LAYING DATA AND NESTING BEHAVIOR OF WILD TURKEYS[1]

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ABSTRACT

This paper reports on the behavior of nesting wild turkeys (*Meleagris gallopavo osceola*) obtained by radio-tracking 97 wild hens during the spring and summer of 1968 through 1971 on two study areas in Florida. More than 80 percent of the 71 nests found were in natural scrub vegetation. They were made when the hens scratched shallow depressions in the soil. A few leaves or other dried vegetation were placed by the hens with their bills over each newly laid egg just before the hens left their nests after laying. Nesting material probably accumulated inadvertently in that way rather than by deliberate construction of a nest prior to laying. Egg covering material was obtained within the reach of hens from their nests. Eggs were covered more often during the laying period than after incubation was underway. Eggs were laid in the nests about mid-day at a rate of less than one per day. Hens generally remained at their nests longer when they laid the seventh egg. One hen was believed to have laid three eggs aimlessly before starting a nest for the remainder of her clutch. Some hens began continuous incubation behavior with the laying of the last egg but an equal number roosted away from the nest the night after the last egg was laid. A few hens roosted away from their nests at least one night after incubation behavior had been underway for several days. Hens left their nests for periods averaging 1 hour and 50 minutes during the incubation behavior period. This happened at all hours of the day, most often in late afternoon, but not every day. At least one hen remained on the nest continuously for three days and others were known to have incubated continuously for more than two consecutive days. Hens walked or flew to and from their nests during the laying and incubation periods. The period of time that hens sat continuously on their nests during the incubation period was less than 27 days but this behavior is complicated by variables which require more study. Clutch size was 9.6 eggs per nest for juveniles and for adults. Juveniles showed a lesser tendency to nest and renest than adults, but they had a larger percentage of successful nests. The hatching rates were similar for adults and juveniles. The greatest limitation on the productivity of juveniles compared to adults appears to be their lesser tendency to renest. Notes on the behavior of hens on nests and some other observations are described.

INTRODUCTION

Information on nesting activities of the wild turkey is meager. A mimeographed preliminary report by H. L. Blakey (1937) is the source of most accounts on this subject in the literature (Mosby and Handley 1943, Schorger 1966, Bailey and Rinell 1967, and many others). Unfortunately, Blakey (1937) did not in every case distinguish between his observations of captive and wild turkeys. His data on the more

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secretive aspects of turkey nesting behavior may be based on penned stock rather than free-living wild turkeys.

The new radio-tracking techniques (Cochran and Lord 1963) have greatly simplified research on many of the little-studied facets of animal field biology. We used this approach in a study of nesting of free-ranging wild turkeys. In this report we describe some of the activities of hens at or near their nests while laying and incubating and present related data on renesting, juvenile nesting success, hatching rates of eggs, incubation periods, and notes on behavior.

We thank Charles P. Lyles and Ben Swendsen of Lykes Brothers, Inc., for their generous cooperation by permitting the use of Lykes Fisheating Creek Wildlife Management Area and Refuge for this study. We appreciate the cooperation of Owens-Illinois, Inc., for permitting a part of this study to be done on their property. Biologists Larry H. Barwick, Michael J. Fogarty, and Jimmie C. McDaniel; Game Managers Herschell Haywood, Jerry A. Brown, and Glynn H. Ivey; student assistants Neal F. Eichholz, William B. Frankenberger, and Harvey L. Hill, Jr.; and E. C. Butler assisted with the field work. Aircraft pilots Lonnie Bell, Jim Carter, Terry Gough, and Phil W. Phillips assisted when called upon. Mrs. Tommie E. Peoples and Mrs. Connie Pearl transcribed many of the field notes and recorded and filed the data. We also wish to acknowledge the invaluable administrative support of James A. Powell and A. Gordon Spratt. H. O. Hillestad and E. B. Chamberlain, Jr. offered helpful criticism on the manuscript.

METHODS

Study Areas

The main study area (Figs. 1 and 2) was on Lykes Fisheating Creek Wildlife Management Area and Refuge in Glades County, Florida, about 12 miles west of Lake Okeechobee. Data on a few nests were obtained on Lochloosa Wildlife Management Area in Alachua County, Florida. The study areas have been described (Williams *et al.* 1972, in press; and Barwick *et al.* 1971, in press). The turkeys on both study areas are *M. g. osceola.*

Radio Tracking

Animal tracking transmitters operating in the 150 MHz range with one or two mercury batteries, of total weight between 50 and 80 grams, were strapped on 146 wild hens in 1966 through 1971. High sensitivity portable receivers and various types of directional antennas were used to track the hens and locate their nests while they were laying or incubating. This equipment and its use, and the method of attaching the transmitters to hens, were described in an earlier report (Williams *et al.* 1969).

Capture Methods

The hens were captured in February, March, or April with orally administered alpha-chloralose (Williams 1966), tribromoethanol (Williams *et al.*, in press) on cracked or whole corn, or with cannon nets (Austin 1965). Most were instrumented and released at or near the capture site the day after being captured. A few were moved about 6 miles for release.

Field Observations

When a radio signal indicated a laying or incubating turkey nearby, radio bearings were marked with plastic flagging material and the nest was found by searching after the hen left the immediate vicinity. When a nest was found, descriptive data were recorded. One hen was flushed from her nest intentionally, and 10 were flushed accidentally.

