Spatial and Historical Drivers of Pool-breeding Amphibian Occupancy in Central New York

Harrison Goldspiel
1 Forestry Drive, SUNY-ESF, Syracuse, NY 13210

Background and Objectives
❖ Pool-breeding amphibians of the northeastern United States have complex life cycles, requiring connected terrestrial and aquatic habitats in a forested landscape that is threatened by habitat fragmentation, land conversions, and climate change.
❖ Efforts to conserve local and regional amphibian populations require a greater understanding of what constitutes adequate aquatic and terrestrial habitat configurations for species with varied life stage requirements (Semlitsch & Skelly, 2008).
❖ Land use history is an important driver of various biogeochemical processes in northeastern forests (Foster et al., 2003), shaping key components of aquatic and terrestrial habitats. Applying a historical perspective that considers land-use legacies may provide additional insight into amphibian conservation challenges.

Objectives:
(1) Quantify amphibian abundances in forested uplands varying in wetland density (0-11 pools) and land-use history (primary forest vs post-agricultural secondary forest).
(2) Identify important upland habitat and site-history criteria for pool-breeding amphibian conservation programs (e.g., vernal pool construction projects).

Results
❖ Roughly twice as many amphibians were observed during 2017, corresponding to dramatic changes in precipitation levels.
❖ Red-backed salamanders, a fully terrestrial species, made up 57% of total amphibian observations. Pool-breeding species made up <2% of observations.
❖ Amphibian data was analyzed using occupancy and N-mixture models in the R package unmarked.
❖ Linear regression was used to assess relationships between habitat and land-use history.
❖ Amphibian sampling:
   • Visual encounter surveys (VES) were conducted in May-July 2016 and 2017
   • Plots were visited twice per season

Methodology
Amphibian observations
❖ 1079 amphibians were found in 2016 and 2169 in 2017.

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Study Location
Helberg Memorial Forest (HMF) in Tully, NY
HMF is a 1,600 ha Northeastern Mixed Forest (McNab et al., 2007) in central NY. The site is representative of much of central New York’s forests, with most of the property (944 ha, or 59%) previously cleared and managed for agriculture until the 1930s. Two arrays of vernal pools were constructed on the site in 2010.

Maps of Helberg Memorial Forest in 1936 and 2015. Amphibian and habitat surveys were conducted in thirty 9.3-ha hexagons that varied in forest history and pool density.

Site selection:
Thirty 9.3-ha hexagonal pools encompassing gradients of historical forest cover and vernal pool density were selected for sampling.
❖ Historical forest cover was manually delineated in ArcMap 10.4.1 from 1936 aerial images
❖ 15 hexagons with construction and/or preexisting natural pools
❖ 15 hexagons without pools

Amphibian sampling:
❖ Visual encounter surveys (VES) were conducted in May-July 2016 and 2017
❖ Plots were visited twice per season

Habitat associations with land-use history
❖ Forest habitat associations with land-use history. Older pools had significantly deeper leaf litter (p = 0.007) and more sparse understory cover (p = 0.02). Older plots also tended to have more decaying CWD (p = 0.06) and denser canopy cover (r = 0.30, p = 0.11). CWD volume did not display any association with land-use history.

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References

Conclusions and Next Steps
❖ Land-use legacies are prominent in HMF, 50+ years since farm abandonment.
❖ Observations of pool-breeding species in forested uplands were low in both years, making abundance modeling problematic. Counts were low even in pools with many pools, despite evidence of healthy spring breeding activity.
❖ Survey method detection limits?
❖ Poor upland habitat suitability in HMF?
❖ Competition and/or predation from green frogs?
❖ Pool density and terrestrial covariates explained occupancy by both spp., although there was high model uncertainty.

Next Steps
❖ Model responses of species with different life cycles (e.g., red-backed salamanders) to land-use legacies in central NY forests.

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