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Historical Occurrence of Malformations in the Cricket Frog, *Acris crepitans*, in Illinois

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INTRODUCTION

In the rural Midwest, the cricket frog (*Acris crepitans*) has undergone a dramatic decline (Lannoo, 1998) including in Illinois (Greenwell et al., 1996) where it was once the most abundant amphibian species present (Smith, 1961). It is on the endangered species list in Minnesota, Wisconsin and Ontario, Canada, threatened in New York, and a species of special concern in Indiana, Michigan and West Virginia (Ramus, 1998; Weller and Green, 1997; Brodman and Kilmurry, 1998). The species may be extinct in Minnesota and Ontario, Canada (Oldham, 1992; Greenwell et al., 1996).

Concurrent with population declines of many other amphibian species, reports of malformed individuals have been increasing (Kaiser, 1997; Reaser and Johnson, 1997). However, long-term population studies are essential to distinguish between natural population fluctuations and declines associated with anthropogenic causes (Pechmann et al., 1991) and there is no evidence that amphibian declines and malformations are linked. Reported amphibian malformations include external deformities, mostly missing hindlimbs, but also missing forelimbs, extra arms and legs, missing eyes and mandibles, as well as internal abnormalities involving the bladder, digestive system and testes (Greenwell et al., 1996).

SAMPLING METHODS

From 1968 through 1971, I studied the cricket frog, *Acris crepitans*, in Illinois; study areas and sampling and marking methods were described previously (Gray, 1971, 1983, 1984). Briefly, the areas (Fig. 1) included the Mackinaw River, Dawson Lake Pond and English Farm Ponds (A, B, and C) in McLean County, Six Mile Creek in Woodford County, and the La Rue' Pine Hills Swamp in Union County. Study areas were visited at least monthly. Three study areas (English Farm Ponds) were visited twice monthly. The Dawson Lake Pond was also visited twice monthly during the fall of 1970. Additionally, cricket frogs from 28 other populations in Illinois were sampled during the spring and fall of 1970.

Because I wanted to identify individuals, I kept detailed records on the condition of each frog sampled. Cricket frogs were captured by hand or with a small net. Specimen number (see below), vertebral stripe color, snout-vent length measured to the nearest mm, and sex were recorded. Cricket frogs at the Mackinaw River, Six Mile Creek, Dawson Lake, Pine Hills and English Ponds A and C (fall 1968 to summer 1969) were marked by removing the same digit from all cricket frogs captured on a given date. Cricket frogs at Pond B and Ponds A and C (fall 1969 to summer 1971) were marked individually (Martof, 1953). Because the incidence of abnormalities was low, I did not previously report the data. Here, I present data on incidence of malformations from almost 10,000 cricket frogs observed prior to population declines. I also compare these data to more limited recent data.

RESULTS AND DISCUSSION

Thirty years ago, morphological abnormalities occurred at low frequencies (0.39 %) in cricket frogs in Illinois (Table 1). The abnormalities occurred in two categories. Abnormal frogs were either missing whole or parts of limbs and digits or had deformed or extra limbs, digits and mouthparts. Most oddities involved missing arms and legs (0.32 %) rather than extra limbs (0.07 %). Only seven obvious developmental errors (extra or deformed arms, deformed digits, underdeveloped mouth) were recorded among almost 10,000 frogs examined. Individuals captured and released at the seven main study sites in August were newly metamorphosed froglets that were emerging from the water.

Most of the abnormalities reported for species other than cricket frogs also appear to involve missing rather than extra limbs. Missing limbs may reflect unsuccessful predation attempts by other animals. Natural phenomena such as limb amputations during predation attempts and parasitism (Sessions and Ruth, 1990), agricultural chemicals (herbicides, insecticides, fertilizers) and other xenobiotic contaminants (Ouellet et. al., 1997), UV-B radiation either directly (Blaustein et al., 1997) or indirectly by triggering production of toxicants from non-toxic chemicals (Dumont et al., unpubl. data), and radioactivity (Meyer-Rochow and Koebke, 1986) have all been linked to amphibian abnormalities.

Higher incidences of malformations have been reported for Pacific tree frogs (*Hyla regilla*) in Idaho (Reynolds and Stevens, 1984), *H. regilla* and long-toed salamanders (*Ambystoma macrodactylum*) in California (Sessions and Ruth, 1990), and for spotted salamanders (*A. maculatum*) (Worthington, 1974). In Minnesota, Quebec, and Vermont where abnormalities currently receive most of the attention, the overall frequency of malformations is 8 % but can be as high as 67 % in some ponds (Kaiser, 1997). A review of North American Reporting Center for Amphibian Malformations (NARCAM) data (www.npwrc.org/narcam) from across North America indicates that where the total number of frogs observed is known, abnormalities can range from 0 to 100 %. However, where incidences of abnormalities are high, sample sizes are often low (i.e., <5). In many cases the total number of frogs examined is not reported, and in all cases, historic data with which to compare are nonexistant.

Resampling (using similar methods) in spring and fall 1998 of the Mackinaw River including my study area by students of Dr. Lauren E. Brown showed no increase in the incidence of malformations from that observed 30 years ago. Of 140 frogs examined,

one had a broken hindlimb and three had a missing digit each. One of those with a missing digit also had a laceration on the same forelimb. On another frog, the digit was obviously damaged. The broken hind limb and lacerated forelimb were most likely the result of some type of accident.

Review of the NARCAM data for *A. crepitans* provides no evidence of high incidences of malformations in the species either presently or in the past. Because cricket frogs appear to have declined in the absence of such evidence, different factors may operate to control these two phenomena.

Conspicuous abnormalities usually constitute a survival handicap (Sessions and Ruth, 1990; Ouellet et. al.,1997) because they interfere with swimming and hopping. Alternatively, Van Valen (1974) speculated that the occurrence of extra limbs and digits at relatively high frequencies in some amphibian populations may result in a morphologically and adaptively discontinuous origin for a new taxon. Interestingly, several of the frogs I marked as abnormal, were later recaptured and two had survived through the winter and following breeding season. The survival of these two frogs is noteworthy given the low frequency of abnormalities in Illinois and suggests that some abnormalities may not be as detrimental to survival as generally assumed.

Evaluation of other historic databases that contain information on past malformation frequencies would show if the incidence of amphibian malformations has changed. Today, this is particularly relevant and urgent given the current status of amphibian populations.

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Table 1. Frequency of Cricket Frog, *Acris crepitans*, abnormalities in Illinois, 1968-1971.

Study Sites	No. Frogs Examined	No. Abnormalities	% Abnormalities
English Ponds			
Pond A	1,022	13	1
Pond B	1,988	20	1
Pond C	480	3	1
Macinaw River	345	0	0
Six mile Creek	715	0	0
Dawson Lake	2,577	1	0.04
Pine Hills	991	2	0.2
Other Locations (28)	1,869	0	0
Total	9,987	39	0.39

Figure 1. Study areas sampled in Illinois, 1968-1971, for cricket frogs, *Acris crepitans*. Main study areas indicated by name.