Changes in a Lake County post-restoration amphibian community over 10 years

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Outline

- Site History
- Sources of Degradation
- Baseline Amphibian Community
- Restoration History
- Post-Restoration Monitoring & Changes in Amphibian Community
- Reintroduction Feasibility & Implementation
- Further Restoration & Emerging Issues
Site History of MacArthur Woods Forest Preserve

- Largest continuous tract of forest in Lake County
- Flatwoods Wetland Habitat
- Degraded by Several Factors:
  - Agricultural Drainage Tile
  - European Buckthorn (*Rhamnus cathartica*) Invasion
  - Fire Suppression
  - Lack of Oak-Hickory Regeneration
Loss of Amphibian Diversity

During the 1980s and 1990s, three characteristic flatwoods amphibians declined and were extirpated from MacArthur Woods:

- Spotted Salamanders (*Ambystoma maculatum*)
- Wood Frogs (*Lithobates sylvaticus*)
- Spring Peepers (*Pseudacris crucifer*)
Pre-Restoration Community

Amphibian species detected:

- Blue-spotted salamander (*Ambystoma laterale*)
  (87% of captures)
- American toad (*Anaxyrus americanus*)
  (10% of captures)
- Western chorus frog (*Pseudacris triseriata*)
  (2% of captures)
- Northern leopard frog (*Lithobates pipiens*)
  (< 1% of captures)
Habitat Restoration

- Hydrologic Restoration
- European Buckthorn Removal
- Prescribed Burns
- Replanting of Native Species
Post-Restoration Amphibian Monitoring

- How has amphibian diversity changed since restoration?
- Has natural recolonization of extirpated species occurred?
- Is reintroduction needed and if so, is it feasible?
Post-Restoration Sampling

- Used terrestrial and aquatic techniques to determine amphibian species richness
- Used visual encounter surveys, dip-net and cover surveys to determine amphibian richness of five neighboring preserves
Post-Restoration Community

Used capture data from 2004-2014 from six ponds to compare changes in:

- Amphibian richness ($S$) and relative abundances
- Amphibian diversity ($H'$) over time
  - Among ponds and for overall site
**Study Ponds**

**Pond 1**: Edge, temporary

**Pond 2**: Interior, temporary

**Pond 3**: Interior, temporary

**Pond 4**: Interior, temporary

**Pond 5**: Floodplain, semi-permanent

**Pond 6**: Oxbow, flashy
Post-Restoration Survey Results

- Trapping effort varied from 2400-9072 trap nights from 2004-2014
- Catch per unit effort varied from 0.03-0.18.
- 5526 amphibians were captured between 2004-2014.
- No natural recolonization of extirpated species but some natural colonization of new species.
- Neighboring preserves had equal or lower amphibian richness.

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Reintroduction Feasibility Assessment

• Natural recolonization of extirpated amphibians did not occur → reintroduction was warranted
• Source populations
  • Spotted salamanders in Will County, Illinois
    ▪ Wood frogs in northwestern Indiana
    ▪ Spring peepers in Lake County, Illinois
Reintroduction Feasibility Assessment

- Compare recruitment in source and restored sites
- Compare recruitment between resident and translocated species
  - Assess likelihood of reintroduced population persistence through PVA
- Monitored environmental variables: DO, pH, canopy cover, salinity, conductivity, hydroperiod
### Spotted Salamander Hatching Success

<table>
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<tr>
<th>Year</th>
<th>Site</th>
<th>Pond</th>
<th># Ponds Restored</th>
<th># Ponds Source</th>
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### Interspecific Ambystomatid Hatching Success in Restored Ponds

<table>
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<tr>
<th>Year</th>
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<th>Pond</th>
<th>Pond*Species</th>
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<td>2006</td>
<td>N.S.</td>
<td>N.S.</td>
<td>$P &lt; 0.001$</td>
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</table>
Field Hatching Rates of Ambystomatids

- Hatching rates appeared related to pond DO
- Restored pond DO levels ranged from a mean of 1.6-6.0 mg/l

Association between *Ambystoma maculatum* (filled circles) and *Ambystoma laterale* (open squares) hatching success (mean proportion hatched in field enclosures) and DO, 2005-2007 (Sacerdote and King, 2009).
Dissolved Oxygen Laboratory Experiments

- Gradient of D.O. levels 0-8 mg/l
- Three replicates of all treatments
- One *A. maculatum* egg mass in each aquarium
- Manipulated D.O. levels with nitrogen gas and air pumps.
- Repeated experiment with blue spotted salamanders with gradient of 2, 4, and 6 mg/l.
Laboratory Hatching Results

Mean (standard deviation) hatching success in *Ambystoma maculatum* (filled circles) and *Ambystoma laterale* (open squares) across laboratory dissolved oxygen gradients. Variation in hatching is depicted in the vertical plane. Variation (standard deviation) in observed dissolved oxygen levels for each DO treatment (0.0, 2.0, 4.0, 5.0, 6.0, 7.0 and 8.0 mg/l) is depicted in the horizontal plane. (Sacerdote and King 2009, *Wetlands*)
Hatching and Hypoxia

