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GAME MANAGEMENT SESSION

A STUDY OF NESTING TURKEYS IN SOUTHERN FLORIDA[1]

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ABSTRACT

Thirty-five turkey *(Meleagris gallopavo)* hens were instrumented with miniature animal tracking transmitters on a study area in March 1968. Twenty nests were found by directional radio location fixes and one nest was found incidentally. Average clutch size was 9.6 eggs per nest in fourteen nests which were observed after incubation began. Eight nests produced 70 poults from 76 eggs. The other nests failed to hatch because of predation or abandonment due to human disturbance associated with the study. Two incomplete nests contained four and six eggs when they were abandoned, one due to human disturbance, the other because of predation. Predators destroyed four nests before the eggs could be counted. The hens showed a strong preference for nesting in a zone along the edge of the low oak scrub plant association. All except three of the 21 nests were concealed beneath saw palmetto *(Seronoa repens)*. Three late nests were in short herbaceous cover of cypress woods--all three were destroyed by predators. Nests were clustered within the preferred nesting cover type. Most of the nests would have hatched in May. Some of the hens were trapped and moved to the study area from distances greater than six miles but none attempted to return to the capture site. None of the hens was known to conceal her eggs with leaf debris when leaving the nest. Hens frequently flew to and from the nests. They were observed away from the nests at all hours of the day. One apparently roosted once away from the nest but returned the next day to resume incubation behavior and hatch the clutch a few days later. One poult hatched in an abandoned nest three days after the hen had left. Most of the nesting hens were captured with alpha-chloralose on bait. There was no evidence that the drug interfered with hatchability. Other observations are presented including notes on behavior, nest descriptions, and some movement data.

INTRODUCTION

Because of the difficulty of finding nests, very few nesting studies of the wild turkey have been done. Those that have been published were based on nests which were found accidentally in many different environmental situations. The new radio-telemetry tracking techniques promise to provide a more useful type of data than could be obtained before.

The radio-tracking field techniques are so new that very little information has yet been published which would be especially helpful on studies of the wild turkey. Consequently, there is probably a great deal of duplicated work on techniques and procedures. The purpose of this preliminary report is to describe our equipment,

[1] A contribution of Federal Aid to Wildlife Restoration, Florida Pittman-Robertson Project W-41-R.

technique, field procedures, and progress through the nesting period on a life history study of the turkey in Florida. A secondary purpose of writing at this time is to make some preliminary interpretations of the data in order to better identify some important questions for investigation.

This report deals with some of the nesting activities of 20 wild turkey hens between the time they were captured and radio-instrumented in March, through the end of the incubation of each nest. Some data on 15 additional instrumented hens, which were not known to nest, are presented. It is preliminary in the sense that it is based on a small part of the nesting data which is expected to be collected as the study proceeds.

We would like to thank Game Managers Herschell Haywood, Glynn H. Ivey, and Harvey Hill, and former Game Manager Jerry Peoples for their assistance in the field. Former research assistants Robert A. Routa and James Brogdon were helpful on the equipment feasibility study which preceded the present investigation. The assistance of airplane pilots Lonnie Bell and George Langford greatly increased our efficiency in searching for lost turkeys. Others who helped with field work when they visited the study area were Dan W. Speake, Jimmie C. McDaniel, Fred Lesser, Billy Hillestad and Mike Fogarty. James R. Davis examined egg shell fragments and offered his opinion on the identification of nest predators. Mr. James A. Powell offered helpful suggestions during the study and critically read the manuscript. Mr. Charles Lykes of Tampa and his company kindly permitted the study to be conducted on their property. Our secretary, Mrs. Carolyn Crawford, performed the feat of turning out the manuscript and its preceding drafts in the few hours before deadline.

METHODS

Study Area

The study area was located on Lykes' Brothers Fisheating Creek Wildlife Management Area and Refuge in Glades County, Florida. The turkeys were free-ranging; consequently, no boundary was drawn around the study area. The known activities of the telemetered turkeys encompassed about 26 square miles east, north, and west of the town of Palmdale on Fisheating Creek (Figs. 1 and 2).

The area is located over half way down the Florida peninsula. It infrequently freezes during winter, the growing season is long, the summers are hot, and the atmospheric humidity usually is high. The wettest season is normally summer when rain comes mainly from thunder showers. The average annual rainfall from 1921 to 1950 at Fort Myers, which is the nearest weather station, was 53.34 inches. Fort Myers is on the Gulf of Mexico, about 30 miles southwest of the study area.

The plant associations on the study area can be classified in six categories: 1) cypress woods, 2) bay heads, 3) low oak scrub, 4) saw palmetto flats, 5) grazed glades, and 6) the ecotones between them. Cypress swamps, ponds, and pinewoods occur on the area in minor proportions. The effects of cattle grazing and frequent flooding are evident everywhere.

The cypress woods *(Taxodium ascendens* and *T. distichum)* are nearly pure stands of young cypress trees (to about two feet DBH and less than 80 feet high), which grow in firm sandy soil outward from the creek for about one-half mile to the average highwater line between 30 and 40 feet elevation. Larger cypress trees grow along the creek-bed proper and in the few *bond fide* swamps. The ground is moderately shaded. When not flooded, there is a ground cover of green herbs, grasses and sedges, especially in the unshaded spots during summer.

