

## SEXUAL DIFFERENCES IN COLORATION IN THE SPOTTED TURTLE, CLEMMYS GUTTATA.

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Very few instances of sexual differences in coloration among the Chelonia are on record. In Boulenger's Catalogue of the specimens of this order in the British Museum mention is made of only two species which present sexual differences in coloration.<sup>1</sup> One of these is *Kachuga trivittata* (Duméril and Bibron), an Indian species not represented in the United States National Museum. Boulenger remarks<sup>2</sup> in his description of this species: "The male *B.* [lege *K.*] *trivittata* is characterized by three black longitudinal bands on the carapace, which are absent in the female according to Theobald, whose opinion I am disposed to indorse rather than that of Anderson, who makes a distinct species (*B. iravadica*) for the specimens (female and yg. male) without bands." The synonym *Batagur iravadica* Anderson, however, is cited by Boulenger with a mark of interrogation, and the existence of a sexual difference in coloration in this species (*Kachuga trivittata*) can not be regarded as definitely established. Gray<sup>3</sup> remarks: "This colour [i. e., the three black streaks] appears to be laid on the shell, and flakes off."

The other species in which a sexual difference in coloration is described by Boulenger is *Emys orbicularis* (Linnaeus), the commonest of European turtles, the soft parts of which are described<sup>4</sup> as follows: "Head dark brown or black, with lighter dots, which are yellow in the female and pale brown in the male. . . ." I have not been able to confirm this statement in an examination of the few alcoholic specimens of this species in the United States National Museum, as those of each sex appear to be spotted alike with pale yellow.

<sup>1</sup> Under *Cinosternum integrum* (p. 42), Boulenger describes the color of the shield as follows: "Carapace brown, with small blackish dots in the male. . . ." Only three adult specimens are listed—an insufficient series for establishing a sexual difference in color; and Dr. L. Stejneger informs me that the supposed difference is non-existent.

<sup>2</sup> Cat. Chelon. Brit. Mus., pp. 55-56, 1889.

<sup>3</sup> Suppl. Cat. Shield Rep., vol. 1, p. 56, 1870.

<sup>4</sup> Cat. Chelon. Brit. Mus., p. 113, 1889.

Among American turtles, the only species in which a sexual difference in color is recorded seems to be *Terrapene carolina* (Linnaeus), the common box turtle, in which the eye of the male is red and that of the female brown.

During the years 1908 to 1912 I collected in Stoughton, Massachusetts, and adjacent towns a series of 18 specimens of the spotted turtle, *Clemmys guttata* (Schneider). All of these were prepared as skins, mounted specimens, or skeletons, and the sex (with the exception of a single young specimen) was determined by dissection in every case. At the close of the first season's collecting I drew up from my series, then amounting to 10 specimens, a table of the sexual differences in coloration, which was confirmed in nearly every respect by later collections of the species. In addition to the material in my own collection, I have been able, through the kindness of Dr. Leonhard Stejneger, to examine the considerably larger series in the United States National Museum, representing various localities throughout the range of the species. The total number of adult or nearly adult specimens in good condition examined is 60 (24 male, 36 female), 17 of which are skins or mounted specimens in my own collection and 43 alcoholics in the National Museum. The sex of the specimens in the latter series has been determined by the ordinary external sexual characters of this group—shape of plastron and proportions of tail—and their examination has fully borne out the differences I had found to exist in my own material. The single specimen which departed from these characters was a male, which possessed some of the color characters of the female. It will be described more in detail later in this paper.

The sexual differences shown in the series examined may be listed in the order of their constancy, as follows:

1. The horny portion of both jaws in the male is dusky, in the female pale yellow. No exception.

2. The plastron of the male is distinctly concave along the midline near the anterior margin of the femoral shields; that of the female is flat or slightly convex essentially throughout. Occasional females have a slight transverse depression extending across the plastron at about the anterior margin of the femorals, but this never assumes the character of a central depression such as is found in the males.

3. The female has a conspicuous yellow or orange mandibular stripe reaching about half the length of the neck; the male has a few spots or almost none, or rarely a weak streak about 5 mm. long. The only exception is the aberrant male mentioned above, which has a rather strong mandibular stripe.

4. The throat of the male is black, with sparse and usually obscure, rarely numerous, small yellow specks; that of the female is heavily streaked and spotted with yellow, usually aggregated for-

ward into a blotch which occupies most of the space between the sides of the lower jaw. The only exceptional specimen is the male just mentioned, which has well-developed throat markings.

