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NOTES ON THE HABITS OF *RANA AREOLATA*
BAIRD AND GIRARD.

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So little is known of the habits and distribution of the gopher frog, *Rana areolata*, and so few are to be found in museum collections that the Museum of Zoology is fortunate in having received, in 1913, from Professor George R. LaRue, four specimens of this species which he had collected in March, 1910, near Calhoun, Illinois. Professor LaRue reported the species as occurring in considerable numbers in the region east of Calhoun and in May, 1913, Helen Thompson Gage and the writer were sent to that locality to obtain additional specimens and further investigate the habits, abundance, and local distribution of the form. Eleven days were spent in the field, from May 14 to May 24, and the studies were made in the locality from which Professor LaRue's speci-

mens were obtained—a farm one mile east of Calhoun. Twelve specimens were secured, with photographs of the animals and the burrows in which they lived, casts of the burrows and notes on the habits.

Apparently the only detailed notes on the habits of *Rana areolata* which have been published are those of Hurter.¹ His observations were made in Montgomery County, Missouri, and as far as they go agree quite closely with ours.

General Environmental Conditions: The country is in general a flat plain with occasional low rolling hills; there are few streams and no natural lakes or ponds. The soil is mostly clay with occasional stretches of sand, especially near the streams. The whole is underlaid at a depth of about three feet with "hard pan", a hard silty clay. A considerable portion of the land is cultivated, but there are many old meadows and along the streams some wooded areas. Scattered about the region are frequent "horse ponds", shallow cisterns which are formed by scraping away the soil from the "hard pan" and using it as a dike to hold the water which falls (Pl. II, Fig. 1). These ponds cover an area of from one-third to one-half of an acre, are from two to four feet deep, and are used as stock-watering places. They bear no relation to the topography of the country, but are located entirely at the convenience of the farmers.

Burrows: The region is a particularly favorable habitat for *Rana areolata* because of the presence in great numbers of the crayfish burrows, in which, as reported by Hurter, this species makes its home. These burrows are quite generally distributed in the meadows and cultivated fields but not in the sandy areas. Their distribution apparently bears no relation to the ponds and streams, which is to be expected since the

¹Trans. Acad. Sci. St. Louis, Vol. XX, No. 5, pp. 116-117

ground water level is above the hard pan and it is only necessary for the crayfish to extend their burrows into the subsoil to insure a constant supply of water.

The old burrows occupied by crayfish were entirely without chimneys, and were approximately round at the entrance, which had a diameter of about three inches. The entrance was more or less overhung with grass and at one side was a small bare space about six inches in diameter. These bare "platforms" are evidently the result of the activities of the crayfish in cleaning out the burrows. The mud that is brought up is more or less fluid and in the case of the old burrows is deposited only occasionally and in small quantities. The mud impedes the growth of grass and serves to keep the earth at the front of the entrance free from vegetation. Immediately inside the entrance the burrows slanted obliquely downward for a few inches and then became nearly perpendicular for the rest of the depth, three feet or more, and the walls were slightly roughened. It is to be presumed that the burrows always extended to water but this could not be verified in some cases.

The burrows occupied by frogs (Pl. III) differed but slightly from those just described. Hurter says of the burrows inhabited by frogs, "The inhabited holes are easily recognized as the entrance as well as a little platform in front of it is worn smooth." Our observations did not bear out this statement. We were quite unable to distinguish by external appearance the old holes occupied by crayfish from those inhabited by frogs. The openings were of approximately equal size and overhung with grass, and the platforms were nearly always present (Pl. II, Fig. 2). Only rarely was an old hole found without a platform and in such cases when dug out it was found to be either entirely abandoned or to contain a crayfish. On the other hand many holes with well-developed platforms contained

crayfish. After excavating for some distance we were able to determine holes occupied by frogs by the slightly smoother appearance of the walls and by the presence of beetle fragments adhering to them. At the bottom of the frog burrows, which usually terminated at a distance of about three feet, was a mass of foul smelling clayey material containing quantities of beetle remains and considerable dead grass, the latter probably having been washed in or accidentally carried down by the frog.

The crayfish in keeping their holes free from debris and open to the water level roughen the walls in the journeys to and from the surface. The frogs of course do not clean their burrows and so the latter tend to fill with soil washed in by the heavy rains. The frogs so nearly approximate the size of the holes that the rubbing of their soft bodies probably tends to smooth the walls, and the longer a burrow has been occupied by a frog the more shallow it becomes by reason of accumulated debris and the less liable it is to contain water. During the spring months, however, the water stands at the very surface of the ground and all the holes are practically filled at that time.

Mode of Life: The frogs were sought in the meadows and fields during the day and at night, and many burrows were opened. The species is so secretive, however, that our observations on the habits are meager. Hurter suggests that the frog comes out in the early morning, "preferring dawn to full daylight", and again that it watches for its prey on the clearing and "as soon as it hears an unusual noise or sees someone creeps back in the hole." These suggestions are supported by our observations. The species is apparently not distinctly nocturnal as repeated search for it at all hours of the night with an acetylene lamp only discovered one specimen and this not

in the vicinity of a burrow. On the other hand, it does not roam about during the day, as only two were found away from holes in the day time and one of these had evidently been turned out of its home by the harrow. Two frogs were observed to drop hurriedly into their holes when frightened by our approach. These individuals had evidently been sitting on the bare spots at the entrance. It is difficult to determine the amount of time which the frogs spend on the clearing at the burrow entrance for at the slightest cause for alarm they disappear into the holes. Hurter states that in Missouri many are killed by mowers, and the farmers in Illinois informed us that in the spring, when the grass is short, they are frequently seen at the mouths of the burrows, observations which seem to indicate that considerable time is spent on the clearings.

