SEASONAL BEHAVIOR OF RIO GRANDE WILD TURKEYS IN WESTERN OKLAHOMA[1]

Tom H. Logan
Oklahoma Department of Wildlife Conservation, Oklahoma City.

ABSTRACT

Rio Grande turkeys (*Meleagris gallopavo intermedia*) were studied in Roger Mills and Beckham Counties from fall 1966 to fall 1969. Three hundred and eight turkeys were trapped and individually marked, and physical measurements were made. Radio transmitters were placed on 31 turkeys. Tagged turkeys were observed 333 times on spring and summer ranges. Daily ranges of spring flocks varied from 160 to 379 acres. Total number of turkeys in the winter flock varied from approximately 280 to 368 birds. Size of winter headquarters area varied from 351 to 507 acres, and spring range included approximately 60,000 acres. Removal of trees on a portion of the winter area in fall of 1968 had a marked effect on daily activities on the winter flock and size of the winter area. During spring dispersal and winter flock formation, an exchange of members from different winter flocks occurred. Although most courtship occurred on the winter area, mating took place after spring breakup and dispersal and continued until onset of incubation. No gobbling territories or gobbler harems existed on spring areas. Most hen flocks were accompanied by at least one adult gobbler which was dominant over other gobblers present. Data were collected on 30 nest sites. Majority of nests were located in three types of sites; alfalfa bottoms, eroded ravine banks and brushy hillsides. Hens with poults began joining brood flocks when their poults were as young as 2 weeks old. Strong social relationships developed within brood flocks and care of broods was shared among adult hens of the flocks. Poults/hen ratios averaged 5 poults/1 hen during July - September of 1967-1968.

INTRODUCTION

Early Oklahoma history indicates during the 19th century the wild turkey flourished in great numbers throughout the savanas and plains of Oklahoma (Underhill and Littlefield, 1970). Following influx of settlers and resulting land use changes, however, the wild turkey shared the plight of many other diminishing game species.

A turkey restoration program was initiated in the mid 1950's and resulted in the wild turkey being restored to huntable numbers in 48 of Oklahoma's 77 counties (Williamson, Oklahoma Department of Wildlife Conservation, personal communication). Although turkeys have been restored in a large percent of Oklahoma, and fall hunts have been held since 1960 and spring hunts since 1963, there has been little research on ecology of the Rio Grande turkey in Oklahoma.

This study was conducted by the Oklahoma Department of Wildlife Conservation from fall 1966 to fall 1969, to examine seasonal movements and life history of Rio Grande turkeys in western Oklahoma. These data were needed to improve wild turkey management in Oklahoma and increase public understanding of management needs.

METHODS

Sandstone Creek Watershed was selected as a study area due to the presence of a well-established Rio Grande turkey population. Initially one major winter concentration of turkeys was studied. As the project progressed, however,

interactions among the study flock and other flocks on spring areas, necessitated including two additional flocks into portions of the study.

I defined a flock as any group of turkeys that was concentrated geographically and interacted socially as a unit.

Trapping periods were late December to early April. During three winters of the study, 308 turkeys were trapped and marked, 252 in the Sandstone flock, 37 in the Sturgeon flock and 19 in the Carpenter flock (Figure 1).

Drop nets (70′ x 70′) and cannon nets (45′ x 60′) were used to capture turkeys. Although 40 to 55 turkeys/drop could be captured, during cold weather, with the drop net, mild weather often necessitated use of cannon nets. Turkeys did not feed as aggressively during mild weather and they seemed more reluctant to pass under the drop net, but would feed readily before a cannon net. An average catch for the cannon net was 20 to 30 turkeys; however, 50 were captured on one occasion.

All captured turkeys were marked with numbered and colored patagial wing tags or neck tags and banded with aluminum leg bands. The wing tags and neck tags 3¼″ x 3¼″ in size and made of colored, plastic Herculite (S. and S. Supply, Oklahoma City, Oklahoma). Numbers were painted on tags with waterproof paint, and colors were coded to flock of capture. Neck tags were attached by fastening a Turk-E-Bit (Decker Mfg. Co., Keokuk, Iowa) through the tag and top of the feather tract on the back of the neck. The patagial wing tags were attached to each wing by fastening a "Burche's Best" Ear Button (Naoco Co., Fort Atterison, Wisconsin) through a corner of the tag and the wing patagium.

All turkeys captured were aged, sexed and weighed. Length of the tarsus, spur and beard were also measured.

Thirty-one turkeys were additionally marked with miniature radio transmitters of the type described by Slagle (1965). Transmitters operated on four 9-volt Mallory Mercury Duracells (Tr-146x, Mallory Bettery Co., Terrytown, New York) in parallel, and transmitted at 26-27 MHz. Transmitters and batteries were sealed inside a 4½″ x 2¼″ x 1¼″ aluminum box with Silicon Rubber (General Electric Co., Schenectady, New York). A 22″ whip antenna was mounted on the posterior end of each box by means of an insulated jack and wired to the transmitter. Several transmitters were tested with a 9-volt, 13 Ma. solar cell mounted on top of the box and connected in parallel with batteries for recharging purposes. Transmitter units weighed approximately 11 oz., and transmitting range varied to 1.5 miles. Surgical tubing harnesses were used to mount transmitters on the turkey's backs.

The primary receiver used was a 23 channel Cobra Model CAM 88 (Dynascan Corp., Chicago, Illinois) with a beat frequency oscillator incorporated into the unit. Two hand-held loop antennas were constructed by F. Hoxie, Tulsa, Oklahoma for use in the study.

After flock dispersal in the spring, locations of both tagged and instrumented turkeys were made by cruising the study area by pickup for a 10 mile radius from the winter area, searching areas known to be used by turkeys during spring. Landowners were also contacted to discuss incidental observations. During the first spring much time was spent searching for tagged turkeys on foot; this proved to be inefficient. By the second spring a knowledge of daily activities of turkeys, dispersal routes and habitat used in spring, facilitated making observations from vantage points with 7 x 35 binoculars and a 25-50x spotting scope. Large portions of the study area were observed in this manner during the turkey's peak activity periods of early morning and late evening.

Turkeys carrying transmitters were located by monitoring appropriate channels while cruising the study area. After making radio contact, locations of instrumented turkeys were determined by triangulating from two or more locations. Movements of both tagged and instrumented turkeys were recorded and later plotted on maps.

All population figures were acquired from direct counts made periodically on the study area.

STUDY AREA

Description

The study area is located in the Sandstone Creek Watershed in southeastern Roger Mills County and northern Beckham County, western Oklahoma. The vegetative types are interspersed mixed-grasses, shinnery oak grasslands and eroded plains (Duck & Feltcher 1943).

