The Effects of Lake Shoreline Development on Turtle Populations

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Outline

- Shoreline Development and Turtles
- Research Questions
- 2009 Field Season
  - Methods
- Question 1, Results
- 2010 Field Season
- Question 2
- What Can You Do?
Lake Shoreline Development

- Lakes are often the site of intense development
- Development leads to loss of fish and invertebrate habitat (e.g., CWD, riparian and aquatic vegetation)
Turtles and Lake Habitat

- Turtle use both riparian and in-lake habitat
- As a result, may be especially vulnerable to habitat disturbance associated with shoreline development
- Yet, no current study has quantified these effects
Quantifying Effects of Shoreline Development

- We quantify the effects of shoreline development on two species of turtle

  Northern Map Turtle
  - More sensitive
  - Narrow diet, nest close to shoreline, intolerant to pollution, dependent on basking

  Painted Turtle
  - Less sensitive
  - Varied diet, travel far to nest, tolerant to pollution
Research Questions

1) What are the effects of lake shoreline development on turtle behavior and populations?

2) What are the long-term impacts of lake shoreline development on long-lived organisms, such as turtles?
2009 Field Season...
Study Area 2009: 3 Lakes in Michigan
Lake Shoreline Development

- Shorelines were classified as developed or undeveloped
- Developed: any modification (retaining wall, house, lawn, agriculture)

Undeveloped Shoreline

Developed Shoreline
Lake Shoreline Development

- **We can measure development as:**
  - Percent shoreline developed
  - Number of piers per kilometer of shoreline
  - Number of houses per kilometer of shoreline
  - Housing density within a buffer of the lake shoreline
  - Roadway density within a buffer of the lake shoreline

- **Today, will just look at percent shoreline developed**
Lake Shoreline Development: Study Lakes

- 2009: 3 moderately developed lakes

45% Developed 55% Developed 61% Developed
Turtle Population Data

- Collected turtles using hoop traps and basking traps
- All painted and northern map turtles were measured, marked, and assessed for injuries from human sources (e.g. boat propellers, cars)
Female northern map turtles were fitted with radio transmitters and tracked throughout the active season (May through September)
Lake Habitat Data

- Quantified: CWD per kilometer of shoreline, water depth, percent cover for submersed, floating and emergent aquatic vegetation
Question 1: Effects of Lake Shoreline Development on Turtle Behavior and Populations

- What are the effects of lake shoreline development on turtle behavior and populations?

- Specifically, what are the effects of lake shoreline development on painted and northern map turtle age and size distributions, sex ratios, and injuries?
**Question 1**: Effects of Lake Shoreline Development on Turtle Populations

- **Expectations: Age and Size Distributions**
  - ↓ Riparian Habitat (e.g., lawns replacing native vegetation)
    - ↓ Nesting Habitat and Nest Success
      - ↓ Bigger and Older Populations
**Question 1: Effects of Lake Shoreline Development on Turtle Populations**

- **Expectations: Sex Ratios**

  - Human Presence (e.g., boats, cars)
    - Mortality and Injuries, esp. for Nest-Seeking Females
      - Male-Skewed Sex Ratios
Question 1: Effects of Lake Shoreline Development on Turtle Populations

- Expectations: Human-Related Injuries

- In-Lake Habitat (e.g., aquatic vegetation, CWD)
- Refuge, Foraging, and Basking
- Mortality and Injuries
**Question 1: Effects of Lake Shoreline Development on Turtle Populations**

- As percent shoreline developed ↑ ....
- Male painted turtle carapace (shell) length ↓
  - Linear regression (p=0.019)
- Expected high rates of juvenile mortality
- BUT, seeing high rates of adult mortality instead
- Also, less sensitive species

**Expectations**
- Riparian Habitat (e.g., lawns replacing native vegetation)
- Nesting Habitat and Nest Success
- Bigger and Older Populations
Question 1: Effects of Lake Shoreline Development on Turtle Populations

- As percent shoreline developed $\uparrow$ ....
- Painted turtle sex ratios were male-skewed
  - Logistic regression ($p=0.020$)

Expectations

$\uparrow$ Human Presence (e.g., boats, cars)

$\uparrow$ Mortality and Injuries, esp. for Nest-Seeking Females

Male-Skewed Sex Ratios
**Question 1: Effects of Lake Shoreline Development on Turtle Populations**

- As percent shoreline developed ↑ ....
- Human-related injuries in male painted turtles ↑
  - Logistic regression (p=0.046)
- For less sensitive species
- And, for males only!
- Females thought to be more vulnerable to injuries and mortality on land

**Expectations**
- In-Lake Habitat (e.g., aquatic vegetation, CWD)
- Refuge, Foraging, and Basking
- Mortality and Injuries
Question 1: Effects of Lake Shoreline Development on Turtle Populations

- Overall, less sensitive species seems to be experiencing:
  - High rates of adult mortality (smaller carapace lengths with more development)
  - High rates of mortality for females (male-skewed sex ratios)
  - And injury from human sources

- May be especially detrimental as turtles have naturally long life spans and low juvenile survivorship
Question 1: Effects of Lake Shoreline Development on Turtle Behavior

- What are the effects of lake habitat degradation on turtle behavior and populations?

- Specifically, what are the effects of lake shoreline development on northern map turtle in-lake habitat use?
Question 1: Effects of Lake Shoreline Development on Turtle Behavior

Telemetry data for female northern map turtles suggest they are avoiding developed shorelines.
**Question 1: Effects of Lake Shoreline Development on Turtle Behavior**

- Also, it telemetry data suggest females prefer nearshore areas with greater diversity of vegetation than areas of the lake with low plant diversity.
2010 Field Season and Beyond...
Study Area 2010: 2 Low Development Lakes in Michigan + 2009 Lakes
2010 Methodology

- Quantifying new measures of shoreline development
  - Road density and housing density surrounding lakes

- Increase sample sizes for both species

- Place transmitters on northern map turtles at low development lake

- Use telemetry data to quantify habitat selection, home ranges and relate to lake habitat and shoreline development
**Question 2: Long-term Impacts of Lake Shoreline Development on Long-lived Species**

- What are the long-term impacts of lake shoreline development on long-lived organisms, such as turtles?

- Specifically, how will changes in populations and behavior in turtles as a response to lake shoreline development impact long-term population persistence?
Question 2: Long-term Impacts of Lake Shoreline Development on Long-lived Species

- Turtles are long-lived species with life history traits that have co-evolved with their long life-span, including...
  - Delayed sexual maturity
  - Long generation times
  - Slow population growth rates

- As a result, are best suited for stable environments and vulnerable to permanent habitat changes
**Question 2:** Long-term Impacts of Lake Shoreline Development on Long-lived Species

- Turtles vulnerable to change and also may take decades to recover from it due to life history characteristics

- We will determine which vital rate (reproduction or mortality) has greatest effect on population growth rates

- Then, we will determine how changes in behavior and populations (Question 1) might affect the eventual persistence of these populations
What Can You Do?

- Don’t boat at high speeds in shallow waters
- Leave some shoreline natural (open sandy areas are best)
- Leave fallen trees in place
  - Or construct basking platforms
Acknowledgements

- Committee, including Brian Roth, Jim Harding, Mary Bremigan, and Tom Getty

- MSU’s Intramural Research Grants Program for funding

- Field assistants, especially Tammy Otto and Rick Henry

- MSU Limnology Lab
Questions?

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