RELATIONSHIPS OF WILD TURKEY SOCIAL AND SPATIAL BEHAVIOR TO MANAGEMENT

By

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*Oklahoma Game and Fish Department, Oklahoma A. and M. College, U. S. Fish and Wildlife Service, and Wildlife Management Institute

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INTRODUCTION

The behavior of animals is of high ecologic significance because it is so largely reflective of an animal's response to its environment. An understanding of an animal's behavior as to sociality and use of space can be expected to provide information concerning the importance of sociality, use of space, dynamics of population, and the complex interrelations of these.

Because of the fact that the turkeys appear to live in discrete flocks and these upon discrete homesteads, certain implications are suggested by this combined behavior which are of considerable significance to the wildlifer. For example, so far as management practices are concerned, a working knowledge of this combined behavior can provide the wildlifer with a realistic basis for the censusing of local populations (inventory) and can supply him with reasonably reliable information concerning pattern of distribution and relative density. It further suggests what may or may not be done, with hope of success, concerning such management practices as stocking, hunting, and habitat management.

There has been some recognition of the significance of sociality for some time. Howard (1920) was an early student of this subject; so was Alverdes (1927). In the United States, Allee and his students have been leading contributors to our knowledge of sociality and its significance. Valuable contributions to the subject of social behavior have also been made by Shoemaker (1939), Lack (1943),

Altman (1952), and Tinbergen (1953).

From these studies it may be seen that sociality has received the attention of naturalists for some time. The significance and application of this behavior to wildlife management, however, is only beginning to be recognized.

More than a score of years ago Mills (1923) and Seton (1929) called attention, without concrete evidence, to the importance of space orientation to animals in their ways of life. For example, Mills called animals "landowners" and "residents of a locality", whereas Seton said, "No animal roams at random over the country; each has a home region---".

Today, increasing objective information is being offered in support of this principle. For example, Nice (1939) studied the territory of the song sparrow. Emlen (1939) studied seasonal movements of valley quail, and Murie (1944) investigated the wolves of Mt. McKinley. Schwartz (1945) and Murphy and Bassett (1952) investigated the spatial relationships of other animals.

Even though concrete data are being gathered, so far as known, very little has been done to integrate and interpret these behavioral traits so that their significance to the practice of wildlife conservation may be clearly brought out.

It has been known for some time that wild turkeys live in flocks (Mosby and Handley, 1943) and that turkeys have a tendency to live in certain areas (Dalke, et al., 1946). These studies, however, did not relate the significance of these traits to management.

This investigation of wild turkeys is concerned mainly with those features of the social and spatial behavior which may be of pertinence

to the wildlife manager in the approach to his job.

Field work on this investigation was begun in December 1953 and was concluded in January 1955. The investigation was centered at the Wichita Mountains Wildlife Refuge in Comanche County, Oklahoma. Some observations also were made in Roger Mills, Ellis, Harper, Cimmeron, Texas, and Beaver counties.

METHODS OF INVESTIGATION

Direct observation through stalking served as the basic approach to this investigation of wild turkey behavior in Oklahoma. Three flocks of Rio Grande wild turkey (Meleagris gallapavo intermedia) were selected for close and continued observation on the Wichita Mountains Wildlife Refuge, Oklahoma. For the sake of clarity, each of these flocks has been arbitrarily assigned a letter for identification (A, B, and C). These flocks were located far enough apart to be recognized as distinct units but yet not too distant to prohibit overlap of homesteads if this were to occur. Other wild turkeys on the refuge also were observed, but they were not followed so closely as the three flocks chosen as a basis for this study.

Techniques

Early in an investigation of this type it is necessary for the investigator to become familiar with the range upon which the turkeys live. It is helpful to know the location of roosting sites, watering sites, feeding areas, and the general lay of the land before actual stalking begins.

Most observations were made during the early morning and the late afternoon when the turkeys were at the height of their activities. Some observations, however, were made for all hours of the day. On several occasions it was possible to stalk a flock of turkeys for many

successive hours and still observe apparently unfrightened behavior. Observation was usually halted when it was plain that the turkeys were reacting to my stalking.

The manner of movement while on the trail was important to successful stalking. Slow, careful steps were taken before the birds were found, and movement was kept to a minimum after a flock was sighted. It was to my advantage to spot the birds before they saw me. This was not always possible, of course, in dealing with such a wily species.

It was often possible to observe the turkeys from an automobile. This was especially true during the spring and summer when the birds frequently fed in open situations. I found, as have others, that the turkeys were less frightened by an automobile than by a person on foot.

The following characteristics were used for sex and age identification in the field:

ADULT MALE	ADULT FEMALE
1. Back and breast feathers glistening black color	1. Back and breast feathers subdued and mottled color
2. Long legs, neck, and tail	2. Shorter legs, neck, and tail
3. Hair-like feathers absent on head and neck	3. Hair-like feathers on head and neck
4. Thick and long beards	4. Short, slender beards or none at all
5. Large body	5. Small body
6. Wattles large and distinct	6. Wattles small or absent

YEARLING MALE	YEARLING FEMALE
1. Extremely long legs	1. Short, slender legs
2. Usually short, stubby beard	2. Beard absent
3. Feathers absent on head and neck	3. Hair-like feathers on head and neck

If a beard were lacking in the adult, yearling hens were difficult to distinguish from adult hens, whereas the males were easily recognized as adult or yearling.

Field signs such as roosting sites, dusting forms, tracks, scattered droppings, and feathers were helpful in locating flocks. I always broke every feather found and erased all tracks seen, in order to avoid confusion and to determine whether the areas were in constant use.

The homestead of each flock was ascertained by plotting the location of each turkey observation on a map and by interpreting and plotting field sign observed. Terrain and vegetation types were helpful guides when drawing the homestead boundaries. Social behavior was investigated by noting all activities of the birds as they were observed during stalking.

Trapping and Marking

The three principal flocks, A, B, and C, were identified in the field by trapping and marking several birds in each. The size of the flock and the general location further identified them. Trapping resulted in the capture of four adults, one yearling, and five poults (Table I). These were individually identified, as indicated, with numbered and with colored leg bands.

The trap was constructed from five-inch mesh steel wire, which was strung around four trees located ten to twelve feet apart (Figure 1). A funnel type entrance was used, which was similar to the one Ligon (1946) described for his pole traps. Three of these traps were constructed in the homesteads under observation.

TABLE I

Wild Turkey Banding Record
Wichita Mountains Wildlife Refuge, Oklahoma - 1954

Metal Band No.	Color Combination	Age	Sex	Flock	Date
800101 Lf leg	Blue/yellow Rt leg	Ye	Male	A	3-5-54
800106 Lf leg	Red/red Rt leg	Ad	Male	B	8-26-54
800107 Lf leg	Red/yellow Rt leg	Ad	Male	B	8-26-54
800102 Lf leg	Yellow/blue/red Rt leg	Po	Male	B	8-27-54
800105 Lf leg	Yellow/blue Rt leg	Po	Female	B	8-27-54
800103 Lf leg	Yellow/green Rt leg	Po	Female	B	9-29-54
800104 Rt leg	Red/yellow/green Lf leg	Ad	Male	B	9-29-54
800109 Lf leg	Green/yellow Rt leg	Po	?	C	10-26-54
800108 Rt leg	Green/yellow/blue Lf leg	Ad	Female	C	11-19-54
800110 Rt leg	Green/red Lf leg	Po	?	C	11-19-54

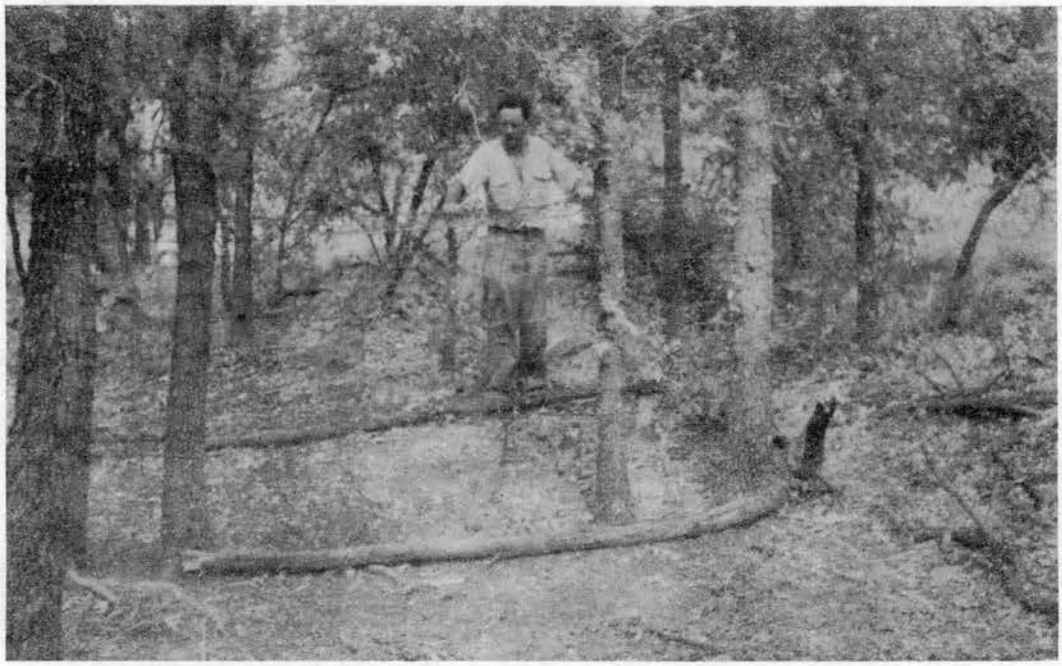

Figure 1. Wild Turkey Trap Used in this Investigation

Figure 2. General Character of the Vegetation of Wichita Mountains Wildlife Refuge, Oklahoma .