Major plant species of the area are communities of sideoats grama (*Bouteloua* curtipendula), blue grama (*B. gracilis*), silver bluestem (*Andropogon saccharoides*), little bluestem (*A. scoparius*), sand bluestem (*A. hallii*), ragweed (*Ambrosia spp.*), and annual broomweed (*Gutierrezia drancunculoides*), interspersed with shinnery oak (*Quercus havardii*), and skunkbrush (*Rhus* trilobata) and sandsage (*Artemisia filifolia*). Creek bottoms contain cottonwood (*Populas deltoides*), American elm (*Ulmus americana*), western hackberry (*Celtis occidentalis*), western walnut (*Juglans rupestris*) and chinaberry (*Sapindus drummondii*).

Soil types are primarily clay-loam with some of the higher terrain being very sandy (*Soil Survey 1963*). Water runoff in the area is excessive. Floods during the early 1900's caused serious erosion resulting in a network of deeply eroded ravines throughout the watershed.

History of Study Flock

In the middle 1950's state game rangers began transplanting wild-trapped Rio Grande turkeys along Sandstone Creek. Origin of these turkeys is not certain because records were not kept of those early transplant efforts. In general, however, most transplant turkeys were trapped from remnant western Oklahoma flocks or populations near Canadian, Texas (B. Burns, ranger, personal communication). Most releases consisted of four hens and two gobblers. One such release was made on the land of Raymond Williams, the present site of the major portion of the winter area of the study flock. Williams reported seeing three turkeys near his hog lot some time after the release but did not see them again. In 1955, Jim Taylor, whose land adjoins the present winter area on the north, sighted one hen and four poults in the release site and approximately six months later saw seven or eight turkeys. Turkeys were not seen again until 1958 when approximately 30 turkeys began feeding in Williams' hog lots and wintered on his land. Turkeys have wintered on Williams' and Taylor's land annually since then and have increased to the present figure of 325 to 370 turkeys. Smaller flocks have established on the periphery of the summer range of the Sandstone flock. Two of the major flocks, Sturgeon and Carpenter flocks, numbering 100 to 110 turkeys each, were included in my study.

Most hunting on the study area is limited to close friends or relatives of the landowners. Although both a spring and a fall hunting season are held in Oklahoma, the spring gobbler season has been slow to gain popularity and most of the study area is only hunted during the fall.

RESULTS

Fall and Winter

Description and Characteristics of the Winter Area. The wintering area of the Sandstone flock is located along Sandstone Creek where Current Creek, its major tributary, joins it (Figure 1). At this junction there is a large cottonwood grove. According to local landowners, this grove has been the winter roose since

the flock was established. The winter area consisted of approximately 500 acres in the vicinity of the roost. Alfalfa, wheat and forage sorghums are grown for cattle and hogs. These also provide a great quantity of food for wintering turkeys.

Flocking Behavior on the Winter Area. Although the winter area of the Sandstone flock was mainly used only during winter, at no time of the year was it devoid of turkeys. Each summer a flock of 12 to 20 gobblers of mixed ages remained there and from 1 to 4 hens nested there.

First movements to the winter area began in early August. Brood flocks, flocks of adult gobblers and flocks of hens without broods returned there. Each flock maintained their social structure and did not combine with other flocks prior to winter flock formation. Flocks commonly shared roosting sites, however, but separated during the day.

Formation of the winter flock usually occurred the latter half of September (September 18-27) and coincided with the first significant temperature drop of the season. Weather remained moderate during the fall of 1969, and winter flock formation did not occur then until the second week of October when a slight temperature drop occurred (Climatological Data 1967, 1968, 1969).

The winter flock formed when all hens that were on the winter area and their broods formed a single flock that roosted and performed all daily activities together throughout the winter. A few juvenile gobblers stayed with the hens when the winter flock was formed, but most joined small flocks of adult gobblers or formed flocks of juvenile gobblers. Observations of tagged individuals indicated these flocks of juvenile gobblers remained together through at least two winters. Watts (1968) observed this in Rio Grande gobblers in Texas and described them as "sibling" units or flocks formed of individuals raised within the same brood flock (social group of hens and broods). Observations of tagged gobblers during this study and information provided by Watts, indicates juvenile gobbler flocks remain together becoming flocks of adult gobblers after the first winter. As size of the "sibling" group decreases, juvenile gobblers are accepted into the group during winter flock formation. It appeared this may have been the origin of mixed-age gobbler flocks. All gobblers roosted with hens during winter but did not associate with them during the day.

Approximately 40 percent of the total winter flock was on the winter area at onset of winter flock formation. The remainder of the flock was still on summer ranges and continued to move to the winter area throughout the winter (Figure 2).

Movements of birds to the winter area increased following first frost, usually in mid-October, and also following fall turkey season in November. The flock did not reach its peak numbers of 368 turkeys in 1967-68 and 325 turkeys in 1968-69 until early February.

A correlation was observed between the pattern of movement to the winter area and poaching pressure on the winter area. During the first winter of the study (1966-67) turkeys continued to move into Sandstone winter area until mid-November, peaking at approximately 280 turkeys. Fall turkey season was held in late November and roost-shooting prevailed throughout the winter (Ranchers and rangers, personal communication). This resulted in several birds leaving the winter area, and flock numbers dropped to approximately 200 turkeys until spring dispersal. Poaching was negligible the remaining two winters (1967-68, 1968-69). In the absence of "roost-shooting" on the winter area, movement to the winter area continued through early February.

Daily Activities on the Winter Area. The Sandstone flock wintered on approximately 351 acres until 1968-69, when the size of the winter area increased to 507 acres. Maximum length of the winter area increased from 1.0 mile to 1.6 miles and maximum width remained at 0.7 mile. This winter area is much smaller than reported by other authors; however, with a large scource of food

adjacent their roost, the Sandstone flock had to move only a short distance to feed. Thomas (1955) stated winter ranges on the Wichita National Wildlife Refuge in Oklahoma averaged 1211 acres. Thomas, et al (1966) reported winter ranges on the Edwards Plateau of Texas averaged 3145 acres and Wheeler (1948) stated that Alabama turkeys used 400 to 1,000 acres, depending upon seasonal abundance of food.

The increase in acreage of the winter area in 1968-69 was probably a result of approximately 30 acres of large timber, which had been used as an alternate roost for many years, being bulldozed from the north side of the winter area. A new laternate roose was selected just southwest of the previous winter area, enlarging the area by approximately 156 acres.

