Transactions of the Illinois State Academy of Science
(2005), Volume 98, #1&2, pp. 39-47

received 12/15/04
accepted 4/24/05

A Survey of Anuran Breeding Activity in Illinois, 1986-1989

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ABSTRACT

Amphibian populations have been declining worldwide, with several documented species extinctions in the past two decades. Although monitoring population health can present challenges, surveys of breeding choruses are relatively effective methods for assessing populations and population trends of many frog and toad species. We analyzed data from breeding chorus surveys conducted throughout Illinois from 1986 to 1989. Of the 20 species native to Illinois, 9 were stable or increasing during the survey period whereas the trends for other species were either inconsistent or indicated a decline in population size. To better assess population trends for Illinois frogs, we advocate re-establishment and regular monitoring of choruses, and improved training for volunteers who conduct the surveys.

Keywords: breeding chorus, frog, population trend, regional biodiversity, survey

INTRODUCTION

Declines in amphibian populations have been widely documented over the past decade (Blaustein and Kiesecker 2002, Guerry and Hunter 2002) with particular attention paid to three phenomena: (a) the recent (since the 1980's) increase in reports of species' extinctions; (b) the declines seem to be occurring simultaneously and over great distances; and, (c) populations in protected, natural areas are declining (Collins and Storfer 2003). Among the hypotheses advanced to explain amphibian declines, habitat alteration has arguably had the greatest impact on population stability for species found in Illinois (Stebbins and Cohen 1995). Habitat destruction and forest fragmentation (usually resulting from land use change) have often led to the isolation of populations in small parcels of habitat having variable quality (deMaynadier and Hunter 1999, Laan and Verboom 1990). Having a smaller size and little to no contact with other individuals (because of fragmentation), isolated populations can become increasingly susceptible to stochastic extinction processes (Sjögren 1991). In addition, geographic isolates often occupy marginal habitat which, due to its poor quality, may compromise the longevity of the population.

Long-term population monitoring is crucial to the understanding of both pattern and process in population declines. For anurans, the monitoring process is made easier by the fact that population health can be qualitatively assessed by surveying breeding choruses. In Illinois, the most extended survey of this type to date took place between 1986 and 1989. During this effort, 19 of the 20 frog species native to Illinois were documented by surveying breeding choruses along 65 routes each 16 km in length. We analyzed this data for these anuran species with the objectives of increasing the knowledge of their distribution, encouraging participation in their continual protection, and increasing interest in frog populations among naturalists.

MATERIALS & METHODS

During the breeding season, volunteer surveryors across the state drove along one of 65 pre-determined 16-km routes (Fig. 1). Each occasion of driving along the route constituted a run; three runs were each separated by approximately one month. Surveyors were asked to complete their runs during the following time intervals: early spring covering the period from late March to mid-April; late spring covering the period from late April to mid-May; and, summer covering the period from late May to mid-June.

During each run, a volunteer would stop every 0.8 km along the route and listen for breeding calls of anurans. The intensity of the calls heard at each stop was used to quantify the abundance of each anuran species at that site. The following guidelines were use to rate the intensity of the chorus and, therefore, a subjective assessment of the number of individual frogs present: 1 = individuals can be counted; there is space between calls; 2 = calls of individuals are distinguishable but some calls overlap; and, 3 = full chorus; calls are constant, continuous, and overlapping. If background noise (e.g., traffic, trains, etc.) prevented the surveyor from hearing anuran chorus activity, the surveyor moved to the next stop along the route where chorusing could be heard. At each stop, the surveyor also recorded the time and temperature (± 1 °C). Descriptions of habitat quality and the distance from the roadside to the nearest wetland (even a water-filled ditch) were not recorded.

When analyzing the data, we noted that volunteers occasionally recorded a species being heard in a county where there was no previous record for that species (Phillips et al. 1999). To allow for the possibility that the species might be rare and potentially unrecorded at the edge of its known range, we considered the record accurate if it was within two counties of the known distribution for the species. If the species was reported in an area further than two counties away from its known distribution in the state, we omitted these data from this analysis.