The traps were baited once a week when trapping was not in progress. This rate seemed desirable to avoid disrupting the normal travels of the birds but at the same time to keep them visiting the trap. The traps, when set, were checked twice a day, usually about 11:00 a.m. and again after sunset in the evening. Commercial chicken scratch feed was used as bait. This was distributed at each visit during trapping. No serious injuries to the birds were known to have occurred because of trapping.

The trapped birds were marked by using combinations of colored celluloid leg bands in addition to numbered aluminum bands. Each trap had a color designation, and the colored bands were applied to the leg opposite the one carrying an aluminum band. The colored leg bands were visible at a maximum of 75 to 100 yards with 6x30 binoculars and at distances up to 300 yards with a 20x scope. If, however, the birds were in tall grassy vegetation, the leg bands were sometimes difficult to observe. Two birds were known to have lost the colored bands. So far as is known, all aluminum bands remained intact.

Field Equipment

A camera, binoculars, note pad, and spotting scope were the most awkward equipment to carry while stalking. Smaller items consisted of a turkey call, pace counter, and wrist compass. My 6x30 binoculars were used for short range and hurried observations, while the 20x spotting scope, mounted on a tripod, was used for sustained, long-range observations. The camera used was a small 35mm Kodak with shoulder strap and case. Field notes were taken on a small note pad.

DESCRIPTION OF INVESTIGATIONAL AREA

The majority of the observations here reported were made on the 59,099-acre Wichita Mountains Wildlife Refuge, which is located near the northwest corner of Comanche County, Oklahoma. The excellent opportunity afforded here for direct observational investigation of the wild turkey is unexcelled in the state of Oklahoma. This added to the attractiveness of this area as the center of this investigation.

Physiography

The highest elevation on the Wichita Mountains Wildlife Refuge is reached at the summit of Mt. Scott, with the altitude of 2480 feet above sea level. In contrast, the lowest part of the refuge is found in the West Cache Creek bottom, where the altitude is 1300 feet above sea level. Many rocky hills are found on the area. These hills are of igneous rocks surrounded by sedimentary formations (Hoffman, 1930).

Climate

The Wichita Mountains Wildlife Refuge lies within an area which has been classified as a humid climate with moderate temperatures (Trewartha, 1954). This refuge has an average annual precipitation of 30.74 inches based on a 30-year period (United States Department of Agriculture, 1941). Seventy-six percent of this annual rainfall

comes during the growing season, which extends approximately from April 10 to October 30. The total rainfall for the period of study, December 1953 to January 1955, was 16.3 inches. It, however, was erratic in occurrence, and downpours were common throughout the year. Because of the terrain a high percentage of this water is lost to the slopes as run-off. It is again captured by the many lakes distributed over the refuge. These lakes are located in the principal drainage systems.

Average temperatures, compiled over a 20-year period, show January to be the coldest month with an average temperature of 38.3°F. and July to be the warmest month with an average of 81.3°F. Official records show the temperature to range from a high of 112°F. to a low of -16°F. (United States Department of Agriculture, 1941). High summer temperatures are common, as well as clear skies and dry, southerly winds. Winters, as a rule, are mild, but radical and sudden temperature changes accompanied by northern winds occur at times.

Vegetation

The Wichita Mountains have been considered a distinct biotic province in Oklahoma on the basis of its characteristic vegetation, which includes forested hillsides and ravines as well as prairies (Blair and Hubbell, 1938). Duck and Fletcher (1943) typed this area as an alternation of grasslands and woodlands. Rolling grass prairies, forested, rocky hills, forested ravines, and various combinations of these may be seen on the area (Figure 2). Abundant vegetation occurs in the ravines where soil accumulation is greatest.

Diehl (1953) reports post oak (Quercus stellata), blackjack oak

(Quercus marilandica), and juniper (Juniperous virginiana) as existing on nearly all mountain slopes as well as in the wooded ravines. He also mentions several other species of oaks as well as cottonwood (Populus deltoides), black willow (Salix nigra), and hickory (Carya spp.) as occurring in the wooded ravines only. The principal grasses on the refuge are the bluestems (Andropogan spp.), panic grass (Panicum spp.), and rye grass (Elymus spp.). Sideoats gramma (Bouteloua curtipendula), hairy gramma (B. hirsuta), and blue gramma (B. gracilis) are also found. These short grasses, however, do not form extensive stands (Eskew, 1937).

RESULTS OF THIS INVESTIGATION

Mating Behavior

Behavior of the Gobbler

The first indication of the 1954 mating season display for the wild turkey on the Wichita Mountains Wildlife Refuge was noted on February 7, at which time a gobbler was observed vigorously strutting. Some strutting, of a rather desultory character, was observed before this date; however, it was not recorded as active strutting. On the basis of 133 observations of male wild turkeys, the active and continued strutting reached a peak between March 7 and April 1 (Figure 3). By comparison, Dalke, et al. (1946), using the period of active gobbling as the criterion for determining the mating period, found that mating began during the latter part of March, reached its greatest intensity between April 15 and April 30, and tapered off by the end of May. It is apparent that on the Wichita Mountains Wildlife Refuge this activity is manifested earlier in the season.

The gobblers under observation during the 1954 mating season apparently preferred an open oak-wooded flat, bordered by prairie as a strutting site. These male turkeys also seemed to prefer a site with a scarcity of ground cover and one with no low-hanging tree branches. The strutting tom sometimes ventured into the open grasslands but was never seen at any considerable distance from the cover of the wooded areas.

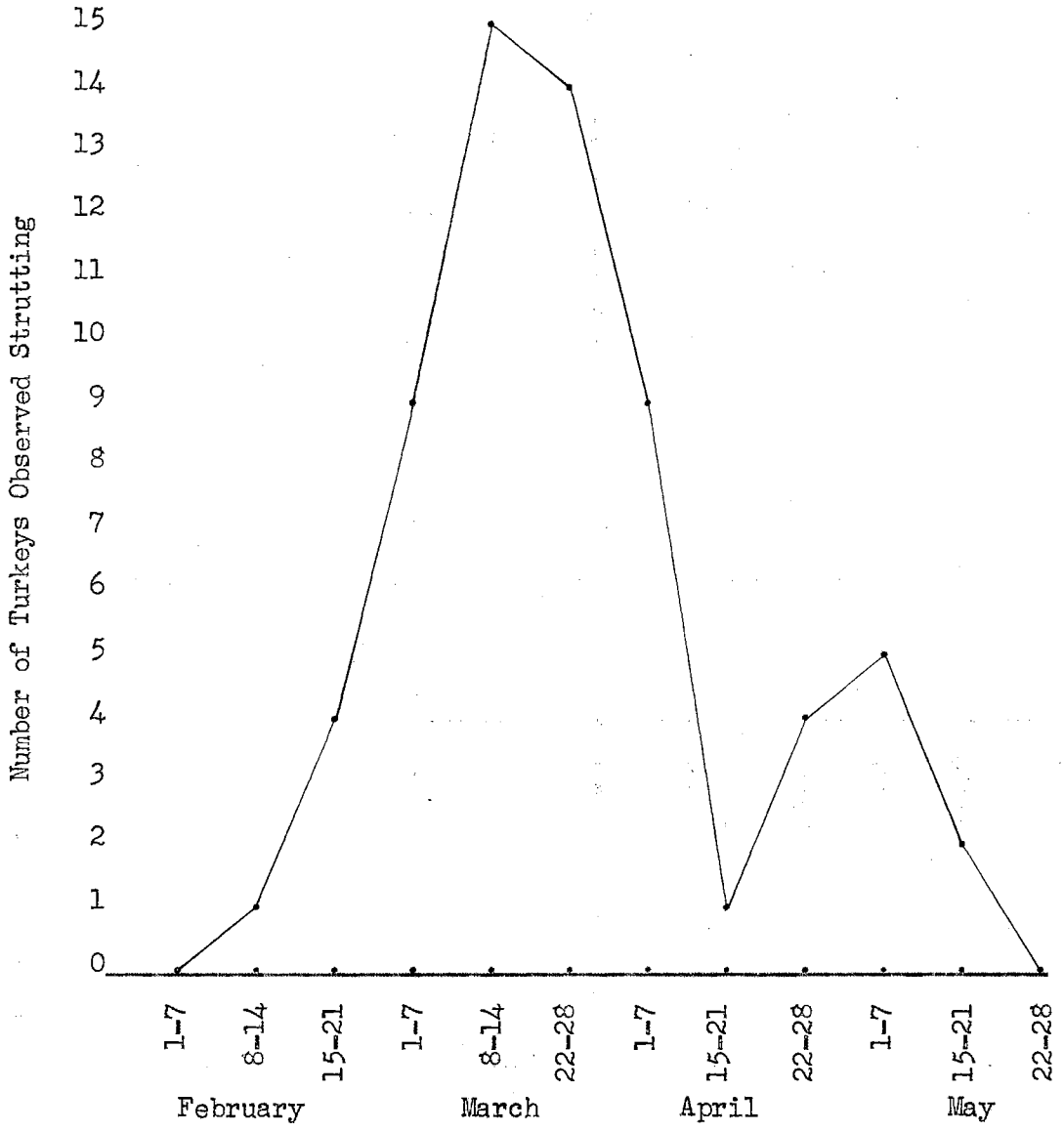

Figure 3. Wild Turkey Strutting Activity on Three Homesteads, Wichita Mountains Wildlife Refuge, Oklahoma - 1954

Mature gobblers seem to strut more vigorously in the presence of other turkeys. When alone, if not already strutting, they immediately began to do so at the sight of another turkey, whether male or female.

