

EGG LAYING HABITS OF THE SLIDER TURTLE (*PSEUDEMYS TROOSTII*), THE PAINTED TURTLE (*CHRYSEMYS PICTA*), AND THE MUSK TURTLE (*STERNOTHERUS ODORATUS*)¹

FRED R. CAGLE

Assistant Custodian of the Museum, Southern Illinois Normal University, Carbondale, Illinois

Numerous turtles were observed along the road leading from Walnut Log Lodge to the biological station of the Tennessee Academy of Science, Reelfoot Lake, during the first weeks in June. Several were captured and taken to the laboratory for examination. All were females containing mature eggs. In order to determine how, when, and where the turtles were depositing their eggs, a rectangular area three hundred feet long and eight feet wide on the side of the road next to the bayou was selected in which to make these observations. The gravel road is built on a low ridge about eight feet above the surface of the bayou and sixty feet from its edge. The sides of this ridge slant gradually toward the water, thus allowing excellent drainage for the area. Although no trees grow in the rectangle, the northern portion is shaded for four or five hours daily by a huge cypress tree growing near the bayou. Gravel from the road has been washed for several feet down the sides of the ridge. The entire area is covered with a dense growth of weeds.

From June 20 to July 24, this area was checked for turtle nests. Records of the number of eggs, size of nests, enemies of eggs, and size of embryos were kept. Time did not allow a more extensive investigation, and no accurate data as to the incubation periods of the turtles studied was collected. Table 1 best expresses the results of the work in the specific area selected.

This table shows that more nests of the slider turtle were found than of any other species. On several occasions these turtles were observed in the process of digging their nests and depositing eggs.

The slider turtle prefers to lay its eggs early in the morning or in late evening. Only three turtles were found laying eggs during mid-day. The turtle crawls out of the water and seeks an elevated ridge that will insure good drainage. An open area somewhat protected by weeds but exposed to the direct rays of the sun is most often chosen. In the egg-laying season the ground is usually dry and hard;

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however, the turtle is prepared for this. The bladder and cloaca are distended with water to be used in softening the ground. A portion of the water is released at the chosen spot (Taylor, 1935). In some cases an area of two feet is wet. While the water is soaking into the dry soil, the turtle assumes her digging position. The front feet are braced against weeds, rocks, or any other convenient support, and the back of the carapace is placed over the place to be excavated. Unlike most animals, the turtle uses the rear limbs for digging. Beginning with one of the hind legs, she tests the soil with a side-ward, scraping motion of the leg. If it is too hard for comfortable digging, more water is released until the soil is softened. The scraping movements of the hind leg are renewed until a shallow hole has been formed. The turtle then shifts to the other leg and digs. The process is an awkward one and the turtle seems to tire easily. She

TABLE 1
Summary of nesting conditions of turtles

NAME OF TURTLE	TOTAL NO. OF NESTS	NUMBER OF EGGS			NO. OF EGGS ATTACKED BY				RANGE OF LENGTH OF EMBRYOES	DISTANCE OF NEST FROM WATER	
		Ave. PER NEST	RANGE PER NEST	TOT.	MOLDS	DRIED	ANTS	FLY LARVAE		RANGE	Ave.
<i>Pseudemys troostii</i>	47	10.5	5-22	498	17	31	12	11	mm. 3-15*	44-50	47
<i>Chrysemys picta</i>	8	4.0	2-7	32	0	2	2	0	7-10†	45-50	47
<i>Sternotherus oderatus</i>	4	2.3	1-3	9	0	0	0	0	11-20‡	45-49	47

*Only sixteen embryos were measured, one each from sixteen nests. A total of eight eggs from three nests were sterile.

†Only two embryos were measured, one each from two nests.

‡Only four embryos were measured, one each from four nests.

rests at frequent intervals, lifting her head to watch for possible enemies and changing her position in order to use the other leg. The carapace rubs on the opposite side to the digging leg, making a long depression in the soil. The hind limbs are moved in a half circle, each scraping movement removing a small quantity of dirt.