The bay heads occur on wet soil of a relatively high humus content. Most of them occupy the seepage areas between the low oak scrub and the creek. The dominant trees are loblolly bay *(Gordonia lasianthus)*, sweet bay *(Magnolia virginiana)*, and red bay *(Persea spp)*. Perennial vines are abundant and sphagnum moss is usually present.

The oak scrub is not exactly what Laessle (1942) calls "scrub" because he considers the presence of sand pine *(Pinus clausa)* essential in his classification. Neither does it fit his definition of "scrubby flatwoods." We will call it low oak scrub. Some of the characteristic plants are the small oaks *(Quercus chapmanii, Q. myrtifolia, Q. inopina, and Q. geminata)*, scrub holly *(Ilex opaca var arenicola)*,

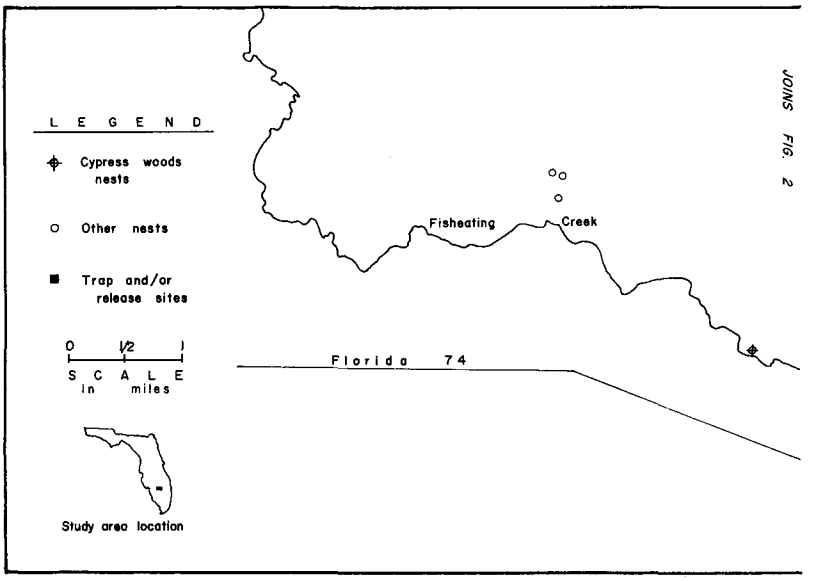

Fig 1. Map of western one-half of study area showing Fisheating Creek, highway 74, four nest sites, and the legend for Figs. 1 and 2. Joins Fig. 2 at right margin.

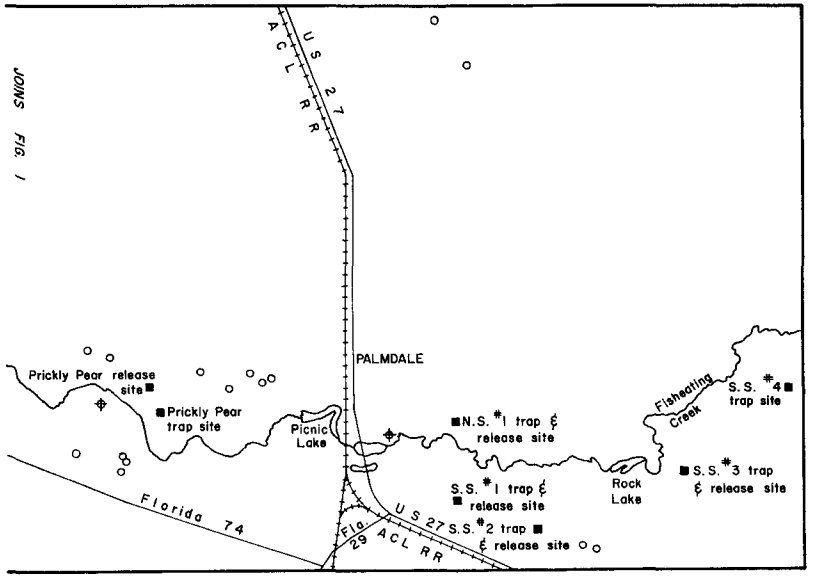

Fig. 2. Map of eastern one-half of study area showing highways, the town of Palmdale, a railroad, Fisheating Creek, 16 nest sites, and other features. Joins Fig. 1 at left margin.

staggerbush *(Lyonia ferruginea)*, tar-flowers *(Befaria racemosa)*, and saw palmetto *(Seronoarepens)*. The sparse ground covering of herbs and grasses leaves up to one-half of the white, coarse sandy soil completely bare in places. When sand pine is absent, as it is from the study area, there are few plants in the scrub which would be called trees. The oak scrub on the study area begins around 45 feet elevation and upward.

A few live oak *(Quercus virginiana)* and cabbage palm *(Sabal palmetto)* hammocks occur with admixtures of a few other hardwood trees in high, moist situations where limestone lies near the soil surface.

Extensive saw palmetto flats make up the largest habitat type in the vicinity of the study area, but the one least often utilized by turkeys. The dominant growth of palmetto is kept shorter than three feet high by winter fires which occur about every two or three years. Between fires, the ground becomes covered with wire grass *(Aristida stricta)*.