The alternate roost was used when disturbance occurred in the immediate vicinity of the main roost prior to roost time during the night, or just after leaving the roost in the morning. The alternate roost usually was used for only one or two nights in succession in 1966-67 and 1967-68. The new alternate roost was located at the extreme opposite end of the winter area from the main roost. On the one occasion it was used during 1968-69, the flock roosted there four weeks before returning to the main roost (Figure 3).

Two peak periods of activity were observed; feeding in early morning and feeding in late evening. Variations in activity period have been indicated for different areas of wild turkey range. Mosley and Handley (1943) observed two peak periods, one in early morning and another in late afternoon in Virginia. Raybourne (1968) stated peak feeding periods of turkeys in Maryland were late morning and late afternoon, and Wheeler (1948) reported Alabama turkeys spent the major portion of the day securing food.

Feeding began shortly after birds left the roost in the morning (Figure 4) and continued until mid-morning, then most of the flock would loaf until mid-afternoon. Loafing sites were located in any vegetation that provided overhead concealment and good visibility, such as plum (*Prunus angustifolia*) thickets and groves of cottonwood, chinaberry or walnut trees. Feeding resumed in mid-afternoon and continued until roost time (Figure 5). Gobbler flocks separated from hens after leaving the roost so each flock had its own source of food. The hen flock fed daily in a hog feed lot in the south portion of the area.On cold mornings, or when ice or snow covered the ground, hens moved rapidly to the hog lots to feed on waste grain scattered around feeders. Gobbler flocks fed mostly in the north portion of the winter area, eating green wheat and oats or shattered grain where cattle were fed oat or millet hay. Gobblers, and occasionally hens, fed readily at these hay sites. During the evening feeding period, food sources used during morning were occasionally used, but turkeys seemed to prefer to feed on foods such as week and grass seeds, mast and insects as they moved to the roost.

Daily activities of the hen flock and the gobbler flocks resulted in the majority of the birds traveling over most of the winter area from day to day. This was substantiated by monitoring instrumented turkeys on the winter area. Movements of an instrumented gobbler are illustrated in Figure 3 and are representative of movements of the majority of instrumented turkeys.

Winter Populations. Populations were determined by periodic counts and numbers varied from 280 to 368 turkeys. Sex ratios varied from 2.0 to 2.3 hens/gobbler (Table 1), and age ratios ranged from 1.1 to 1.4 juveniles/adult. A difference in age ratios between hens and gobblers was observed; 1.0 and 1.2 juvenile hens/adults hens 1967-68 and 1968-69 respectively and 2.0 juvenile gobblers/adult gobbler both years.

Age ratios were assumed to represent annual replacement and in turn mortality of the wintering population. Mortality of both sexes was 55-59 percent. Mortality was estimated at 50-55 percent and 67 percent for hens and

gobblers respectively. Mortality rates reported by other authors were 60 percent (Powell, 1965) 50 percent (Jonas, 1966), 60 percent (Bailey and Rinell, 1968) and 46 percent (Thomas, 1955).

Age and sex ratios remained constant from September through March. Ratios did not change throughout winter although turkeys continually moved to the area. Therefore it was assumed ratios of turkeys on the winter area were indicative of total population, including those birds not yet on the winter area. Little evidence of mortality was detected on winter areas except during the first winter of the study when poaching occurred. Generally mortality of juveniles occurred before they arrived at the winter area where they replaced 55-59 percent of the adult population that had succumbed since the preceeding winter. Wheeler (1948) and Lewis (1973) reported sources of mortality for young poults are exposure, severe weather, accidents, parasites, poaching, disease and predation. Few losses occurred on the winter area apparently because of an abundance of food, mild winters and low harvest by hunters. Mortality of adults must have occurred after leaving the winter area and, theoretically, prior to peak of hatching in early summer. Potential sources of spring and summer mortality of adults are physical stress of spring dispersal, courtship, nesting and predation.

Courtship on Winter Area. Daily patterns of behavior of the winter flock began changing when gobblers became sexually active as indicated by their courtship displays and vocalizations. Gobblers occasionally gobbled and displayed as early as mid-December. This increased in frequency as several gobbler flocks began to associate more closely on the winter area. Some gobbling was done by most age classes of males; however, the majority of the displaying was done only by adults. Juvenile males became aggressive toward each other but seldom challenged displaying adults.

Gobbling developed to such an intensity by early February that hen vocalizations, other animal sounds or mechanical noises often stimulated outbursts of gobbling from most gobblers on the area. These outbursts were most often heard while birds were still on the roost, but they were also heard throughout early morning. Gobbling decreased during mid-day and increased during late afternoon. Outbursts of gobbling, however, were seldom heard after early morning.

Head coloration was developing at the time gobbling intensity was high, and many gobblers began joining the hen flock. Gobblers continued to display to each other at first but soon began displaying to hens. Hens usually indicated no response to displays until late February. By the second week in March hens began assuming breeding postures in response to displays of gobblers. Mating, however, was not observed on the winter area before spring breakup. When hens assumed breeding postures on the winter area prior to breakup, dominant gobblers continued displaying while surrounding subordinate gobblers often performed mock matings.

Spring Period

Dispersal to Spring Areas. Although a few small flocks of turkeys left the winter area before late March, the majority of turkeys remained there until spring breakup began, usually between March 21 and April 1. The number of birds on the winter area usually decreased to 25-50 turkeys within 4-7 days after dispersal began. In spring 1969, however, breakup began March 21 and, for undetermined reasons, was not completed until late April.

Most turkeys left the winter area as mixed flocks of up to 20 hens and 6 gobblers. Most adult gobblers left with hens; however, all flocks of hens were not accompanied by gobblers. Some juvenile gobblers left the winter area with hens and adult gobblers. Many, however, left as flocks of juvenile gobblers only. These juvenile gobbler flocks usually did not travel more than 2-3 miles from the winter area.

Observations of tagged turkeys indicated the winter flock dispersed in a radius of up to 9 miles. Approximately 70 percent traveled less than 4 miles. Size of spring range averaged approximately 60,000 acres (Figures 6, 7).

According to Thomas (1955), Rio Grande turkeys in the Wichita National Wildlife Refuge, Oklahoma, did not leave their winter area to nest. Bailey and Rinell (1968) reported Eastern turkeys (*M.g. silverstris*) in West Virginia dispersed as far as 25 miles in spring. Jonas (1966) reported Merriams' turkeys (*M.g. merriami*) in Montana moved 14.5 miles and Thomas, et al (1966) stated Rio Grande turkeys on the Edwards Plateau of Texas moved an average of 10.9 miles in spring.