After a small hole one inch or slightly more in depth has been formed, the character of the movements change. The turtle has to strain every muscle to dig the nest. Ceasing to enlarge the first opening, she hollows out a jug-shaped cavity below the opening, measuring from three to ten inches in diameter (Fig. 1, A). The left foot is used in digging out the left portion of the nest and the right foot in enlarging the right side. If the turtle is disturbed while she is building her nest, she stops work and remains perfectly quiet until she locates the source of the disturbance. If she senses danger, she leaves the partially constructed nest and flees cumberously to the water. No turtles were observed returning to a partially completed nest.

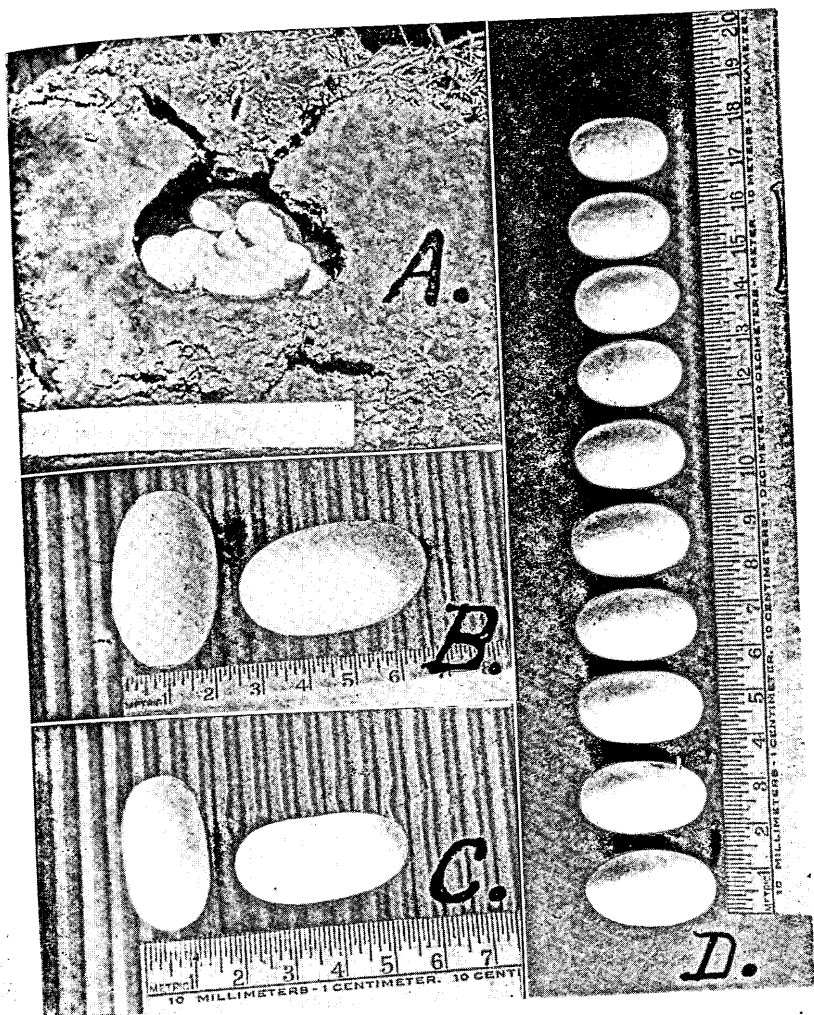


Fig. 1. Nests and Eggs of Some Reelfoot Lake Turtles. *A*, Cross section of the nest of *Pseudemys troostii*. This large section of hard-packed dirt was removed with spade and shovel, carried to the laboratory, sectioned and photographed. A very small amount of loose dirt was removed from around the eggs in order to facilitate making the picture. This is a freshly constructed nest as indicated by the dark plug of moist earth in the entrance to the nest. The mud plug has been loosened to demonstrate its compactness. Notice the debris mixed with the mud. This aids in concealing the nest. However, the turtle does not deliberately mix this debris with the mud. *B*, Eggs of *Pseudemys troostii*. *C*, Eggs of *Chrysemys picta*. *D*, Eggs of the Musk Turtle (*Sternotherus adoratus*).