Grazed glades is the term we will use for the long, narrow zone between the cypress flats and the vegetation which borders the scrub. The conspicuous vegetation in this zone is heavily-grazed grasses and sedges. There are few trees or shrubs in large portions of it, giving it the appearance of an improved cattle pasture. The present nature of the grazed glades is probably due to the combined effects of frequent flooding and cattle grazing. The borders of ponds are similar. These areas are heavily used by turkeys, especially during summer.

Parts of the study area have usually been open to legal turkey hunting during the fall for several years. The annual kill of both sexes has usually been heavy during the past five or six years by some standards, probably exceeding 60% of the fall population. Part of the study area lies within a refuge which adjoins the public hunting area. A large number of turkeys were removed annually from the refuge by trapping until the spring of 1967. The estimated average fall turkey densities during the last 3 years were one bird per 25 acres and one bird per 100 acres for the occupied range in the refuge and hunting area, respectively, but for the lack of a suitable method, no objective census has been made.

Telemetry Equipment

The tracking transmitters (Fig. 3A) were manufactured by Sidney L. Markusen (92 West Harney Road, Esko, Minnesota) and by Davidson Company (907 Thomas Avenue North, Minneapolis, Minnesota). Transmitting frequencies were spaced on 24 channels 10 to 15 KHz apart between 150.815 MHz and 151.210 MHz. The whip antennas were about 12 inches long. The transmitters were covered with epoxy resin and powered by 1.4-volt mercury batteries.

Markusen's transmitters with antenna (Fig. 3A) weighed about 10 grams. The batteries (Fig. 3A) weighed 40 grams. The entire packaged transmitting units with straps, coated, and ready to attach to turkeys (Fig. 4) measured about 50 x 35 x 20 millimeters and weighed 65 to 70 grams.

Davidson's somewhat cylindrical units (Fig. 3A) measured about 80 x 20 x 20 millimeters and weighed 60 to 65 grams ready for installation.

The practical differences between the transmitters were that the signals from Davidson's transmitters were pulsed, and the batteries were encased in cement with the transmitters (Fig. 3A).

The two receivers (Figs. 3B and 5) were crystal-controlled on 24 channels, powered by size D dry-cell flashlight batteries, with BFO, vernier tuning, sensitivity control, volume control, and microammeter. They were light and portable. Both receivers were made by Sidney L. Markusen. Earphones were used. The receiving antennas were single, 1/4-wave whips, mounted permanently on the trucks and airplanes, and several hand-held two-element yagi beams.

To assemble a Markusen transmitting unit, the battery was wrapped to the transmitter with electrical tape. To this package the straps were attached and wound with more tape. The whole transmitting system except the antenna was coated with a final waterproofing compound before attachment to a turkey. Several different types of tape, straps, materials, and waterproof coatings were tested in the field. We found

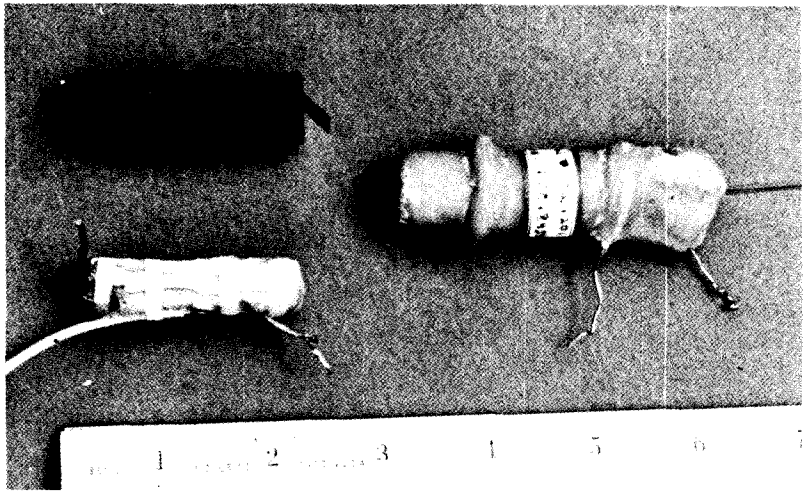

Fig. 3-A

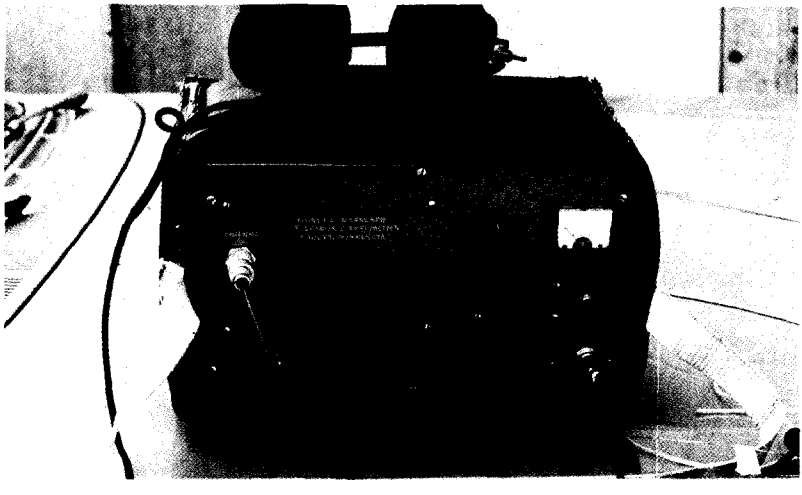

Fig. 3-B

Figure 3. A. Markusen transmitter and battery (left) and Davidson transmitting unit with battery enclosed (right). B. Receiver in carrying case, with ear-phones.