The vegetation around three nests was clipped on one side so that the nests could be seen through a telescope from a tower blind (Fig. 3) about 50 feet away. Data on these and three other nests were obtained by about 200 hours of visual observation time from blinds. Five additional nests were observed visually and by radio signals from a distant blind as the hens walked or flew to their nests.

FIGURE 1. Approximate locations of two study areas in Florida.

Of the 146 hens which were instrumented for this study, 97 were monitored regularly during the nesting season. Sixty-four nests were found by telemetry, three others were found incidentally, and four other nests were found during the feasibility phase of the study before 1968, for a total of 71 nests examined.

When a nest was found during the laying period, chicken or turkey eggs injected with strychnine alkaloid were sometimes placed in the immediate vicinity to kill egg-eating predators which might destroy the nest. In two cases where predation on a closely studied nest seemed imminent during the laying period, the eggs were removed from the nest before darkness each night and replaced before daylight each morning. One of these nests hatched normally but one was eventually destroyed by a predator when we discontinued nightly egg storage because the hen had begun incubating continuously.

One-half of the study area was intensively treated with poisoned eggs during the nesting season in connection with another study.

MISCELLANEOUS

All hens were leg banded with numbered revited aluminum bands made by National Band and Tag Company and some were wing-tagged (Knowlton *et al.* 1964) as a means of visual identification. Adults and juveniles (younger than 1 year) were distinguished by inspection of the greater upper secondary coverts (Williams and Austin 1970). Airplanes and helicopters were used to search for hens when they were not heard on ground receivers for about two weeks.

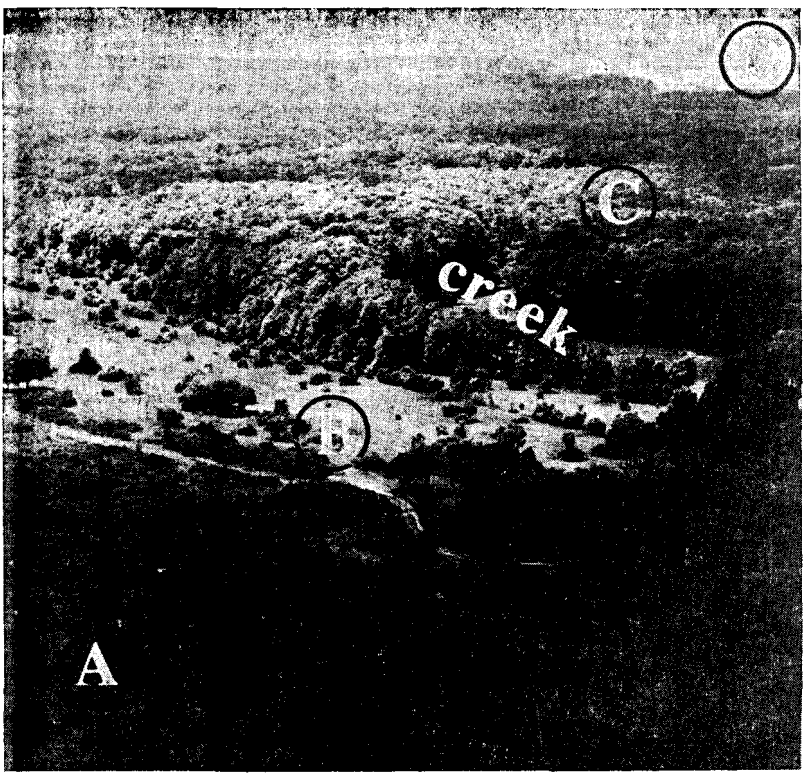

FIGURE 2. Aerial view of study area in southern Florida (Fisheating Creek) showing major plant communities in typical juxtaposition. Vegetation zones from lower left to upper right; A) low oak scrub, palmetto, and wire-grass; B) grazed glades with scattered live oaks; C) cypress woods; and D) unforested saw palmetto flats. Fisheating Creek is between (B) and (C) in the photograph.