Gobbling was more intense in the early morning and late evening, yet it was occasionally heard throughout the day. For example, on April 3, 1954, at 6:05 a.m. three different toms were heard gobbling regularly about once a minute until approximately 8:00 a.m.. After that time only an occasional gobble was heard. On the day before, April 2, a male turkey was watched between 2:30 p.m. and 5:30 p.m.. He was strutting and he gobbled only occasionally. I left the immediate vicinity of this tom but remained within hearing distance of him. At 6:25 p.m. he began to gobble steadily, on an average of once a minute. This he continued until 6:45 p.m..

The main function of gobbling appeared to be that of announcing the male's presence and thus attracting the female. It seemed to attract other males as well. In view of the fact that males were heard gobbling in late evenings, gobbling could possibly induce the females to return after feeding to roost near the adult tom.

The strutting male turkey produces a vocal sound somewhat similar to the strumming of a single string of a base fiddle. Wheeler (1946) compares it to the "vibrant noise that accompanies the stroke of a hydralic ram." Yearling males were never heard to utter this peculiar sound as they attempted to display. Most yearling toms roam about widely during the mating season in contrast to the mature toms, who remain more or less in one small area during the day. This is illustrated in Table II, which gives the time interval of observation and

TABLE II

Occupation of Mating Territory by Adult Wild Turkey Gobblers on Wichita Mountains Wildlife Refuge, Oklahoma - 1954

DATE	HOMESTEAD	TIME OBSERVED	APPROXIMATE AREA COVERED IN SQ. YDS.
3-7-54	A	7:00-10:15 am	900
4-2-54	B	2:30-5:30 pm	62,500*
4-3-54	B	6:15-9:00 am	2,500
4-3-54	B	10:00 am-1:30 pm	625
4-3-54	C	2:00-4:05 pm	10,000
4-4-54	A	6:20-11:00 am	22,500
4-16-54	B	3:30-5:40 pm	2,500
TOTAL SQ. YDS.			101,025
AVERAGE SQ. YDS.			14,503

*An attempt was made to force this gobbler out of the area.

the area covered by adult gobblers during the mating season.

The area of the territory seems to depend a great deal on the terrain and vegetation. The territorial areas occupied by gobblers during the mating season of 1954 is shown in Table II. The observation entered for April 2, 1954 was of one adult tom. After this tom was found on his strutting site, he was pressed only closely enough to make him walk rapidly but not to take to the air. This turkey circled the original location but remained in an approximate radius of 200 to 250 yards, which suggests a marked orientational attraction to its territorial site.

Territoriality

A territory has been defined by many authors. Nice (1939) defines it as any defended area. Dice (1952) sums up several viewpoints and defines a territory as a home range or part of a home range that is defended against trespass by other members of the same species.

Territories have been classified into several basic types (Nice, 1939): (a) mating, nesting, and feeding ground for the young, (b) mating and nesting, (c) mating, (d) narrow surroundings of the nest, (e) winter territories, and (f) roosting territories. The wild turkey gobbler appears to establish only a mating territory. The precise location of this territory, however, does not seem to be permanently established for the season, and it may change slightly from day to day.

Strutting and gobbling as well as actual combat appeared to be the means by which the adult gobbler defended a piece of ground and thereby established a territory. Table III shows the observations made

on the Wichita Mountains Wildlife Refuge of the mating territory defense by one or two gobblers during March and April 1954. The strutting tom normally defended his territory by advancing toward the intruder, all the while displaying vigorously. If this intensive bluff did not effect the retreat of the trespasser, it was not infrequent to see the defending gobbler lower his head and charge the other tom. In all cases of defense by a male turkey on the refuge, a series of these charges with several pecks being exchanged was the extent of the battles. Defense thus appeared to be accomplished more by threat than by destructive combat.

TABLE III

Defense of Mating Territory by Wild Turkey Gobblers on the Wichita Mountains Wildlife Refuge - 1954

DATE	HOMESTEAD	MALES DEFENDING	MALES INTRUDING	NATURE OF DEFENSE COMBAT	BLUFF
3-7-54	A	1	6	X	X
3-21-54	B	1	4		X
4-2-54	B	1	1		X
4-3-54	B	2	4	X	X
4-3-54	C	1	1		X
4-16-54	B	1	2	X	X
4-30-54	A	1	2	X	X

These observations suggest that a gobbler defends a mating territory. An observation on April 3, 1954, however, suggests the tom will

change territorial locations abruptly. In this instance two adult males followed a single hen for approximately 500 yards and defended another small plot of ground.

The wild turkey gobbler normally moved to attack a turkey intruder of his territory when the trespasser was 100 or 150 yards away. This is assumed to be the turkey's "critical distance" as discussed by Hediger (1950). Thus, the mating territory would be approximately four acres in size. As already mentioned, however, he may change location and move as far as 500 yards and leave the previously used site undefended. Dalke, et al. (1946) report that "the average gobbling territory embraces an area from 100 to 300 acres with exceptions occurring in both directions." It seems doubtful that on the Wichita area one turkey gobbler could defend 100 acres of ground because of the difficulty of seeing other turkeys at that distance. This variance in territory size could be due to interpretation rather than error.

Territoriality has several important functions. Dice (1952) points out that in some animals it "may be assumed to promote conservation of food,..." and other essentials for the successful rearing of the young. He also relates that it helps to "maintain stability in the community, restricts the population density, and consequently preserves the carrying capacity of the ecosystem."

The information gathered during this investigation concerning the wild turkey's mating territory suggests that the establishment of the territory and consequently its defense apparently reduced the amount of fighting during the mating season. With a reduction of fighting and competition for the females' attention, an orderly mating season resulted as compared with a situation where attempts at mating might be

interrupted frequently by contesting males.

Turkeys have been found to establish gobbling territories as far as two miles from the nearest winter flock range (Dalke, et al., 1946). Although no exact distances were determined during this investigation, one male turkey was seen strutting in a location approximately one mile from any known winter homestead area. This suggests that the winter homestead may be at times only a part of a larger annual homestead.

Behavior of the Female

The harems observed with the gobblers averaged 5.08 individuals (Table IV). Slightly more than 50% of the females in harems were accompanied by single gobblers, approximately 26% by a pair of gobblers, and the remaining 24% by a group of more than two gobblers.

During the mating season the females reacted to the gobbler's antics as though nonchalant. When in the presence of a displaying male, the hen usually appeared engrossed in feeding, only occasionally looking up at the male. Although hens usually go to the male on his territory, a gobbler was observed on one occasion to follow a hen for a short distance outside his presumed territory. The females associated with the gobbler only for brief periods during the day after the breeding season was underway. The two sexes were never seen to roost together at night during this period.

TABLE IV

Wild Turkey Harems on the
Wichita Mountains Wildlife Refuge, Oklahoma - 1954

FLOCK	DATE	HAREM SIZE	MALES ATTENDING
A	3-6-54	7	6
A	3-7-54	3	1
A	3-14-54	5	2
A	3-21-54	7	1
A	3-27-54	7	4
A	4-3-54	7	2
B	3-6-54	14	1
B	4-3-54	1	2
B	4-3-54	4	1
B	4-15-54	2	2
B	4-16-54	1	1
C	3-14-54	3	1
TOTAL		61	24
AVERAGE		5.08	2.00

Hen and Brood Behavior

Nesting Success and Survival of Young

During June, July, August, and September 1954 a total of nineteen different broods were observed and carefully counted on the Wichita Mountains Wildlife Refuge (Table V). The average size of these broods at the time of the first observation was 4.94 poults. This average is lower than the average of 9.6 poults which Dalke et al. (1946) reported for the eastern turkey in Missouri. Taylor's (1951) estimate of an average of 8.9 poults for the Rio Grande turkey in Texas also is higher than my Oklahoma data.

Nine individual turkey broods were closely observed during June, July, and August to obtain a measure of attrition during the summer months (Table VI). Summer attrition for the 41 poults observed amounted to only 17%. Although it is not known how many hens lost their entire broods or how many failed to hatch a brood at all, twelve hens were observed without poults, Table VII, as compared to nineteen which had poults (Table VI). From these counts it is estimated that 61% of the 31 hens observed did successfully hatch and raise young on the Wichita Refuge during this season.

