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THE BREEDING HABITS OF THE FLORIDA ALLIGATOR

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While collecting material with which to study the development of the alligator, I have had the opportunity, during parts of three summers, to study, at first hand, the habits of this interesting reptile. The first occasion was in 1901, when I went into the Everglades to the west of Palm Beach, Florida: this expedition was undertaken partially under the auspices of the Elizabeth Thompson Science Fund, and was unfortunately cut short before much could be accomplished. The second trip was in the summer of 1905, under the auspices of the Smithsonian Institution: six weeks were spent among the small lakes and sloughs of central Florida, far from the usual haunts of tourists and hunters. During this time nearly one thousand alligator eggs were collected, and considerable information in regard to the breeding habits of the alligator was obtained. A short visit was also made, on the way north, to the Okefenokee Swamp in Georgia. In the summer of 1906 the Okefenokee was again visited; this time the swamp was penetrated to its centre, and nearly one hundred alligators were killed by the three hunters with whom I was traveling. It is this vigorous hunting, done chiefly at night, with a bull's eye lantern and shot gun, that has so diminished the numbers of alligators that where, twenty years ago, hundreds could be seen, to-day scarcely one may be found. It seems a very wanton destruction of life to kill so many of these large animals, especially when it is remembered that a large alligator hide is worth to the hunter only about \$1.50.

Just how soon (if at all) the alligator is likely to be exterminated in our southern states it is impossible to say, but so long as those

two great swampy wastes, the Everglades and the Okefenokee, remain undrained, the great American reptile is not likely to become entirely extinct.

One of the first things to be determined, of course, in the collection of embryological material is the time at which the eggs are laid. Judging from the statements of native hunters the laying season of the alligator might be thought to be at any time from January to September. As a matter of fact the month of June is the time when most, if not all, of the eggs are laid. S. F. Clarke gives June 9th and June 17th as the limits of the laying season in Florida, but I found at least one nest in which eggs were laid as late as June 26th: no eggs were found before the first date given by Clarke. It seemed quite certain that the laying, during the season in question, had been delayed by an extreme drought that had dried up the smaller swamps and reduced the alligator holes to mere puddles. Nests were found in considerable numbers as early as June 8th, but no eggs were laid in any of them until the end of the dry period which occurred nearly two weeks later. Almost immediately after the occurrence of the rains that filled up the swamps eggs were deposited in all of the nests at about the same time. From the fact that all of these completed nests had stood for so long a time without eggs, and from the fact that all of the eggs from these nests contained embryos in a well advanced state of development, it seemed evident that the egg-laying had been delayed by the unusually dry weather. Eggs taken directly from the oviducts of an alligator that was killed at this time also contained embryos that had already passed through the earlier stages of development. Thus it was that the earliest stages of development were not obtained during this summer.

It is said that during the mating season, which precedes by some time, of course, the laying season, the males are noisy and quarrelsome, and that they exhibit sexual characteristics of color by which they may be distinguished from the females. Never having been in the alligator country at this season, the writer has made no personal observations along these lines, but from the frequency with which alligators with mutilated or missing members are found it is evident that fierce encounters must sometimes take place, whatever the cause. During June and July, at least, and, probably, during most of the year the alligators are very silent, an occasional bellow during the very early morning hours being the only audible evidence that one has that the big reptiles are in the neighborhood. Whatever may be the sexual differences during the mating season, at ordinary times the two sexes are so much alike that I have, on

more than one occasion, seen experienced hunters disagree as to the supposed sex of an alligator that had just been killed.

Although I have never seen a nest actually during the process of construction, it is easy to imagine, after the examination of a large number of freshly made nests, what the process must be like.

The alligator, probably the female, as the male, after the mating season, takes no interest whatever in the propagation of his species, selects a slight elevation on or near the bank of the "hole" in which she lives. This elevation is generally, though not always, a sunny spot, and is frequently at the foot of a small tree or clump of bushes. Where the alligator is living in a large swamp she may have to go a considerable distance to find a suitable location for her nest; when her hole is scarcely more than a deep, overgrown puddle, as is often the case in the less swampy regions, she may find a good nesting place within a few feet of her cave. That the female alligator stays in the neighborhood of her nest after she has filled it with eggs seems pretty certain, but that she defends it from the attacks of other animals is extremely doubtful: certainly man is in very little danger when he robs the nest of the alligator, and, according to the statement of reliable hunters, bears are very persistent searchers for and eaters of alligator eggs. Having selected (with how much care it is impossible to say) the location for the nest, the alligator proceeds to collect, probably biting it off with her teeth, a great mass of whatever vegetation happens to be most abundant in that immediate vicinity. This mass of flags or of marsh grass is piled into a conical or rounded heap and is packed down by the builder repeatedly crawling over it.