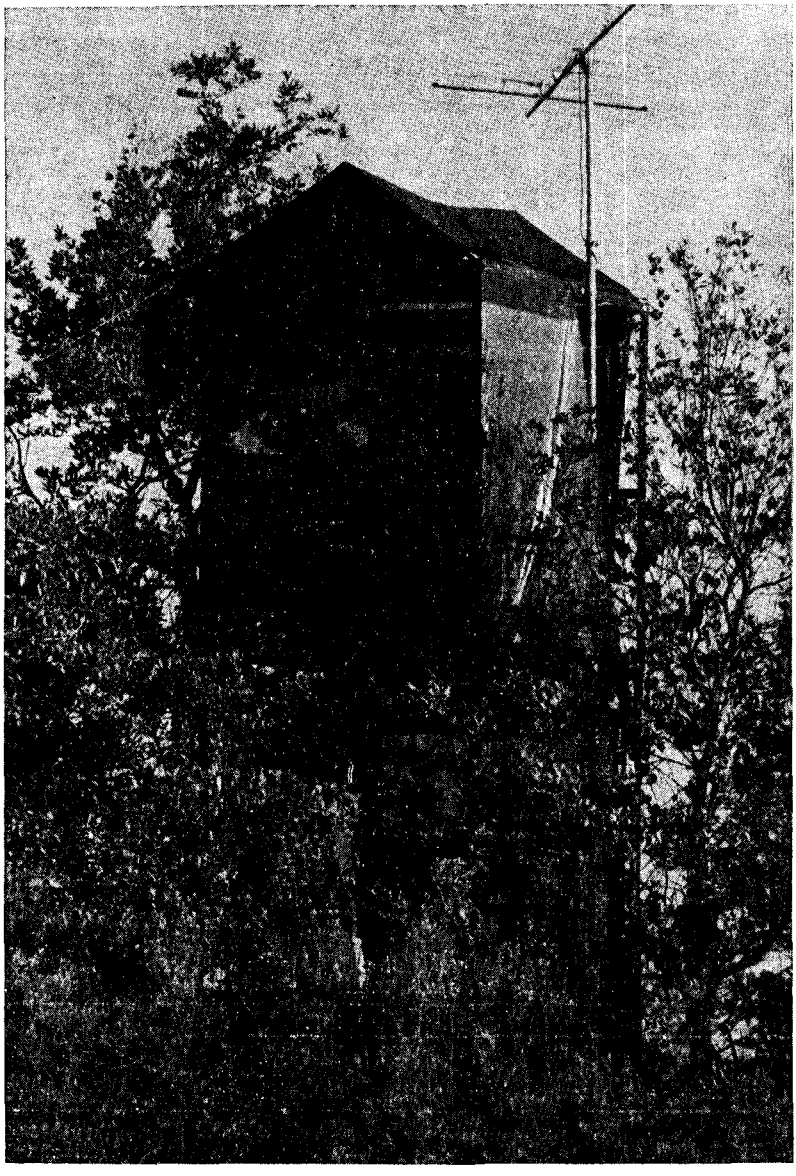

FIGURE 3. Observation blind erected on a portable steel frame.

RESULTS AND DISCUSSION

Nesting Habitat

Our earlier reports on this study identified preferred nesting habitat of turkeys in southern Florida as low saw palmetto (*Seronoa repens*) and wire grass (*Aristida stricta*) in the natural ecotone between a grazed glade (grassy) zone and low oak scrub and saw palmetto flats. In one report (Williams *et al.* 1969) 18 of 21 nests were in that ecotone. Over 80 percent of the 66 nests examined on the Fisheating Creek study area were in this vegetation (Fig. 4). Too little data are available to identify nest cover preferences on the study area in northern Florida.

FIGURE 4. Typical nesting cover directly in front of man. The darker waist-high vegetation is myrtle oak. The woods on the left horizon are cypress woods about ¼ mile distance.

Nesting Season

Most laying began during April, but nesting was noticeably earlier in 1971 in which year the hens were instrumented during February. Trapping, tranquilizing, holding, and instrumenting during March and early April may have delayed nesting during 1968, 1969, and 1970. An accurate description of normal nesting seasonality must await a better understanding of these possible sources of bias.

Nest Building and Egg Concealment

Upon inspection of a nest which was discovered by radio-position at the time the first egg was laid, it was evident (by nail marks in the soil) that the hen had merely scratched a shallow depression (with one or both feet) laid the first egg in it, and placed over the egg a few strands of dried plant debris before leaving. Scratch marks were found in the debris about 6 inches from three nests suggesting the possibility that these nests were started with litter under the first egg rather than on bare ground, but a number of observations suggested that the dried plant materials found in the nests accumulated gradually. Two hens were watched during most of their laying periods. When they came to lay, they settled on the nests without removing the plant debris they had placed there the day before. In this way the nesting material accu-

mulated, inadvertently as a result of debris placed there after each laying.

All hens which were observed as they sat on nests during the period of continuous incubation behavior placed dried plant debris on their backs and along the sides of their nests during their idle moments from time to time (Table 5). Thus nesting material continued to accumulate even after the clutch had been completed. We watched laying hens cover their eggs 7 times using only material that could be reached while they stood in their nests. Several other nests were inspected after eggs were laid. Their appearance also suggested that nesting material was accumulating gradually as each egg was laid. We did not see a turkey transporting nesting material and found no material in a nest that was not available within reach of the nest.

In an earlier paper (Williams *et al.* 1969) we reported that we had not observed nest concealment in the more than 50 times we had inspected turkey nests in Florida; however, those observations involved only nests being incubated continuously by the hens. Data obtained since, from laying as well as incubating hens, have revealed that turkeys on our study areas usually covered their eggs with plant debris after each egg was laid (except the last when they remained overnight) but did not usually cover their nests when they were away from them after continuous incubation behavior was underway.

LAYING

Data on the laying sequence were obtained from seven nests. One of these was under our continuous observation beginning with the first egg (Table 1). Two nests were under observation beginning with the second laid egg (Tables 2 and 3). Four other nests were observed for varying periods during smaller portions of the egg laying process of each clutch (Table 4). A few disconnected observations were made on one other nest during the laying period.

