
OBSERVATIONS ON THE NARROW-MOUTHED SALAMANDER¹

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In Oklahoma, the narrow-mouthed salamander, *Ambystoma texanum* Matthes, is shown by Bishop's Manual (1) to occur only in the Northeast; but, since its type locality is in Texas, its presence in eastern Oklahoma is to be expected. Actually, it has recently been reported twice from Cleveland County almost in the center of the state (2, 3), as well as much farther north (Payne County by Moore and Rigney, (5); Osage County by Dundee, (3), and north-eastern Kansas (6). Bishop (1) summarizes the distribution as wide-spread to the northeast and to the south from Oklahoma.

Many notes have been published on this form (summarized excellently by Smith, (6)), but its breeding habits appear still to be somewhat obscure and the extent of its geographic range within Oklahoma is unknown. Furthermore, very little has been published which indicates its ecological relations in various parts of its range and virtually nothing is known of this phase of the matter in Oklahoma.

Incidental to the study of salientian breeding habits locally in Cleveland and adjoining counties, Oklahoma, I have watched the development of the larvae of *Ambystoma texanum* for several years and have studied its local ecological distribution. In addition, extensive field observations in various parts of the state from 1945 through 1949 now give a fair basis for an outline of the state distribution, ecologically as well as geographically, and some basis for understanding its breeding period, its length of larval life, and other phases of its life history. I have by no means exhausted the possibilities in the study of the form, however.

GEOGRAPHIC DISTRIBUTION IN OKLAHOMA. Over fifty collections made in eastern Oklahoma from February to May, 1949, included eggs, embryos, larvae, or adults of *A. texanum* and collections in other years have also included some specimens. Altogether I have (or have seen) specimens taken in the following counties: Adair, Atoka, Choctaw, Cleveland, Craig, Hughes, Le Flore, Mayes, McCurtain, McIntosh, Muskogee, Pawnee, Pittsburg, Pushmataha, and Rogers. The total record, therefore, indicates a geographic distribution over the whole eastern half of the state. At present, it is not known west of Cleveland County², but, as implied below, it may well follow flood plains of the larger rivers a considerable distance westward from this.

¹Contribution from the Oklahoma Biological Survey, University of Oklahoma, Norman.

²A specimen in the University of Oklahoma Museum, supposedly of this species and collected in Eger Mills County, is *A. tigrinum morvortium* Baird. I am not certain whether this was ever published as a record, but if so, it is incorrect.

ECOLOGICAL DISTRIBUTION. In Cleveland County, Oklahoma, three basically different ecological communities occur: (1) mixed grass prairie, (2) oak-hickory savannah, and (3) flood plain forest, the last best represented as the narrow belt of woodland fringing the northeastern bank of the Canadian River. *A. texanum* occurs only in the flood plain forest, both of the Canadian and of some of its major tributaries. Two general areas of breeding activity are known: the sloughs along the river flood plain, including low wooded areas on the highest levels of the plain such as that mentioned by Dundee (3) and a low, easily flooded wooded area in the valley of Hog Creek near Little Axe in the eastern part of the county. Pools in the surrounding oak-hickory savannah have been explored for years at all seasons in my studies of *Salientia* but these salamanders have never been found in the oak-hickory community. The same is true in the pools of the prairie in which a related species, *A. tigrinum morvortium* Baird, is common. The flood plain community is essentially a sprawling ecological island following the lowest areas through both the mixed prairie and the savannah and it appears that here, near the western limits of its range, the salamander is able to exist only in the moist habitat afforded by it.

In the Northeast, the picture is quite different. In Payne County, some eighty miles northeast of Cleveland County, the mixed prairie takes on some of the character of the tall grass prairie which extends from the valley of Black Bear Creek (near the northern Payne County line) northward and eastward. More and Rigney (5) report this salamander common in upland pools of Payne County, which means that it is there the prairie form. I am able to confirm this for the tall grass prairie proper, for I have collected eggs and larvae in abundance from prairie pools and overflows of small streams in Pawnee, McIntosh, Mayes and Rogers Counties.