• Some ponds required further restoration to improve oxygen levels.
• Changes in overstory composition may influence pond hypoxia through differences in leaf litter decomposition rates.
Ambystomatid Hatching and DO Restoration Management in MWFP

- **2005:** Spotted salamanders hatch in Ponds 1 and 2
- **2006:** Spotted salamanders hatch in Ponds 1, 2, and 3
- **2007:** DO increased in Pond 4
- **Prescribed burn in Pond 3 basin reduces silver maple leaf litter**
- **Selective thinning and girdling of silver maples in Pond 4 reduces leaf litter and increases canopy openness**
- **2008 and 2009:** Spotted salamanders hatch in all ponds
Hatching Experiment Conclusions

- Spotted salamanders need > 4 mg/l for hatching
- Blue-spotted salamanders are more tolerant of hypoxia
- Differences in egg structure and oxygen delivery → differences in persistence
- Restoration methods targeting overstory improved DO and hatching success.
Larval Survival

Compared survival to metamorphosis in enclosures:

- Between spotted salamanders in restored and source sites
- Between spotted and blue-spotted salamanders in restored sites
- Among ponds within restored sites for spotted and blue-spotted salamanders, wood frogs, and spring peepers
Larval Survival

- Redistributed larvae
- Bi-weekly counts of all larvae
- Estimated survival rates

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<thead>
<tr>
<th>Species</th>
<th>Restored</th>
<th>Source</th>
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<td>Blue-Spotted Salamander</td>
<td>0.07-0.60</td>
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<td>Wood Frog</td>
<td>0.06-0.57</td>
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<tr>
<td>Spring Peeper</td>
<td>1.00</td>
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Larval Survival

- Both aquatic and terrestrial habitat quality may affect reintroduction success.
- Hatching and larval survival are essential to successful reestablishment of populations.
- Egg and larval stages are preferred for reintroducing populations.
Implementation of Reintroduction

- Egg mass counts at source sites
  - No more than 10% breeding effort removed
  - From 2007-2009, released 269 successful spotted salamander metamorphs
  - From 2008-2010, released 285 wood frog metamorphs
  - From 2008-2009 released 100 spring peeper metamorphs
Post-Restoration Survey Results

- Following reintroduction and supplementation efforts, richness continued to increase as amphibians established in the site.
- Spring peeper
- Wood frog

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Increasing Diversity with Time Since Restoration

\[ R^2 = 0.80 \quad (F_{1,10} = 41.0, \quad p<0.001) \]

\[ H' = 0.62 + 0.06x \]
Summary

- Habitat restoration had positive impacts on amphibian diversity
- Facilitated natural colonization by leopard frogs, tiger salamanders, and incidental bullfrogs and green frogs
- Improved site characteristics necessary for persistence of amphibians
- As of 2013, only spring peepers showed evidence of persistence and recruitment.
- In 2014, documented persistence and successful recruitment of wood frogs.
- No evidence of establishment for spotted salamanders yet.
Further Restoration

- Lake County FPD is conducting an oak-woodland restoration effort in MWFP and other nearby sites
- Should improve hypoxia issues in additional ponds
- Improve terrestrial habitat quality facilitating migration and movement
- Continuing to examine effects of oak-woodland restoration efforts on amphibians
Regional survey of *Batrachochytrium dendrobatidis*

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Mary Beth Manjerovic, Wildlife Disease Ecologist, mmanjerovic@lpzoo.org
Emerging Issue-Chytrid in the CW

- 20 sampling sites in Boone, Cook, DuPage, Kane, Lake, and McHenry Counties
- Sampled lentic water bodies
- 8 watersheds
## Samples Obtained

*N = 104 swabs from 20 sites in six counties*

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<thead>
<tr>
<th>County</th>
<th>Site</th>
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Results

- Six of 20 sites tested positive for *Bd*
- **Positive sites:**
  - Lincoln Park Zoo Nature Boardwalk (Cook)
  - Salt Creek/Bemis Woods (Cook)
  - Lemont Woods (Cook)
  - Lyman Woods (DuPage)
  - Campton Hills Forest Preserve (Kane)
  - Glacial Park Nature Preserve (McHenry)
Chytrid Study Summary

- 33% site prevalence of those tested
- Small sample size for pilot study, but sites within six watersheds were positive
- Did not observe sick/dead frogs at any of the sites
- Need for more surveillance of multiple species
- Need for implementation of decontamination protocols when visiting aquatic sites  www.northeastparc.org
- Need to understand the disease landscape prior to conducting translocation or reintroduction
Special Thanks To:

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Lake County Forest Preserve (Gary Glowacki, Tim Preuss, Ken Klick, Debbie Maurer, Jim Anderson)
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Questions??

Thanks for listening!!