Project 80: Birds as Indicators of Contaminant Exposure and Effects in the Great Lakes – Waukegan Harbor

Christine Custer and Thomas Custer,
USGS, Upper Midwest Environmental Sciences Center
La Crosse, WI
Introduction

Why swallows?

Overview – GLRI project

Specifics for Waukegan
Contaminant research on birds since the 1970s

Worked on the East Coast and Gulf Coast before moving to the upper Midwest in 1991

Began working with tree swallows in the mid-1990s
Why swallows - rather than other bird species
Attributes

- Feed on benthic invertebrates
- Close ties to sediment contamination
- Nest boxes at areas of interest
- Adequate sample size
- More localized feeding (+ 0.5 km)
- Integrate over appropriate time and space scales
- Linkage is short
- Numerous sampling points
- Efficient to sample
Scope of Work for GLRI Project 80

Use tree swallows and colonial waterbirds to:

1) Assist States & EPA in the assessment of wildlife BUIs (n = 2 BUIs)
2) Evaluate remedy effectiveness
3) Enhance our understanding of contaminant effects
1. Bird or Animal Deformities or Reproduction Problems

2. Degradation of Fish and Wildlife Populations
Wildlife BUIs

Tissue concentrations (e.g. PCBs, dioxins and furans, pesticides, PBDEs, trace elements [Hg, Se, Cd, etc.]), relative to effect concentrations

Directly measure reproductive rates

plus other effect endpoints (EROD, -omics, genetic damage, oxidative stress). Perfluorinated chemicals and other trace elements.

Diet samples for chemical analysis
States (MI & WI) seek to address these two wildlife BUIs in two ways –

- Actual data on deformities or adverse reproductive effects associated with contaminants
- Comparison of tissue concentrations associated with adverse population-level effects

“State of Wisconsin’s criterion for acceptable removal of the Deformities or Reproductive Problems BUI is to collect and evaluate observational data and make direct measurements for a minimum of two reproductive cycles. If reproductive rates at problem sites are not statistically different from those at minimally impacted reference areas, then the BUI can be delisted (WI DNR 2008, pg 25)”

“Michigan states that BUI of Bird or Animal Deformities or Reproductive Problems will be accomplished based on field assessment of birds or other wildlife (MI DEQ2006, pg 23). An alternative or additional approach identified by Michigan is to use levels of contaminants in biotic tissues known to cause reproductive or developmental problems, as an indicator of the likelihood of reproductive problems.”
Remedy Effectiveness

Before and After assessments

AOCs where dredging has occurred
- Maumee River (Ottawa River)
- Milwaukee (Lincoln Park)
- Muskegon (Division St. outfall)
- Raisin River
- Fox River/Green Bay
- St. Louis River
Strengths of this Project 80 are that

- Sampling the same matrices across all AOCs which allows for a much better assessments and understanding of contaminant exposures
- Multiple classes of chemicals – legacy + newer chemical classes
- Benchmarks for effects are available for birds so can interpret our results
- Directly measuring endpoints identified by States in their RAP documents
Overview and Progress -

• 60 sites (24 in 2010 ▲; 11 new in 2011 ▲; 12 more in 2012 ▲; 6 new in 2013 △; 7 new in 2014) are being assessed

• Sampling includes 27 AOCs & nearby areas for comparisons

• Sampling multiple bird species at 5+ AOCs to model to other parts of the aquatic ecosystem
Acknowledge our field teams

Tom and I – La Crosse
Paul Dummer & helpers – La Crosse
Chris Franson & helpers – USGS, National Wildlife Health Center, Madison, WI

Collaborators – other USGS offices, as well as, EPA and University personnel

http://www.umesc.usgs.gov/wildlife_toxicology/glri_project80.html
Waukegan Harbor AOC
Study Design and Overview

20 nest boxes per site

Monitor ~weekly (# eggs laid, # that hatch)

Collect samples at appropriate times

Chemical analysis done at Axys Analytical, Canada

Monitored nest boxes in 2012, 2013, 2014

2012  3 boxes used
2013  4 boxes used
2014  5 boxes used

Data are from 2012 only
PCBs (polychlorinated biphenyls)

Many industrial uses such as insulating and coolant functions in electrical apparatus and transformers, cutting fluids for machining operations, carbonless carbon paper, plasticizers, and many other uses. Stable in the environment and are lipophilic.

Banned in 1973
Tree swallows

Geo. mean (eggs)

<1 µg/g wet wt.
1.0 – 1.9
2.0 – 2.9
>3.0

St. Louis River
Stockton Isl.
Lake Superior
Manistique
Menominee
Green Bay Fox River
Sheboygan River
Lincoln Park Lakeshore Park
Lake Michigan
White Lake Muskegon
Kalamazoo
Lake Calumet area
Portage, IN
Bay City & Midland
Lake Huron
Lake Erie
Conners Creek
River Rouge
Wyandotte
Lake Erie MetroPark
River Raisin
Ottawa & Maumee Rivers
Ottawa Nat’l Wildlife Refuge
Trenton Channel
Clinton
Cape Vincent, NY
Stockton Isl.
Waukegan
Kalamazoo
Niagara
Lake Ontario
Lake Erie
St. Clair

Geo. mean (eggs)

<1 µg/g wet wt.
1.0 – 1.9
2.0 – 2.9
>3.0

USGS
New work

In 2014 collected barn swallow eggs from under the docks.

Expand our information on contaminant exposure and also assess whether there are differences between the two species.

In 2015, if funding permits, add additional study sites north and south of the harbor to quantify the geographical distribution of these high PCBs.
http://www.umesc.usgs.gov/wildlife_toxicology/glri_project80.html

Goals and objectives

Maps and habitats at current study sites

Preliminary results

Why use swallows?

PFCs

PBDEs
Thank you