In the southeast, this salamander not only is very abundant in the heavily wooded and low valleys of the larger streams (Little River, Kiamichi River, etc.) but it occupies the hillsides as well as the wooded valleys in the oak-hickory pine woodlands of the Ouachita uplift. It also occurs in the southern portion of the Ozarks in northern Sequoyah County, where its larvae were collected in several spring-fed pools and ditches, one of them about half way up a wooded mountainside. Its associates in this habitat include other salamanders (*Eurycea griseogaster* which occupies the intermittent streams forming the pools, *Plethodon cinereus angusticlavius*, found under rocks near such springs and pools, and perhaps others) and such *Salientia* as *Pseudacris triseriata*, *Rana areolata*, and *Bufo terrestris americanus*.

As might be expected, the extensive "islands" of the tall grass prairie to the west and south of the mountain masses, both north and south in Oklahoma, have populations of *A. texanum* and the animals are plentiful in the valley of the Arkansas River which separates the main uplifts near the eastern state border.

We may summarize the ecological distribution as follows: common in tall grass prairie, flood plain forests, and oak-hickory pine woodland. Not present in mixed prairie (except in or near the ecotone to tall grass), in oak-hickory savannah nor in short grass prairie. The principal limiting factor seems to be moisture, the animals' burrowing habits enabling them to withstand conditions conducive to development of mesic prairie and woodlands but not the more xenic conditions of other types of prairie or oak-hickory savannah.

RELATIONS WITH OTHER CLOSELY RELATED SPECIES. *A. maculatum* was also represented (as adults, eggs, or larvae) in several of my collections and some of these indicate a partial overlap in the ranges of the two forms. Both are extremely abundant in the wooded valley of Little River, north of Idabel, McCurtain County, for example, where another *Ambystoma* (*A. opacum*) also is very common. During the active breeding season of both *A. texanum* and *A. maculatum*, when eggs and larvae of each were abundant in pools, I never found them utilizing the same water. I found this also true farther north in

the valleys of the Ouachitas. Part of this is probably due to the selection of different types of breeding sites (see below) but other facts suggest a possible antagonistic effect of the presence of one species of *Ambystoma* on the presence or abundance of another in some habitats. I do not consider this proved and I offer the following indications of it to be explained in this or some other way as further facts may later indicate.

In Cleveland County, Oklahoma, *A. tigrinum morvortium* Baird is the prairie form but it occurs sparingly also in the oak-hickory savannah. Pools of the ecotone between the habitats of this form and *A. texanum* often contain larvae of one or the other but never of both. In Payne County, Moore and Rigney (5) say that *A. tigrinum* is unknown but expected. Note that it is here that *A. texanum* is in the prairie. South of Idabel, McCurtain County, on the broad flood plain of the Red River, I was never able to find *A. texanum* in the extensively flooded woodland, either of deciduous trees or of pine. This looks like an ideal place for this species to be abundant and I searched it for hours at several times when a dozen adults could be found on Little River (about 10 miles to the north) in a half hour's time. But *A. tigrinum* occurs there. I have a small specimen, thought to be a *A. t. tigrinum*, collected in an open pine forest in this region, but whether it represents this subspecies or some other makes no difference to the point under discussion.

BREEDING SITES, BREEDING SEASON, AND LARVAL DEVELOPMENT. *Ambystoma texanum* utilizes several types of breeding sites, all of which are shallow, clear, and well vegetated. Occasionally, when shallows are not available, eggs are laid on grasses or other plants trailing into the edge of a deeper pool. I have found the eggs in 2 inches of water attached near the shore line but never in water more than one foot deep where the eggs were actually laid. In most places, the water is not more than 4 inches deep. That shallow water is actually selected is indicated by several observations, the most striking of which is as follows: Between Idabel and Broken Bow, Oklahoma, on a gravel road essentially in the valley of Little River but well up from the main stream, an extensively flooded area of nearly permanent water occurs, extending along the roadside for about $\frac{1}{2}$ mile and from this a considerable distance into the woods. The water here is about 3 feet deep at the breeding season. Several amphibians breed here (*Hyla c. crucifer*, *H. versicolor chrysoceles*, *Acris crepitans*, *R. clamitans*, *R. a. areolata*, and some form of the leopard frog; all were seen or heard in February, March, or April, 1949). Yet diligent search for *A. texanum* eggs and larvae failed several times to reveal any. But only a few feet away, immediately across the road, eggs and larvae of the species were abundant in a shallow ditch and roadside pools near the woodland border.

