WHOO’S WHOO? The Great Horned Owl as a Terrestrial Indicator Species in the Ecological Risk Assessment of the Tittabawassee River and Floodplain.

Chippewa Nature Center, April 27 2006

Sarah Coefield
Doctoral Candidate
Michigan State University
WHOO’S WHOO?

Matthew J. Zwiernik, Ph.D
Rita M. Seston
Timothy B. Fredricks
Jeremy N. Moore
Dustin L. Tazelaar
David W. Hamman
Bethany R. Opperman
Michael W. Nadeau
Emily M. Koppel
Lori E. Williams
Michael J. Kramer
Melissa S. Shotwell
Mike M. Fales
Patrick W. Bradley
John P. Giesy, Ph.D
And many more . . .
Special thanks to:

- Participating landowners
- Local resources
- The Dow Chemical Co.
This study will examine exposure levels and effects in various wildlife populations.

- Multiple receptor species
- Multiple lines of evidence
- Site-specific study
Tittabawassee River Ecological Studies

Receptor species

- Mink
- Belted kingfisher
- Great blue heron
- American robin
- House wren
- Tree swallow
- Eastern blue bird
- Hooded merganser
- Wood duck
- Great horned owl
Tittabawassee River Ecological Studies

Multiple lines of evidence

- Dietary exposure assessment
- Tissue-based exposure assessment
- Population health measurements
Tittabawassee River Ecological Studies

- Food web dietary items
  - Multiple time-points
  - Multiple locations
Food web dietary items
Lines of Evidence

Great horned owl population health and sustainability

Productivity and Abundance

- Swallows/Muskrats
- Aquatic emergent insects/Aquatic Plants
- Sediments

Tissue Concentration

- Small mammals & Passerines
- Terrestrial insects and Plants
- Soils
Why do we need a terrestrial indicator species for an aquatic-based contamination?

- Dioxin-like chemicals bind to sediment and are deposited in the floodplain during flood events.

- Terrestrial invertebrates, small mammals, and plants are exposed to this contamination, granting it access to the terrestrial food web.
Great Horned Owls as Indicator Species

There are several factors to consider in choosing an indicator species:

- intensity of exposure
- relative sensitivity to contaminants
- ecological function
- time spent on-site
- ease or difficulty of conducting field studies with the organisms
- appropriateness of the surrogate species
- size and types of the contaminated habitat
Great Horned Owl

Physical Characteristics

- 18-24 inches
- 2-5 pounds
- Distinctive ear tufts and large yellow eyes
- No seasonal, sex, or age difference in plumage
- Females larger than males
The great horned owl has the most extensive range, the widest prey base, and the most variable nesting sites of any American owl.
Great Horned Owl

Habitat

- Open and secondary-growth temperate woodlands, swamps, orchards, and agricultural areas
Great Horned Owl

Nest Selection

- Do not build or maintain a nest
- Male selects the territory
- Nest sites can include hawk nests, crow nests, hollow trees, tussocks of grass, rocky outcrops, caves, abandoned quarries, etc.
Great Horned Owl

Reproduction

- Monogamous
- Pair remains in territory year-round
- Sexually mature at 1yr old, but usually not active until at least 2 yrs old
Great Horned Owl

Reproduction

- Early nesters (January-February)
- Typically lay 1-4 eggs
- 30 day incubation
- Female stays on nest while male provides food
- Altricial
- Nestlings stay in nest for ~7wks before “branching”
- Parents continue to care for offspring until early fall
Great Horned Owl

Longevity

- Known to live up to 28 yrs in the wild
- Causes of mortality included starvation, predation (typically young owls), leg-hold traps, automobile collisions, shooting
Great Horned Owl

Diet

✓ Nocturnal predators
✓ Prey on mammals and birds
✓ Regurgitate pellets
Great Horned Owl