Figure 4. Receiver operator, with hand–held antenna, adjusting dials on receiver for accurate bearing.

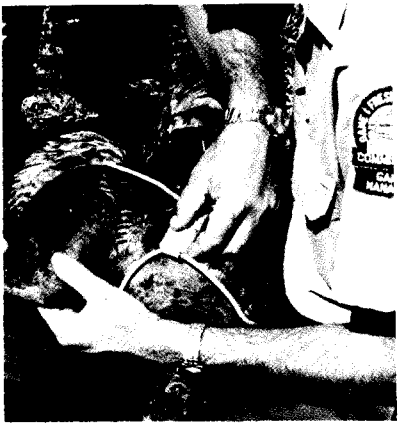

Fig. 5-A

Fig. 5-B

Fig. 5–C

Fig. 5-D

Figure 5. Attaching a tracking transmitter to a wild turkey hen.
A. Packaged unit with straps is positioned on back.
B. Straps are tied under each wing.
C. Square knot is drawn tight and tension checked under wing.
D. Instrumented hen ready for release.

that strong plastic and fiberglass tapes, available from several manufacturers, held the batteries, transmitters, and straps together satisfactorily. The straps were of 1/8-inch inside diameter, 1/32 inch wall, surgical tubing; and the most satisfactory outside waterproofing compound was Carboline Series K self-priming vinyl by the Carboline Company, 328 Hanley Industrial Court, St. Louis, Missouri. None of the 29 transmitters attached with surgical tubing was lost; most of 13 attached with plastic electrical tubing eventually fell off in the field when the tubing broke.

The packaged units were attached to turkeys by underwing loops (Fig. 5). The tubing was tied with one square knot or one single beckett bend under each wing, and the excess ends were cut off close to the knots. The birds were not noticeably hindered by this arrangement, and no appreciable chafing was apparent in several which were recaptured.

Because the receivers could accommodate only 24 channels, some frequencies had to be duplicated in the field for the 35 experimental hens. They could be distinguished in some cases by pulsed versus unpulsed signals. In cases involving continuous wave signals, individuals could not be distinguished on the duplicated channels with certainty by radio signals alone, but this did not present a problem in the final interpretation of the data because it was learned early in the study that they could be distinguished by their discreet ranges and localized movement. The number of duplicated channels was reduced to only two by the time nesting began due to the death of three turkeys and the loss of two transmitters which fell off the turkeys when the straps of plastic tubing broke.

The performance of the equipment varied in relation to the height of the transmitter above the ground, time of day, condition of the battery, individual variation among the transmitter, terrain, operator skill, and many other factors. The maximum receiving range with transmitter and receiver both about 3 feet above the ground was about two miles under ideal conditions. When a turkey was in a tree at night, the range sometimes exceeded four miles. When the receiver was in an airplane at about 300 feet, signals were sometimes received farther than 8 miles. A useful signal could normally be received from the ground during daytime at about 1/2 mile. Transmitting life varied from nearly zero to over 150 days. No practical differences in performance between the electronic products of the two manufacturers were noted.

Only about 20 feet of elevation separated the highest and lowest points on the study area. This greatly minimized physiographic influences on the radio signals.

Direction-finding Technique

Except when aircraft were used, most of the field location data were obtained by early evening and pre-dawn morning fixes. Interference from extraneous transmitters was at a minimum during the dark hours, and the effective range of the tracking transmitters was much greater from turkeys roosting in trees. Atmospheric conditions during darkness were probably more favorable also.

All position fixes were obtained with portable receivers and antennas. Searching from surface vehicles normally began before sunrise by two-man teams with direction-finding equipment, assigned to different parts of the study area. The study area was searched systematically nearly every day or night by checking the areas where the turkeys were thought to be, then checking other likely places, and finally checking even some unlikely places. No exhaustive effort was made to inventory all transmitting turkeys at a given time by surface vehicle. Five hours of systematic searching usually turned up more than half of the transmitters.

The surface vehicles were two half-ton, four-wheel drive Chevrolet pick-up trucks with oversized tires, and a small four-wheel drive Land Rover. The aircraft occasionally used were a two-place Bell helicopter with a 210 horsepower Franklin engine and floats, and a float-equipped Piper Super Cub. All vehicles were equipped with two-way radios.

About twice per month during April, May, and June, the area within about six miles of release sites and the more likely-looking habitat out to about ten miles were searched thoroughly with the portable receivers in airplanes. Nondirectional whip antennas were used on the planes. Circling and criss-crossing at 200 to 300 feet

altitude indicated the position of radios accurately enough for a surface crew to find them later.