In the Oliver Biological Preserve on the highest level of the Canadian River Flood Plain south of the University of Oklahoma Campus at Norman, these salamanders start to breed each year in February and end by the middle of March. Most eggs are laid during the last three weeks in February. At the Hog Creek breeding site (see above) young larvae usually occur in March, larger ones in April and May. In other parts of the state, indications are of about the same season. Embryos and very young larvae were found in late February and early March in southwestern, and in early March in north-eastern and north central Oklahoma. In late April and in May, only well-grown larvae occurred. In northern Sequoyah County, young larvae (but no eggs) were found on March 3, 1949. By April 17 they had made considerable growth (mean total length of 10 = 44.5 mm. range-41-49) and all others in the collection (23) appeared comparable. On May 7, another collection made here (10 individuals) showed a mean length of 48.1, range, 39-60. There is no way of being certain that all were of the same age at either collection but since they were all small to begin with, there should be no great difference. Assuming comparable ages, the data indicate considerable variation in growth rates among individuals and this is substantiated by other collections and by observations near Norman.

In Payne County, metamorphosis occurs in July (5). I personally have not seen normal emergence from pools, but I have collected very small gillless specimens in late June and I suspect that in the warmer waters to the south, development may be slightly more rapid than in the north. It needs to be in some places. Twice, I have come upon regions in Oklahoma where the water was just about gone by evaporation and larvae of these salamanders as well as large masses of tadpoles were struggling to survive. In neither case (one in mid-June, the other in mid-May) was there any evidence of hastened metamorphosis.

BEHAVIOR OF THE LARVAE. Larvae of these salamanders at all ages tend to remain hidden in vegetation. Occasionally one will float languidly in the open. But many times I have approached a pool carefully and looked it over thoroughly for these larvae without seeing any and then have found them in abundance hidden at the edges in vegetation or in algal mats farther out. I find that the easiest way to collect them is by blind sweeping through such vegetative clumps with a strainer. Once the pool is disturbed, they become very wary and are difficult to collect individually. But I have caught as many as six or more in one sweep through vegetation just outside an area already disturbed. On the whole, they are easier to catch than similar larvae of *A. maculatum* but not so easy as those of another close relative, *A. t. morvortium* (when small) which, by comparison, appear stupid and sluggish.

In one place where general collections had been made earlier, and I knew the larvae to be abundant, I approached a long ditch from one end and was puzzled to find only one or two larvae through nearly its whole length. At the upper end, however, in 1 to 2 inches of water, I found them in abundance with thousands of tadpoles of *Bufo terrestris americanus*. Since the salamander larvae are carnivorous, I suspected that they might be attacking the small tadpoles, but I could not prove this. I also suspected them of attacking each other. One was found with a leg missing; and fully half of those collected had regenerating tails. I could find no predators in this water in sufficient numbers to account for so much mutilation of the larvae. This, therefore, seems good circumstantial evidence for cannibalism.

SUMMARY. *Ambystoma texanum* occupies the eastern half of Oklahoma. Ecologically it is a part of the fauna of the tall grass prairie, oak-hickory pine woodland, and flood plain forests. It is not a member of the biota of the mixed grass prairies nor of the oak-hickory savannah. In all parts of its Oklahoma range it breeds in shallow, well vegetated pools in February and early March and its larvae metamorphose by at least July (possibly earlier to the south). Larvae grow differentially in pools and spend much time hidden in vegetation. They are suspected of attacking toad tadpoles at times and there is circumstantial evidence of cannibalism.

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