Introduction to Vernal Pools and Pool-Breeding Amphibians

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Vernal Pools: What are they?

- Depressions in the land
- Surface water for part of the year
- Fill between late fall and spring
- Dry up during summer or early fall
- Located in upland or wetland
- Sometimes referred to as “seasonal ponds”
Vernal Pools: Size and depth

Most < ½-acre, < 4 feet deep at high water
Vernal Pools: Topographic and geologic setting
Vernal Pools: Hydroperiod

Number of pools (n = 65)

Drying date

- 10 May
- 14 June
- 19 July
- 23 Aug.
- 27 Sept.
- 1 Nov.
- 6 Dec.
- 10 Jan.

2001
2002
Vernal Pools: Vegetation

- Water lilies
- Non-woody Emergents
- Trees
- Shrubs
- Litter or moss
Aquatic invertebrates

Amphibians

Reptiles

Waterfowl

Songbirds

Mammals
Seasonal drying excludes fish
Vernal Pool Amphibians in RI

Wood frog
Spotted salamander
Marbled salamander
Spring peeper
Gray treefrog
Pickerel frog
American toad
Green frog
American bullfrog
Red-spotted newt
Pool-breeding Amphibian Life Cycle
(e.g., Wood Frog)

Aquatic habitat (pool)

Eggs  Larvae

Terrestrial habitat (forest)

Adults  Metamorphs
Conservation of Pool-breeding Amphibians

Vernal pool

Forest ed upland
• Worldwide amphibian declines
• Main reason: habitat loss and fragmentation
• Vulnerability of pools due to:
  - small size
  - inconspicuous when dry
• Loss of pools and upland habitats critical
• Urban sprawl prime threat in RI
Limitations of Wetland Regulations

- Laws pertain to wetlands, upland edge
- RI regulations protect vernal pools as “ponds,” “vegetated wetlands,” or “special aquatic sites”
- Protection of upland habitat minimal
- Amphibians need extensive forest
- Regulations not designed to meet that need
An Example: Spotted Salamander Dispersal

150-m (500-ft) “life zone” would protect 50% of females and 80% of males.
A Non-regulatory Approach

• One alternative solution:
  - identify and rank all pools in watershed for amphibian diversity and productivity
  - target areas with high-ranking pools and extensive forests for acquisition, easements

• Approach used in Queen’s watershed

• Questions:
  - How to assess individual pools?
  - What key characteristics to look for?
Research on Key Habitat Features

- Last 10 years – NRS identified features influencing presence, abundance, diversity of amphibians in vernal pools
- Key features:
  - internal characteristics of pool
  - characteristics of surrounding landscape
Central Role of Hydroperiod (Hp)

- Hp: length of time pool holds water (no. weeks after 1 March)
- Hp determines which amphibians can breed successfully; each species has minimum required Hp
- *Paton & Crouch (2002):* 95% of metamorphs out of pool by:

<table>
<thead>
<tr>
<th>Species</th>
<th>Time Event</th>
<th>Weeks</th>
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<tbody>
<tr>
<td>Wood Frog</td>
<td>mid-July</td>
<td>21 wks</td>
</tr>
<tr>
<td>Spring Peeper</td>
<td>mid-Aug</td>
<td>24 wks</td>
</tr>
<tr>
<td>Gray Treefrog</td>
<td>early Sept</td>
<td>27 wks</td>
</tr>
<tr>
<td>Pickerel Frog</td>
<td>mid-Sept</td>
<td>29 wks</td>
</tr>
<tr>
<td>American Toad</td>
<td>late Sept</td>
<td>30 wks</td>
</tr>
<tr>
<td>Spotted Salamander</td>
<td>early Oct</td>
<td>31 wks</td>
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</tbody>
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- Premature drying → death of larvae
- Pools with longer hydroperiods can support more species
Hydroperiod and Amphibian Productivity

Wood frog

- $R^2 = 0.496$
- $P < 0.001$

Spotted salamander

- $R^2 = 0.375$
- $P < 0.001$
Creation of Hydroperiod Classes

- So Hp affects amphibian diversity and productivity, but it may vary widely among years.
- To simplify habitat assessment, we used Pawcatuck Hp and egg mass data to develop 4 Hp classes that described a pool’s Hp *in most years* and reflected its habitat value for amphibians:

<table>
<thead>
<tr>
<th>Class</th>
<th>Hp</th>
<th>Pool drying</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt; 20 wks</td>
<td>by mid-July</td>
</tr>
<tr>
<td>2</td>
<td>20-27 wks</td>
<td>mid-July – early Sept</td>
</tr>
<tr>
<td>3</td>
<td>28-36 wks</td>
<td>early Sept – early Nov</td>
</tr>
<tr>
<td>4</td>
<td>37-44 wks</td>
<td>after early Nov</td>
</tr>
</tbody>
</table>

- Hp class useful for predicting pool’s potential amphibian diversity and productivity; for example:
  - Class 3 pools have most species, most egg masses
  - Class 1 pools have fewest species, fewest egg masses
• Hp time-consuming to monitor; is there any way to estimate Hp class quickly?

• Using Pawcatuck data, we created two methods for estimating Hp class based on 1-2 visits

• *Skidds method:* used measurements of pool depth, tree canopy cover, water chemistry, geology, soils

• *Mitchell method:* based on types of plants in deepest zone

• Methods allowed rapid assessment of habitat suitability, based on Hp
Wood frog and spotted salamander egg mass counts positively associated with:

- pool size
- pool depth
- area of upland forest within 1 km (0.6 mi)

Counts for both species negatively associated with location on alluvium

Wood frog counts negatively associated with residential development within 1 km
Applying Research Results in the Queen’s

- Goal of NRS research
  - to understand vernal pools and their fauna better
  - to contribute to more effective conservation

- Queen’s project: watershed-scale planning for vernal pool conservation

- Funding: RIDEM Office of Water Resources via EPA Non-regulatory Wetland Pilot Demonstration Grant

- Project team:
  - Jon Mitchell, Research Associate
  - Mike Narcisi, Field/Lab Assistant
  - Peter Paton, Professor
  - Dennis Skidds, NPS Data Manager
  - Frank Golet, Professor
This presentation features photos by:

– Frank Golet,
– Scott Egan,
– Mike Narcissi, and
– Bob Deegan.