Location fixes on the surface were obtained with directional antennas by moving with a portable receiver and hand-held antenna (Fig. 4) alternately toward and at right angles to, or in semi-circles around, the strongest signal bearing until closing range and several cross-bearings indicated the position of the radio. Accuracy was often verified by approaching close enough for visual observation of the transmitter.

As fixes were made, they were recorded by their distance and bearing from landmarks known to all the field personnel. Nest sites, landmarks, and other places of importance were plotted on U. S. Coast and Geodetic Survey quadrangle maps and on rough outline maps which were sometimes carried in the field. Immediately after a field observation period, all data were separated by radio channel number, and extra copies were filed in a distantly removed place to avoid loss in case of fire. Finally, the field data were revised and summarized and recorded in a separate bound record book for each turkey.

Capture Methods

On 5 March 1968, 20 adult and six juvenile hens were captured with orally-administered alpha-chloralose, held in paraffin-treated paper boxes, and instrumented and released on 8 March after they recovered. On 14, 21, and 22 March one juvenile and eight more adult hens were captured with cannon nets and released at the trap sites as soon as they could be instrumented, which required about 5 minutes per turkey. Both trapping techniques have been described in detail elsewhere (Austin, 1965; Williams, 1966; and Williams, Austin, and Peoples, 1966).

The 35 hens were leg-banded with numbered, size 11, model 213, National Band and Tag Company (721 York Street, Newport, Kentucky) aluminum bands. Table 1 shows release dates and some other initial data for each hen. Figures 1 and 2 show capture and release sites.

RESULTS AND DISCUSSION

Dates of Nesting

Eighteen of the 21 nests were located by fixes on incubating hens. Two nests were found by fixes on laying hens, and one nest of an uninstrumented hen, which had been destroyed by a predator was found accidentally near an instrumented hen's nest.

Table 2 contains the calculated nesting dates for 16 hens based on a 28-day egg incubation period and a 12-day laying period, dated in whole days forward or backward from an observed event. From these calculations, it is seen that 12 of 16 nests would have hatched in May. The only hatching date not in May or June was on 1 July, from a second nesting.

For practical purposes, Table 2 represents the chronology of the 1968 nesting season on the study area. No nests were found after 1 July although 23 instrumented hens were being tracked regularly thereafter.

It is tempting to construct a graph of the nesting season based on these data but we believe that this should await more data so that the influences of age, renesting, seasonal differences between years, and some other factors can be separately identified.

Clutch Size

There is a question as to what constitutes a *clutch.* In this paper the term refers to the largest number of eggs found in a single nest.

Eighteen nests reached the incubation stage. Four of them were destroyed by predators before the eggs were counted; the other 14 contained 135 eggs for an average of 9.6 eggs per nest. This is fewer eggs than has been reported for clutches in any other part of the turkey's range (Mosby and Handley, 1943, see p. 124; McDowell, 1956, see p. 10; Dalke, Leopold, and Spencer, 1946, see p. 49), but the sample is too small to encourage any generalizations at this time.

One nest contained only 5 eggs when it was found after incubation had begun. This may have been a partial clutch in the sense that some of the eggs may have been

TABLE 1
Some tracking data on 16 adult and 2 juvenile hens.

Band No.	Trap[1] Location	Release Date	Release Location	Miles From Release To Nest	Days From Release To Laying	Days In Tracking Period[2]	Days[3] Tracked	Total Fixes
239R	S.S.no.1	14 Mar.	S.S.no.1	4.3	53	107	30	31
229R	S.Ham.	8 Mar.	P.P.	3.9	34	123	36	48
215R	S.S.no.4	8 Mar.	P.P.	0.8	25	125	69	81
215R	S.S.no.4	8 Mar.	P.P.	0.9	77[4]	125	69	81
231R	S.S.no.4	8 Mar.	P.P.	0.8	56	108	37	42
237R	P.P.	8 Mar.	P.P.	3.9	35	86	24	35
220R	S.S.no.4	8 Mar.	P.P.	0.6	44	88	25	33
213R	S.S.no.4	8 Mar.	P.P.	0.3	28	108	41	68
247R	S.S.no.2	22 Mar.	S.S.no.2	1.6	--	68	19	21
2813M	S.Ham.	8 Mar.	P.P.	3.7	24	115	31	33
246R	S.S.no.2	22 Mar.	S.S.no.2	0.5	12	57	19	21
238R	S.S.no.4	8 Mar.	P.P.	1.7	--	126	30	35
2845M	S.S.no.2	26 Mar.	S.S.no.2	0.4	−2	96	19	26
233R	P.P.	8 Mar.	P.P.	1.1	26	124	69	93
222R	S.S.no.4	8 Mar.	P.P.	0.5	23	123	71	96
236R	P.P	8 Mar.	P.P.	4.0	--	122	32	33
214R	P.P.	8 Mar.	P.P.	1.0	34	122	53	68
218R	S.S.no.4	8 Mar.	P.P.	0.9	28	121	49	67
234R	P.P.	8 Mar.	P.P.	0.9	--	93	26	28
234R	P.P.	8 Mar.	P.P.	0.5	63[4]	93	26	28

[1] Abbreviations: P.P.—Prickly Pear; S.S.no.1 —Southside trap number 1; S.S.no.2 —Southside trap number 2; S.S.no.4 —Southside trap number 4; S.Ham.—Stormy Hammocks; Mar.—March.
[2] From day instrumented through date last heard or through last entry used in this report.
[3] Different days in which at least one fix was obtained.
[4] Days after deserting first nest.

removed earlier by predators, or the hen may have been interrupted while laying elsewhere and was forced to complete the laying process in a second nest.

