THE WASMANN JOURNAL OF BIOLOGY

Vol. 8, No. 1 SPRING, 1950

Observations on Microhyla (Salientia: Microhylidae)[1]

ARTHUR N. BRAGG, *Department of Zoological Sciences, University of Oklahoma, Norman, Oklahoma*

Recently Dunn *et al* (1948) have pointed out that genera in the Microhylidae have few external characters by which they can be separated. It is, therefore, not to be expected that specific (and, still less, subspecific) differences should be externally clear-cut and definite. Hecht and Metalas (1946) found only one external character which would consistently separate *Microhyla carolinensis* (Holbrook) and *M. olivacea* (Hallowell), a difference in ventral coloring, the former being mottled, the latter immaculate. But they also studied specimens from southeastern Oklahoma and Texas with only slight mottling which they interpreted as intergrades between these two forms. It is obvious from the foregoing that, should intergradation of these two microhylids occur, a mottling of the venter, fainter than typical of *M. carolinensis*, is the only thing that could show it in adults.

In a forthcoming paper (Bragg, 1950) I confirm Hecht and Metalas' observation of faint mottling on specimens from Latimer County, Oklahoma. Furthermore, I know this region to be on the borderline between the ranges of the two forms, in exactly the place where intergradation is to be expected if it occurs. Accordingly, I have accepted Hecht and Metalas' interpretation that the forms in question represent subspecies and am now using the trinomial designations for them.

Smith (1947), working with Bryce C. Brown, however, failed to find evidence of intergradation in southern Texas in a region of overlap of ranges and therefore questioned the interpretation

Received for publication September 29, 1949.

1. Contribution from the Department of Zoological Sciences and the Oklahoma Biological Survey, University of Oklahoma, Norman.

of Hecht and Metalas. He points out that faintness of mottling in long preserved specimens is suspect in any case.

It seems necessary to find further facts before we can be reasonably certain as to which of the above viewpoints is to be accepted generally—and this should be done as soon as possible to avoid more confusion, both in conception and in naming of these two forms.

Since both forms occur in Oklahoma, since one of them *(M. c. olivacea)* has been under observation by me off and on for approximately fourteen years and the other four years, since both differences and similarities between them are well known to me, and since external morphological characters appear to be lacking by which the questions at issue might be settled, I summarize below some observations on the habits of the two forms which may aid in getting a truer picture of the place each occupies. The observations do not absolutely settle the question but I believe that they bear strongly upon it.

Breeding call. The call of the breeding male differs in the two forms. A ten minute record of each, made by a Sound Scriber[2], has been used for comparison with the following results: (*M. c. carolinensis* in each case given first): (1) Mean No. of calls per minute=5.8 and 7.1 (2) Mean duration of each call=0.8 and 2.7 secs. (3) Mean interval between calls=9.7 and 5.2 secs. Even though these records were taken at different temperatures (31°C, air and 34°C, water for *M. c. carolinensis* and 28°C, air, 26°C, water, for *M. c. olivacea*) the difference is striking. *M. c. carolinensis* has a much shorter, deeper call with the interval between calls not only longer but less uniform in duration than *M. c. olivacea*. The number of calls per minute varies widely in *M. c. carolinensis* so that its mean number (5.8 in the above illustration) does not give a true picture of modal condition, whereas in *M. c. olivacea* the corresponding mean number (7.1) is close to the modal number at any one time and place. As noted by Wright and Wright (1933) the call of *M. c. olivacea* characteristically opens with a very short high peep. This is very evident

2. The Sound Scriber is an office recorder which makes a permanent record at a constant rate on a plastic disc. A portable model, powered by a car battery working through a transformer, is a very satisfactory instrument for recording animal calls. The machine used was furnished through the Faculty Research Fund, administered by a faculty committee of the University, whose aid is hereby acknowledged.

in my Sound Scriber records as well as in the field. Only once have I heard this opening note in the calls of *M. c. carolinensis.* This was in a spring-fed ditch in Cherokee County, Oklahoma, on a hot dry afternoon. The animal could not have been a stray *M. c. olivacea,* as might be suspected, for several reasons including the important one that no rain had fallen here for weeks (see below). It *could* have been an intergrade, since both forms are known in this county which, therefore, includes a possible intergrading zone.

Calling station: The males of *M. c. olivacea* are often gregarious while calling as though attracted by each other. It is common to find them in twos and threes in single grass clumps, although many call singly. I have not seen this phenomenon in *M. c. carolinensis* although it may occur, for I have as yet had only limited opportunity to determine the point (eleven breeding congresses seen as contrasted with hundreds in *M. c. olivacea*).

The calling station of *M. c. carolinensis* in all cases observed has been in tall vegetation such as grass or sedge clumps protruding from the water. *M. c. olivacea* also uses such places but often utilizes shorter vegetation. This supposed difference may be only a matter of season (see below). Further observations are needed.

Breeding season: In this we see the greatest contrast in habits between the two forms. *M. c. olivacea* has a strictly xeric breeding pattern similar to that of the shadefoot toads (*Scaphiopus*), *Pseudacris clarkii* Baird, and the prairie-limited species of *Bufo.* Breeding congresses occur only after rains from late April through early September (observed) and their size depends upon the intensity and amount of rainfall at any one time and place. Since individuals do not breed without the initial stimulus of rainfall, there is no breeding season in the sense that this term can be used for mesic species like the bull frog. As is common with xeric forms, females collectively "stagger" the laying of eggs through the warm months of each year, some laying eggs after each rain of any consequence, others not at all, depending upon their individual hormonal and ovarian rhythms as influenced by rainfall. Of literally hundreds of congresses observed (over 100 have been recorded as to time, place, and condition), no exceptions have been seen.