5. The anal opening is situated much nearer the base of the tail in the females than in the males. This character and character No. 2 above are those commonly used for the discrimination of the sexes in museum material, but the measurements which I have made of the series of alcoholics in the National Museum show that there is some overlapping in this character. In 15 males the total length of the tail, measured in a straight line along its underside from the notch in the anal plates to its tip, varied from 30 to 43 mm. (in an exceptional case only 23 mm.) and averaged 36.8 mm. The distance from the notch in the anal plates to the middle of the anal opening varied from 11 to 16 mm. (in two cases only 8 mm.) and averaged 12.7 mm.; the length from the middle of the anal opening to tip of tail varied from 20 to 28 mm. (in two exceptional cases 15 and 17 mm.) and averaged 24 mm. In the 27 females measured the tail varied from 20 to 37 mm. (with a single exceptional specimen of 40 mm.) in length, with a average of 29.6 mm.; the preanal measurement was 2 to 7 mm. (in two exceptional specimens 10 mm.), with an average of 5 mm.; and the postanal length 15 to 33 mm., with an average of 24.6 mm. From these figures it will be seen that the tail of the male averages 36.8 mm. in length, that of the female 29.6 mm.; its preanal length in the male averages 12.7 mm., in the female 5 mm.; while the postanal portion of the tail is essentially the same in both sexes (24 mm. in males, 24.6 mm. in females). There is some overlapping in each of these measurements, which is least in the case of preanal length of the tail. The shape of the tail is subject to considerable variation in both sexes. On the whole the tail of the female is perhaps more slender than that of the male, but the variation seems too great to make this difference of any diagnostic value.

6. The female has a well-developed supra-auricular line of yellow or orange spots, which are usually aggregated into a streak. In the male this is much less developed, except in the case of the abnormal specimen, to which reference has already been made. A few of the more weakly marked females, however, are not distinguishable in this regard from the more heavily marked males.

7. The female has almost invariably a few yellow spots on the crown in front of a line connecting the posterior corner of the eyes. Of the 24 males examined only about 8 showed one or two such spots. It may be noted that the abnormal male already referred to had no spots in this region.

The distinctive characters just described may be summarized for the sexes thus:

*Male*.—Jaws always dusky; plastron always distinctly concave in the median line toward anterior margin of femorals; mandibular stripe nearly or quite lacking (developed in one specimen); throat sparsely or rarely densely speckled with yellow, the specks never (except in one specimen) aggregated forward into a blotch; tail averaging 36.8 mm. long, its preanal length averaging 12.7 mm.; supra-auricular streak little developed (except in one specimen); anterior portion of crown usually immaculate (with one or two spots in one-third of the specimens).

*Female*.—Jaws always pale yellow; plastron never concave posteriorly along midline, sometimes somewhat depressed transversely in the region of the femorals; mandibular stripe always conspicuous; throat always streaked and spotted with yellow, this developed anteriorly into a blotch; tail averaging 29.6 mm. in length, its preanal length averaging 5 mm.; supra-auricular line usually well developed; anterior portion of crown with several yellow spots.

The single specimen in the series of 60 adult or subadult specimens examined which provides an exception to some of the more important characters listed is a male (Cat. No. 51785, U.S.N.M.), collected in Fairfax County, Virginia, June 29, 1914, and presented by Mrs. E. P. Miller. In this specimen the characters of plastron, tail, jaw color, and lack of spots on anterior portion of crown are normal for the male. The throat markings and mandibular and supra-auricular stripes, however, are those of the normal female. Dissection of the specimen showed nothing abnormal in the genital organs, and the cause of its peculiar coloration can only be assumed to be due to some abnormality in its embryonic history.

Another apparent exception to the constancy of the characters above described is furnished by the excellent colored plate<sup>5</sup> of this species published in Babcock's memoir on the turtles of New England. The colors of the carapace in this plate were taken from the shell of a Massachusetts specimen, while those of the soft parts, which agree with those described above as characteristic of the female, were copied by the artist, R. Deckert, from "a live male captured in New York City." Doctor Babcock writes me with regard to this illustration that he sent a fine shell in his possession to the artist "with instructions to draw the soft parts from a male as nearly the same size as possible. He evidently drew from a female . . ."