There is a great deal of variation in the size and form of the different nests, some being two meters or more in diameter and nearly a meter in height, while others are much smaller in diameter and so low as to seem scarcely more than an accidental pile of dead vegetation. It is probable that the nests are under construction for some time, perhaps to give time for the fresh vegetation of which they are composed to ferment and soften, and also for the material to settle into a more compact mass. The compactness of the alligator's nest was well illustrated one day when the writer used an apparently deserted nest as a vantage ground from which to take a photograph: on opening this nest it was found, after all, to contain eggs, and though some of the eggs were cracked, none of them were badly crushed. This nest although it was so low and flat that it was thought to be one that had been used during some previous season, contained forty-eight eggs, a greater number than was

found in any other nest; while in other nests that were twice as large as this one were found less than half as many eggs, showing that there is no relation between the size of the nest and the number of eggs. The average number of eggs per nest, in the twelve nests that were noted, was thirty-one. One observer reported a nest that contained sixty eggs, but this, if true, was a very unusual case. Reports of still larger numbers of eggs in one nest probably refer to crocodiles, which are said to lay one hundred or more eggs in a nest. Although crocodiles may be found in certain parts of Florida, the writer has had no opportunity of observing their nesting habits.

The eggs are laid in the nest without any apparent arrangement. After the nest has been prepared, and has had time to settle properly, the alligator scrapes off the top, and lays the eggs in a hole in the damp, decaying vegetation; the top of the nest is again rounded off, and it is impossible to tell, without examination, whether the nest contains eggs or not.

As to whether the same nest is used for more than one season there is a difference of opinion among alligator hunters, and the writer has had no opportunity of making personal observations.

While it is usually stated that the eggs are incubated by the heat of the sun, it is held by some observers that the necessary heat is derived not from the sun but from the decomposition of the vegetable matter of which the nest is composed. Possibly heat may be derived from both of these sources, but it seems likely that the conditions that are especially favorable to normal incubation are moisture and an even, though not necessarily an elevated temperature. Moisture is certainly a necessary condition, as the porous shell allows such rapid evaporation that the egg is soon killed if allowed to dry. The inside of the nest is always damp, no matter how dry the outside may become under the scorching sun, so that this condition is fully met. The eggs of the Madagascar crocodile, according to Voeltzkow,¹ offer a marked contrast to those of the alligator. Instead of being laid in damp nests of decaying vegetation, they are laid in holes that are dug in the dry sand, and are very sensitive to moisture, the early stages, especially, being soon killed by the least dampness.

The daily range of temperature in the southern swamps is sometimes remarkably great, so that if the eggs were not protected in some way they would often pass through a range of temperature of

¹ Voeltzkow, A., *The Biology and Development of the Outer Form of the Madagascar Crocodile*. Abhandl. Senckberg. Gesell., Bd. 26, Hft. I.

possibly fifty degrees or more; while in the center of a great mass of damp vegetation they are probably kept at a fairly constant temperature. Unfortunately no thermometer was taken to the swamps, so that no records of the temperatures of alligator nests were obtained, but it was frequently noticed that when, at night or very early in the morning, the hand was thrust deep into the center of an alligator's nest the vegetation felt decidedly warm, while in the middle of the day, when the surrounding air was, perhaps, fifty degrees (Fahrenheit) warmer than it was just before sunrise, the inside of the same nest felt quite cool. It is probable, then, that the conditions of temperature and moisture in the center of the nest are quite uniform. One lot of eggs that had been sent from Florida to Maryland continued to incubate in an apparently normal way when packed in a box of damp sawdust, the temperature of which was about 80 degrees Fahrenheit. Another lot of eggs continued to incubate, until several young alligators were hatched, in the ordinary incubator, at a temperature of about 95 degrees Fahrenheit.¹

The fact that eggs taken directly from the oviducts of the cold-blooded alligator contain embryos of considerable size seems to indicate that no such elevation of temperature as is necessary with avian eggs is necessary with the eggs of the alligator.

