

# Productivity of American Robins (*Turdus migratorius*) in the Tittabawassee River Floodplain.

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## ABSTRACT

Measures of reproductive success and population sustainability are important assessment endpoints in evaluations of ecological risk. During spring 2007, productivity data for the American robin were collected from the Tittabawassee River floodplain from 31 nests at reference sites upstream and 44 nests at target sites downstream of the city of Midland, MI, USA. Previous studies have indicated that target sites were exposed to concentrations of polychlorinated dibenzofurans (PCDFs) and polychlorinated dibenzo-*p*-dioxins (PCDDs) that were greater than in nearby reference areas. Estimates of dietary exposure for the American robin, based on analysis of PCDF and PCDD congeners in dietary items and soil normalized to 2,3,7,8 dibenzo-*p*-dioxin equivalents (TEQ) by use of WHO 1998 avian TEFs, suggested that the median daily dose was two orders of magnitude greater at target sites than reference sites, with 95th centile estimates of the daily dietary dose downstream of Midland being 430 ng TEQ/kg BW/d. Reproductive success and population sustainability of the American robin was assessed by measuring clutch size, hatch success, fledge success and nest success. Clutch sizes ranged from 1 to 4 eggs at both reference and target sites, and hatch success ranged from 0 to 100% at both reference and target sites. Fledge success ranged from 0 to 100% at both reference and target sites. Successful nest %, where one or more nestlings fledged, was 42% from reference sites and 45% at target sites.

## INTRODUCTION

The American robin (*Turdus migratorius*) is a useful receptor for the ecological risk assessment of study areas contaminated with bioaccumulative contaminants of concern (COCs) (Henning *et al.*, 2003). American robins have an intimate relationship with soil as a nest building material and soil ingesting invertebrates as dietary components, including earthworms. Robins are common and nesting distribution is widespread, making data collection and sampling realistic. The American robin is an ideal representative passerine study species exposed to the soil-to-invertebrate food web in the area of concern.

## METHODS AND MATERIALS

- American robin productivity endpoints measured in 2007 from nests located within the floodplains of target and reference areas throughout the Tittabawassee River floodplain
- Nests visited approximately every third day to record productivity variables
- Predicted daily dietary dose estimated using Crystal Ball with literature based dietary compositions, Wheelwright, 1986 and Howell, 1942 and site-specific dietary item TEQs
- Soil samples collected from the Tittabawassee River floodplain from 2003-2006
- Chemical extraction EPA methods 3540C and 3541
- Analyses of the seventeen 2,3,7,8 substituted PCDF/D congener concentrations in samples are conducted at AgriQuality Limited (Lower Hutt, New Zealand) using EPA method 8290
- All TEQ values based on avian World Health Organization toxicity equivalency factors (Van den Berg *et al.*, 1998)
- The TEQ concentrations are calculated by assigning a proxy value of 1/2 the detection limit (DL) for congeners below the DL
- Concentrations of TEQ in soil are expressed as ng/kg on a dry weight basis