Family Relationships

The young birds, for the most part, kept in constant contact with their mother by staying close to her side. Only occasionally did one become separated from its mother. If this did happen, the frightened poult immediately began to "peep-peep". Its mother answered with a

TABLE V

Brood Size among Wild Turkey on the
Wichita Mountains Wildlife Refuge, Oklahoma - 1954

DATE	BROOD NUMBER	SIZE OF BROOD	APPROXIMATE AGE OF POULTS
6-22-54	1	4	1-2 weeks
6-23-54	2	6	3-4 weeks
6-23-54	3	3	3-4 weeks
6-24-54	4	5	2-3 weeks
6-24-54	5	4	2-3 weeks
6-25-54	6	3	3-4 weeks
6-25-54	7	2	3-4 weeks
6-30-54	8	7	3-4 weeks
6-30-54	9	4	5-6 weeks
7-2-54	12	3	5-6 weeks
7-2-54	13	5	3-4 weeks
8-27-54	14	3	4-6 weeks
9-5-54	15	7	No Estimate Made
9-5-54	16	5	"
9-27-54	17	7	"
9-27-54	18	7	"
9-27-54	19	7	"
9-27-54	20	4	"
9-28-54	21	8	"
AVERAGE		4.94	

TABLE VI

Attrition among Wild Turkey Poults on the Wichita Mountains Wildlife Refuge, Oklahoma During June, July, August, and September 1954

BROOD NUMBER	FIRST OBSERVATION	SIZE	LATEST OBSERVATION	SIZE	ATTRITION	HOMESTEAD
1	6-22-54	4	9-29-54	2	2	C
2	6-23-54	6	9-29-54	5	1	C
3	6-23-54	3	9-26-54	3	0	C
4	6-24-54	5	8-18-54	5	0	A
5	6-24-54	4	8-18-54	3	1	A
8	6-30-54	7	9-28-54	6	1	B
9	6-30-54	4	9-28-54	4	0	B
12	7-2-54	3	8-5-54	3	0	Extra
13	7-2-54	5	8-5-54	3	2	Extra
TOTALS		41		34	7	
PERCENT ATTRITION					17%	

TABLE VII

Broodless Hens Observed on Wichita Mountains Wildlife Refuge During Mating Season - 1954

DATE	NUMBER OF HENS	ACCOMPANIED BY
6-29-54	2	2 Males
7-21-54	1	2 Hens - 11 Poults
8-4-54	1	1 Hen - 2 Poults
8-5-54	1	1 Male
8-18-54	3	7 Males
8-19-54	1	2 Hens - 8 Poults
9-29-54	1	1 Male
9-30-54	2	Unknown
TOTAL	12	

soft "purt-purt", which led her strayed young one back to the family group.

The behavior described above was only one of the several ways which the mother employed to protect and keep her brood together. It seemed that while the poults were very young and while they still possessed their brownish plumage, the hen fed in vegetation that afforded natural protection. Most feeding was done in tall grass, and thus the poults were very difficult to see.

Later, as the poults became older and acquired the ability to fly, their main protective behaviorism changed from one of hiding to one of active escape. On June 30, 1954 I disturbed two hens and eleven poults while they were "loafing" at the edge of a post-oak ravine. The hen gave a sharp "purt-purt" as I approached, followed by a leisurely retirement. Her poults, however, flushed similar to bobwhite quail and lit in the surrounding trees. These poults were estimated to be between four and six weeks old. A mother appeared to be the bodyguard or sentinel for these broods, since she gave the alarm signal.

On two occasions observations were made which suggested that the turkey mother is concerned about her young. The first occasion was July 1, 1954, when a striped skunk approached a hen and her brood. The hen indicated awareness of the skunk's presence when it was 75 to 100 feet distant. She immediately gave a sharp "purt-purt" - "purt-purt" and advanced toward the skunk with outstretched neck and flapping wings. She made several of these short, threatening approaches until the intruder changed its route and disappeared into thick underbrush.

On the second occasion, August 27, 1954, two poults, who belonged to a flock of three females and ten poults, were trapped. At

the time when the two captured birds were being removed from the trap, the remainder of the flock returned to the vicinity of the trap site, called frequently, and darted back and forth as if doing everything in their power to attract my attention. The old hens in the group came to within 25 yards of the trap at one time as if to aid the poults.

Of the nineteen hens observed with broods, sixteen were accompanied by another hen with poults. The other three were alone with their broods. Two of these three, however, were known later to join a small flock. As Table VII points out, a hen without young was occasionally observed with a mother and her poults. Not once was a hen without poults ever seen alone following the termination of the nesting season in early August. She was with other hens without broods, with gobblers, or with brooding hens.

This banding together of hens apparently was the beginning of winter flock formation. It could also serve as a mutual protection for the young and provide companionship for all concerned. Furthermore, if one mother hen met with fatal disaster, there is the possibility that the other mother might rear the young. At least it appears possible that the motherless poults might thus have a foster mother and could take advantage of the care and protection she afforded her own. Behavior of this kind has been observed among some other species, for example, among wolves (Murie, 1944).

It was readily apparent that the poults were capable of distinguishing their mother from other hens in the flock. While feeding, each hen's poults followed her closely. The mother also appeared to recognize her young both by sight and voice. This was demonstrated on July 20, 1954, when three poults became separated from a flock of two

females and six poults. Each hen possessed three poults. The lost poults could be heard peeping 50 to 75 yards away. One hen left the flock and proceeded to the vicinity of the lost poults. In a short time she rejoined the flock with the poults following closely behind her.

Bent (1932) cites Audubon (1840) as saying the female broods her young at night by spreading her wings over them both before tree-roosting begins and for a time afterwards. This habit was not observed during this investigation. On July 20, 1954, however, two hens and eight poults were observed as they went to roost. One hen possessed five poults, and the other had three. The poults of each brood finally settled down on the same limb as their respective mothers. The hens selected the roosting site, and the poults followed them into the tree.

It did not appear from observations that the hens with broods restricted themselves to a certain type of terrain. They were seen on the prairie flats, rocky hillsides, wooded ravines, and grassy meadows bordering the larger lakes. As already mentioned, however, most feeding was done in tall grass.

The hens with poults seemed to avoid the gobblers. When, however, a hen with poults did chance to meet a gobbler, the gobbler was never seen to molest the young or to show any interest in them whatsoever. His interest seemed to be directed to the hen, for attempts were made at strutting and gobbling, but seemingly in a half-hearted manner. After a brief association the hen and poults retired in one direction and the gobbler in another.

Winter Flock Formation

The three wild turkey flocks, A, B, and C, which were under close observation during this project were observed during the late winter flock "break-up" period (1953-1954), the mating and nesting season, the brooding period, and finally during the re-formation of the winter flocks (1954-1955).

Flock A was formed by two hens with nine poults, which apparently united soon after the poults hatched. This group numbered a total of eleven individuals (Table VIII) with one hen possessing six poults and the other hen three poults. These hens were observed cruising together on June 24, 1954, when their poults were estimated to be two to three weeks old. Later, by October 27, this group was joined by three brood-less hens. Flock A now numbered a total of thirteen individuals, since one of the poults had been lost. The latest observation of this flock, January 26, 1955, revealed that the total number had now been reduced to eleven individuals. At this stage in the life of the poults it is very difficult to distinguish between an adult hen and yearling hen. The most reliable count, however, as shown in Table VIII, revealed three adult hens and eight poults. Apparently two hens had left the flock.

The first observation of grouping in flock B was made on June 30, when two hens and eleven poults were seen (Table IX). One of these two hens had seven poults, and the other had four. By July 22 a brood-less hen had joined the flock and thereby brought the total to fourteen birds. A count made on August 8 revealed that one poult was missing

TABLE VIII

Formation of Winter Wild Turkey Flock A
on Wichita Mountains Wildlife Refuge, Oklahoma - 1954-55

DATE	NO. OF HENS	NO. OF POULTS	TOTAL NO.
6-24-54	2	9	11
8-18-54	2	8	10
10-27-54	5	8	13
12-19-54	4	6	10*
1-26-55	3	8	11

TABLE IX

Formation of Winter Wild Turkey Flock B
on Wichita Mountains Wildlife Refuge, Oklahoma - 1954-55

DATE	NO. OF HENS	NO. OF POULTS	TOTAL NO.
6-30-54	2	11	13
7-21-54	3	11	14
8-19-54	3	10	13
12-19-54	3	10	13
1-25-55	3	10	13

*Count made on roost after dusk

from this group. At the last winter observation January 25, 1955 the flock still contained three hens and ten poults for a total of thirteen individual turkeys.

Flock C had begun its formation by June 23, when two hens were observed with broods of six and three poults each (Table X). A brood-less hen had apparently joined this flock by this time and thus made a total of twelve turkeys. One poult was lost from this group between June 23 and July 21. By August 29, one additional hen and two poults had joined flock C and thus brought the total to fourteen individuals at this time. Another hen and her three poults added themselves to flock C at some time after August 29. By September 10 there was a total of eighteen turkeys in this group. The last count on December 19, 1954 gave a total of seventeen birds, for apparently one poult had been lost.

TABLE X

Formation of Winter Wild Turkey Flock C
on Wichita Mountains Wildlife Refuge, Oklahoma - 1954

DATE	HENS	POULTS	TOTAL
6-23-54	3	9	12
7-21-54	3	8	11
8-29-54	4	10	14
9-10-54	5	13	18
12-19-54	5	12	17

During the winter months, when a flock of hens with their young of the year were found, usually a smaller flock of adult gobblers was also in the vicinity. These gobblers, as a rule, remained to themselves but on occasions were seen feeding with the flocks of hens and their young. In Table XI is indicated the number of adult males associated with each brood flock on each of the three homesteads under study. The males on each of the homesteads were associated as a single flock.

TABLE XI

Adult Male Turkey Flocks Associated with Winter Flocks of Hens and Broods on the Wichita Mountains Wildlife Refuge, Okla. - 1954

FLOCK IDENTIFICATION	NO. OF ADULT MALES	NO. OF HENS AND POULTS	TOTAL TURKEYS ON WINTER HOMESTEAD
A	7	11	18
B	9	13	22
C	8	17	25

Winter flocks of wild turkeys on the Wichita Mountains Wildlife Refuge appear to live in two major groupings. One group is comprised of the hens together with the young of the year. The other group consists of adult toms. This organization into groups of females together with the young of the year on the one hand and groups of adult males on the other is similar to what Darling (1937) found in the herds of Scottish red deer.