Preferred nesting cover

Of the 21 nests found (including the one found accidentally), 14 were in the low oak scrub-to-glade ecotone. The seven nests which were not in that vegetation type were in the cypress woods (three), clumps of saw palmetto in the edge of the grazed glade zone (two), and on the edge of the palmetto flats (two). No nest was more than 1/4 mile from good roosting cover (most were much closer) and except for three late nests placed in the cypress woods, none was more than about 1/8 mile away from the grazed glade zone. Only the three cypress woods nests were not intimately associated with saw palmetto.

More nests must be found in habitat situations similar to the study area before conclusions about nest cover preferences can be made with confidence, but there are suggestions of striking management implications in the possibility that over 85% of the turkey nests can be expected to be located in an easily recognizable cover type which occupies less than 5% of the study area.

Clustering of nesting sites

The nesting sites were distinctly clustered (Figs. 1 and 2). The pronounced preference shown by the hens for locating their nests in the ecotone between the low oak scrub and grazed glades was undoubtedly a contributing factor in the clustering.

Randall (1946, see p. 310) attributed nest clustering in the ringneck pheasant *(Phasianus colchicus)* to the localization of hens in the vicinity of cock crowing areas.

Our data are not sufficient to suggest whether similar influences effected the placement of turkey nests on the study area.

Some of the nests were so close that they suggested the possibility that social factors may have caused the hens to nest close together, but there is evidence that this was not the case.

On 5 April a nest was discovered when the hen was found in the act of laying her fourth of fifth egg. She was flushed by accident and did not return to the next. Her activities were monitored for a few days as she re-established her non-nesting social relationships with some other turkeys in the study area. She was not known to visit the immediate vicinity of her nest site during the following three weeks or more. On 14 May, another instrumented hen was discovered on a nest as she began incubation approximately 20 feet from the site of the first hen's abandoned nest. Based on the chronology assumptions in Table 2, the second hen laid her first egg on 2 May, or about then. It seems doubtful that any social factors could have influenced the placing of the two nests so close together when more than four weeks of time separated the establishment of the nests.

From this we conclude that there are factors in nest site selection more subtle than our present gross analyses can reveal and probably more precisely determinant than has been suspected before. The factors may be ecological rather than social.

Seasonal Shift of Preferred Nesting Cover

The three nests in the cypress woods were started relatively late (all would probably have hatched in June) and were found (and presumably established) during a rather short interval of time. The factors contributing to the selection of the low cypress woods for late nesting (one of which was second nest after a predator had destroyed the first) are not known, but it is clear that the amount of ground cover there was not sufficient for nesting earlier. The nests were in new herbaceous spring vegetation (primarily smarkweed *(Polygonum sp.)* and boneset *(Eupatorium coelestinum)*, about knee high. The ground had been virtually bare one month earlier.

TABLE 2

Calculated[1] nesting chronology of 16 nests accurate to ± 2 days.

Channel Number	*Leg Band Number*	*Calculated First Egg Laid*	*Incubation Began*	*Hatching Date*
1M	239R	6 May	18 May	14 June*
2M	229R	10 April	22 April	19 May*
3M1	215R	1 April	12 April	9 May[2]
3M2	215R	23 May	4 June	1 July*
7M	226R	2 May	14 May*	10 June
8D	237R	11 April	23 April	20 May*
10M	220R	20 April	2 May*	29 May
11M	213R	4 April	16 April	13 May*
12M	2831M	31 March	12 April	9 May*
12D	246R	2 April	13 April*	10 May
13D	2845M	24 March	5 April*	2 May
14M	233R	2 April	14 April	11 May*
16D	222R	30 March	11 April	8 May*
19M	214R	7 April	19 April*	16 May
21M	218R	5 April	17 April*	14 May
24D2	234R	9 May	21 May	17 June[3]

[1]Calculated in full days from observed event assuming hatch on 28th day of incubation and 12 days to lay full clutch (not including 1st day of incubation).

[2]Fourth egg laid on 5 April.

[3]Fifth egg laid on 15 May.

*Date of event definitely known through visual observation.

This suggests the possibility that turkey hens may prefer this kind of place to nest instead of the scrub-glade ecotone, but perhaps normally would not find it available on the study area at the time nests are begun.

Howell (1942, see p. 549) mentioned a seasonal shift of preferred nesting locations by the robin *(Turdus migratorius)* in which that species, in successive nestings, took advantage of more preferred cover as it became available during the on-coming summer.

Another possible explanation for the switch to the cypress for nesting is that the scrub-to-glade ecotone became less attractive for nesting due to sharply increasing daytime temperatures as spring progressed into summer.