The Sandstone flock moved to traditional spring roosts each spring and the pattern of dispersal was similar each year (Figures 1, 6, 7). Movement data collected the first spring were not as extensive due to a lack of knowledge of the range and behavior of turkeys. Spring roosts were similar to winter roosts, but were usually smaller. Trees were more scattered and it was an upland site. Turkeys preferred cottonwood trees year-round for roosting; they are the largest and most available tree species in most of western Oklahoma.

Daily Activities on Spring Areas. After turkeys arrived on spring areas, daily activities again adhered to a set pattern. Although as many as 30-40 turkeys often used the same roost, they usually separated into small flocks of 4-7 hens and 2-3 gobblers after leaving the roost. Observations of tagged gobblers indicated most hen flocks were accompanied by at least one adult gobbler that was a permanent member of the flock and dominated other gobblers associating with the flock. Juvenile gobblers and a few adult gobblers did not stay permanently with any certain hen flock. These gobblers typically associated with a hen flock for only 1-5 days. The changing daily movement patterns of these gobblers usually resulted in their coming in contact and associating with several different hen flocks throughout spring.

Juvenile gobblers not associated with adults maintained their own flocks and followed rather sporatic daily movement patterns compared to hen flocks. They seldom associated with hen flocks on spring areas except to roost.

After leaving the roost, flocks usually moved to high ground between major draws and ravines to feed during the first 3-4 hours of early morning. After feeding, they moved to more densely vegetated draws and creek bottoms to loaf until feeding resumed in late afternoon. Afternoon feeding usually took place in bottomlands as flocks moved toward roost areas. When hens were selecting nest sites and laying, they were often observed separating from their flocks at various times of the day and returning by evening roost time.

Daily ranges of five individual flocks on two major spring areas varied from 160-379 acres (Figure 8). A correlation appeared to exist between size of daily range and terrain. Turkeys traveling over rough terrain of numerous draws and ravines moved over smaller ranges than those traveling over more open and level terrain.

Courtship and Mating. Most adult gobblers engaged in courtship throughout the day and were seldom observed feeding. Gobblers were often observed beginning displaying in morning while still on the roost. Peak periods of courtship correlated with early morning and late evening feeding periods of hens, the early morning period being more active.

No existence of gobbling or mating territories was observed. This agrees with findings of Capel (1968). The only defense observed on spring areas was by the dominant gobbler over subordinant gobblers on spring areas. This gobbler did the majority of displaying and according to Watts (1968), does all mating of the hens within the spring flock of which he is a member.

Watts and Stokes (1971) described variations between the "lek" system of mating for Rio Grande turkeys on the Welder Refuge and harem system

characteristic of the Eastern subspecies, and suggested variations in display and mating behavior of these turkeys may be attributed to a rainfall - vegetation - insect interrelationship. They also described a combination of the two systems in a "part of Oklahoma" of intermediate climate where the "Rio Grande subspecies display on leks but do not usually mate until afterward, when they go off to form harems." It is unfortunate this interpretation was not documented as neither true leks nor evidence of harem formation was observed during this study.

The most fierce fight witnessed between two gobblers occurred on April 3, 1969, when an adult gobbler and a hen joined a spring flock, and the newly arrived hen allowed the accompanying gobbler to tred her shortly after joining the flock. Before actual mating took place the dominant gobbler of the flock struck the gobbler from the hen's back, and a fight took place resulting in the dominant gobbler winning. The defeated gobbler and the newly arrived hen remained with the flock.

Most courtship occurred on feeding areas of hens. Hens usually moved to these areas immediately after leaving the roost and were followed by displaying gobblers. These feeding areas usually had low, sparse vegatation and provided excellent areas for hens to feed and sites for gobblers to court and breed hens. As hens finished feeding and left feeding areas to loaf, gobblers followed continuing to display.

A sharp decline in number of hens seen daily occurred when most hens began incubating (Figure 9). At this time frequency of displaying and gobbling declined as gobblers began to reflock. Gobblers in Alabama were also observed to reflock during this period (Barwick and Splake, 1973). Capel (1967) reported a second peak in gobbling at this time in Kansas but stated the turkey population was of low density, and gobblers probably increased gobbling to locate other males.

Each year a flock of 12-14 non-breeding hens was seen on the spring range, and one or two additional hens were occasionally seen with gobbler flocks. The few hens that did not attempt to nest either maintained their flock structure throughout summer or joined gobbler flocks after onset of incubation. These flocks of non-breeding hens were identified by tagged members of the flock and were assumed to have not attempted to breed because they were observed as a flock throughout spring and summer and associated with gobblers only during roosting.

Daily ranges were established after gobblers flocked together and were maintained until turkeys began returning to the winter area. Daily movements of juvenile gobbler flocks, now yearlings, remained erratic.

Mixing of Flocks. Shuffling of members of separate winter flocks was observed during two periods; (1) during early dispersal from the winter areas, prior to spring break-up, and (2) on spring areas as birds formed flocks upon arrival.

On March 8, 1969, two hens, tagged as members of the Sturgeon flock, 5.5 miles north of the Sandstone winter area, were observed with the Sandstone hen flock, and by spring break-up two more hens from the Sturgeon flock had joined the Sandstone flock. These hens dispersed to spring areas as members of the Sandstone flock. Two of them returned in fall, with broods to the Sandstone winter area.

Observations of tagged turkeys in spring, 1969, indicated spring areas were often shared by both hens and gobblers of different winter flocks. Hens returned to the areas used in spring again in late summer with their broods. These brood flocks remained together and returned to a common winter area. This resulted in a mixing of flocks during winter flock formation in addition to the shuffling that was observed prior to spring break-up. Thomas, et al (1966), in contrast, reported Rio Grande turkeys of separate flocks in Texas mixed on spring and

summer areas but returned to their respective winter areas.

Nest Sites. Data were collected on 30 nests reported by landowners or game rangers. Most nests were located in bottomland fields of alfalfa, eroded ravine banks, or brushy hillsides (Table 2). Other nests were located in dry creek bottoms and fields of Austrian winter peas; these sites were similar to the alfalfa fields. Nests other than those located in alfalfa were in clumps of vegetation that provided surrounding and overhead concealment but did not hamper visibility or escape from the nest.

Nest Abandonment. Incubating hens displayed a remarkable ability to withstand harassment without abandoning their nests, contrary to reports that hens abandon nests at the least provocation. Williams et al (1971) observed similar behavior of Florida turkeys.