TABLE 1. Laying sequence and nest attendance while laying by juvenile hen No. 399R.[1]

Date (April)	Time [2] Arrived at Nest	Time [2] Left Nest	Minutes at Nest	Egg Laid
9	1150	1225	35	1st
10	(Hen did not visit nest all day)			(No egg laid)
11	(Unknown time between 0630 and 0800)			2nd
11	1425	1500	35	(No egg laid)
12	1040	1133	53	3rd
13	(Hen did not visit nest all day)			(No egg laid)
14	0750	0822	32	4th
15	1035	1110	35	5th
16	1115	(Unknown)	(Unknown)	6th
17	1300	1635	215	7th
18	1150	1640	290	8th
19	1048	1814	446	9th
20	1340	(Hen remained on nest overnight—began continuous incubation behavior)		

1 Data obtained by radio-tracking from nearby blind.
2 Eastern Standard Time.

One hen (Table 1) laid the first egg about noon, spending 35 minutes at the nest. The next day she did not visit the nest. On the third day, she laid the second egg. The fourth day she visited the nest but did not lay in it. She laid her third egg on the fifth day and again skipped the next day. The fourth through 9th eggs were laid in mid-day on successive days, the clutch of 9 requiring a total of 12 days.

TABLE 2. Laying sequence and nest attendance of juvenile hen No. 398R while laying.[1]

Date (April)	Time [2] Arrived at Nest	Time [2] Left Nest	Minutes at Nest	Egg Laid
15	0910 [3]	1030	80	2nd
16	0945	1215	150	3rd
17	1031	1131	60	4th
18	1015	1055	40	5th
19	0944	1030	46	6th
20	1100	1425	205	7th
21	1202	1537	215	8th
22	1034	1646	372	9th
23	0935	(Remained on nest overnight)		10th
24	(Continued incubation behavior)			

1 Data obtained by radio-tracking, electronic recording device, and direct visual observation from a blind.
2 Eastern Standard Time.
3 Already on nest at this time.

TABLE 3. Laying sequence and nest attendance of adult hen No. 226R while laying.[1]

Date (April)	Time [2] Arrived at Nest	Time [2] Left Nest	Minutes at Nest	Egg Laid
8	1445	1515	30	2nd [3]
9	(Hen did not visit nest all day)			(No egg laid)
10	0845	0915	30	3rd
11	1025	1055	30	4th
12	0954	1104	70	5th
13	1122	1147	25	6th
14	1025	1619	354	7th
15	1105	1650	345	8th
16	1015	1650	395	9th
17	1042	1755	433	10th
18	0937	1753	496	11th
19	1048	1755	427	(No egg laid)
	(Hen did not return to nest. Reason unknown)			

1 Data obtained by radio-tracking from nearby blind.
2 Eastern Standard Time.
3 Nest discovered after first egg had been laid.

From observations made on the seven nests during the laying period, a few generalizations can be made. Hens came to lay their eggs in mid-to-late morning or early afternoon (or about mid-day), usually about the same general time of day throughout the laying period. They stayed longer at the nest toward the middle of the laying process and stayed much longer at each laying beginning with the seventh egg. Eggs were laid at a rate of less than one per day, but the hens varied greatly with respect to the days skipped.

One juvenile hen skipped more days than any other hen in laying her clutch (Table 1) and another juvenile skipped fewer days (Table 2). The one nest by an adult hen from which sufficient data were obtained was intermediate in this respect (Table 3). These observations differ from Blakey's (1937) widely quoted description of the laying process in which he said that each egg was laid about an hour later each day, beginning in early morning, then skipping one day late in the laying cycle because of nightfall.

TABLE 4. Data on partial laying sequences and nest attendance for four nests.[1]

Date (April)	Age Class	Time [2] Arrived at Nest	Time [2] Left Nest	Minutes at Nest	Egg Laid	
15	Juv.	0955	1820	505	12th	
22	Ad.	1130	1445	195	8th	
23	Ad.	1140	1525	225	9th	
24	Ad.	(Unknown)	1600	(Unknown)	10th	
21	Ad.	1125	1815	410	4th	(7th)[3]
22	Ad.	1230	1815	345	5th	(8th)
23	Ad.	1140	1827	407	6th	(9th)
24	Ad.	Before 1000	(Began continuous incubation)			
26	Ad.	Before 1605	1920	At least 255	6th	
27	Ad.	1725	Overnight	At least 895	7th	
29	Ad.	0935	After 1400	At least 265	8th	
30	Ad.	0820	(Began continuous incubation)		9th	

1 Data obtained by radio-tracking and visual observations.
2 Eastern Standard Time.
3 This was the 4th egg deposited in the nest but believed to be the 7th in the clutch, the first three having been "dropped" in the vicinity outside the nest.

We were not able to ascertain exactly when, during the nest visits by the hens, the eggs were laid. Hens remained in sitting or crouching positions while at the nest to lay.

EGG DROPPING

At the time one nest with four eggs was found during the laying period, three other eggs were found lying on the ground near the nest. They were not grouped or lying in scratched-out nest depressions. Radio signals had positioned the hen there several times during the few days preceding the discovery of the nest and we think that she was laying the three loose eggs then. This hen was on the nest for 410 minutes (Table 4) when she laid the fourth egg in the nest. This compares closely to the length of time the other hens remained on their nests with the laying of their seventh eggs. Furthermore, she stopped laying after the 6th egg in the nest was laid. If the three loose eggs were considered part of this hen's clutch, it would account for both the seemingly anomalous sitting period with the fourth egg and the abnormally small clutch she finally completed. (This clutch is counted as containing six eggs for computations in this paper.) Wheeler (1948:55) reported three instances of turkey eggs being found on trails or in the woods outside of a nest.

INCUBATION

The term *incubation* is commonly used in reference to the hen sitting ("setting") on the nest continuously and also in reference to the *incubation period* of eggs. The two meanings are different. The first refers only to the behavior of the hen; the latter to the period of embryonic development. We use the term *incubation behavior* in reference to the "setting" hen.