Whatever the reasons were for the last nests being placed in the herbaceous growth in the cypress woods, it was not a wise choice for the hens because all three were destroyed by predators soon after they were discovered by us, and even had they not been predatorized, the creek would have flooded them when it rose suddenly less than two weeks after these nests were discovered.

This behavior may not represent a significant limitation of turkey productivity on the study area, however, because the creek is not usually low enough to permit nesting there at that date (in two of the three sites) and it does not usually rise in the summer before hatching would have normally occurred.

Homing

Of the 24 hens released in the study area on 8 March, only 6 had been captured there. Twelve were captured six miles away at Southside number 4 trap site (Fig. 2) and six were brought from more than 6 miles away. The original capture sites were checked with tracking receivers repeatedly for over three months but none of the 18 turkeys returned to the vicinity of the location from which they had been trapped and moved. Casual inspection of the data reveal no obvious tendency for movement in the direction of the capture site but a more conclusive analysis of the data in this regard must await a larger sample. It is clear at this point that the concepts of "home range" do not apply to the wild turkey as they do to mammals (Jewell and Loizos, 1966).

Migration

One hen may have exhibited a kind of short migration between her winter range and her nesting area. She left the release area after one month and assumed localized movement about three miles away. About two weeks later she was found on a nest one mile farther away from the release site in the same direction, or about four miles from the release site. Her nest was destroyed by a predator on 7 May. She remained in the general vicinity of the nest site until at least 7 June. On 12 June she was found back in the vicinity of the release site where she remains at the time this is being written (24 July).

The apparent reluctance of wild turkeys to leave a distant release site to roam or to search for "home'. is probably a major factor contributing to the high rate of success in establishing turkey populations in new range with relatively few liberated birds.

Concealing Eggs.

In more than 50 visual observations of 24 nests (which includes three nests found during the equipment feasibility study in 1966) on the study area, no evidence of egg-covering was found although debris was abundant within convenient reach of every nest.

There is a wide-spread idea that the function of egg-covering in wild turkeys is concealment from predators. Mosby and Handley (1943, see p. 113) mention this belief without explicitly endorsing it.

Another explanation is given by McCabe and Hawkins (1946, see p. 20) in reference to a similar habit of the Hungarian partridge *(Perdix perdix)* in Winconsin, that the function of egg-covering is for insulation from chilling.

Neither concealment nor insulation would seem to be useful functions on the study area in Florida where the weather is normally very warm during the laying

vegetation chosen for nesting is dense enough to provide good concealment.

Some light could be cast on the insulation idea of egg-covering by comparing the extent of the habit in wild turkeys at different latitudes, and the concealment theory might be tested by tabulating the amount of covering in relation to the natural concealment provided by the nesting vegetation in specific situations.

Effect of alpha-chloralose on hatchability

Of the 26 hens which were captured with alpha-chloralose on bait, 15 were known to have nested; two of them renested after their first nests were destroyed. From the eight full-term nests, which together contained 76 eggs, 70 poults hatched. Three of the unhatched eggs showed no embryonic development; 3 reached the pipping stage. One incomplete clulch, which was abondoned, had one partially developed embryo and three eggs which were apparently undeveloped after 28 days in an incubator. Another nest which was destroyed by a spotted skunk *(Spilogale putorius)* contained several large embryos, one of which hatched three days after abondonment. The eggs had been left there by the investigators to entice the skunk to continue to return until it could be captured.

Behavior of hens during incubation

The data on hen behavior during incubation are very incomplete due primarily to the excessive amount of time an observer would be required to stand by nest sites waiting for something to happen while the hens merely sat there. Electronic nest activity recorders will be tested next spring which should help relieve this deficiency. A few observations were made which may be of interest.

The frequency and time of day that hens left the nests during incubation were highly variable. Hens were found temporarily away from the nests at all hours of the day from soon after sunrise to sunset. Although the data are too skimpy to reveal any definite patterns at this time, our impression was that hens left the nests more often during mid-morning and mid-afternoon, if they left at all. The period of absence was about one hour or less.

Hens commonly flew to and from the nests, taking wing a few feet from the nest and alighting a few yards away in an opening. On occasion they were seen flying from the nest and walking back, and *vice versa*. Some have been observed walking to and from the nest. The relative frequency of the two modes of locomotion cannot be calculated accurately at this time.

Nest characteristics

Twenty-one nests were examined carefully. Their measurements and some other data about them are presented in Table 3. Soil samples were taken for future analysis and notes were made on the type and amount of debris in each nest and that found within a few inches of the nest depression. From these data a few generalizations can be made.

A definite depression was made for all but one nest. The usual depression depth to bare soil was 1 1/2 to 2 inches. A typical nest depression was 10 inches long and 8 inches wide.

Thirteen of the 21 nests contained more debris than was found in the immediate vicinity indicating that most of the hens gathered at least some nesting material. The material in all 21 nests was similar in type and proportion to the surrounding debris. It could have been placed in the depression while the hen sat on it. In any case, hens probably did not bring nest materials from any distance.

One nest was on level ground (no depression) and contained less debris than the ground in the immediate vicinity which suggests that the hen may have removed it. The nest was not examined until after it had hatched--it is possible that the spot was cleared of leaves during the hatching process, but the other nests that hatched showed no evidence of major rearrangement of nest material.