Of the 30 nests observed, 17 were destroyed by mowers in hay fields, one by a 2.6 inch rain and two were destroyed when hens were killed by predators. The hen whose nest was destroyed by the 2.6 inch rain returned to dig three eggs from the mud-filled nest before abandoning it. One of the hens killed on her nest by a predator had returned to her nest and resumed incubation after having a toe cut off when a mower cut over her nest one week previous. The remaining nine hens were flushed repeatedly from their nests, and only two abandoned their nests. Both of these hens were still laying eggs when first flushed; one was flushed twice before she abandoned her nest, and the other was flushed once. The most extreme example of a hen that nested successfully despite harassment was one flushed at least 12 times and having a seismograph crew set off a dynamite charge in a hole just 30 yards from her nest.

Productivity. McDowell (1956) reported that of 37 initial nesting efforts of turkeys in Virginia 35.1 percent were successful. Mosby and Handley (1943) reported 21 of 40 nests were unsuccessful, and Wheeler (1948) stated only 50 percent of Alabama hens attempted to nest and approximately 50 percent of those were successful. Thomas (1955) noted 61 percent of the hens raised broods on the Wichita National Wildlife Refuge.

Nesting success was not calculated from nest data because of data source. I calculated from annual poult production, however, a maximum of 39 percent of the hens alive through the reproductive period actually reared poults.

Example:

Total winter flock 1967-1968		369 (107 gobblers, 262 hens)
Calculated annual mortality based on age ratios of winter population		-204 (73 gobblers, 131 hens)
Population alive through reproductive period		165 (34 gobblers, 131 hens)
Number of poults needed to maintain population level		204
Minimum poults/hen ratio observed in September, 1968		4 poults/hen
Number of successful hens required to produce 204 poults	204/4	51
Calculated percent of hens that had to be successful	51/131	39%
Adult population in early fall		165
Surviving poults in early fall		+204
Stabilized population by winter		369

Poults/hen ratios (Table 3), as discussed in the next section, are a minimum figure because it is very difficult to distinguish individual broods except early in the brood rearing period. Some adult hens in brood flocks do not have poults, this lowers the poults/hen ratio. A low poults/hen ratio in the above example results in a higher calculated percentage of hens that must contribute to the population. For example, if the poults/hen ratio could be improved by identifying only hens with broods, and was actually 5 poults/hen instead of 4 poults, then the percentage of successful hens would drop from 39 to 31 percent.

Poults/hen ratios averaged approximately 5 poults/hen in July through September, 1967 and 1968 (Table 3). Ratios declined from July to September each year which concurs with findings for Eastern turkey in Tennessee (Lewis, 1973).

Summer Period

Formation and Activities of Brood Flocks. The brood flock is a strong social group that behaves as a single flock and is composed of hens with broods and occasionally broodless hens. Each brood within the flock maintains its organization and attachment to its mother, but each hen within the brood flock shares the care of all broods on occasion. Based on observations of tagged hens these flocks remained together until winter flock formation.

Hens were observed forming brood flocks when their broods were as young as 2 weeks of age. At this age poults were strong enough and feathered enough to at least fly to overhead limbs if the need for escape occurred (Barwick et al 1970, Williams et al 1973).

Formation of brood flocks was apparently a behavioral function to unite broods as larger groups. A strong bond formed between the broodless hens and the broods similar to the bond between the brood hens and their young. On several occasions, as young poults were flushed or approached, both the brood hen and the broodless hen were observed to feign injuries as a diversion from the brood.

Another instance of cooperation among hens was observed after flushing a flock of 3 hens and 3 broods, approximately 4-6 weeks of age. The poults scattered to surrounding trees and brush as hens flew to the next ravine, approximately 400 yards beyond. After 30 minutes one hen left the others and circled to the concealed poults. She gathered the poults by clunking to them and joined the other two hens.

Daily Brood Flock Activities. Daily activities of brood flocks were similar to those of winter flocks. They fed until mid-morning on sparse hillsides or open fields where both hens and poults were regularly observed flushing and eating grasshoppers (*Orthoptra spp.*). Hamrick and Davis (1971) found grasshoppers were the most important animal food eaten by Eastern turkey poults in Alabama. After feeding during early morning, broods loafed in sites typical of those used by adults in winter. Feeding resumed in late afternoon before broods moved to roosts.

Brood flocks used a variety of tree species for roosts; cottonwood, American elm, western walnut and western hackberry. Trees of dense canopy were usually selected for brood roosts, rather than trees with open canopy such as used by the winter flock.

CONCLUSIONS

A broad study such as this often stimulates as many, if not more, questions than are answers. Some definite conclusions may be made, however, particularly concerning harvest.

An annual replacement rate of 55-59 percent, characteristic of the Sandstone flock, certainly justified greater harvest than the 10 percent currently estimated. Replacement rates (mortality rates) can be used in conjunction with poults/hen ratios to monitor turkey population responses to various harvest rates and annual climatic conditions. Furthermore, a 50-55 percent annual replacement of hens justifies their harvest.

Earlier dates should be considered for the fall hunting season because populations are less concentrated than in late fall. Thereby more occupied turkey range that is not posted would be accessible to hunters and a more efficient harvest could be attained.

The mortality of gobblers in spring should be investigated to determine causes and dates of occurrence. If this mortality begins prior to spring hunting season, an earlier season, held during the dispersal period, should be considered to insure that harvest replaces natural mortality as much as possible.

This study should serve as a basis for additional research. Of particular importance are data concerning limiting factors and carrying capacities on both winter and summer ranges, productivity responses to various harvest rates and changes in rainfall, and sustained yields possible in Western Oklahoma. Data are also needed on effects of various habitat practices on turkey populations on both private and public lands.

This study has provided the ecological framework on which answers to the above questions may be pursued.

ACKNOWLEDGEMENTS

I wish to acknowledge the many rangers and biologists who assisted with portions of this study. Particular appreciation is extended to rangers John Lowrey, Haskell Moseley and Byron Randall; biologists William McCaslan and Jack Miller, and George Wint who supervised the study. Thanks are also due Tom Himes, Jim Lewis, Gene Stout and typist Barbara Hurn for their assistance in preparation of this manuscript.

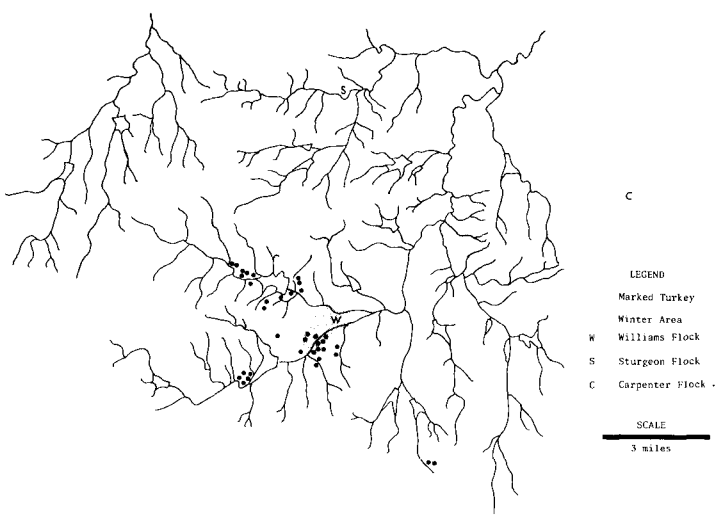

Figure 1. Spring movements of turkeys marked in Williams' flock, Sandstone Creek Watershed, 1967.