In spite of the volunteers' effort to collect quantitative abundance (in the form of chorus intensity ratings), data were too irregular to assess local or statewide population trends. Additionally, because some frog species were actively breeding in more than one of the three sampling periods within each year, we pooled all data for each species across routes and runs (within years). Thus, the results reported below reflect inter-annual population trends for each species across the entire state and not trends specific to any region or particular populations. Population trends for each species were plotted over all years (even if absent during a particular year) and Pearson's regressions were performed for each spe-

cies to express the strength of each trend. We did not describe a population trend for any species where the coefficient of correlation for these regressions was less than 0.40, or if the species was observed for fewer than three years within the survey period.

RESULTS & DISCUSSION

Volunteers who participated as surveyors in this study included private individuals, college students, and personnel from the Illinois Department of Natural Resources (IDNR). Of the 65 established routes, 21 were not surveyed and five routes (3 in the north-eastern, and 2 in the central, portions of Illinois) were surveyed all four years. The remaining 39 routes were surveyed 1-3 times. Figures 2 through 4 summarize the percent occurrence by year of all species found in Illinois.

Four species of toads are known from Illinois, two of which are found statewide. Trends for these species were variable, with no consistent pattern of change (Table 1; Fig. 2). *Scaphiopus holbrookii* was not observed during the study period due to the lack of survey routes crossing its known distribution in the state. Healthy populations have been observed in extreme southern Illinois since the time period of this study (S. Mullin, pers. obs.). Populations of *Bufo fowleri* increased, whereas no trends were apparent for either *B. americanus* or *Gastrophryne carolinensis*.

Of the four smaller hylid species in Illinois (Fig. 3a), *P. crucifer* and *A. crepitans* increased, *P. triseriata* decreased, but no trend was apparent for *P. streckeri illinoiensis* and it remained relatively rare. Two species of treefrogs are found statewide and two are found in the southern extreme of Illinois. Of these four species, occurrence of *Hyla cinerea* and *H. chrysoscelis* increased, whereas trends for *H. versicolor* and *H. avivoca* were not apparent (Fig. 3b).

Populations of *Rana blairi*, *R. areolata*, *R. sphenocephala* and *R. catesbeiana* increased during the study period (Fig. 4a,b). In contrast, population trends for *R. pipiens*, *R. clamitans*, *R. sylvatica*, and *R. palustris* were not apparent during the study period, with the latter two species being relatively uncommon.

Lack of consistent route coverage (less than 3 runs per year) and lack of data entirely from nearly one third of all routes hampers more definitive assessments of Illinois frog and toad populations. We suggest that any future efforts attempt a broader and more consistent coverage of more wetland areas across the state so that isolated populations (perhaps those representing uncommon species in Illinois) are not overlooked. Additionally, increased consistency within years would improve the quality of future survey data (e.g., seasonal changes, abundance estimates, etc.).

Another possible problem during the survey was the misidentification of certain species of anurans. Volunteer surveyors' experience in identifying frog/toad calls ranged widely and, in spite of their having been provided with instructional materials and tapes of frog calls, errors occurred in the data set. We excluded 36 out of 1314 total records (2.74 %) due to the observed species being reported well outside its known distribution. Additionally, in the few instances where the volunteer described the microhabitat for a particular stop along a route, an observed frog species was occasionally associated with an incorrect

habitat type. The North American Amphibian Monitoring Program (NAAMP; <http://www.pwrc.usgs.gov/naamp/>) has recently established an internet-based guide to the various frog breeding calls as well as a tool for assessing a prospective volunteer's ability to correctly identify a frog species based on its calls. For future survey efforts in Illinois, we recommend that IDNR adopt a recruitment policy that encourages volunteers to train themselves on the NAAMP website prior to surveying anuran breeding choruses.

ACKNOWLEDGMENTS

We are grateful to R. Szafoni and the Illinois Department of Natural Resources for providing the opportunity to examine the data set generated during the study period. Funding for this study and publication costs were provided by the Undergraduate Research Council of Eastern Illinois University and Illinois Chapter of The Nature Conservancy.

LITERATURE CITED

Blaustein, A.R., and J.M. Kiesecker. 2002. Complexity in conservation: Lessons from the global decline of amphibian populations. Ecol. Letters 5:597-608.