It is a curious fact that not one of the fairly conspicuous and constant sexual differences in coloration of *Clemmys guttata* has previously been recorded, although sexual differences in the shape of the plastron and position of the anal opening in this and other turtles have long been familiar to herpetologists. Indeed, beyond the slight

<sup>5</sup> Mem. Boston Soc. Nat. Hist., vol. 8, pl. 27, figs. 1, 2, 1919.

differences in two or three species mentioned in the first part of this paper, no difference in coloration between the sexes seems to have been recorded in any member of the Chelonia. This is undoubtedly due to the fact that practically all collections of turtles consist chiefly of alcoholic material. The examination of series of such specimens is much less convenient than that of skins; the specimens are often badly distorted or have the members drawn under the shell; and the colors are poorly preserved, although the distribution of the markings can usually be made out satisfactorily. It is somewhat remarkable that Agassiz, who had "thousands" <sup>6</sup> of living specimens of turtles of different species under observation in his yard, apparently failed to distinguish these differences, although he noted <sup>7</sup> sexual differences in the form of the shield, the length of the tail, and the scalation of the legs in the Kinosternidae.

In 1905, in a report of a meeting of the American Society of Zoologists, R. M. Yerkes <sup>8</sup> published the preliminary results of his study of the spotted turtle, in the following words:

1. The young of this species of tortoise usually have a single yellow spot on each plate of the carapace except the marginals. With age the number of spots increases; they appear on the marginal plates also, and their arrangement becomes irregular.

2. The epidermal layer is transparent immediately over the mass of yellow pigment in the outer bony layer, hence, window-like regions in the outer portion of the shell.

3. Although the females are slightly smaller than the males they usually have about 15 per cent more spots on the carapace. The average number for the males is 60, for the females 69. This would seem to indicate that the brightly colored spots serve as both sex and species marks. Probably they serve to render the females conspicuous.

4. Statistics indicate a greater number of spots on the left side of the carapace than on the right in both males and females. It is possible that this is to be correlated with right-handedness and right-eyedness.

Professor Yerkes informs me that these conclusions were based on the examination of several hundred specimens, and that several years ago all his data were turned over to Dr. C. B. Davenport for elaboration, but that nothing further has been published. (Doctor Davenport writes me that Professor Yerkes' manuscript has been mislaid.) In the absence of this detailed information it is impossible to assign much weight to the possible correlations suggested in his third and fourth paragraphs. His suggestion that the slightly greater average number of spots found on the females in his series serves as a sex-distinguishing character in nature is rendered very improbable when the great variability of the spotting in both sexes is considered.

Agassiz's description <sup>9</sup> of the newly hatched young of this species agrees with that of Yerkes: "When hatched, there is but a single dot

<sup>6</sup> *Contr. Nat. Hist. U. S.*, vol. 1, p. 252, footnote, 1857.

<sup>7</sup> *Idem*, p. 419.

<sup>8</sup> *Science*, new ser., vol. 21, p. 386, 1905.

<sup>9</sup> *Contr. Nat. Hist. U. S.*, vol. 1, p. 443, 1857.

upon each scale of the shield, and none upon the marginal scales; as it advances in age new dots appear, one by one, upon each scale, until they become very irregular, and extend to the margin of the shield. I have, however, seen old specimens that were entirely black, and others in which the dots remained few and regular."<sup>10</sup>

There are in the National Museum seven very young specimens of this species, with a carapace varying from 28 to 33 mm. in length.<sup>10</sup> In only one individual are the marginals free from spots. The others have single spots on from 8 to 18 marginal scutes. The specimen (No. 23331, U.S.N.M.) with spots on 18 scutes is the youngest of all, the umbilical aperture not yet being closed by shell. It measures 28 mm. in length. The other specimen (No. 12701) of this length entirely lacks spots on the marginals. Despite Agassiz's statement that the newly hatched young are without spots on the marginals, the specimen which he figures<sup>11</sup> has spots on two marginal scutes on one side. Dr. H. L. Babcock, to whom I have recently written for information on this subject, informs me that of the two newly born young available to him for examination one has three spotted marginals on each side and the other four. From this it is evident that the statements of Agassiz and Yerkes with regard to the absence of spots on the marginal scutes in the newly hatched young are not true of all specimens. It is interesting to note that the color characters distinctive of the sexes can be clearly seen in these very young specimens, although the structural characters of tail and plastron are not discernible.