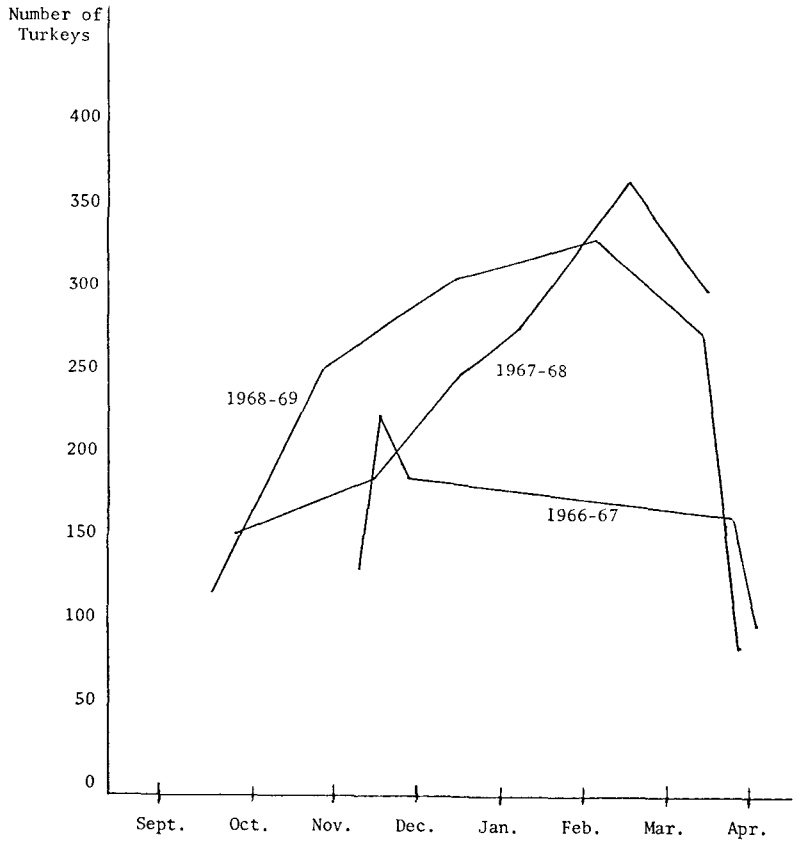

Figure 2. Chronology of turkey movements to winter area of Williams' flock Sandstone Creek Watershed, 1966-69.

Table 1. Peak winter populations, age and sex ratios of Williams' flock, Sandstone Creek Watershed, 1966-67, 1967-68 and 1968-69.

	Winters		
	1966-67	1967-68	1968-69
Peak Winter Populations	225	368	325
Hens/Gobblers	—	2.1/1.0	2.3/1.0
Juveniles/Adults			
Hens	—	1.0/1.0	1.2/1.0
Gobblers	—	2.0/1.0	2.0/1.0

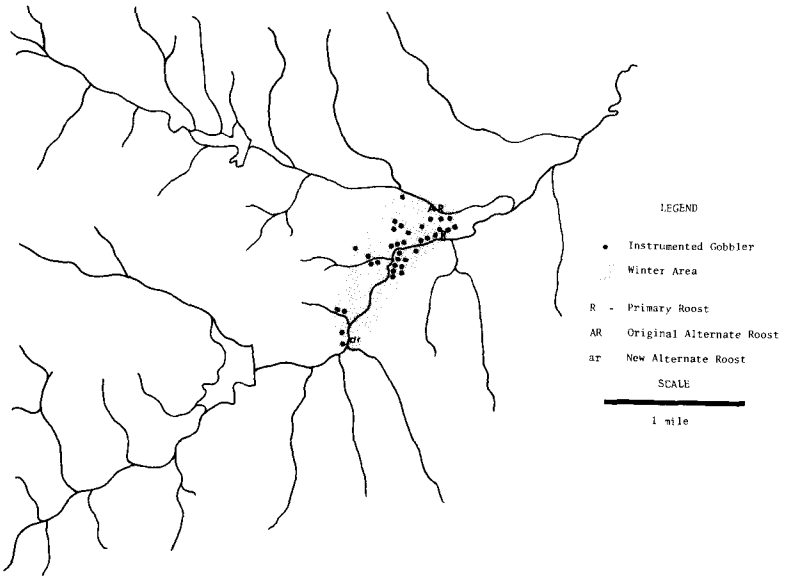

Figure 3. Movements of instrumented gobbler on winter area of Williams' flock, Sandstone Creek Watershed, January 25 - March 22, 1969.

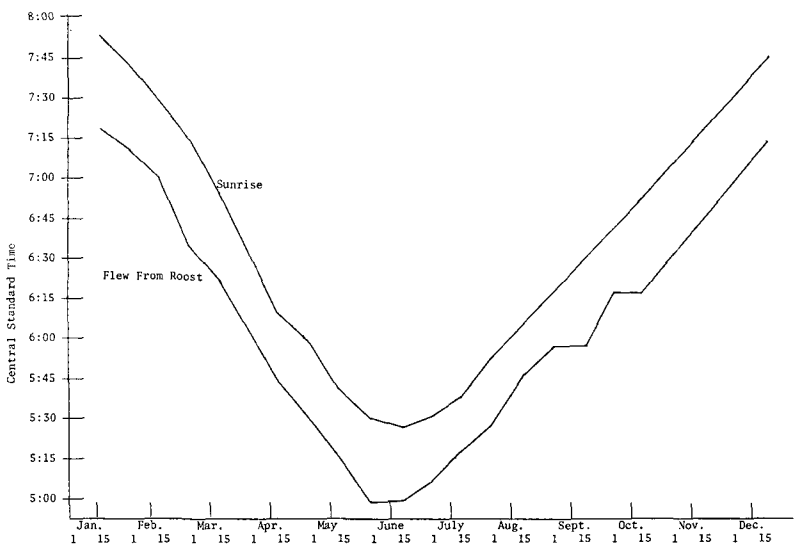

Figure 4. Approximate time Williams' flock flew from roost in relation to sunrise.