Continuous incubation behavior—Of the 7 nests for which we obtained sufficient data, three of the hens began to incubate overnight for the first time the same day that the last egg was laid, three sat on their nests at least part of an additional day (after the day the last egg was laid) before spending the night on the nest, and one hen sat overnight the day the seventh egg was laid and also began continuous incubation behavior by sitting the night she laid the last egg.

At least 3 other hens were known to roost in trees some distance from their nests one or more times after having incubated continuously for several days.

Hens left their nests for brief periods after incubation behavior began, but they did not leave every day as is commonly believed. Our nest attentiveness data do not span the entire incubation behavior period (without interruption) for any hen, and are not very complete on this behavior, but we did observe that one hen sat on her nest continuously for three full days without leaving, and a few others were known to sit continuously for at least two consecutive days. Our impression was that incubating hens left their nests once about every two days but considerably more data are needed to describe this behavior in quantitative terms.

Hens favored mid-morning and late afternoon for leaving their nests during incubation behavior (Fig. 5). On ten occasions, hens were observed when they left and returned to their nests. The average time away was 1 hour and 50 minutes. The data for Figure 5 were constructed from fragmentary data by adding 1 hour and 50 minutes to the time that four hens were seen leaving (but not seen returning) and by subtracting 1 hour and 50 minutes from the time that five other hens were seen returning (but had not been seen leaving) to provide an absence interval. In plotting these data in Figure 5, a hen was counted as being off the nest if she was off during any part of the hour. Thus a hen departing the nest at 0850 hours and returning at 1030 was considered to have been off during the hour-intervals of 0800, 0900, and 1000. In 17 other cases, the absence of the hen from the nest was noted but neither the time of her leaving nor returning were known. Each of these times is plotted once in Figure 5, at the appropriate hour-interval. In all, the data in Figure 5 reflect 46 direct observations of hens coming, going, or absent from their nests. Absences of hens roosting in trees away from their nests after incubation behavior had been well underway were not used to calculate the average time away from the nests or used in Figure 5.

Hens left their nests by walking and flying. In 27 observations of 17 different hens leaving their nests during the laying period, 14 walked and 13 flew. In returning during the laying period, 24 walked and 1 flew. During the period of continuous incubation, 3 hens were observed leaving their nests by walking and 6 were seen flying from their nests. In returning during the period of continuous incubation, 3 walked and 4 flew. Adults did not vary from juveniles in this behavior appreciably.

In flying from the nest, they took zero to five steps before flying. In returning by flight, they landed 50 to 3 feet from their nests. In walking from the nests, they departed promptly after standing erect. In returning to their nests by walking, they approached cautiously, stopping occasionally. Ligon (1946) mentioned a hen *(M. g. merriami)* that was seen flying to and from her nest and Hillestad (1971) reported a hen (*M. g. silvestris*) flying to and from her nest. We (Williams *et al.* 1969) reported this also.

Incubation period of eggs—The incubation period of eggs involves variables which are difficult to measure, even with radiotracking techniques. Some of these are: the number of hours of incubation time accumulated during the laying period; warming-up and cooling-off time of eggs; effects on embryonic development of brief nest leaving and overnight roosting off the nest; time period required for whole clutches to hatch; and hatching synchronization. One objective of our current studies is to measure some of these things, but it does not seem fruitful to attempt to discuss this at any length until more data are collected. Surprisingly, we have found that the period of continuous incubation behavior of the hen (the "setting period") is less than 27 days, closer to 26 on the average. This is usually given as 28 days for the wild turkey.

Incubation Behavior of the Hen

At least 200 hours of observation time were spent watching 4 hens while they sat on their nests. The events in Table 5 are the typical activities in the day of an incubating hen.