Eighteen of the 21 nests were well concealed beneath low perennial vegetation. The area within five feet of them was more than 50% concealed overhead by saw palmetto. Wiregrass was present at most of these 18 nests sites. Three nests were in relatively exposed situations in the cypress woods far from the nearest palmetto or wiregrass.

TABLE 3
Miscellaneous data on 20 turkey nests.

Band Number	*Age Class*	*Clutch*[1] *Size*	*No. Eggs*[2] *Unhatched*	*Size of*[3] *Nest In Inches*	*Elevation In Feet*	*Date End of Nest*	*Fate of Nest*
239R	Ad	8	2	1x10x10	42	14 June	Hatched
229R	Ad	10	1		47	19 May	Hatched
215R	Ad	4		1½ deep	40	5 April	Abandoned
215R	Ad	11		½x10x10	45	1 July	Hatched
231R	Jv	10			40	30 May	Abandoned
237R	Jv	9		2x8x10	48	20 May	Hatched
220R	Ad	8		2x9x11	39	21 May	Predatorized
213R	Ad	11	1	1½x9x11	44	13 May	Hatched
247R	Ad	--		1½x10x10	31	17 May	Predatorized
2813M	Ad	12	2	2x8x12	45	9 May	Hatched
246R	Ad	11		1½x7x10	33	17 April	Abandoned
238R	Ad	--		--	34	18 May	Predatorized
2845M	Ad	9		2x8x10	34	5 April	Abandoned
233R	Ad	10		None	40	11 May	Hatched
222R	Ad	5		1x8x9	44	8 May	Hatched
236R	Ad			1x7x10	43	7 May	Predatorized
214R	Ad	11		--	40	13 May	Predatorized
218R	Ad	--		2x8x10	38	2 May	Predatorized
234R	Ad	--		1½x8x11	46	29 April	Predatorized
234R	Ad	6		1½x8x10	36	17 May	Predatorized

[1] Number of eggs found in nest.
[2] In nests which were not abandoned or predatorized.
[3] To nearest inch in length and width; to nearest ½ inch in depth.

Predation

Nine of the 21 nests were destroyed by predators. Although a few feathers were found in the vicinity of one nest after it was predatorized, no nesting hen was significantly injured by predators during the study as far as we know.

There was no conclusive identification of the initial predator species in any of the nine cases but a spotted skunk and a raccoon *(Procyon lotor)* were captured at two nest sites immediately after they were predatorized, and dogs were seen molesting another nest. Evidence at the nest sites suggested raccoons in two other cases. Greater effort will be made in the future of the study to identify nest predators.

There is a wide-spread belief that activities of observers in the vicinity of bird's nests cause unnaturally high predation rates. We plan to investigate this possibility in the future.

Miscellaneous observations

In two cases, hens were captured in cannon nets at bait sites after they had begun laying, without interruption of laying as far as could be determined, and they assumed normal incubation behavior later. (One of these occurred in 1967 during equipment tests which preceded this study).

For reasons we were unable to determine, one hen was found roosting in a tree at 10:30 p.m. near the end of the incubation time for her clutch. She resumed incubation behavior the next day and hatched her eggs five days later. Her nest had contained no more than five eggs after it was found.

A hen which was interrupted in the process of laying her fourth or fifth egg deserted the nest. Her eggs were collected and proved to be exceptionally large, measuring in length and width in millimeters: 71 x 49, 70 x 49, 68 x 50, and 65 x 48. When the second nest by this hen was inspected hurriedly while she was temporarily away during incubation, it was immediately obvious that the eggs in her second nest were smaller than those in her first nest. The largest- looking egg in the second nest

measured in millimeters only 62 x 45--smaller than any of the four eggs from the first nest. Bent (1932, see p. 341) gives 61 x 46.3 millimeters are the average of 56 eggs from turkeys in Florida.

Late nests often have more infertile eggs than earlier nests (Mosby and Handley, 1943, see p. 129). It is interesting to note, in this connection, that all 11 eggs in our latest nest hatched on 1 July.

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A TELEMETRIC STUDY OF DEER HOME RANGES AND BEHAVIOR OF DEER DURING MANAGED HUNTS[1]

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ABSTRACT

The home ranges of five white-tailed deer *(Odocoileus virginianus)* were determined on the Clark Hill Wildlife Management Area using telemetric equipment. The population density of deer on the 800 acres study area was estimated to be 50-55 deer per square mile (1 deer/12 acres) prior to the managed hunts in 1967. A six year old doe, radio-tracked from April 4, to May 9, 1967, had a home range of 121 acres. The same animal was tracked from October 12, to October 25, 1967, and had a home range area of 87 acres. A three year old doe with a fawn was radio-located from May 18, to July 8, 1967, and ranged on a 40 acre area during this period. The doe and fawn were instrumented from November 16, to December 31, 1967, and had a home range of 78 acres. These animals were never separated while both were instrumented. A 1½ year old buck was radio-instrumented from October 12, to November 1, 1967, and from November 13, to November 18, 1967. During this period, the animal had a home range of about 360 acres. A 1½ year old doe was

1 This is a contribution of Georgia Pittman-Robertson Project W-37-R-7.