Babcock has recorded the fact that the males are less in evidence in late summer and fall than the females, which accords with my own observations. Most of my males were taken in March and none later than May. My earliest date of observation of the species is March 5, 1910, when a female was collected in North Easton, Massachusetts; my latest December 6, 1912, when I saw two, one of which, a female, was collected, in a pool in woods in Stoughton. I have the following notes on the development of eggs: A female collected on April 11, 1908, contained nine well-developed eggs in the yolk. One taken on June 19, 1908, contained three mature eggs, which are still in my collection, and eight in the yolk. One taken on March 29, 1909, held nine round eggs in the yolk. The specimen captured on March 5, 1910, contained three eggs in the yolk, about 14 mm. in diameter, and some smaller ones. The one taken on December 6, 1912, contained two eggs in the yolk, about 1 cm. in diameter, as well as smaller ones.

<sup>10</sup> Babcock (Mem. Boston Soc. Nat. Hist., vol. 8, p. 398, 1919) gives the length of the carapace in the newly hatched young as 26 mm., at the end of the first month 30 mm., and at the end of the second month 32 mm.

<sup>11</sup> Contr. Nat. Hist. U. S., vol. 2, pl. 1, fig. 7, 1857.

In eastern Massachusetts I have always found this species inhabiting different territory from that frequented by the painted turtle (*Chrysemys picta*). The latter is a species of ponds and rivers. *Clemmys guttata*, on the contrary, is found chiefly in wet woods, marshes, or shrubby ground traversed by brooks or ditches, and is much more easily captured than its shy relative.

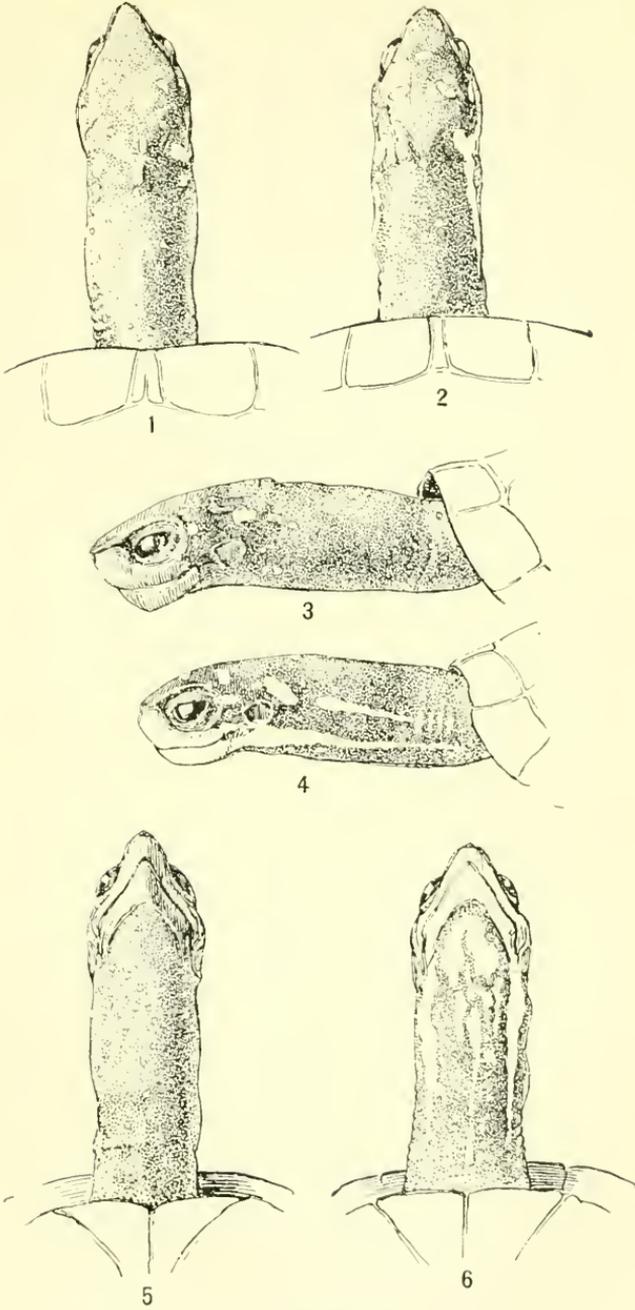
EXPLANATION OF PLATE 99.

*Clemmys guttata*, showing color pattern of head and neck, about natural size.

Fig. 1, 3, 5, male; U.S.N.M. No. 63409; Stoughton, Mass.; S. F. Blake, collector.

Fig. 2, 4, 6, female; U.S.N.M. No. 63407; Randolph, Mass.; S. F. Blake, collector.





COLOR PATTERN OF CLEMMYS GUTTATA.

FOR EXPLANATION OF PLATE SEE PAGE 469.