Having completed the excavation of her nest, the turtle removes all excess dirt particles by carefully lifting them out with the hind legs. The author has never observed a turtle using either of her front legs to dig or seal a nest. The eggs are deposited within a few minutes. One turtle was observed moving the eggs about with her foot. Others made no effort to place the eggs in any definite position. Eggs in the nests examined were laid haphazardly in all positions, some horizontally, some vertically.

The soil that had been removed was packed about the opening to the nest. Although the dirt was already quite wet, the turtle dampened it thoroughly and began to work it over the top of the nest, forming a plug of moist earth (Fig. 1, A). All the loose material was gathered in and padded into place over the entrance and for several inches around it. This layer of mud may be one-half inch to two and one-half inches thick. The back portion of the carapace and the hind feet were used in padding the final covering into place. Without a single glance of inspection at her nest, the turtle sidled away through the weeds apparently satisfied with the ability of her posterior working tools.

The completed nest of *Pseudemys troostii* consists of a jug-shaped hole in the ground plugged with a closely packed layer of mud that fills the opening but does not fill in around the eggs. However, Grant (1936) says that the turtle appeared to pack the eggs in or cover them separately. The eggs in the nests examined at Reelfoot Lake were not covered separately with dirt; in fact, very little dirt was found in the nest proper. The mud used to plug the entrance was not forced down into the nest around the eggs. However, in some cases the nest may be too shallow and the last laid eggs will be in contact with or embedded in the mud plug of the nest. These few eggs are usually destroyed by excessive heating. Examination of such eggs revealed a thickened, partially dried yolk.

The nests are found quite easily. From the surface one sees what seems to be a splotch of mud appearing as if some one had rolled a large soft mud ball and dropped it on the ground, thus forming an irregular mass of mud. This surface covering and the neck of the nest is solidly molded together and lifts out in one solid piece exposing the eggs beneath.

No observation was made of the painted turtle constructing its nest. The nest is a miniature of that of the slider turtle, and the process of construction may probably be the same. The largest painted turtle's nest found contained seven eggs. Most nests contained only three or four eggs.

The nests of *Chrysemys picta* were not numerous in the area examined. Of the eight nests found (on July 9), only two contained eggs with embryos. The other nests had been constructed within the past few days.

Unlike the former turtle, the musk turtle lays her eggs in the first convenient spot she locates. Apparently carefree about the deposit

of her eggs, she assumes little responsibility—even for effectively concealing them. Quite often eggs are left exposed on the ground or covered with a slight layer of debris. Although her favorite spot is the decaying wood under a fallen log, she may deposit her eggs in the most amazing places. Several nests were found in the decaying tops of dead stumps. One of these nests was five feet from the ground. The base of a decayed tree, the broken roots of an overturned cypress, the end of a fallen log, the top of a stump—all seem to be favorite places for this turtle to deposit her eggs. Only rarely will she build a nest. Three mud-covered, shallow holes were found containing musk turtle eggs. These nests were found in an open area where none of the other means of concealing the eggs were available.

These poorly constructed nests indicate that this turtle is rather lazy, particularly at egg-laying time. However, one indolent mother turtle must have somehow been aroused to do some energetic digging, for she had scratched a long, slanting tunnel through the mud covering of a painted turtle's nest and deposited her eggs in a shallow depression close to the egg chamber of the painted turtle. The tunnel leading to the depression had been refilled with mud. This was an unusual nest. The five eggs of the painted turtle had been deposited in a perfectly constructed chamber and covered with an excellent mud seal. The musk turtle had found this new nest and, attracted by the soft mud, decided to lay there. Her eggs were deposited about two inches to the side of the egg chamber of the painted turtle.

Although the eggs of the musk turtle had been deposited after those of the painted turtle, they contained large, well-developed embryos and the eggs had very young 8 mm. embryos. Either the incubation period of the musk turtle eggs is much shorter or their development is not so easily retarded by adverse conditions as those of the painted turtle.