Microhyla c. carolinensis has been seen in breeding congresses on eleven occasions. Three of these were after heavy rains, the remainder at times when no rain whatever had fallen for several weeks in the region concerned with each. Two of the eleven congresses were found at night (both after rains); two were in mid-forenoon with eggs present in one pool but not seen in the other. One of these was certainly, the other probably, a continuation of a congress the preceding night (after a general, very violent and heavy rain the preceding afternoon). The remainder (i.e., five) congresses occurred on bright, very hot afternoons at times when no rain had fallen for long periods. These were all small congresses. While the observations show that *M. c. carolinensis* may call at night after rain, they also indicate that rain is not a necessary initial stimulus. I have also noted on two occasions that heavy rains (3 inches or more) failed to stimulate breeding congresses, one in June and the other in September. Low temperature may have been a factor in the former but not in the latter case. Furthermore, I have seen two heavy rains in regions, at times and under conditions which would allow one to expect breeding congresses to develop if rain were the necessary and usual initial stimulus, but no breeding congresses (even small ones) could be found in 100 miles of travel in a region known to have a large population of this form. Under similar conditions within its range, individuals of *M. c. olivacea* would have been calling in large numbers from every shallow, grassy pool (as, indeed, they were farther westward on the same night).

The observations show clearly that *M. c. carolinensis* has a mesic pattern of breeding. They breed only after the weather is quite warm (summer rather than spring) starting usually in June and ending before September. They, therefore, can be said to have a breeding season extending through the summer months and to be comparatively little influenced by rainfall. Like many other mesic forms, they often breed in small groups (I have never seen a really large congress), another contrast with the related *M. c. olivacea* in which (after very heavy rain) large congresses are the rule.

Tadpoles: Developmental rates, both of embryos and tadpoles, are very rapid in both forms, probably associated in part at least with the high water temperatures in pools, often in *M. c. olivacea* and usually in *M. c. carolinensis* exceeding 35°C. In behavior,

coloring, variations in coloring in different waters, and in size at a given age, they are much alike. Aside from a slightly different average position of the eyes, as noted by Wright (1929), the only reasonably consistent difference seems to be the same as that of adults, namely, a mottled venter in *M. c. carolinensis*, an immaculate one in *M. c. olivacea*. However, I once (and only once) found a pool crowded with large microhylid tadpoles in a region well within the range of *M. c. olivacea* (and ecologically right for this form) in which nearly all tadpoles had mottled venters. The region was, however, near enough to the known geographic and ecological range of *M. c. carolinensis* that these may have been intergrades. If so, it is a clear-cut case of gene drift westward from an intergrading zone. It should be noted, however, that coloration in tadpoles of many species varies widely in different waters, as I have had very ample opportunity to observe; differences in coloration in tadpoles, therefore, unless supported by other evidence, is not a safe guide in taxonomic matters.

Conclusions

(1) *Microhyla c. carolinensis* and *M. c. olivacea* are structurally similar externally, both as adults and as tadpoles.

(2) Their breeding habits are widely different, the former having a mesic, the latter a xeric breeding pattern.

(3) Such a difference in breeding pattern, associated with adaptation to a difference in present ecological distribution is exactly what would be expected of two closely related forms.

(4) The evidence, if interpreted on the seemingly reasonable assumption that the mesic pattern of breeding is the more primitive, suggests that *M. c. carolinensis* is the older form, *M. c. olivacea* either evolving from it or both being derived from a mesically adapted common ancestor.

(5) Although not by any means proved, it seems likely that one of these forms, whose ranges meet along a wide ecological ecotone, should have been derived from the other, and, if so, then the western *(M. c. olivacea)* should have been derived from the eastern *(M. c. carolinensis)* through an adaptive change in habits rather than a change in morphology.

(6) Smith's finding that *M. c. olivacea* and *M. c. carolinensis* have an overlap of ranges in a limited area would be good evi-

dence for specific distinction were it not counteracted by that of Hecht and Metalas and myself in other regions. It is not usual that two intergrading forms always intergrade where their ranges meet. Ecological conditions may make the difference. In one habitat they may intergrade and in another mix with no intergradation.

(7) On the whole, therefore, it seems likely that Hecht and Metalas' interpretations of these forms as subspecies will be shown to be correct. At least, till further evidence is forthcoming, I shall continue to use the trinomial designation for them.

LITERATURE CITED

BRAGG, ARTHUR N.

1950. Salientian range extensions in Oklahoma and a new state record. Researches on the amphibia of Oklahoma, University of Oklahoma Press.

DUNN, E. R., HAROLD TRAPILO, AND HOWARD EVANS

1948. A new species of the microhylid frog genus *Chiasmocleis* from Panama. American Museum Novitates, 1376: 8 pp.

SMITH, HOBART M.

1947. *Microhyla carolinensis* in Kansas. Herpetologica 4:13-14.

WRIGHT, A. A., AND A. H. WRIGHT

1933. Handbook of Frogs and Toads. Ed. 1. Comstock Publishing Co., Ithaca, N. Y.

WRIGHT, A. H.

1929. Synopsis and description of North American tadpoles. Proceedings of the United States National Museum, 74(11):1-70.