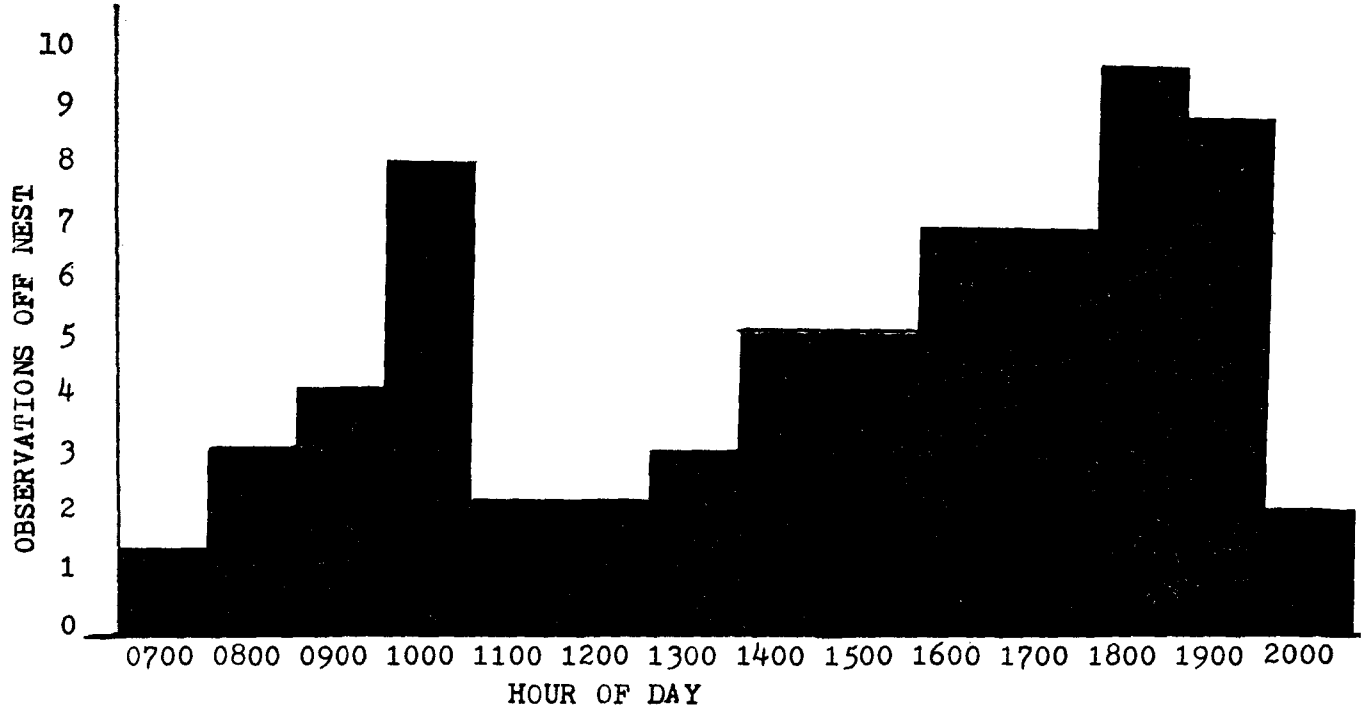

FIGURE 5. Temporal (shown in twenty-four hour clock time) distribution of brief nest-leaving by turkey hens during their period of continuous incubation behavior.

TABLE 5. Activities of adult hen No. 342R during most of her eleventh day of incubation, 4 May 1970.

Eastern Daylight Time	Activity
0929	Began observations.
0930–0948	Hen on nest: dozing asleep occasionally,
0948–0950	Asleep.
0950	Waked, very alert; preened back and half-stood in crouch; turned 1 or 2 eggs.
0951	Settled back to incubating position.
1006	Rose in crouch and preened; did not turn eggs.
1007	Settled back on nest.
1010	Dozed asleep for intervals of 2 to 10 seconds.
1020	Pecked at insects on vegetation.
1025	Rose in crouch; turned 2 or 3 eggs, preened 1 minute.
1026	Settled back on nest.
1030	Preened and scratched skin with bill; very alert posture; looked at sky several times.
1031	Crouched; turned a few eggs; settled back after 1 minute.
1034	Watched small airplane overhead for 8 seconds.
1037	Dozed for short intervals.
1041	Preened vigorously.
1045	Dozed.
1055	Picked up debris with bill and placed it on back and around sides of nest (material placed on back fell to side of nest).
1056	Ate what appeared to be an earth worm; crouched; turned 1 egg.
1057	Settled back on nest; dozed.
1107	Pecked at fly on back; dozed.
1114	Suddenly became very alert, as if sensing danger, for 15 seconds; resumed dozing.
1120	Twisted neck about 270°.
1145	Yawned.
1154	Crouched; preened.
1155	Began panting (rate 3 per second); bill open about 2/3 width of eye; tongue moving with each pant.
1157	Raised back feathers and preened.
1159	Pecked at leaf debris.
1200	Picked up 8 small pieces of debris—placed 1 on back and 7 on sides of nest.
1203	Picked up 7 pieces of debris—placed 4 on back and 3 at side of nest.
1207	Preened; panting again; more widely awake now.
1212	Panted steadily with bill opened wider than at 1155; moved head out of direct sunlight (stretched neck to avoid sunlight the remainder of day).
1215	Crouched; turned one egg; preened briefly.
1218	Preened neck.
1224	Dozed.
1226	Crouched; preened, turned 2 eggs.
1247	Dozed with neck forward to avoid sunlight.
1253	Crouched; turned 1 egg.
1255	Picked up debris, placed mostly on back; continued picking debris for four minutes.
1300	Crouched; settled back; panting again.
1310	Two military jets flew over at 300 feet altitude with considerable noise—no response from turkey.
1314	Dozed; awake; panting again.
1318	No response to distant train whistle.

Eastern Daylight Time	Activity
1325	Became "nervous" as noisy train approached to about 120 yards.
1327	Relaxed as train sounds diminished in distance.
1327	Dozed.
1338	Crouched; turned several eggs, moving some across nest in the process.
1344	Pecked at debris.
1400	Observations discontinued until 1715.
1715	Observations resumed. Hen crouched; turned a few eggs.
1734	Crouched; turned a few eggs; had not dozed since 1715 and had not panted (temperature cooler than before).
1742	Crouched.
1743	Crouched; turned a few eggs.
1746	Dozed.
1751	Scratched neck with bill.
1816	Preened and scatched with bill; crouched; continued to preen for 2 minutes.
1821	Crouched; turned 1 egg; pecked at insect; settled back.
1825	Crouched; turned 1 egg.
1829	Dozed.
1845	Crouched; turned several eggs in opposite sides of nest.
1849	Crouched; turned 1 egg; smacked bill as if tasting.
1850	Preened.
1851	Crouched; turned 1 egg; preened.
1852	Crouched; turned 1 egg; preened.
1858	Dozed for 19 minutes.
1923	Crouched; preened.
1925	Crouched; turned a few eggs.
1926–1958	Little movement during this period; more sleeping; head posture for deep sleep; dozing for periods up to 1 minute.
2006	(Getting dark) Turkey sleeping.
2012	Crouched; turned eggs.
2015	Still awake.
2016	End of observations—too dark to see.