Collins, J.P., and A. Storfer. 2003. Global amphibian declines: Sorting the hypotheses. Diversity & Distributions. 9:89-98.

DeMaynadier, P.G., and M.L. Hunter, Jr. 1999. Forest canopy closure and juvenile emigration by pool-breeding amphibians in Maine. J. Wildl. Manage. 63:441-450.

Guerry, A.D., and M.L. Hunter, Jr. 2002. Amphibian distributions in a landscape of forests and agriculture: An examination of landscape composition and configuration. Conservat. Biol. 16:745-754.

Laan, R., and B. Verboom. 1990. Effects of pool size and isolation on amphibian communities. Biol. Conservat. 54:251-262.

Phillips, C.A., R.A. Brandon, and E.O. Moll. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Natural History Survey, Champaign, IL.

Sjögren, P. 1991. Extinction and isolation gradients in metapopulations: The case of the pool frog (*Rana lessonæ*). Biol. J. Linn. Soc. 42:135-147.

Stebbins, R.C., and N.W. Cohen. 1995. A Natural History of Amphibians. Princeton University Press, Princeton, NJ.

Table 1. Population trends of anurans in Illinois breeding choruses as determined by road-side surveys conducted along 65 routes from 1986 to 1989.

Species	Years observed	Illinois distribution	Population trend
Scaphiopus holbrooki	0	southern extreme	n/a
Bufo americanus	4	statewide	none
Bufo fowleri	4	statewide	increasing
Gastrophryne carolinensis	1	southern extreme	none
Pseudacris crucifer	4	scattered statewide	increasing
Pseudacris triseriata triseriata	4	statewide	decreasing
Pseudacris streckeri illinoensis	2	isolated populations	none
Acris crepitans	4	statewide	increasing
Hyla cinerea	4	southern extreme	increasing
Hyla versicolor	4	statewide	none
Hyla chrysoscelis	4	statewide	increasing
Hyla avivoca	4	southern extreme	none
Rana blairi	3	central	increasing
Rana pipiens	4	northern half	none
Rana sphenocephala	4	southern half	increasing
Rana areolata	3	southern extreme	increasing
Rana palustris	1	southern half	none
Rana catesbeiana	4	statewide	increasing
Rana clamitans	4	scattered statewide	none
Rana sylvatica	1	isolated populations	none

Figure 1. Map of the Illinois counties where anuran breeding chorus surveys were conducted between 1986 and 1989. The number within each county corresponds to the number of routes contained within that county. Values of "0.5" indicate a portion of one route contained within that county.

