REGIONAL AND STATE SURVEYS IN THE NORTHEAST REGION OF THE USGS AMPHIBIAN RESEARCH AND MONITORING INITIATIVE (ARMI)

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ABSTRACT

The U.S. Geological Survey (USGS) Amphibian Research and Monitoring Initiative (ARMI) was established by Congress in 2000 to monitor amphibian populations and to determine causes of amphibian declines and malformations in the United States. The northeast ARMI region, covering 13 states from West Virginia and Virginia to Maine, is home to about 30 anuran (frog and toad) and 56 salamander species. NE ARMI has conducted and sponsored several regional and state-based projects focused on stream salamanders, vernal pool amphibians, and calling frogs and toads. These studies are being used to determine if amphibians serve as good indicators of the health of the aquatic-terrestrial habitats in which they live and whether population presence and abundance and changes in these parameters over time are related to various environmental or landscape features. State and regional surveys such as these are leading to a broader understanding of the status of amphibians in the northeastern U.S.

STREAM SALAMANDERS

Regional survey

Since 2001, we have been monitoring stream salamanders at 47 streams each summer in 4 National Wildlife Refuges and 5 National Parks. We use standardized methods at all sites: two 15 x 2 m transects and two 4 m^2 quadrats spanning 1 m on the stream bank and 1 m in the stream channel. For transects, we use removal sampling (3 passes) to allow estimation of salamander population sizes. Data have revealed some interesting patterns. For example, northern two-lined salamander (Fig. 1) counts in 2003 (wet year) were significantly lower than in 2001 and 2002 (drought years) at Shenandoah National Park and perhaps region-wide, probably a result of differing stream flow conditions altering search areas and salamander detection (Fig. 2).

Figure 1. *Eurycea bislineata* (northern two-lined salamander).

State surveys

In Maryland and West Virginia, we conducted stream salamander surveys at sites also surveyed by state stream monitoring programs. Both states used a probabilistic random sampling scheme to select stream sites on private and public lands. Though the states do not currently collect herpetological data, they collect other biological (aquatic invertebrates, fish), physical habitat and water chemistry data. Adding salamanders to these monitoring programs is important, particularly in small headwater streams where salamanders replace fish as the top vertebrate predators. Using the same methods described in the Regional survey, MTS conducted stream salamander surveys at 76 state stream sites in MD (2001-02), and TKP surveyed stream salamanders at 46 state stream sites in WV (2002-03). These surveys have allowed us to develop a stream salamander index to biotic integrity, in which salamander parameters correctly identify reference versus degraded stream conditions (Fig. 3). In both states, we found positive relationships between salamander abundance and percent forested cover in the stream watershed.

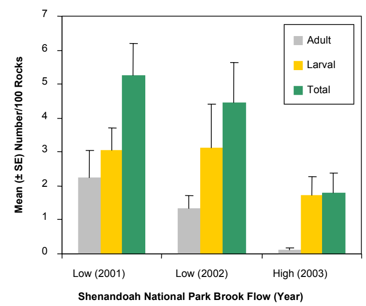

Figure 2. Mean (± standard error) counts of adult, larval and total northern two-lined salamanders per 100 rocks in 8 streams in Shenandoah National Park, Virginia, June-August, 2001-2003.

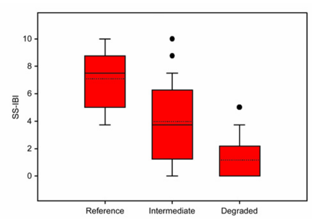

Figure 3. Distribution of non-Coastal Plain Stream Salamander Index of Biotic Integrity (SS-IBI) scores for 76 sites separated into reference, intermediate and degraded stream classes based on % forest, benthic invertebrate IBIs, and physical habitat variables.

VERNAL POOL AMPHIBIANS

Regional survey

Vernal pools are ephemeral wetlands that lack predatory fish and are critical breeding habitats for certain amphibians. In partnership with 15 National Wildlife Refuges, 4 National Parks, and 1 State Park (Fig. 4) each spring, we conduct double-observer egg mass counts of wood frogs (Fig. 5) and spotted salamanders (Fig. 6) at focal vernal pools and also assess amphibian species presence at these and other pools found off 250 m transects heading in cardinal directions from the focal pools. These data allow us to estimate population sizes and the percent of area occupied (PAO) by these species over time, and to relate these estimates to environmental and landscape variables. For example, in 2002, a preliminary PAO analysis showed that the model best explaining spotted salamander presence at a pool held PAO (psi) constant and allowed detection (p) to vary with distance from a road (Table 1).

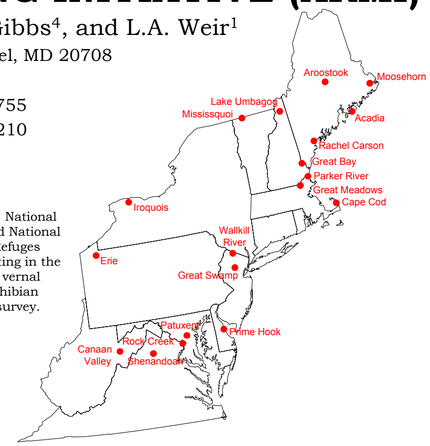

Figure 4. National Parks and National Wildlife Refuges participating in the NE ARMI vernal pool amphibian regional survey.

Figure 5. *Rana sylvatica* (wood frog).

Figure 6. *Ambystoma maculatum* (spotted salamander).

CALLING FROGS AND TOADS

State surveys

Retrospective study in New York

From 1973-80, Fred Scheuler surveyed 519 sites in New York for calling frogs and toads. In 2001-02, JPG resurveyed 300 of these sites. Comparing amphibian presence and absence and land use then and now, local population declines were associated with urban development (American toads, spring peepers), increased forest cover (western chorus frog; this species prefers grasslands and shrub habitats), and high-intensity agriculture (spring peeper), although populations were generally stable where wetlands had not been destroyed.

NAAMP study in Maryland

In collaboration with the North American Amphibian Monitoring Program (NAAMP), which collects data on calling frogs and toads at night along roadside routes in the eastern United States, LAW conducted 6 additional calling surveys at 17 NAAMP routes in Maryland in 2002. Season, air temperature, time, moon illumination and % palustrine forested wetland cover were often selected in best models explaining species detection and site occupancy.

Table 1. PAO analyses for spotted salamanders. Site and sampling covariates were tested for their influence on psi (site occupancy) and p (detection probability). K represents the number of parameters in the model. QAICc (Akaike's Information Criterion corrected for small sample size and overdispersion), ΔQAICc (AICc differences) and QAIC weights were used to determine the best model, shown in bold.

Models	*-2Log(L)'*	K	QAICc	ΔQAICc	QAIC weights
psi(.)p(distance road)	**270.034**	**3**	**119.655**	**0.000**	**0.468**
psi(.)p(.)	281.448	2	122.460	2.804	0.115
psi(woodland)p(.)	277.048	3	122.607	2.952	0.107
psi(.)p(pond area)	277.843	3	122.942	3.287	0.091
psi(.)p(water temp)	279.423	3	123.607	3.952	0.065
psi(.)p(woodland)	280.285	3	123.970	4.315	0.054
psi(distance road)p(.)	280.874	3	124.218	4.563	0.048
psi(pond area)p(.)	281.392	3	124.436	4.781	0.043
psi(.)p(t)	275.064	6	127.773	8.117	0.008
*psi(distance road, pond area, woodland)p(t)	269.946	9	131.619	11.963	0.001
***c(hat)**	**2.3759**				