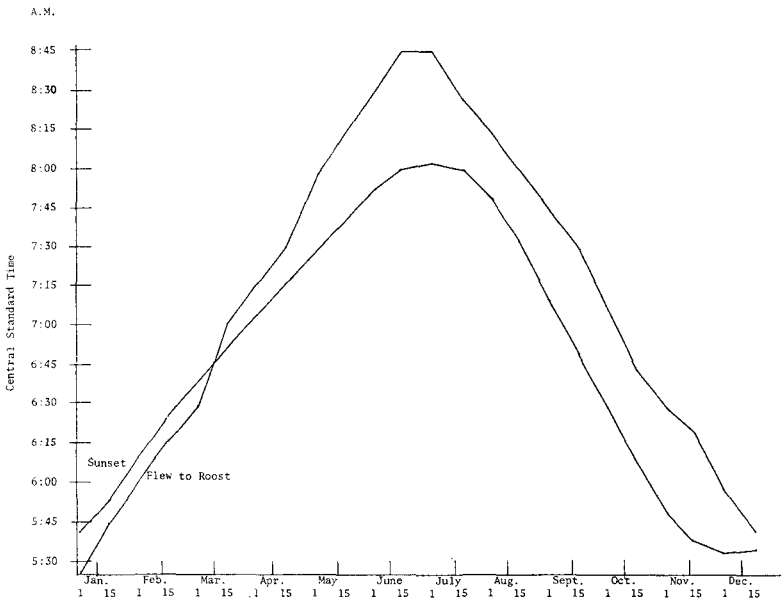

Figure 5. Approximate time Williams' flock flew to roosts in relation to time of sunset.

Figure 6. Spring movements of turkeys marked in Williams' flock, Sandstone Creek Watershed, 1968.

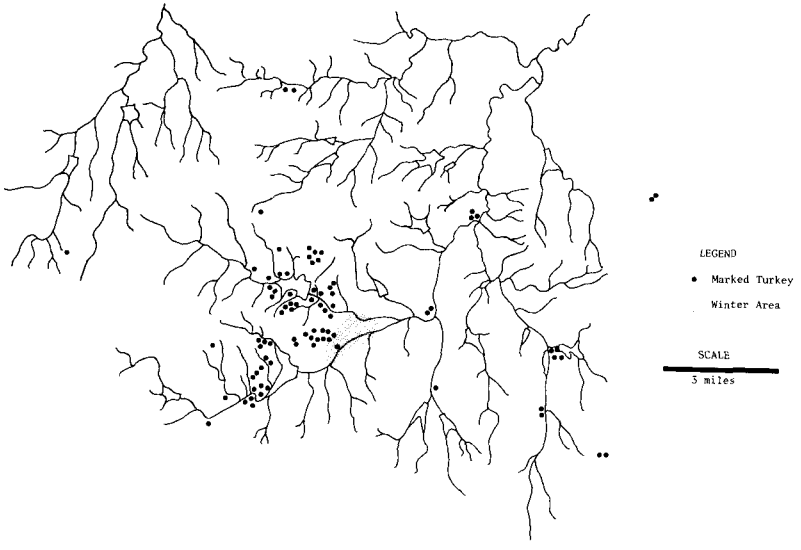

Figure 7. Spring movements of turkeys marked in Williams' flock, Sandstone Creek Watershed, 1969.

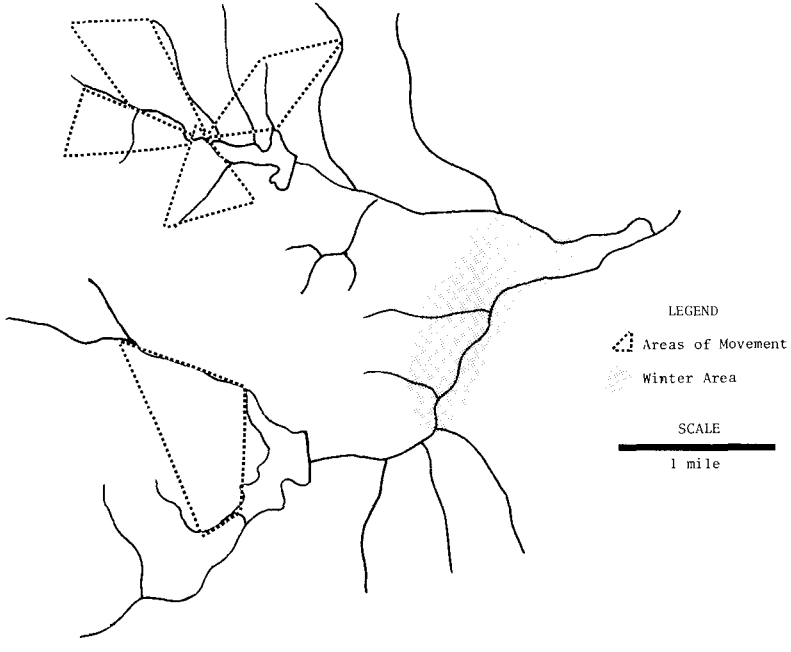

Figure 8. Spring ranges of five marked turkey flocks prior to onset of incubation, Sandstone Creek Watershed, 1969.

