

Growth and Survivorship in the Illinois Chorus Frog (*Pseudacris streckeri illinoensis*)

John K. Tucker
Illinois Natural History Survey, Great Rivers Field Station
8450 Montclair Avenue
Brighton, Illinois 62012, USA

ABSTRACT

Growth and survivorship were examined in the Illinois chorus frog (*Pseudacris streckeri illinoensis*) in Madison County, Illinois. Growth was rapid with sexual maturity attained by at least some individuals in the first year after transformation. Females grew faster than males, attaining 90% of maximum size after year 1 compared to 78% for males. Annual adult survivorship of a cohort of frogs initially marked in 1993 and followed through 1998 averaged 26%. Because juvenile survivorship is low ($\approx 2.8\%$), conservation plans designed to increase the number of transforming froglets would increase population sizes.

INTRODUCTION

The Illinois chorus frog (*Pseudacris streckeri illinoensis*) occurs in Arkansas, Illinois, and Missouri (Conant and Collins, 1991). It is a threatened species in Illinois (Herkert, 1992). Following transformation from ephemeral, fishless bodies of water in late May or early June, *P. s. illinoensis* is highly fossorial. Except for the early spring when frogs emerge from their burrows to breed, they bury themselves in sandy soils during the remainder of the year. Further information on the life-history of this frog was reviewed by Tucker (1998). The species is particularly difficult to study because it spends nearly all of its postmetamorphic life underground.

Except for growth characteristics immediately after transformation (Tucker, 1995) nothing is known about the growth of *Pseudacris streckeri illinoensis*. Tucker (1995) found evidence that at least some individuals return as breeding adults the year after transformation. The current research examines growth of this same cohort of frogs from 1993 to 1997, the last year recaptures were made. Growth rates and timing of sexual maturity are important determinants of population size (Turner, 1960; Breden, 1988). Thus, knowledge of growth in *P. s. illinoensis* is important and may contribute to its conservation in Illinois. I also estimate adult survivorship for a cohort of individuals initially marked in 1993 based on recaptures through 1998.

METHODS

Tucker (1995, 1998) previously described the study sites in detail. Generally, the habitats at these sites have sandy soils with old-field vegetation. The frogs breed in shallow ephemeral wetlands associated with abandoned borrow pits. The froglets ($n = 722$) were captured with drift fences and initially marked by toe clipping (Tucker, 1995). Because only toes on the hind feet could be used, frogs were not given individually unique toe clips. Instead, they were marked in year cohorts with frogs newly collected each year given a different clip pattern.

Recaptures of frogs marked as froglets in 1993 were made in 1994, 1995, and 1997 at chorus sites and along drift fences placed at sites bordering Sand Road in Madison County, Illinois (Tucker, 1998). Recaptured frogs were measured from snout to vent (SVL) to the nearest 1 mm, had their sex determined, and were then released immediately. Sex and reproductive status were determined using the method of Tucker (1998).

I used SAS (SAS Institute, 1988) for statistical comparisons. Because sample sizes were small, I used nonparametric statistics including the Wilcoxon rank sum test (Z) to compare means.

Voucher specimens include 13 froglets collected in 1993 and 23 road-killed adult frogs collected in 1994 (INHS 10938-39; INHS 10946-56 and INHS 12329-12351, respectively). The froglets were preserved under Illinois Department of Natural Resources (IDNR) permit number 93-8s. The road-killed frogs were preserved under IDNR permit A-93.0207.

RESULTS AND DISCUSSION

Recaptures of sexually mature frogs marked as froglets in 1993 were made in 1994, 1995, and 1997. No recaptures of 1993 froglets were made in 1996 and 1998. For all years, 41 frogs were recaptured one or more times from the 722 froglets marked in 1993 (Table 1).

The cohort of transforming froglets collected in 1993 at drift fences furthest from the pond averaged 21.2 mm in SVL (Fig. 1-1993 Field cohort, Tucker, 1995). Frogs from this 1993 cohort grew rapidly as indicated by those recaptured in 1994. Males on average increased their SVL by 15.6 mm (74%), whereas females increased their SVL by 18.1 mm (85%). Females recaptured in 1994 were larger than males recaptured in 1994 ($Z = 2.45$, 1 df, $P = 0.0142$) suggesting that they initially grew faster than males (Fig. 1). However, recaptured males and females did not differ significantly in size in either of the other two years ($Z > 1.41$, 1 df, $P > 0.10$). Sample sizes are, however, small for all year cohorts (Fig. 1).

The frogs grew at slow rates between 1994 and 1997 (Fig. 1). During these three years (1994-1997), females added 2 mm (5%) to mean 1994 SVL, and males added 3.3 mm (9%) (Table 1). If these rates are reasonable approximations of post-sexual maturity growth rates, then adult growth rates were slow, averaging 0.67 mm per year for females and 1.1 mm per year for males.

Tucker (1995) noted the relatively large size at transformation for *Pseudacris streckeri illinoensis* in Madison County. Most toads (*Bufo* species) and hylids (e.g., *Acris*, *Pseudacris*, and *Hyla*) transform at smaller sizes of 10 to 17 mm (Turner, 1960 for a review). Moreover, *P. s. illinoensis* grows rapidly its first growth season following transformation. Females reach 90% of their maximum observed size (41.3 mm for 1997) in their first season of growth (i.e., 39.3 mm for 1994, Table 1). Males, however, attain 78% of maximum growth in their first season of growth.