The majority of the musk turtle eggs were found under large cypress logs fifteen to sixty feet from the edge of the water. The turtle moves around a fallen log until she finds a soft place. She burrows her way under for several inches, deposits her eggs, and leaves. Apparently she frequently misplaces the last egg, for many nests were found containing three or four eggs with one laying a few feet from the nest. Quite often this "after thought" is left exposed on the ground near the log. The eggs are firmly embedded in accumulated debris under the log or placed in one of the cavities left by the wood-devouring grub of the beetle, *Passalus cornutus*.

Only four nests of the musk turtle were found in the rectangle near the biological station, but the nests were exceedingly common at Brewers Bar about three and one-half miles south of the station. Forty nests were found here under five logs. These logs were partially embedded in the waste and rubbish left from the activities of the *Passalus* beetle. This material seems to provide an ideal place for the development of musk turtle eggs. Eggs were embedded to a depth of four to seven inches under the edges of the logs.

Sixteen nests were found under one log three feet long. The nests were so close together that many of them were intermingled. Thus what appeared to be one nest frequently contained eggs of several sizes. All of these eggs contained well-developed embryos with the exception of three that had been destroyed by mold. No freshly laid eggs were found, and no new nests were found after July 17. The musk turtle lays its eggs in this region during the last part of July and the first three weeks of August.

The nests of both the slider turtle and the painted turtle are completely sealed by the heavy plug of dense mud caked into the opening of the egg chamber. This seal aids in retaining the moisture and in keeping the temperature constant.

Temperatures in four nests were checked over periods of seven days each. Centigrade mercury thermometers were embedded in the egg chamber of the unopened nests. The mud seal was left intact except for the small hole made for the thermometer. Temperature changes never exceeded eight degrees Centigrade. Temperature readings were taken at regular intervals, and the highest temperature recorded was 31 degrees Centigrade, the lowest, 25.7 degrees. The maximum temperature was taken at 6:00 P. M. on a very clear day, and the lowest, at 8:00 A. M. in a heavy rain.

Although the nest and seal were thoroughly dampened at the time of laying, the direct rays of the sun rapidly evaporated the excess moisture. Nests two days old were almost completely dried out. Despite this fact, the eggs seem to lose moisture very slowly in the nest. Of the 555 eggs examined, only 33 had been destroyed by excessive drying. The yolk in these eggs was thickened and congealed into an irregular granular mass. Eggs removed from the nests and exposed to the air lost enough moisture in four to five hours to destroy life. In some nests only two or three eggs were dried while the others were apparently normal. These few dried eggs were invariably in contact with or embedded in the mud seal. No nests were found with all of the eggs destroyed by drying.

As no nests over six weeks old were examined, no definite conclusions could be made as to the extent that excessive drying might later damage the eggs. Undoubtedly continuously dry weather would destroy the greater part of the eggs. Dry conditions probably retard the development of the embryos.

The hard-shelled eggs of the musk turtle (Fig. 1, *D*) are much less susceptible to drying than the leathery shelled eggs of the painted and slider turtles (Figs. 1, *B-C*). Eggs of the musk turtle are frequently deposited on the surface of the ground and thus exposed to the drying action of the sun and air. Many of these eggs contained living, healthy embryos.

The hard-shelled, bird-like eggs of the musk turtle vary considerably in size. They are white and ovoid in shape. The shell has a thick layer of calcium attached to a thin, transparent layer of tissue. The

eggs break easily and are often broken by the turtle as she attempts to push them into their proper places. The embryos usually develop diagonally across one end of the egg. Eggs containing mature embryos may readily be distinguished from others by their dark color.

At least 30 per cent of the eggs examined after July 9 contained well-formed embryos able to move about in water. These embryos could swim but were unable to control the direction of their movements. The eggs would probably have hatched in one or two weeks.