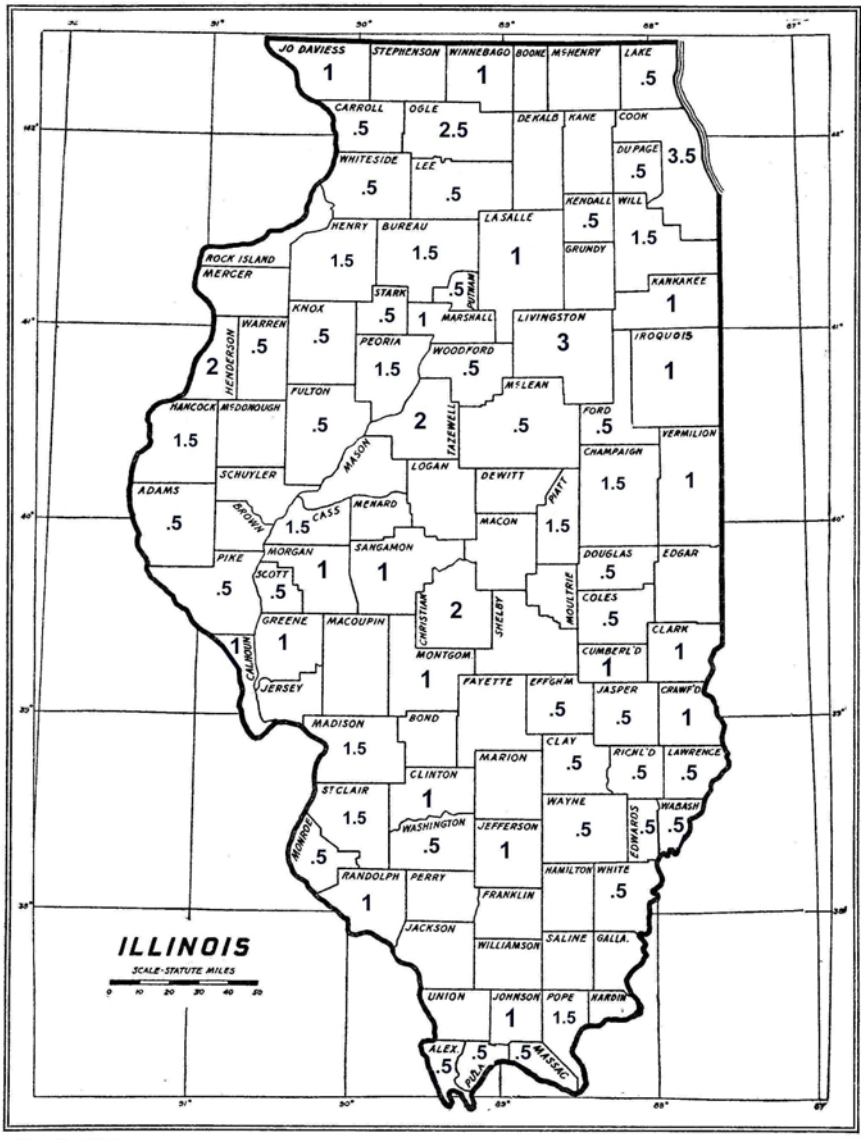

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Figure 2. Percent of routes reporting breeding calls of three different species of anurans in Illinois from 1986 to 1989. Coefficients of correlation (r^2) are based on Pearson's regressions.

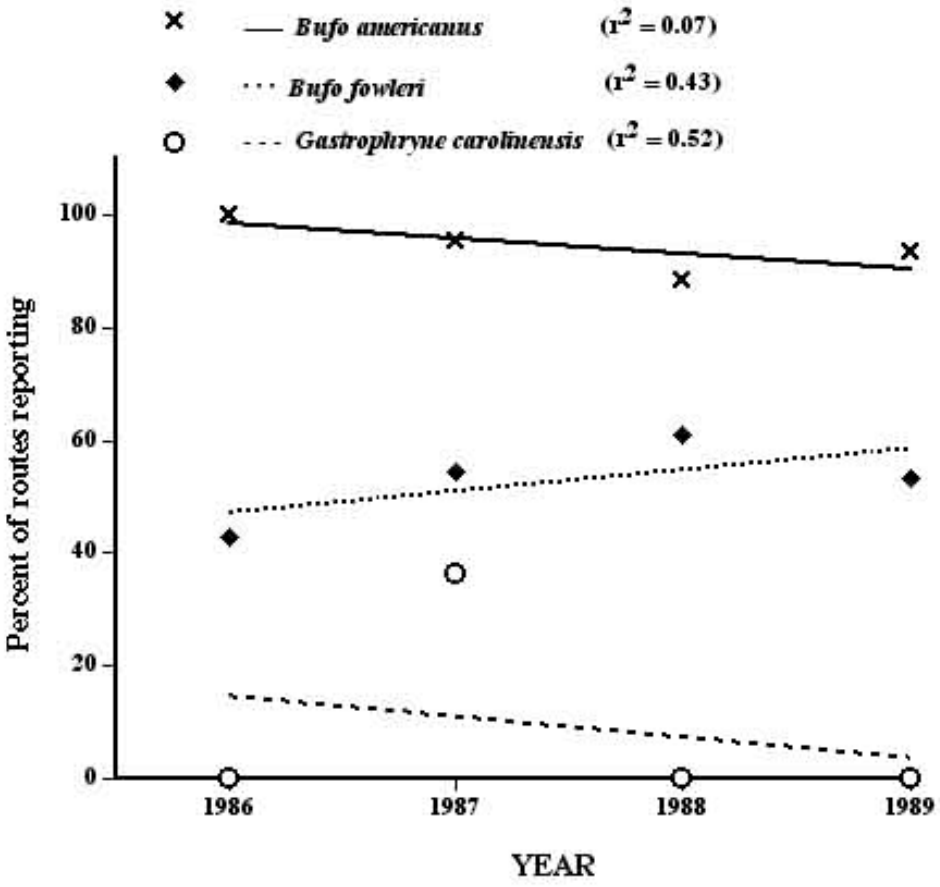

Figure 3. Percent of routes reporting breeding calls of four species of small hylid frogs (A) and four species of treefrogs (B) in Illinois from 1986 to 1989. Coefficients of correlation (r^2) are based on Pearson's regressions.