Some other anurans may grow as quickly as does *Pseudacris streckeri illinoensis*. For instance, Bayless (1969) found that the cricket frog (*Acris crepitans*) in Texas could reach sexual maturity and potentially breed in the same season that they transformed. Other small anurans grow at slower rates. The narrow-mouthed toad (*Gastrophryne carolinensis*) may take four years to reach maximal sizes (Anderson, 1954) and becomes sexually mature in their second year compared to the first year observed by me for *P. s. illinoensis*.

The observation that growth may be faster for females than males is not unique. Females of Fowler's toad (*Bufo woodhousi fowleri*) also grow faster than males (Clarke, 1974; Breden., 1988). Shirose and Brooks (1995a) noted that female green frogs (*Rana clamitans*) and female mink frogs (*Rana septentrionalis*) from Ontario grew at faster rates than did males of either species.

Tucker (1998) estimated annual adult survivorship at 30% from recaptures of 1993 marked frogs through 1995. This estimate (method of Shirose and Brooks, 1995b) can now be extended through 1998. Given no recaptures of 1993 frogs in 1996 and 1998, average annual adult survivorship is estimated to be about 26%. Thus, seven frogs would be expected to remain alive in 1998 from a cohort of 1000 transforming froglets marked in 1993.

Adult survivorship estimated at 26% stands in contrast to the 2.8% estimated survivorship from transformation to sexual maturity (Tucker, 1998). The large difference between adult and juvenile survivorship estimates suggests that future population size will be strongly influenced by the number of transforming froglets. Conservation plans for *Pseudacris streckeri illinoensis* should include efforts to increase the likelihood that tadpoles will successfully transform along with habitat protection programs.

ACKNOWLEDGMENTS

I thank J. B. Camerer and J. B. Hatcher for field assistance. L. E. Brown discussed the biology of the frog with me. Permits necessary for this research were made available by G. Kruse. This research was supported by Illinois Department of Transportation contract 1-5-90179 with the Illinois Natural History Survey, J. K. Tucker and D. P. Philipp, Co-Principal Investigators. Support was also provided by the Long Term Resources Monitoring Program for Mississippi River Pool 26.

LITERATURE CITED

- Anderson, P.K. 1954. Studies in the ecology of the narrow-mouthed toad, *Microhyla carolinensis carolinensis*. Tulane Stud. Zool. 2:15-46.
- Bayless, L.E. 1969. Post-metamorphic growth of *Acris crepitans*. Amer. Midl. Natur. 81:590-592.
- Breden, F. 1988. Natural history and ecology of Fowler's toad, *Bufo woodhousei fowleri* (Amphibia:Bufonidae), in the Indiana Dunes National Lake Shore. Fieldiana Zool., new series, 49:1-16.
- Clarke, R.D. 1974. Postmetamorphic growth rates in a natural population of Fowler's toad, *Bufo woodhousei fowleri*. Can. J. Zool. 52:1489-1498.
- Conant, R., and J.T. Collins. 1991. A Field Guide to Reptiles and Amphibians [of] Eastern and Central North America, Third edition. Houghton Mifflin Co., Boston, USA.
- Herkert, J.R. 1992. Endangered and threatened species of Illinois: Status and distribution. Volume 2 - Animals. Illinois Endangered Species Protection Board, Springfield, Illinois, USA.
- SAS Institute. 1988. SAS/STAT User's Guide. SAS Institute, Cary, North Carolina, USA.
- Shirose, L.J. and R.J. Brooks. 1995a. Growth rate and age at maturity in syntopic populations of *Rana clamitans* and *Rana septentrionalis* in central Ontario. Can. J. Zool. 73:1468-1473.
- Shirose, L.J. and R.J. Brooks. 1995b. Age structure, mortality, and longevity in syntopic populations of three species of ranid frogs in central Ontario. Can. J. Zool. 73:1878-1886.
- Tucker, J.K. 1995. Early post-transformational growth in the Illinois chorus frog (*Pseudacris streckeri illinoensis*). J. Herpetol. 29:314-316.
- Tucker, J.K. 1998. Status of the Illinois chorus frog in Madison County, Illinois. pp. 94-101. In: M.J. Lannoo (ed.), Status and Conservation of Midwestern Amphibians. University of Iowa Press, Iowa City, Iowa, USA.
- Turner, F.B. 1960. Postmetamorphic growth in anurans. Amer. Midl. Natur. 64:327-338.

Table 1. Snout-vent length of Illinois chorus frogs (*Pseudacris streckeri illinoensis*) recaptured in 1994, 1995, and 1997 from 722 froglets initially marked in 1993. No frogs marked in 1993 were recaptured in 1996 or 1998.

Sex	1994		1995		1997	
	N	mean(SD)/range	N	mean(SD)/range	N	mean(SD)/range
F	7	39.3(2.0)/37-43	2	40.5(0.7)/40-41	6	41.3(0.8)/40-42
M	13	36.8(2.0)/32-40	4	38.3(1.7)/36-40	9	40.1(2.0)/37-43

Figure 1. Growth of the Illinois chorus frog (*Pseudacris streckeri illinoensis*) from recently transformed froglets (1993) to adult males and females (other years). Horizontal bar represents the mean, the vertical bar represents the mean \pm 1 standard deviation. Numbers above (females) and below (males and froglets) the vertical bars represent sample sizes.