Formation of flocks A and B was evidently begun when two hens with

their broods joined, and flock C was begun by the banding together of three hens. At least one broodless hen joined each flock with the earliest union being before June 23 and the latest before October 27. Flock A had no additions after October 27, flock B had none after July 22, and flock C none after September 10. Therefore, the three flocks which were observed intact during December and January had all been formed as early as October 27.

The wild turkeys on the Wichita Refuge appear to live in discrete flocks and these on discrete homesteads. Since they do apparently live in this manner, it is suggested that all the individuals of a flock may also be blood relatives. This receives some support from the fact that the winter flocks began to form shortly after the hens left the nest with young, suggesting that the adult females of a single winter flock nested close together. Furthermore, the close nesting, the discreteness of homesteads, and the possible kinship suggest that all the adult individuals forming a winter flock had been associated in a flock the year before. If these assumptions are valid, a flock of wild turkeys could easily be a closed society similar to those found among some other species. King (1954) reports that groups of litter-mate domestic dogs rejected strange dogs which were subjected to the groups. Strangers of the same sex and breed as the group were rejected more often than strangers of unlike sex and breed. Guhl (1953) points out that when strange birds were introduced into an established flock of domestic chickens, the established birds attacked the newcomers and chased them to a far side of the pen. Strange wolves, at least at some times, appear to be refused admittance to an established pack (Murie, 1944).

Winter Flock Homesteads

The winter homestead as used here is the area on which numbers of wild turkeys reside and make their living during the period following nesting up to the time when the flock breaks up again for mating purposes.

The total number of turkeys residing on each homestead is variable (Table XII). Not only were they variable from one homestead to another but also from year to year.

TABLE XII

Comparison of Wild Turkey Populations on Winter Homesteads
During 1953-1954 and 1954-1955
on the Wichita Mountains Wildlife Refuge, Oklahoma

FLOCK	ADULTS 1953-54	ADULTS 1954-55	JUVENILES 1953-54	JUVENILES 1954-55	TOTAL 1953-54	TOTAL 1954-55
A	?	10	?	8	22	18
B	?	12	?	10	29	22
C	?	13	?	12	15	25
TOTALS	?	35	?	30	66	65
AVERAGES		11.66		10	22	21.6

The total population of flocks A and B decreased, whereas the total population of flock C increased from 1953-54 to 1954-55. The total combined population of the three homesteads was decreased by one bird or by 1.8% from the first season to the second. During the winter of 1953-54 there was a total of sixty-six turkeys on the three homesteads. Yet during the winter of 1954-55 there were only thirty-five adult turkeys present on the three homesteads. With this decrease it is suggested that a large number of the 1953-54 occupants left their homesteads or that mortality was extremely high during the year.

Flock A of the refuge turkeys contained eleven yearling males and four mature gobblers at the beginning of the mating season. By midsummer only three of these yearlings and the four adult gobblers were present. This suggests that a spring dispersal of young toms may have taken place or that mortality was extremely high among this age group. A dispersal of the very young is not uncommon in the animal world. Young beavers are forced to leave the home flowage when they approach two years of age (Bradt, 1938). "Young beavers tagged and released at the home flowage and caught when adults averaged six miles of travel" and "almost all adults tagged were retaken at the same flowage" (Hodgdon and Hunt, 1953). A dispersal of young coyotes is believed to occur in the fall of the year of their birth (Stebler, 1951). A dispersal of wild turkeys in the spring would have the effect of allowing for population density to be brought about on the homestead by the unborn poults. It would also be the time when uninhabited but potential homesteads might become established naturally with turkeys.

Flock homesteads, on the contrary, seem to have remained relatively stable as to location for a number of years on this refuge

area. The crossed symbols in Figure 4 depict flock locations as determined in 1939 by F. B. McMurry, former Wichita Mountains Wildlife Refuge wildlife biologist. Most of these areas, fifteen years later, are still in use as shown by the circular symbols in the same figure.

The winter homesteads as determined during this project are depicted in Figure 5. The area in acres of each homestead included in this investigation is given in Table XIII together with the number of turkeys in residence at the close of the field work, January 1955.

TABLE XIII

Resident Population and Area of Each Homestead of Three Flocks of Wild Turkeys on the Wichita Mountains Wildlife Refuge 1954-55

FLOCK	NUMBER OF TURKEYS IN EACH FLOCK	ACRES WITHIN HOMESTEAD
A	18	1049
B	22	1514
C	25	1071
TOTALS	65	3634
AVERAGES	21.6	1211

The average area of these homesteads was 1211 acres with a resident population numbering an average of 21.6 turkeys. The winter flock together with its home range provides a basis for a realistic approach to the problem of estimating population density among wild turkeys.

The homesteads were distinct from each other. No turkey flocks

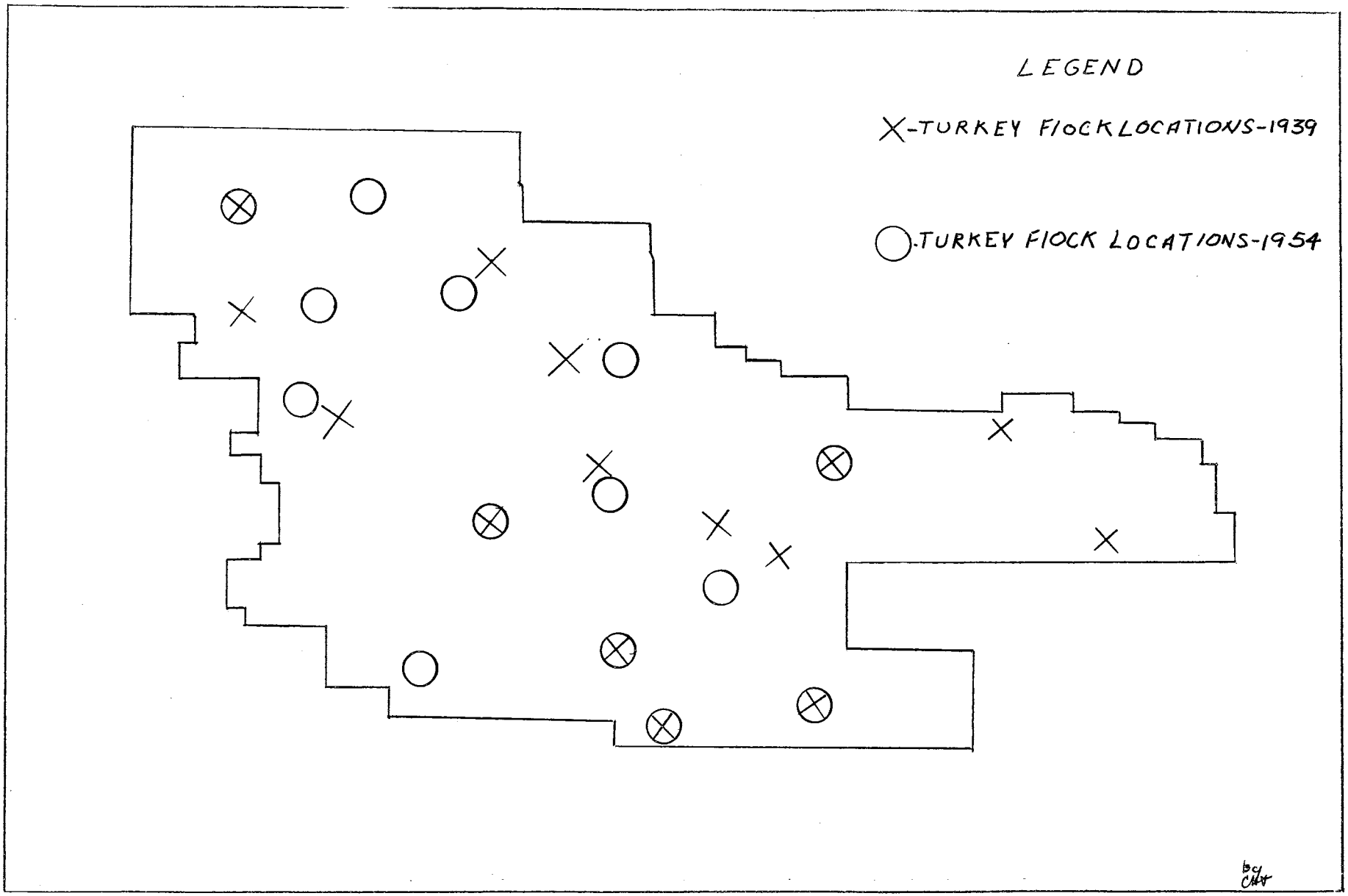

Figure 4. Comparison of Wild Turkey Flock Location on Wichita Mountains Wildlife Refuge, Oklahoma - 1939 and 1954