Hens sat quietly and still (no vocal sound was heard until hatching commenced). They occasionally napped and showed an alert reaction to certain (but not all) sounds nearby. They sometimes watched flying birds intently and usually appeared to us to be tense when crows or other loud-calling or low flying birds came near. They attempted to catch insects that came near and spent a considerable amount of time preening and scratching their skin with their bills. They occasionally swallowed feathers. They turned one, two, or three of their eggs approximately two to five times per hour, sometimes much more frequently, and sometimes they did not turn an egg for an hour or longer.

Incubating Postures and Body Movements

Sitting—Hens sat on the eggs with body parts positioned as for normal standing except that the legs were folded under the body. Evidently the joints were flexed and the tarsometatarsus more or less flat in the nest. In sleeping on the nest, the head and neck were drawn in on the anterior back, the eyes were closed, and the wings drooped along

the sides somewhat more than when wide awake. Some of the variation seen in positioning of the neck, head, and limbs was correlated with degrees of alertness and probably ambient temperatures.

Crouching—In turning the eggs and often while preening, and occasionally at other times, hens rose part way up by articulating the joint between the tarsus and the tibia. In this position, the tarsus appeared to remain approximately horizontal in the nest. They did not stand fully erect to turn eggs.

Standing—When standing in the nest, body posture was similar to standing posture at other times while standing.

Settling back—The hens resumed the setting posture after crouching or standing by a peculiar motion in which the breast was moved forward and up with a swinging motion, then the whole body rocked back as the hen settled on the eggs.

Alert—A state of alertness was signaled by widely opened, unblinking eyelids and the neck stretched upward farther than in other postures.

Egg-turning—Eggs were turned by rolling one at a time with the underside of the bill and anterior throat. Sometimes several eggs are re-arranged in one motion, but the activity seemed to be directed at only one egg at a time.

Looking at eggs—Hens had a peculiar way of inspecting eggs in a way that suggested that some sensation or satisfaction was achieved and it appeared to be psychologically related to egg-turning. The human observer was sometimes of the impression that an egg-gazing hen was in some way momentarily satisfied in the urge to turn the eggs by merely gazing at them.

Disturbance of Nesting Hens

Of 64 nests which were studied closely, two were deserted for unknown reasons. The hens were still alive and there was no evidence of attempted predation at the nests. Neither hen undertook typical continuous incubation before deserting.

Seven nests were deserted when the hens were flushed by an investigator. Four other hens were flushed from their nests but did not desert. Of those that were flushed without deserting, one was in the laying period; of those deserting, one was also in the laying period. It is well known that turkeys will often desert their nests when flushed. Leopold (1944) reported that 3 of 4 nests were deserted after the hen was flushed by a man.

On approximately 40 occasions, incubating or laying hens were approached within 25 feet by an investigator in view of the hen but none flushed or deserted. No nesting hen flushed unless the investigator was within 8 feet of the nest and on at least 10 occasions an investigator approached within that distance without causing the hen to flush. On at least 20 occasions, hens were diverted off course by an investigator near their nests while returning to or leaving, but none deserted. This was sometimes done deliberately to delay the hen's return while data were being collected at the nest. (These cases were not used in plotting Figure 5.)

Disturbance caused by this study cannot be readily quantified for comparison with other kinds of human disturbances. We believe that by concentrating our activities as we did around nests and roosting places, and by pursuing instrumented turkeys to make frequent visual observations, we exerted an effective disturbance of much greater magnitude than would be exerted by hunters, fishermen, or other people who were not using radio-tracking equipment or for other reasons would not be likely to confront the turkeys so frequently. We believe that the disturbance related to the mere presence of people in turkey range has much less effect on the number of turkeys on an area or upon their behavior than is commonly believed.

This is becoming an increasingly more important consideration in this day of exploding human populations and resulting demands for more space for outdoor recreation. This question deserves more careful study, in other types of wildlife as well as turkeys, to insure that neither the wildlife nor the people are hindered unnecessarily.

Nesting by Juvenile Hens

There is disagreement in the earlier literature about the nesting rates and clutch sizes of juvenile hens as compared to adults. The most liberal statement about juvenile hens nesting is by Leopold (1944:160) who states that "Young hens . . . breed and nest freely." Wheeler (1948:37) takes the opposite view in discussing nesting of juvenile hens in Alabama by saying "It is believed that few if any of these birds nest the first year." Speake et al. (1969:54) found a number of color-marked juvenile hens with broods in their study in Alabama.

In our study, 64.1 percent of the adult hens and 51.5 percent of the juveniles were known to nest (Table 6). In interpreting the data in Table 6, the reader is cautioned that we could not determine with certainty whether a given nest was actually the hen's first for the season or possibly represented a re-nesting effort. We believe that some nests were lost to predation during the laying period and not detected by us. This means that the re-nesting tendency is probably greater than Table 6 suggests for both age classes, but the tendency for juvenile hens to nest at a lesser rate than adults is probably reflected accurately in the percentages.

