests, making accessing the nest for exposure and population health measurements difficult. Herein we describe the methodologies utilized to assess kingfisher burrows daily in order obtain exposure and effects data. In short once active nesting burrows were located, access doors were installed at the rear of the nest chamber by excavating the ground behind the nest. These doors allow for monitoring of clutch size, nestling weights over time to construct growth curves, hatching and fledging success, and sample collection for both dietary composition and tissue exposure measurements. Additionally, the doors are fitted with video ports which allow for video-recording of activities occurring in the nest. These methodologies have been shown to be effective for obtaining the necessary data to use the belted kingfisher as a receptor species. These methodologies may increase the potential utilization of this important receptor species in ecological risk assessments.

INTRODUCTION

- Around the turn of the century, dibenzofurans, dioxins and other contaminants were released into the Tittabawassee River near Midland, MI.
- 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.

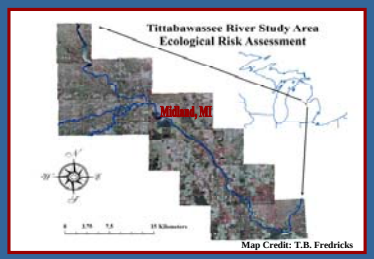


Figure 1. Target area consists of 38 km of river, stretching from the city of Midland, MI to the confluence of the Tittabawassee and Shiawassee Rivers. Reference areas include the Tittabawassee River upstream of Midland, along with the Chippewa and Pine Rivers.

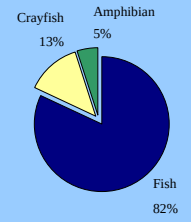
NEST LOCATION AND EXCAVATION

- Float rivers from mid-April to mid-May examining steep, unvegetated banks for distinctive burrows.
- Determine status of nest by evidence of fresh digging, presence of "two-track", defensive KF behavior, and inspection with burrow cam.
- Location of nest cavity determined by measuring length and angle of burrow from the entrance, and marking this spot on the ground surface.
- A trench is dug behind estimated nest location to a depth approximately 8 inches below the estimated depth of the nest cavity. The excavation moves toward the nest cavity by 1-2 inch intervals.
- Once the nest cavity is located, an access door is installed to allow for easy access to the nest on return visits [1] and video recording of nest activities.

DETERMINATION OF DIETARY COMPOSITION

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)



Tittabawassee River, 2005

- 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.

Tittabawassee River dietary composition based on prey item occurrence, determined through identification and enumeration of prey remain skeletal items recovered from kingfisher nest chambers. This site-specific dietary composition will be used to predict dietary exposure to the contaminants of concern.

COLLECTION OF TISSUE SAMPLES

Egg Sampling

- Egg collection was done at the time of nest excavation if eggs were present.
- One egg was collected from clutches containing three or more eggs.
- All eggs considered abandoned were also sampled.
- Sampled eggs were wrapped in chemically cleaned aluminum foil and placed in individual I-Chem jars.
- Fertilization and stage of development were determined for each egg.
- Eggs were analyzed for concentrations of the seventeen 2,3,7,8 substituted PCDF/D congener were conducted at AgriQuality Limited (Lower Hutt, New Zealand) using EPA method 8290.

Nestling Sampling

- Nestling collection was done at an age of 15 days.
- One nestling was collected from each nest.
- Sampled nestlings were placed in individual I-Chem jars.
- Whole-body homogenates were analyzed for concentrations of the seventeen 2,3,7,8 substituted PCDF/D congener were conducted at AgriQuality Limited (Lower Hutt, New Zealand) using EPA method 8290.

POPULATION HEALTH MEASUREMENTS

Nestlings

- Measures of productivity (clutch size, hatching success, and fledging success).
- Construction of nestling growth curves.
- Nestlings were banded to determine survivorship and nest site fidelity.
- Activities in the nest were video-recorded using an infrared camera inserted through a port in the access door. Allowed for the observation of nestling behavior and adults bringing prey items to nestlings.

Adult

- Adult trapping was done at the entrance of nesting burrows.
- Spring-loaded trap with a hoop lined with mist net.
- Adult trips trigger wire upon entering burrow, covering burrow entrance with mist net.
- Trapping was done only when nest contained nestlings.
- Adults were banded for information regarding nest site fidelity and survivorship.

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

MULTIPLE LINES OF EVIDENCE

Dietary Exposure Assessment

Tissue-based Exposure Assessment

Population Health Measurements

→ **Population Health and Sustainability**

SUMMARY OF COLLECTED TISSUES

Study Area	Year	Nests	Eggs*	Nestlings*
Reference	2005	4	2 (7)	2 (1)
	2006	2	1 (1)	- (5)
Target	2005	6	4 (7)	4 (1)
	2006	14	9 (36)	4 (2)

*Values in parentheses were collected as salvage

CONCLUSIONS

- Installation of an access door behind kingfisher nests is an effective way to monitor productivity parameters, collect prey remains for dietary composition determination, and collect tissue samples for analysis of contaminant concentrations.
- Use of the spring-loaded mist net trap allowed for capture and banding of breeding adults for information on nest site fidelity and survivorship.
- Video-recording of activities in the nest is a useful way to monitor nestling behavior and feeding.
- These methodologies can be utilized in other ecological risk assessments to facilitate the use of the belted kingfisher as a receptor species.

REFERENCES

1. Mazeika, S., et al. (2006) *Waterbirds* 29(3):258-270.

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