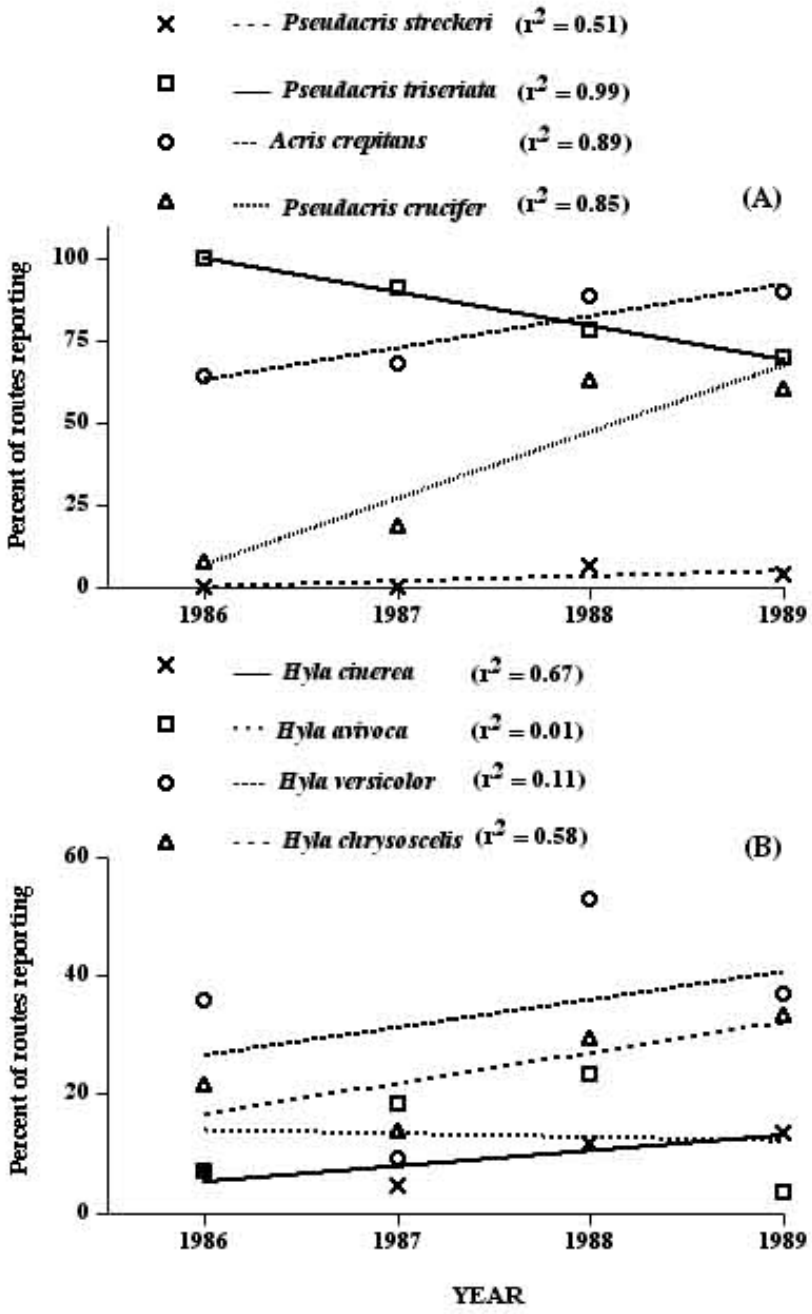

Figure 4. Percent of routes reporting breeding calls of eight different species of ranid frogs (*Rana* sp.; leopard and crayfish frogs in [A], other ranid frogs in [B]) in Illinois from 1986 to 1989. Coefficients of correlation (r^2) are based on Pearson's regressions.