Dietary items

- Voles
- Squirrels
- Mink
- Skunks
- Raccoons
- Opossum
- Armadillos
- Cats and dogs
- Shrews
- Moles
- Muskrats
- Bats
- Grouse
- Woodpeckers
- Crows
- Turkeys
- Pigeons
- Red-tailed hawks
- Bitterns
- Great blue herons
- Ducks
- Swans
- Gulls
- Snakes
- Turtles
- Lizards
- Alligators
- Fish
- Insects
- Scorpions
- Centipedes
- Crayfish
- Worms
- Spiders
- Road-kill
- Marmots
- Kangaroo rats
Great Horned Owls as Indicator Species

- **Intensity of exposure**
  - Secondary consumers = high trophic status
  - Wide variety of prey species integrating several trophic levels
  - Potential for bioaccumulation

- **Relative sensitivity to contaminants**
  - Both captive and field studies have shown owls to be highly sensitive to a wide variety of environmental contaminants

- **Ecological function**
  - Top of terrestrial food chain
Great Horned Owls as Indicator Species

- **Time spent on-site**
  - Non-migratory (year-round)

- **Ease or difficulty of conducting field studies with the organisms**
  - Great horned owls will utilize artificial nesting structures
  - Fledgling offer little resistance
  - Dietary composition can be determined from pellets

- **Size and types of the contaminated habitat**
  - The combination of emergent forest, fields, and agricultural properties along the Tittabawassee River and reference areas provide miles of habitat for the owls.
Great Horned Owls as Indicator Species

As top predators, GHOs effectively integrate exposures from multiple trophic levels and habitats, and their abundance can be directly related to available prey and ultimately ecosystem health.

As a result, the owls can be good indicators of effects on all trophic levels.
Great Horned Owl

Tissue-based exposure assessment

Blood plasma is collected from both juvenile and adult great horned owls.
Great Horned Owl

Tissue-based exposure assessment: fledglings

Nest platforms
Great Horned Owl

Tissue-based exposure assessment: fledglings

Nest platform installation
Great Horned Owl
*Tissue-based exposure assessment: fledglings*

- Nest platform locations
  - 54 nest platforms installed
  - Owls have nested in 10 platforms
Great Horned Owl

_Tissue-based exposure assessment: fledglings_
Great Horned Owl

Tissue-based exposure assessment: fledglings
Great Horned Owl

Tissue-based exposure assessment: adults
Great Horned Owl

*Tissue-based exposure assessment*
Great Horned Owl

Population Health: Abundance and Productivity
Great Horned Owl

Population Health: Abundance and Productivity
Great Horned Owl
Population Health: Morphological measurements
Great Horned Owl
Population Health: Foraging range, dispersal, survival
Great Horned Owl

Dietary Composition Analysis
Great Horned Owl

Dietary Exposure

Imerman Park GHO Dietary Composition by Frequency

- Bird
- Lagomorph
- Peromyscous
- Meadow Vole
- House Mouse
- Meadow Jumping Mouse
Great Horned Owl

Dietary Exposure

Imerman Park GHO Dietary Composition by Biomass

- Meadow Jumping Mouse
- Meadow Vole
- House Mouse
- Bird
- Peromyscus
- Lagomorph
Great Horned Owl

Dietary Exposure Assessment

Representative Reference Small Mammal PCDD/DF Concentrations (Site 2)
Great Horned Owl
Dietary Exposure Assessment

Representative Downstream Small Mammal
PCDD/DF Concentrations (Site 3)

Avian TEQs (ng/kg)

Shrew
Deer mouse
Eastern chipmunk
House mouse
White footed mouse

0
1000
2000
3000
4000
5000
6000
So what is a TEQ, anyway?