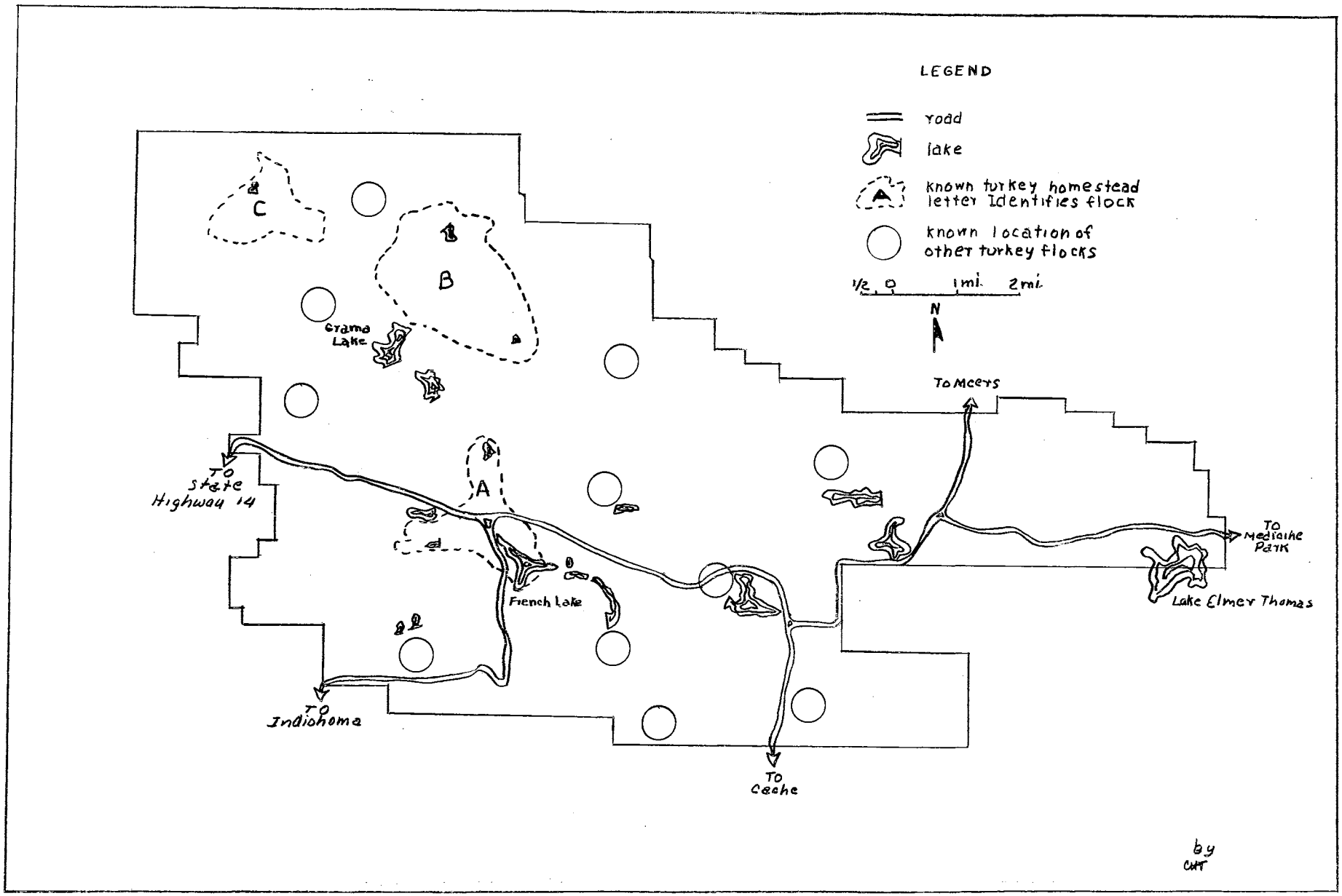

Figure 5. Homesteads of Wild Turkey Flocks A, B, and C on Wichita Mountains Wildlife Refuge, Oklahoma - 1954

other than those associated with the marked individuals were ever observed upon their respective areas. Dalke et al. (1946) report that in areas of high turkey populations there is a "tendency for individual flocks to group together in droves". They go on to say, however, that this grouping was only temporary.

The size of the winter flock appeared to influence neither its daily movements nor the size of the homestead. During the winter of 1954-55 flock A, which comprised eighteen individuals, cruised over approximately 1049 acres. Flock B comprised twenty-two turkeys and cruised over 1514 acres. Flock C, with twenty-five individuals, cruised over 1071 acres (Table XIII). Thus, flock C with the largest number of turkeys cruised over approximately the same number of acres as flock A, which had the smallest number of individual members. According to this information, there is no direct proportion between flock size on the one hand and homestead area on the other. Since no strange turkeys were noted on the homesteads of the three flocks, forming the basis for this study, it is suggested that each flock has its own discrete homestead. Here all the requirements for life presumably are found.

Daily Movements and Behavior of the Winter Flock

The observations summarized in Table XIV were made of flocks A, B, and C during the winter and early spring. Only the observations of 55 minutes duration or more are included.

The birds traveled at an average rate of 196 yards per hour including the time spent loafing. Assuming the average winter day has about eleven hours of sunlight, sunrise to sunset, the turkeys would travel an average distance of 2156 yards during a day's activities. The flocks normally fed in one location for an hour or so before moving on, at a rapid rate, to a new location several hundred yards away. Occasionally a flock was noted to feed over areas already covered earlier in the day.

On three occasions flock B was noted to cruise approximately the same route while feeding. It was noticeable also that in all three homesteads certain areas were used more frequently than others. This was determined by the concentration of sign and by direct observations in these areas. Flock A was the only one which appeared to have a favored roosting site during the winter months. Several widely scattered roosts were used in the other two homesteads. Watering places were visited in the early morning and late evening.

The turkeys observed during the winter months fed primarily at the edges of wooded areas. Occasionally, however, they were found deep in the woods. The usual procedure was to feed around the edges, cross through the woods still feeding, and emerge on the other side, where they again fed along the edge.

TABLE XIV

Daily Movements of Winter Wild Turkey Flocks
on the Wichita Mountains Wildlife Refuge, Oklahoma

DATE	FLOCK	TIME OBSERVED FROM	TO	TOTAL TIME	DISTANCE TRAVELED	AV YDS PER HR
1954						
1-23	B	(tracked birds in snow)			2795 yds	?
2-13	B	8:05 am	3:20 pm	7' 15"	1620 yds	222
3-6	A	10:00 am	1:45 pm	3' 45"	400 yds	102
3-7	A	6:00 am	10:15 am	3' 15"	250 yds	59
10-26	C	6:45 am	10:20 am	3' 35"	300 yds	84
11-20	C	6:45 am	8:45 am	2' 00"	100 yds	48
12-19	C	4:10 pm	5:05 pm	0' 55"	200 yds	216
1955						
1-13	A	2:10 pm	5:55 pm	3' 45"	650 yds	164
1-14	B	7:40 am	3:30 pm	7' 50"	2655 yds	336
1-15	A	8:00 am	10:00 am	2' 00"	200 yds	100
1-25	B	9:25 am	5:00 pm	7' 35"	1850 yds	240
TOTALS				41' 55"	8225 yds	
AVERAGE						196

Cooperation and a systematic organization were demonstrated among these winter flocks of wild turkeys as they fed during the day. While feeding, the adult hens of a flock appeared to be more on the alert than the others. Furthermore, the flock as a whole apparently did not indicate an awareness of danger until an alarm was given, usually by an adult hen, in the form of sharp, quick "yelps" or "purts". If this alarm proved unjustified, there was at least one bird that remained on the alert for several minutes after the rest of the flock had resumed its feeding. A similar sentinel system is reported for herds of elk by Altman (1952).

Cooperation and systematic organization also were exhibited by wild turkeys during the mid-day rest period. The resting site usually was in a wooded area with good overhead cover and scant ground cover. The birds scratched away the leaves to prepare individual shallow depressions in the ground. On one occasion, February 13, 1954, the entire flock, except one female, thus bedded down. This hen assumed a stance to one side of the resting flock. Here she remained motionless for fifty minutes, except for turning her head about in a casual manner. When I disturbed the quiet, the hen delivered several rapid "yelps" which aroused the flock. After several minutes of searching and calling, the flock had moved about 20 yards, where the process of preparing a bed site was repeated. Once again, the hen assumed her stance as an apparent sentinel. This time she remained still for one hour and fifteen minutes, at which time the flock arose one by one to begin leisurely feeding.

Further examples of social cooperation among the members of a turkey flock have been described by Ligon (1946). In one instance

he reports that groups of gobblers bluffed threatening predators by making "exuberant noises" and "daring exhibitions". These actions seemed to have the effect of causing the predators to retreat. Two observations of mine described earlier suggest that the mother will defend her young.

Leadership in a flock of wild turkeys appears to exist in the form of "follow the leader". A small flock of hens was observed feeding on March 6, 1954 about forty-five minutes before sun-down. This group appeared to be unorganized at the time, but when one hen walked swiftly away, the others quickly followed in single file. While feeding, the flock, usually composed of hens and young of the year, seemed to follow the adult hens with whom they were associated. It was not possible to tell if the same hen was followed constantly. This leadership apparently is one of family relationship, since the poults remain with their mother at least until the spring break-up of the flock.

The intensity of social cohesion of flocking and organization among these turkeys was illustrated by their hesitancy to disband and, when so, by their tendency toward speedy assemblage. A flock of turkeys will retreat from danger on foot if at all possible, but if disturbed suddenly and noisily, it will take flight, and a considerable scattering of the flock may occur. When the individuals of a flock are thus dispersed, their main concern seems to be to regroup. Even feeding is put aside until re-assemblage is accomplished.