**Table 1.** Concentrations of TEQ (ng/kg dw) measured in surface soil of the Tittabawassee River floodplain.

	Reference	Target
N	11	27
Mean	10.9	5650
SD	13.7	4430
Min	3.95	425
Max	24.8	18800

**Table 3.** Mean clutch size and total clutches located (N) for American robins of the Tittabawassee River floodplain.

	Reference	Target
N	31	44
Mean clutch size	2.8	3.0
SD	1.1	1.0

**Table 2.** Predicted average daily intake of TEQs (ng/kg body weight/day) for robins of the Tittabawassee River.

Centile	Reference	Target
50th	1.3	140
95th	3.6	430

**Table 4.** Concentrations of TEQ (ng/kg ww) measured in diet items of the Tittabawassee River and composition.

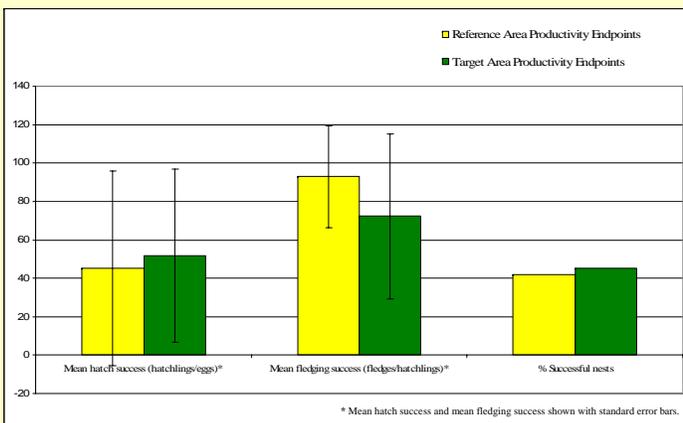
Order and % Composition	Ref. median	Ref. max	Target median	Target max
Plant 7%	0.6	1.8	2.7	13
Coleoptera 25%	3.3	16	410	1900
Lepidoptera 25%	1.0	1.5	42	98
Misc. 25%	1.2	4.5	23	380
Earthworm 18%	1.4	2.4	220	530

**Figure 1.** Predicted average daily intake calculation.

$$\text{Predicted average daily intake (ng WHO}_{1998} \text{ avian / kg BW / d)} = \frac{\sum (C_k \times FR_k \times NIR_k)}{k}$$

\* Normalized Ingestion Rate (NIR) = 0.71 g / g BW/day, food intake = 55g/d, and body mass = 77 g (USEPA, 1993)(Dunning, 1984).

**Figure 2.** Comparison of reference and target area American robin productivity.



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## RESULTS

TEQ concentrations in soil and predicted daily dietary intake are greater in target areas than in reference areas. Concentrations measured in reference area soils are as little as 3.95 ng/kg (dry weight) while target location soils exhibit concentrations as great as 18800 ng/kg (dry weight) (**Table 1**). In reference areas, the 95<sup>th</sup> centile predicted average daily intake for adult robins is 3.6 ng/kg body weight/day. In target locations, the 95<sup>th</sup> centile predicted daily intake is 430 ng/kg body weight/day (**Table 2**). The total number of nests located in reference and target areas was 31 and 44, respectively. Reference area mean clutch size was 2.8 eggs/clutch while target area mean clutch size was 3.0 eggs/clutch (**Table 3**). Reference area mean hatch success was 45% while target area mean hatch success was 52%. Mean fledge success was 93% in reference areas and 72% in target areas. % Successful nests was 42% and 45% in reference and target nests, respectively (**Figure 2**).

## CONCLUSIONS

- Mean soil TEQ concentrations are more than 500 times greater in target locations than in reference locations.
- 95th centile predicted average daily intake for American robins is over two orders of magnitude greater in target areas than in reference areas.
- Mean clutch size was similar in reference and target areas nests.
- Mean hatch success was similar in reference and target area nests.
- Mean fledge success was about 20% higher in reference areas than in target areas, though not statistically significant.
- % Successful nests was similar between reference and target areas.
- % Successful nests was higher than that of American robins of the Housatonic River where reference area % successful nests was 25% and target area % successful nests was 29%. (Henning *et al.*, 2003).

## REFERENCES

- Henning *et al.* (2003) *Environ. Toxic. and Chem.* 11: 2783-2788.
- Wheelwright (1986) *Auk* 103: 710-725.
- Howell (1942) *American Midland Naturalist* . 28: 529-603.
- Van den Berg *et al.* (1998) *Environ. Health Perspect.* 106: 775-79.
- USEPA (1993) *Wildlife Exposure Factor Handbook*. Fig. 4-7.
- Dunning (1984) *West Bird Band. Assoc. Mono.* 1 May: 19.

Nest success is similar for American robin nests in reference and target areas.

Mean target soil TEQs over 500 times greater than reference soil TEQs.