The complete process of incubation probably extends through a period of about eight weeks, but no accurate observations along this line could be made. For some hours previous to hatching the young alligators make a curious squeaking sound inside the shell, that may be heard for a distance of several yards: this sound may be for the purpose of attracting the attention of the female alligator, who will open the top of the nest in time to allow the just hatched alligators to escape: unless thus rescued, it would seem impossible for the little animals to dig their way out from the center of the closely packed mass of decaying vegetation.

At the time of hatching the alligator is about eight inches in length, and it seems impossible that it should have been contained in so small an egg.

The size of alligator eggs, as might be expected, is subject to considerable variation. In measuring the eggs a pair of brass calipers was used, and the long and short diameters of more than four hundred eggs were obtained. A number of eggs of average size, when weighed in mass on the scales of a country store, gave an average of 2.8 oz. per egg.

¹Reese, A.M., "Artificial Incubation of Alligator Eggs." *Amer. Nat.*, March, 1901, pp. 193-195.

There was more variation in the long diameter of eggs than in the short diameter.

The longest egg of all those measured was 85 mm.; the shortest was 65 mm. The widest egg (greatest short diameter) was 50 mm.; the narrowest egg (least short diameter) was 38 mm.

The average long diameter was 73.742 mm.; the average short diameter was 42.588 mm.

The greatest variation in long diameter in any one nest of eggs was 15.5 mm.; the greatest variation in short diameter in the eggs of any one nest was 11 mm.

The average variation in the long diameter of the eggs from the same nest was 11.318 mm.; the average variation in the short diameter of the eggs from the same nest was 5.136 mm.

It will be seen from the above that the average variation in the long diameter of eggs from the same nest is between one-sixth and one-seventh of the long diameter of the average egg; while the average variation in the short diameter of the eggs from the same nest is less than one-eighth of the short diameter of the average egg.

S. F. Clarke² gives the limits of the long diameter as 50 mm. and 90 mm., and the maximum and minimum short diameters as 45 mm. and 28 mm. No such extremes in size were noticed among the eight hundred or more eggs that were examined.

EXPLANATION OF PLATES

PLATE LXV

FIG. 1.—Jackson Slough; near Lake Kissimmee, Florida. In the vicinity of this pond several alligator nests were found, either within a few yards of the edge, or on the banks of smaller "holes" which were connected with the larger pond by narrow "trails."

FIG. 2.—A typical 'gator "hole." Only a few yards across, and surrounded by a dense growth of vegetation. On the far side is seen an opening in the surrounding grass and flags where the ground is worn smooth by the alligator in crawling out of the hole. Under the bank, probably near the place where the alligator "pulls out," is the deep cave into which the inhabitant of this hole quickly goes on the approach of danger. As this cave may be fifteen or twenty feet deep it is not an easy matter to get the animal out. When a female alligator inhabits such a hole, a nest may often be found within three or four yards of the water, though it is sometimes at a greater distance. Such a hole as this may be connected by narrow, winding "trails" with larger ponds, as noted under Fig. 1.

²*Journal of Morphology*, Vol. V.



FIG. 1. JACKSON SLOUGH; NEAR KISSIMMEE, FLORIDA.



FIG. 2. A TYPICAL 'GATOR "HOLE."



FIG. 3. ALLIGATOR'S NEST, CHIEFLY GRASS.



FIG. 4. ALLIGATOR'S NEST; CHIEFLY FLAGS, OPENED TO SHOW EGGS

PLATE LXVI

FIG. 3.—A typical alligator's nest, made chiefly of grass. The guide is feeling for eggs without disturbing the outside of the nest. Being made of the same material as the background, the nest does not stand out very sharply, though in nature the contrast is somewhat more marked, owing to the fact that the surrounding grass is green while the grass of which the nest is built is dead and brown.

FIG. 4.—An alligator's nest, somewhat smaller than the one represented in Fig. 3, built chiefly of flags. The nest has been opened to show the irregularly arranged mass of eggs inside. The size and shape of the egg is shown by the one in the guide's hand.