The eggs of *P. troosti*, the slider turtle, are white and have a thin leathery shell consisting of two principal layers. The inner strong, elastic membrane is covered with a dense layer of calcium crystals. These crystals of calcium are arranged in a definite pattern that is probably typical of the species. This outer shell is quite flexible. The size of the eggs varies extensively with the size of the female and

TABLE 2
Turtle egg size in centimeters (one egg from a nest)

SLIDER TURTLE (PSEUDEMYX TROOSTI)		PAINTED TURTLE (CHRYSEMYX PICTA)	
LENGTH	DIAMETER	LENGTH	DIAMETER
4.2	2.0*	3.4	1.1‡
4.5	2.1†	3.5	1.7
4.2	2.2	3.0	1.0
4.3	2.3	3.4	1.8
4.0	2.2	3.3	1.0
4.3	2.3		
4.1	2.2		

*This egg had a volume of 11.2 cc.

†This egg had a volume of 13.3 cc.

‡This egg had a volume of 5.5 cc.

the number of eggs laid. A series of measurements (Table 2) were taken from a group of eggs. Each egg is from a different nest. Although extensive measurements were not taken, these will suffice to demonstrate the variation in size. The eggs are regular in shape and are bluntly oval in outline.

Eggs of this turtle were examined until July 24. No embryos larger than 15 mm. were found. Apparently the egg-laying period of the turtles at Reelfoot Lake extends over a considerable period. Nests examined on June 23 contained 14 mm. embryos and were probably two to three weeks old. Fresh nests were found on the last day of work at the station, July 24. Undoubtedly many eggs are laid after this date.

The painted turtle lays an egg similar in shape and structure to that of the slider turtle. They differ from them in size and the thickness of the outer layer of calcium which is somewhat thinner. The

shell is finely pitted. The eggs of the sliders have no pits. The larger painted turtle eggs found were only slightly smaller than the smallest slider turtle eggs. Size is not a reliable means of differentiating these eggs, however.

Measurements were taken on eggs of *Chrysemys picta*, the painted turtle, from different nests (Table 2). The eggs of this turtle were not numerous in the area studied. Only thirty-two eggs were found and two of these had been attacked by ants. Ants are apparently fond of dried turtle eggs. In several of the nests examined colonies of small red ants were actively removing bit by bit the contents of one or more of the eggs. These eggs were quite dry and were probably so when first attacked by the ants. No definite conclusions were made as to the actual destruction caused by these ants. No ants were observed entering fresh healthy eggs, however. Whether these eggs were dried or healthy when first attacked was not determined. In all probability the ant should not be accused of destroying the eggs but lauded for their activity in removing the remains of dried eggs.

In eleven of the eggs a number of small white larvae were found. The number varied from fifteen to thirty-eight per egg. In order to secure the adult stage, a number of these larvae were placed with their food supply in a container protected from the light. The larvae formed pupae in eight hours. The adults, small active flies emerged in a few days and were found moving nervously about in their birthplace.

These flies probably deposit their eggs on the surface of the egg when it is laid. They would have some difficulty in penetrating the well formed mud seal protecting the nest. No flies were observed in the act of depositing eggs.

Undoubtedly man is the greatest enemy of the turtle. Although the slider turtles are an important food crop of the lake, the fishermen dig thousands of eggs annually. They are supposed to make excellent fish bait. These fishermen often use several hundred eggs in one morning to bait their trot lines. Unfortunately, the best eggs for baiting are those of the large slider turtles. Several thousand pounds of the dressed meat of this turtle are shipped from the lake each year. The eggs of the worthless musk turtle cannot be used successfully for bait because of their hard shell.

Children of all ages engage in prolonged turtle egg hunts during the summer months. The eggs are collected and sold to the fishermen for fifteen to twenty cents per hundred. "These enthusiastic egg hunters follow the turtles into the fields, break open the carapace with a hammer, remove the eggs, and leave the turtles to die. One farmer said they had killed so many turtles in his field that his mule "refused to plow."

It is doubtful if the fishermen get value returned from their egg digging efforts. One fisherman said that he and his family had used at least twelve hundred turtle eggs that summer and that the yield

of fish could not have been more than fifty pounds. Although this does seem to be very poor yield, the eggs are undoubtedly worth considerably more to the fisherman.

Small newly hatched turtles are worth one cent at his neighborhood store. If this fisherman's "fish bait" had been taken proper care of, he would have received at least ten dollars for his crop of turtle eggs.

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