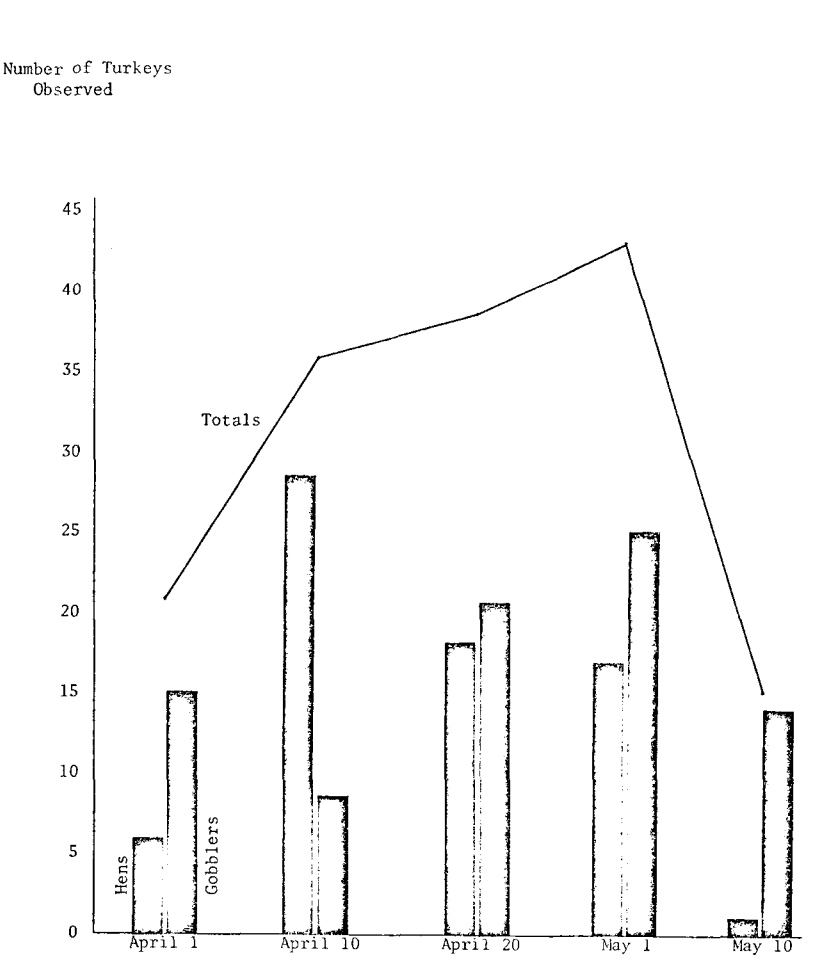

Figure 9. Hen/gobbler ratios observed on spring range of Sandstone flock, Sandstone Creek Watershed, 1969.

Table 2. Characteristics of Rio Grande turkey nest sites, Western Oklahoma, 1967-69.

Habitat Type	No. of Nests	Vegetation	Height of Vegetation	Soil Type
Alfalfa Bottoms	17	Alfalfa	16″ - 20″	Clay or clay loam
Ravine Banks	4	Johnsongrass (*Sorghum halepense*) or Big Bluestem clumps	24″ - 40″	Clay or clay loam
Brushy Hillsides	6	Clumps of vegetation such as weeds, tall grasses, sand plum (*Prunus angustifolia*), skunkbrush, sandsage or shinnery oak	24″ - 40″	Sand, sandy loam or clay
Dry Creek Bottoms	2	Shrub willow (*Salix nigra*) or sandsage	20″ - 48″	Sand
Austrian Winter Field Peas	1	Austrian Winter field peas (*Pisum sp.*)	16″ - 20″	

Table 3. Poults/hen ratios observed on summer range of the Williams' flock, Sandstone Creek Watershed, 1967-68.

	1967			1968		
	July	Aug.	Sept.	July	Aug.	Sept.
Number of flocks observed	6	8	5	5	6	6
Poults/hen	5.3/1.0	5.0/1.0	4.5/1.0	6.3/1.0	4.7/1.0	4.1/1.0
Average		4.9/1.0			5.0/1.0	

LITERATURE CITED

Bailey, R. W. and K. T. Rinell. 1968. History and management of the wild turkey in West Virginia. West Virginia Department of Natural Resources.

Barwick, L. H., D. H. Austin and L. E. Williams. 1970. Roosting of young turkey broods during summer in Florida. Proceedings of the Annual Conference of the Southeastern Game and Fish Commissioners. 24:231-243.

Barwick, L. H. and D. W. Speake. 1973. Seasonal movements and activities of wild turkey gobblers. Proceedings of the Second National Wild Turkey Symposium. Columbia, Missouri. 125-134.

Capel, Stephen W. 1967. Management and hunting of wild turkeys. Kansas Forestry, Fish and Game Commission. P-R Project. W-23-R. Job C-9-1.

1968. Management and hunting of wild turkeys. Kansas Forestry Fish and Game Commission. P-R Project. W-23-R. Job C-9-2.

Duck, L. G. and J. B. Fletcher. 1943. A survey of the game and furbearing animals of Oklahoma. Oklahoma Game and Fish Comm. Sta. Bull. No. 3. 144 pp.

Hammerick, W. J. and J. R. Davis. 1971. Summer food items of juvenile wild turkeys. Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners. 25:85-89.

Jonas, R. 1966. Merriam's turkeys in Southeastern Montana. Montana Fish and Game Department. Bull. 3. 36 pp.

Lewis, J. C. 1973. The world of the wild turkey. J. B. Lippincott Co. Philadelphia and New York. 158 pp.

McDowell, R. D. 1956. Productivity of the wild turkey in Virginia, Virginia Commission of Game and Inland Fisheries, Bull. 1.

Mosby, H. S. and C. O. Handley. 1943. The wild turkey in Virginia; its status, life history and management. Virginia Commission of Game and Inland Fisheries. 281 pp.

Powell, J. A. 1965. The Florida wild turkey. Florida Game and Fresh Water Fish Commission. Bull. 8. 28 pp.

Raybourne, J. W. 1968. Telemetry of turkey movements. Proceedings of the Annual Conference of the Southeastern Game and Fish Commissioners. 22:47-54.

Slagle, A. K. 1965. Designing systems for the field. Bio Science. Feb. 1965. 109-112 pp.

Thomas, C. H. 1955. Relationships of wild turkey social and spatial behavior to management. Oklahoma A. and M. College, Masters Thesis. 64 pp.

Thomas, J. W., C. Van Hoozer and R. G. Marburger. 1966. Wintering concentrations and seasonal shifts in range in the Rio Grande turkey. The Journal of Wildlife Management. 30(1):35-49 pp.

Underhill, L. D. and D. F. Littlefield, Jr. 1971. Wild turkeys in Oklahoma. The Chronicles of Oklahoma. Vol XLVIII (4):376-388.

United States Dept. Agr. 1963. Soil survey, Roger Mills County, Oklahoma. Ok. Agr. Exp. Sta. No. 29.

United States Dept. Commerce. 1967. Climatological Data. Environmental Data Service. Vol. 76(9).

. 1968. Climatological Data. Environmental Data Service. Vol. 77(9).

. 1969. Climatological Data. Environmental Data Service. Vol. 78(10).

Watts, C. R. 1968. Rio Grande turkeys in the mating season. Trans. N. A. Wildlife Conference. 33:205-210.

Watts, C. R. and A. W. Stokes. 1971. The social order of turkeys. Scientific American. 224(6):112-118.

Wheeler, R. J. 1948. The wild turkey in Alabama. Alabama Department of Conservation. 92 pp.

Williams, L. E., D. H. Austin, T. E. Peoples and R. W. Phillips. 1971. Laying data and nesting behavior of wild turkeys. Proceedings of the Annual Conference of the Southeastern Game and Fish Commissioners. 25:90-106.

and . 1973. Observations on movement, behavior, and development of turkey broods. Proceedings of the Second National Wild Turkey Symposium. Columbia, Missouri 77-99.