Upland – Wetlands Linkages: The Role of Wetland Hydroperiod and Upland Landscape Features on Amphibian Populations

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Hydrologic Gradient

Adapted from: Werner and McPeek (1994)
Amphibians Have Complex Life Cycles

Life Cycle of the Spotted Salamander

- Adult (terrestrial)
- Eggs laid in water during early spring
- Larva (aquatic)
Importance of Upland Landscape for Amphibians

- Non-breeding summer habitat
- Winter hibernation sites
- Upland characteristics may influence water chemistry of wetlands.
Why are amphibians susceptible to landscape alteration?

- Vulnerability to heat, desiccation, pollution
- Low mobility
Metapopulation: a group of small populations which interact
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Amphibian Metapopulations

- Each wetland is a habitat patch
- Amphibians breeding for the first time may move to new wetlands
- Wetland populations exist within a matrix of upland landscape
Research Goals

- Examine the influence of wetland hydroperiod on the distribution of amphibians.

- Examine the effect of upland landscape characteristics on amphibian use of wetlands as breeding sites.
Study Area for Hydroperiod Study - Southern New Hampshire

- short
- intermediate
- long

14 blocks with wetlands of each hydro-period
Amphibian Species Richness

$P < 0.001$

Hydroperiod Category

Short

Intermediate

Long

$1998$ $1999$
Composition of Amphibian Assemblages in 1998 and 1999

Ambystoma maculatum
Notophthalmus viridescens
Hyla versicolor
Pseudacris crucifer
Bufo americanus
Rana sylvatica
Rana palustris
Rana clamitans
Rana catesbeiana
Wetland Area and Amphibian Richness

Amphibian Richness (1998)

Amphibian Richness (1999)

$r = 0.24, P = 0.127$

$r = 0.21, P = 0.229$
Management Implications

- Species using shorter hydroperiod wetlands live in a spatially-temporally variable environment. “Insurance” wetlands within dispersal distances may be critical.
- Wetland size is not a good criterion for wetland regulation.
- Current regulations are not adequate for protecting species that are obligate vernal pool breeders.
GIS Methods

Landcover (forest/non-forest) was digitized from 1:40,000 aerial photos
Dispersal Distances

- Wood frog: 1140 m
- Spotted salamander: 200 m
- Eastern newt: 1000 m
Buffers were generated around each wetland

<table>
<thead>
<tr>
<th>Distance</th>
<th>100m</th>
<th>500m</th>
<th>1500m</th>
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<tbody>
<tr>
<td></td>
<td>250m</td>
<td>750m</td>
<td>2000m</td>
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<tr>
<td></td>
<td>1000m</td>
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Within each buffer, four variables were measured:

- Percent forest
- Road density
- Percent wetland
- River density
Conceptual Example of Landscape Analysis
Spotted salamander
*(Ambystoma maculatum)*
Logistic regression model at 750m
Positive relationship with percent forest - most important variable
Eastern newt

*(Notophthalmus viridescens)*
Logistic regression model at 500m
Eastern newts were positively associated with percent wetland
Eastern newts were positively associated with percent forest.

The graph shows the number of sites with Eastern Newts at different percentages of forest within 500m, indicating a positive association.

- At 0-10% forest, 1 site with 0 newts.
- At 20-30% forest, 3 sites, 2 with newts.
- At 40-50% forest, 1 site, 2 with newts.
- At 60-70% forest, 10 sites, 11 with newts.
- At 80-90% forest, 19 sites, 11 with newts.
- At 90-100% forest, 11 sites, 11 with newts.
Spring peeper
(*Pseudacris crucifer*)
Spring peepers were positively associated with percent forest at 500m
Wood frog
\textit{(Rana sylvatica)}

No response to the landscape
Gray treefrog
(*Hyla versicolor*)

No response to the landscape

Photo by Matt Tarr
Species Not Caught

Northern leopard frog (*Rana pipiens*)  Blue-spotted/ Jefferson’s salamander (*Ambystoma laterale x jeffersonianum*)
Conclusions

• Spotted salamanders were most strongly influenced by the landscape (percent forest).
• Wood frogs may be more resilient to land use change.
• Eastern newts responded to percent forest and percent wetland.
• Spring peepers were associated with percent forest.
Management Implications

- Effects of land use change were detected even in a largely forested landscape.

- Species differ in their responses to changes in land use.

- Question of whether buffers are a feasible or appropriate management approach.