The idea that juvenile hens lay smaller clutches is widespread. Our data show identical clutch size for both age classes (Table 6).

TABLE 6. Comparison of nesting data for adult and juvenile turkey hens.[1]

	Age Class		Both Age Classes
	Adult	Juvenile	
Hens monitored [2]	64	33	97
Number nesting at least once [3]	41	17	58
Number nesting twice	5	1	6
Percent known to nest once	64.1	51.5	59.8
Percent known to nest twice [4]	29.4	14.3	25.0
Complete 1st nests providing egg counts	32	15	47
Total eggs in 1st nests counted	306	144	450
Average eggs in 1st clutches	9.6	9.6	9.6
Complete 2nd nests providing egg counts	5	None [5]	5
Total eggs in 2nd nests counted	50	Unknown	
Average eggs in 2nd clutches	10	Unknown	Unknown
Number of successful 1st nests	24	10	34
Percent successful 1st nests [6]	63.2	76.9	66.7
Number of successful 2nd nests	3	1	4
Percent successful 2nd nests	60.0	100.0	66.7
Eggs in successful 1st nests	209	73	282
Eggs in successful 1st nests hatched	181	64	245
Percent of eggs in 1st nests producing a living poult [7]	86.6	87.7	86.9
Eggs in successful 2nd nests	33	Unknown	Unknown
Eggs hatched in successful 2nd nests	32	Unknown [4]	Unknown
Percent of eggs in 2nd nests producing living poults	97.0	Unknown [4]	Unknown
Average clutch size, all nests	9.6	9.6	9.6

1 Approximately two-thirds of these nests were in a part of the study area which was treated with poisoned eggs in connection with another study objective. Hatching success and related statistics are higher than they would be from an untreated area, but the differences between adults and juveniles are probably valid.

2 Number of hens tracked between 30 April and 30 June.

3 Number found nesting is not a complete tabulation of the number actually nesting because not all nesting was detected.

4 Based on 17 adult and 7 juvenile hens available for re-nesting (i.e., those being monitored during the period after their first nests were lost or deserted).

5 The one nest hatched before the eggs were counted. One of the eggs had not hatched.

6 This calculation does not include the 7 nests which were deserted as a result of investigative disturbance.

7 Not including unhatched, pipped eggs, or dead poults found out of their shells in the nest.

There is a basic notion among writers and laymen that juvenile turkey hens are less productive than adults. The data in Table 6 reveal a tendency for juveniles to nest at a lesser rate (51.5% *vs.* 64.1% for adults) and to renest after the loss of the first nest at less than one-half the rate of adults (14.3% *vs.* 29.4%), thus supporting the idea of lower productivity in juveniles. However, juveniles were surprisingly more successful in first nestings (76.9% *vs.* 63.2%) than adults. There was little difference in hatchability (defined in Table 6 as production of living poults rather than mere pipping or breaking of the egg) between adults and juveniles (86.6% *vs.* 87.7%) and no difference between adults and juveniles in first clutch size. The tendency of juveniles to renest less often than adults evidently represents a limitation on the productivity potential of young hens. This would be most significant where nest predator populations are high.

Hatchability of Second Nests

Although the amount of data is small (3 nests), second nests which were observed closely enough to provide useful data had an average rate of hatching higher (97%) than first nests (86.6%) (Table 6). Some of the nests tabulated as first nests may have been second or third nests, but it is certain that three nests containing 33 eggs and hatching 32 (hatching rate 97%) were second or later nests. The average clutch size of 10 for the second nests is greater than the average for first clutches (9.6). It is generally believed that both clutch size and hatchability are lower for second or later nests.

CONCLUSIONS

The findings of this study do not support some of the concepts about turkey nesting to be found in the literature. It is not possible to guess which disagreements are because of differences between *M. g. osceola* and the other subspecies, which differences are due to limitations of sample size in our study, or to misconceptions in the previous literature. More intensive study in other parts of the species' range will clarify this.

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PROPAGATION OF THE AMERICAN ALLIGATOR IN CAPTIVITY

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ABSTRACT

Wild caught, captive alligators (*Alligator mississippiensis*) over a seven-year period exhibited a successful nesting rate of 48 percent in six pens maintained on Rockefeller Refuge. Hatching success in pens (56 percent) closely correlated the 58 percent determined for wild alligators inhabiting natural marsh.

Pen construction methods, stocking rates, and maintenance techniques were implemented to simulate natural marsh conditions, thereby encouraging breeding and contributing to the well being of the alligators.

Diseases posed no problem during this investigation although fighting did cause some concern during the early stages of the study.

Courtship activities, nest construction techniques and maternal duties following egg laying were highly variable among the various alligators under study. Also, courtship behavior was highly ritualized.

Behavior of pen reared alligators as compared to wild captured adult alligators were compared. Stocking rates were found to differ greatly. Pen reared adult animals could be maintained in much closer confinement and under less stress when compared to wild captured adults.

INTRODUCTION

Alligators have been kept in captivity throughout Louisiana for many years. However, only on rare occasions do they reproduce under captive conditions. As alligators are easily maintained in captivity and fairly disease free, in the past they were sold by the thousands in Louisiana as pets. Also, alligator hunters would capture young alligators at a nest site and return home to confine them to some type of make shift pen under the pretense of starting an "alligator farm".