

A Hypothesis to Explain the Almost Exclusive Use of Temporary Water by Breeding Spadefoot Toads

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With few reported exceptions, both groups of spadefoots (*Scaphiopus* and *Spea*) use temporary pools for breeding activities. So far as I am aware, no one has yet offered an explanation as to why this should be. For many years I have speculated upon possible causes and finally in 1962 formulated a hypothesis to be tested as opportunity came.

The chance to make a partial test of my "arm chair" thinking came quickly and I offer the results here to stimulate any who have opportunity further to check the hypothesis.

My reasoning proceeded as follows: (1) spadefoots ready to breed must receive sensory cues from either (a) temporary water which attracts them or (b) from permanent water which repels them. (2) These cues more likely are chemical than physical in nature. (3) Permanent water often smells different to humans than does temporary water. Hence (4) it is likely (or at least possible) that it also does so to spadefoots. If this be true, then (5) it may well be that the smell of permanent pools (as opposed that of temporary, recently formed ones) may repel spadefoots. Since, however, practically nothing is known about chemical sense perception by adult spadefoots, this hypothesis cannot be accepted unquestionably till the pertinent physiological facts are known.

The observations reported below merely enhance the probability of the hypothesis, but by no means demonstrate its validity.

In western Pottawatomie County, Oklahoma, a small pool, known in my notes as P₁, was first found in June, 1939. Its floor is a basin of solid rock covered by earth washed into it by rain, intermixed with accumulated organic debris of plant growth. One end is quite shallow, but at the other a small stand of cattails (*Typha* sp.) occurs. I have observed this site closely for the 24 years since I first found it and have seen many congregations of most of the local frogs and toads in it and studied their tadpoles here. Spadefoots never used it in the 24 years. Since no drainage occurs (except overflow after heavy rains) practically all water loss is from evaporation. During hot weather, the water level has often been low, but till June 1963 I have never found it completely devoid of standing water. Hence, I have always considered it a permanent pool.

In February 1963 during a very dry winter the water level was very low, water being present only in small puddles beneath the *Typha*. However, the water contained half-grown tadpoles of the local leopard frog, presumably derived from eggs laid after the latest rains of consequence, in the previous December. Some standing water, therefore, had been present at least since that time. I visited this place at approximately 2 week intervals during March and early April and conditions did not materially change.

On April 26, 2+ inches of rain fell in Norman, approximately 20 miles to the west, and that night I found three congregations of Hurter's spadefoot (*Scaphiopus holbrooki hurteri* Strecker) in temporary pools within a few miles of this site. Knowing that these spadefoots (although abundant in its vicinity) never had used pool P₁ for breeding, I did not visit it that night. Consequently, I was surprised to find a clutch of their

eggs in it the next day. These eggs hatched normally on the 3rd day after this, but the tadpoles grew very slowly for a few days and then completely disappeared. Other young tadpoles (*Hyla*, *Rana*, and *Bufo*) from eggs laid the same night as those of *Scaphiopus* grew normally as did also the older *Rana* already present.

Two related questions are raised by these observations: (1) Why did the spadefoot tadpoles fail here and (2) why did the adults use P₁ for the first time in 24 years? My attempts to answer the first question by raising tadpoles collected from the temporary pools and in water from this pool (i.e., P₁) were negative. The larvae developed as well in P₁-water as in tap water or water from their own pool. If, therefore, a difference in the solution which we call natural water affected these spadefoots, it must have done so at a very young stage.

Concerning the second question, it is quite unlikely a matter of chance, since I know the population of spadefoots here to be of considerable size. But it could be that the water here being very low before the rain and the pool's basin filling quickly to overflowing "fooled" the adults; i.e., by them it was sensed as a temporary pool due to lack of sensory cues usually associated with a permanent pool due to extreme and sudden dilution. This is in accord with the hypothesis stated above and, therefore, is minor evidence for it.