Everitt (1928) reports that the most successful turkey hunters are those who can call the birds in their own language. He says that this is possible because of a "dominating trait of character in the

wild turkey, sociability." When a flock is flushed and widely separated, he continues, they act crazily. Their fear, however, is gradually overcome by their desire to be with their associates. Considerable calling is voiced, therefore, until regrouping takes place.

All this evidence suggests that socially flocking is a very important factor to the welfare of the wild turkey. It seems to have a protective value, to engender a sense of security or well-being, and it seems to be a necessity to normal, successful living.

INTERDEPENDENCE OF SOCIAL AND SPATIAL BEHAVIOR

This investigation brings to attention several significant points, all of which have been stressed to some extent throughout this report. Among them, those bearing upon interrelations between social and space behavior are of particular interest.

The results of this investigation suggest that the refuge wild turkeys live on discrete homesteads and in discrete flocks and only sometimes make contact with a neighboring flock. The organization of the turkey flock on its particular homestead is effected through the high degree of sociality of the species.

The flocks apparently live in two principal groups: (1) females and the young of the year and (2) adult males, which include all males except the young of the year. The adult gobblers appear to establish mating territories during the spring to which the females come. This is where the copulatory act occurs. The females then retire to nesting sites, where the eggs are layed and incubated.

At the termination of the breeding season the gobblers again begin to form small flocks. The females, with their broods, also unite to form their winter flocks. Finally, these two types of turkey flocks occupy the same homestead and live in harmony with one another. Occasionally, the two are seen cruising together. It may be suggested that this apparent harmony between the two kinds of social groups on the same homestead may be due to constant family association during the younger part of their lives either as brood mates or by the association of blood-related families as a winter flock.

As described above, the homestead is occupied by both of these groups during the winter, with each group cruising more or less independently. During the spring and summer months the homestead area is divided into mating territories, nesting sites, and finally brood grounds or areas. Following the termination of the mating and nesting season winter flocks begin to reform and to cruise over the homestead as a unit of females and young once again.

It is apparent that this combination of social and spatial behavior peculiar to the wild turkey constitutes a basic and integral aspect of the way of life of this species. They are interdependent and are seemingly of basic importance. If this importance later is demonstrated by experiment, then this behavior will need to be recognized in any program of wild turkey management.

MANAGEMENT SIGNIFICANCE OF THIS INVESTIGATION

Population Estimate and Density

It has been pointed out earlier in this report that it is a behaviorial trait of wild turkeys to live together in flocks during the winter. Moreover, these flocks appear to be discrete social groups, perhaps each being a clan of associated families. It has also been pointed out that each winter flock of wild turkeys lives on a particular area, its homestead. For the wild turkey, these behavioral traits do not yet seem to be widely recognized. The existence of the winter flock together with its homestead provides a basis for a distinctly realistic approach to the problem of estimating population density among wild turkeys as well as that of ascertaining their pattern of distribution in any region.

The three turkey flocks studied on the Wichita Mountains Wildlife Refuge, A, B, and C, averaged 22 birds each during the winter 1954-55. The average area of the homestead upon which each flock lived was 1211 acres. This is a density of one bird per 55 acres of occupied habitat.

There are 59,099 acres in this refuge. Extended observation suggests the presence in this area of 14 discrete flocks of turkeys. On the basis of the average homestead area as here ascertained, the 14 turkey flocks occupy an estimated total homestead area of 16,954 acres (1211 x 14). The turkeys thus reside upon only an estimated 30% of the total area of the refuge.

The matter of finding the total population of wild turkeys on the inhabited part of the refuge is one of simple proportion. The average number of individuals per flock is multiplied by the estimate of the total area inhabited, and this product is divided by the average area of homestead; thus: $\frac{22}{1211} \times \frac{x}{16,954} = 308$, the total estimated population for the refuge. The density of population still remains at one bird per 55 acres of inhabited range. This estimate of the total wild turkey population is in remarkable accord with the population estimates made by refuge personnel. During recent years their estimate of the total refuge population of turkeys has varied from 250 to 350 birds.

It is believed that the density of one turkey to 55 acres of inhabited range, representing the winter population of the species on the refuge, derived as explained above, is much nearer reality than if no distinction were made between the turkey-inhabited as against the turkey-uninhabited areas of the refuge. If the total area of the refuge had been used as a basis for estimating wild turkey population, the density would have been of the order of 308 birds to 59,099 acres, or one bird per 191 acres. This density is approximately 28% less than the one based upon inhabited area only.

It is to be expected that population density will vary, among other reasons, from one cover type to another. This requires that in any region an independent density estimate be made of each of the major cover types used by turkeys. An average of their sums will provide a reasonable picture of actual density.

Various earlier attempts to estimate wild turkey population

desnity failed to take into account specifically that part of any region which actually is inhabited by the species. For example, Mosby and Handley (1943) estimated the Virginia wild turkey population at a density of one flock per 6.59 square miles of occupied range. The amount of occupied range was estimated by assuming a two-mile cruising radius per flock of birds. This assumption may introduce considerable error in the size of the area actually utilized by the individual flocks. The flocks for which they had a talley of the known number of birds in each averaged eleven turkeys per flock. At the rate of eleven birds per flock, the Virginia population could then be estimated at one bird per 381 acres, which is considerably less dense a population than found in connection with this study.

Bick (1947) showed the Louisiana wild turkey population to be 158 flocks on 1320 square miles. This reduces to one flock per 5976 acres. This is grossly less than the density estimated in the present study.

According to Wheeler (1948), Alabama turkeys varied in density from one bird per 253 acres to one bird per 1970 acres; for a game sanctuary area he reported a density of one bird per 27 acres. In this instance density is seen to vary greatly, but for the game sanctuary area it is of the order of twice that estimated for the Wichita Mountains Wildlife Refuge.

For West Virginia, Bailey, et al. (1951) found wild turkey density to vary from a high of one bird per 171 acres in one region to a low of one bird per 304 acres in another region. His greatest density is about one third of that found here.

While the work reviewed above evidently was done with care and in

some cases with a plain awareness of the possible varying influence of different cover or soil types, in no case was density based upon ascertainment of the area of one or more homesteads as was done in this investigation.

Since population is a dynamic phenomenon, receiving increment at least once a year and undergoing some attrition throughout the year, it cannot be conceived as being fixed or static. Moreover, it is of great importance to develop an understanding of the influences that give population its dynamic character. While the evidence presently available as to the discreteness of the winter social group of turkeys or as to the area occupied by them is not to be considered conclusive, the available evidence does provide results much more satisfying because of their tangible realness. This approach to population behavior as applied to the wild turkey, moreover, conforms with a like approach developed earlier in connection with coyotes and timber wolves (Stebler, 1951).

Habitat Management

The homestead as ascertained during this investigation may serve as the basic unit for establishing a habitat improvement program, since the flocks of wild turkeys studied apparently lived on such discrete areas. It should be more to the point first to improve conditions at home before extending to uninhabited areas. In order to have a maximum number of turkeys on an area, it should be learned if the area in use by the birds, that is, the homestead, can be managed to support a population of greater density. If this can be achieved, then a basis may be provided for attempting development of unoccupied areas in an endeavor to provide acceptable home sites for a spreading population.

Emlen and Glading (1945) recognized that quail, like livestock, will not spread and establish themselves on poor and inferior range. This point can also be expected to hold for wild turkeys. This investigation shows that only 30% of the refuge land was being used by wild turkeys. On this 30% the population appears to have reached a steady state with flock density varying not greatly from year to year. The remaining 70% of the refuge is presumably unattractive for settlement by the turkeys in its present state. Yet to our eyes unused area, in general, appears to be similar to the occupied area. An analysis of the homestead by the use of line transects or quadrats (Odum, 1953) and this compared with a similar analysis of vacant areas might reveal important deficiencies of the unused range.

Hunting

Validity of a Harvest

According to Allen (1954), it has been determined that 40% of the total ruffed grouse population can be harvested during the fall and thus leave a stock sufficient for replenishment purposes. He points out further that there is no biological objection to taking 50% of the bobwhite quail population each year or 40% of the fox squirrel population.

As far as refuge areas are concerned, live trapping should be one satisfactory method for removing the surplus. On private lands where a growing but small population of wild turkeys exists the annual surplus apparently could be harvested by a controlled hunt with no ill effects to the local population. For bobwhite quail Baumgartner (1944) reported that their population remained relatively the same on hunted as on non-hunted areas.

In December 1953 the three flocks of wild turkeys under close observation on the Wichita Mountains Wildlife Refuge contained 66 birds. In December 1954, a year later, the flocks contained a total of 65 turkeys, 30 of which were new birds, young of the year (Table XII). This indicates that 35 turkeys, or 46% of the 1953 population, were lost from the three flocks. Although some dispersal was suggested, the total population of the refuge has not shown any apparent increase during the past several years. This 46% then might be made available to harvest.

Time of Hunting

It is generally recognized that hunting activities should not be scheduled so as to interfere with critical periods in the life pattern of a species. Activities leading to natural propagation are among these. Mating began on the Wichita Mountains Wildlife Refuge early in February, reached a peak in March, and continued well into April. Young turkeys were first noticed in June, and the winter flocks were not completely formed until the latter part of October. Hunting during this period could be a disturbance, adversely affecting mating success as well as the survival of the young. On the other hand, hunting between November 1 and January 1 would find the turkeys settled in organized flocks on their winter homesteads. Hunting during this period not only would avoid any interference with mating activity but also would provide a time for harvesting an annual surplus before losses associated with winter took place.