- TEQ = Toxic equivalent
- TEQs allow toxicologists to speak to each other with a minimum of confusion
TEQs: an example for the real world

Take a trip around the world

- 50,000 pesos
- 25 pounds
- 72 euros
- 800 yen
- 374 marks

How much money do you have?
### Great Horned Owl

**Dietary Exposure Assessment**

Estimated Daily dietary dose (ng/kg/day) based on WHO Avian TEQs for total TCDDs

<table>
<thead>
<tr>
<th>Small Mammals</th>
<th>Herbivorous Small Mammals</th>
<th>Shrews</th>
<th>Total Small Mammal Dietary Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ADDPot Reference</strong></td>
<td>0.0004 to 0.0109</td>
<td>0.0003 to 0.0013</td>
<td><strong>0.0007 to 0.0123</strong></td>
</tr>
<tr>
<td><strong>ADDPot Target</strong></td>
<td>0.04 to 1.04</td>
<td>0.0565 to 0.283</td>
<td><strong>0.0979 to 1.32</strong></td>
</tr>
</tbody>
</table>
Great Horned Owl

Summary

Dietary exposure assessment

- Examination of prey remains
- Dietary items have been sampled
- Telemetry is being used to determine foraging area

Tissue-based exposure assessment

- Samples collected
  - Addled eggs
  - Blood plasma

Population health

- Productivity measurements
  - Clutch size
  - Hatching success
  - Fledging success
Chippewa Nature Center
Seminar Series

Wildlife Health Within the Tittabawassee River Basin

Chippewa Nature Center  400 S. Badour Road  Midland, Michigan 48640  p: (989) 631-0830

All Sessions of the Seminar Series will be held in the Visitor Auditorium at 7:00 p.m.

Seminar Series delivered by the Aquatic Toxicology Laboratory of the National Food Safety & Toxicology Center, Michigan State University

April 13, 2006  7:00 p.m.

Ecological Risk Assessment and the Tittabawassee River: Why, How, and Who Cares?
Presenter: Matthew Zwiernik, PhD  Professor, Michigan State University

Discussion of the following:

What is an ecological risk assessment?
What is it used for?
What information is typically collected?
Who uses an ecological risk assessment?
A description of the MSU Wildlife studies.

April 20, 2006  7:00 p.m.

Fishing for Answers! Using Two Fish-Eating Birds (the Belted Kingfisher and Great Blue Heron) as Receptors in the Tittabawassee River Ecological Risk Assessment
Presenter: Rita Seston, Doctoral Candidate  Michigan State University

Discussion of the following:

Background information on the Belted Kingfisher and Great Blue Heron.
Characteristics of the Belted Kingfisher and Great Blue Heron that make them desirable species to study.
Overview of how these species will be used in the Tittabawassee River Risk Assessment.
Summary of dietary exposure information from the first year of study.
Overview of methods used to gather all the necessary information.

April 27, 2006  7:00 p.m.

WHOOS WOOG?? The Great Horned Owl (Bubo Virginianus) as a Terrestrial Indicator Species in the Ecological Risk Assessment for the Tittabawassee River and Floodplain
Presenter: Sarah Coefield, Doctoral Candidate  Michigan State University

Discussion of the following:

Discussion of the natural history of the Great Horned Owl.
Why the Great Horned Owl is an appropriate species for study.
Methods used to study the Great Horned Owl and its dietary items.
Work that has been completed with the Great Horned Owls in the Tittabawassee Floodplain.
Dietary exposure at reference areas compared to target locations.

May 4, 2006  7:00 p.m.

From Bugs to Birds: An Assessment of Song Bird Dietary Exposure to PCDFs and PCDDs in the Tittabawassee River Floodplain
Presenter: Timothy Fredricks, Doctoral Candidate  Michigan State University

Discussion of the following:

Discussion of some characteristics of House Wren, Tree Swallow, and Eastern Bluebird.
Why we choose these species of song bird to study.
Why and how song birds are important in the risk assessment process.
Overview of dietary information from the first year of the study.
Dietary exposure estimates at reference areas compared to target locations.
Questions...

Sarah J. Coefield
Graduate Research Assistant
Michigan State University
Aquatic Toxicology Laboratory
(517) 432-3100 x172
coefield@msu.edu