Apparently when alarmed the frogs do not ordinarily descend far into the burrows, for they are plowed out in numbers and the ground in that region is only plowed to a depth of about three inches. When one attempts to dig them out, they descend farther into the holes, but even then do not generally go to the bottom. We found it difficult to capture them without enlarging the holes, the exceptionally powerful hind limbs and the extent to which they can distend the body serving to secure them so firmly that they could be mutilated before being dislodged. Even when water or thin plaster was poured into the holes the frogs remained to drown rather than come to the surface.

Food Habits: The stomach contents of several frogs taken by us have been examined by Mr. A. W. Andrews, and he reports that from 60-70% of the total contents consists of *Scarites subterraneus* and several species of *Chlaenius*, beetles nocturnal in their habits. This would seem to indicate that the frogs,

since they are not nocturnal, feed in the early morning. The stomach contents of four individuals are tabulated below.

Mus. No.	Beetles	Spiders	Larvae	Ants	Crickets	Total
44463	2 Carabidae	2	1			5
44465	1 Elateridae 9 Carabidae 2 Scarabidae	1		1	1	15
44467	4 Carabidae	1				5
44468	16 Carabidae	1				17

Breeding Habits: Unfortunately the breeding season had passed at the time the investigations were made, but Professor LaRue obtained his specimens in March and made notes on the breeding habits, which he has kindly placed at our disposal. During the latter part of March, 1910, the frogs were found in numbers about the ponds at night, and many large masses of eggs were seen. One captured female laid her eggs in the collecting bag. The song is described as a loud trill, hoarser than that of the leopard frog and pitched somewhat higher than that of *Rana catesbiana*. We were not successful in finding the tadpoles in May, altho the ponds were searched for them. Professor LaRue found the frogs in the mammal burrows along the shores of the ponds, as well as in crayfish holes, but it is probable that they were only temporarily occupying the former during the spawning season for we were unable to discover any mammal burrows, either in the vicinity of ponds or elsewhere, inhabited by frogs.

General Notes: Altho very agile in seeking the concealment of their burrows when alarmed, these frogs are in many ways rather sluggish and appear stupid in their actions. As stated, they usually do not retreat to the bottom of the hole when one is digging them out, and they do not try to escape

when the holes are filled with water. Similarly, when handled they make very little effort to escape. They do, however, characteristically assume a defensive attitude (Pl. 1, central figure) by puffing up the body, raising themselves rigidly upon their legs and occasionally snapping their jaws at their captor.

We did not find the species as abundant in the region as reported by Professor LaRue, and the farmers stated that it is yearly becoming more rare. This is to be expected since more of the land is being cultivated, and the frogs are killed in comparatively large numbers each year by the plows and mowers. We found them much more numerous in the meadows than in the cultivated fields, and it was evident that with the continued breaking up of the meadows the species would become even more rare in the region. It is also probable that many of the individuals, living as they do in burrows far removed from the ponds, do not breed each year and this acts as an additional check to the increase in numbers.

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PLATE I.

Characteristic attitudes of *Rana areolata* Ba. & Gir.

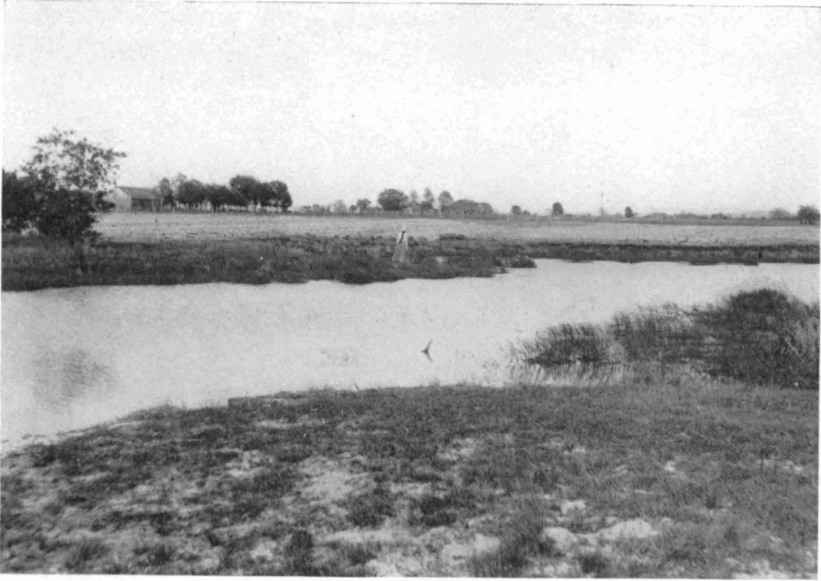


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PLATE II.

Figure 1. Artificial pond near Calhoun, Illinois. Breeding place of *Rana areolata* Bd. & Gir.

Figure 2. Entrance to abandoned crayfish burrows inhabited by *Rana areolata* Bd. & Gir. One-sixth natural size.



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PLATE III.

A sketch of a crayfish burrow inhabited by a frog. Drawn to scale from a plaster cast in the Museum of Zoology (Cat. No. 44545), one-sixth natural size.