These dates as given above probably will vary in different sections of the geographical range of the wild turkey. For the sake of example, the 14 states which provided hunting of wild turkeys during 1954, as well as the season dates and bag limits, are listed in Table XV. The hunting seasons of six of the 14 states listed, Alabama, North Carolina, New Mexico, Pennsylvania, Texas, and Virginia coincide reasonably with the proposal suggested by this investigation.

Single Sex vs Either Sex Hunting

Within a population of a polygamous species a surplus of males, necessary to successful breeding, will normally exist. Since yearling turkey gobblers are considered non-breeders (Mosby and Handley, 1943)

TABLE XV

Hunting Seasons on Wild Turkey in United States, 1954-55*

State	Dates	Daily Bag	Season Limit
Alabama	Nov 20 - Jan 1	1	5
Arizona	Oct 2 - to be set	P e r m i t s	
Arkansas	To be set	1	1
Florida	Nov 20 - Feb 1	1	2
Georgia	Nov 20 - Feb 25	2	2
Maryland	Oct 5 - Oct 31	1	1
Mississippi	Apr 1 - Apr 10	1	1
New Mexico	Nov 6 - Nov 21	1	1
North Carolina	Nov 25 - Jan 31	1	2
Pennsylvania	Oct 30 - Nov 27	1	1
South Carolina	Nov 24 - Mar 1	2	20
Texas	Nov 16 - Dec 31	Not given	
Virginia	Nov 15 - Jan 20	1	2
West Virginia	Oct 1-16 - Nov 11-27	1	1

* Adapted from Field and Stream (Nov 1954)

and since these males gain some degree of protection because of their resemblance to the female, they need not be considered for the present purpose. There are still normally present on a homestead sexually adult males that do not participate in the propagational activities. To what extent can the males be harvested without impairing the welfare of the local population?

Within flocks A, B, and C of this investigation there were 24 adult gobblers during the winter of 1954-55 as compared with 26 females. The average harem size was calculated to be 5.08 individuals. A harvest of 80% of the adult males would still leave a ratio of one breeding male to each five females. This 80%, however, would have to include loss to natural causes as well as to hunting. This investigation suggests the possibility of a harvest of a major part of this 80% surplus.

On the other hand, the hunting of both sexes would certainly result in the death of a number of females that would be capable of propagation. At the same time, a certain percentage of the females, otherwise lost through natural conditions, would be harvested by man. An either sex season would furthermore provide a more even population harvest and thereby reduce the surplus evenly as nature herself would do it.

Considering both sides of the question, however, it seems most advisable to harvest only the evident surplus of males. This, of course, would apply only to a population that had not reached a saturation point, that is, the carrying capacity of the habitat. If carrying capacity of the range is reached, it might be necessary and proper to harvest both sexes in order to prevent overcrowding.

Restocking

Composition of the Stocking Unit

After their release in an area wild turkeys frequently have a tendency to drift great distances soon after release and are never seen again (Mosby and Handley, 1943; Bailey, et al. 1951). It is possible that the use of socially strange birds may be responsible for some of the lack of success following a stocking attempt.

The wild turkey is a highly social animal. It travels in flocks composed of hens and young of the year on the one hand and flocks of adult gobblers on the other. When these winter flocks are greatly disturbed and widely scattered, everything, including feeding, seems to cease until the flock is reassembled. Even during the spring mating season there is close companionship. The adult gobblers establish mating territories, and harems of females visit the males on these territories for mating. Therefore, it appears that this high degree of sociality is a factor important to the welfare of the wild turkey.

In view of these considerations, it appears that it might be advantageous to use as a stocking unit birds that are members of a single flock. For example, when possible, one should trap all or as many as possible of the birds from one flock and release these together without any strangers being included in such a group. For another purpose, but recognizing the pertinence of the same principle, Hediger (1950) has called attention to this consideration.

If small groups of turkeys from several flocks are trapped, placed together, and released as one group, they might have a tendency to separate into the original social groupings and wander apart, independent of each other. The individuals belonging to a single flock, however, are already familiar with and adjusted to each other.

Season for Restocking

The mating season seems to have been overlooked as an important consideration in present stocking practices. Such matters as trapping success and condition of habitat at release time, however, have received much attention (Ligon, 1946; Bailey, et al. 1951). When these matters are used alone as the criteria for timing a stocking operation, they may interfere seriously with the established living pattern of the turkey. For example, the annual season of food scarcity, winter and early spring, has been recognized as a very favorable time to trap (Ligon, 1946; Bailey, et al. 1951). Trapping operations during this time may be expected to interfere with mating activities. Release may, in turn, further disrupt mating activity for the season because of the birds being placed in a strange area.

Trapping and transplanting operations might better be done at a time when they will not interfere with mating activities, nesting, or care of the young. The fall and early winter appear to be a superior time for these operations on the Wichita Refuge. Birds trapped and released during the fall would be concerned with neither mating nor with the care of extremely young poults. The flocks then could also be more easily trapped as a unit. Furthermore, there would be time for the transplanted turkeys to become accustomed to

their new surroundings before mating begins.

Selection of Area

It appears that when there is a stock of wild turkeys established in a region, the liberation of additional birds is unnecessary (Taylor, 1951). It has been recommended that an area intended for restocking should be at least 10,000 acres in size (Bailey, et al. 1951). This recommendation was based upon the idea that wild turkeys wander great distances. If this wandering could be reduced as mentioned above by stocking with individuals from a single flock, it would no longer be a drawback to stocking smaller areas.

The space behavior of the wild turkey as ascertained in this investigation suggests the practicability of stocking suitable areas considerably less than 10,000 acres, since the turkey flocks studied lived each on its own homestead. The area of this homestead averaged 1211 acres on the Wichita Mountains Wildlife Refuge. Each such area supported, on the average, 22 turkeys through the winter. If an area existed which was similar in habitat type to the Wichita Refuge and turkeys were desired, it can be calculated from this information approximately how large a population the area in question might support. In principle, this approach could be applied to any potential turkey country by ascertaining both the extent of several homesteads and the population density of each. An average of each of these measures would serve as a basis for stocking.

This approach to stocking, as here described, appears more realistic than that of selecting areas haphazardly for the transplanting of wild turkeys, since it recognizes their living pattern.

CONCLUSIONS

On the basis of this investigation it seems apparent that each wild turkey flock lives on a discrete homestead area. Furthermore, each flock itself appears to be a discrete population unit as against one made up of freely intermingling groups. This apparent discreteness of the flocks may result from a clan type of social organization.

These behavioral characteristics suggest the desirability of modifying management practice to conform with the way of life, that is, the living pattern characteristic of wild turkeys. For example, it appears realistic to use the homestead area as the basic unit for establishing a habitat improvement program. Likewise, it is suggested by this research that by using members of a single flock as a transplanting unit, the chances of stocking failure may be reduced. In addition, the discrete wild turkey flock, together with its homestead area, provides the basis for a distinctly realistic approach to the problem of estimating population density.

While these management suggestions stemming from a more adaquate understanding of the wild turkey's inherent behavior seem readily apparent, it is recognized that in so far as this study is concerned, they are by no means conclusive. Limitations of time and scope associated with this project prevented any such degree of achievement. Furthermore, the management suggestions offered here are not intended to replace any need for more complete knowledge concerning the habitat requirements of the species. It, however, is believed that on the

basis of this preliminary investigation the management considerations brought to attention appear to be of significance sufficient to require experimental verification as a reasonable next step toward establishing the foundation of an increasingly adequate management program for the wild turkey.

SUMMARY

1. Direct observation of wild turkeys served as the basic approach to this investigation of the social and spatial behavior of the Rio Grande wild turkey (Meleagris gallapavo intermedia) from December 1953 to January 1955.
2. The Wichita Mountains Wildlife Refuge, located near the northwest corner of Comanche County, Oklahoma, was selected as the area upon which to center this investigation.
3. Wild turkey gobblers were found to establish mating territories consisting of approximately 14,503 square yards (three to four acres).
4. The average brood size based on 19 separate broods was 4.94 poults. Among 41 poults observed, attrition amounted to 17% during the summer months.
5. Each of the three winter flocks of wild turkeys studied lived on a discrete homestead comprising an average area of 1211 acres each.
6. Winter flocks of wild turkeys on the refuge numbering an average of 22 individuals were formed by October 27 and began the spring breakup by the last of February. These flocks appeared to live in two major groupings. One group was comprised of the hens together with the young of the year, and the other group consisted of adult toms.
7. The density of population was one turkey to 55 acres of inhabited area.

8. The winter wild turkey flocks traveled over the homestead at an average rate of 196 yards per hour including the time spent loafing.

9. The size of the winter flock appeared to influence neither its daily movements nor the size of the homestead. The total number of turkeys residing on each homestead varied from one homestead to another and from year to year.

10. Social flocking of these wild turkeys appeared to have a protective value, to engender a sense of security or well-being, and to be a necessity to normal, successful living.

11. A method for taking a census of wild turkeys is described.

12. This investigation suggests an approach to habitat management.

13. A 46% population surplus of wild turkeys on the refuge appears to have existed during the time of this project. It is suggested that all or part of this surplus can be safely harvested.

14. It appears that a surplus of breeding males exists and that upwards of 80% of this adult male population might be harvested without endangering the established sex ratio.

15. Because of the social cohesion characteristic of the wild turkey it is suggested that by using members of a single flock as a stocking unit, and releasing them in the fall, stocking success might be improved.

16. An approach to the stocking of unoccupied, but potential, habitat is offered.

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