5-1969

The Social Organization of Wild Turkeys on the Welder Wildlife Refuge, Texas

Charles Robert Watts
Utah State University

THE SOCIAL ORGANIZATION OF WILD TURKEYS ON THE WELDER WILDLIFE REFUGE, TEXAS

by

Charles Robert Watts

A dissertation submitted in partial fulfillment
of the requirements for the degree

of

DOCTOR OF PHILOSOPHY

in

Wildlife Biology

UTAH STATE UNIVERSITY
Logan, Utah

1969

ACKNOWLEDGMENTS

This study was supported by predoctoral fellowship No. 5-F1-MH-28,806 from the National Institutes of Mental Health, and by the Rob and Bessie Welder Wildlife Foundation, Sinton, Texas. Special thanks are extended to W. C. Glazener, assistant director of the Welder Refuge, for guidance, help in the field, and particularly for sharing the knowledge gained from many years of turkey research. Thanks are also extended to Bill and Bobbi Low for countless hours of help in the field in addition to their professional stimulation over a two-year period.

Dr. Allen W. Stokes, my major professor, originated this study. His timely encouragement and criticism were instrumental in its successful termination. I extend special thanks to Dr. John T. Emlen, Jr., for many helpful ideas during his five months at Welder. I am indebted to Dr. Wolfgang M. Schleidt who contributed time in the field in addition to professional guidance. The names given to various displays in this paper are those used by Dr. Schleidt in a manuscript not yet published.

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ABSTRACT

The Social Organization of Wild Turkeys

on the Welder Wildlife Refuge, Texas

by

Charles Robert Watts, Doctor of Philosophy

Utah State University, 1969

Major Professor: Dr. Allen W. Stokes
Department: Wildlife Resources

This study is of the social organization of the wild turkey (Meleagris gallopavo intermedia Sennett) on the Welder Wildlife Refuge in southern Texas.

The earliest turkey nests hatched in April, with the peak of hatching a month or more later. These poults may remain with their mother until winter. This brood flock, however, often combined with other brood flocks to form composite brood flocks when the poults were a few weeks old. Hens not successful in rearing young combined into broodless flocks.

The juvenile males left the brood flocks in late fall or winter. They remained a distinct unit, the sibling group. These sibling groups attempted to join adult male flocks which were composed of older sibling groups. Most often the juvenile sibling groups were forced to join others their own age to form juvenile male winter flocks. Female flocks, after losing their juvenile males, combined with other female flocks to form large bands of up to 200 females.

In spring the adult male flocks split into sibling groups for breeding. The sibling groups joined the female bands on display

grounds. Only the dominant male of the dominant sibling group mated while hens were on the display ground. Later in the breeding season the female bands split into their flocks and returned to former nesting areas. Resident flocks continued to use the display ground, but later broke up into nesting groups of 2-5 females localized near their nests. The male sibling groups accompanied the females from the display ground, but did not become territorial. Incubation or nest loss broke down the female nesting group. This in turn led to formation of brood flocks or broodless flocks of hens.

(68 pages)

CHAPTER I

INTRODUCTION

This study, conducted from September 1965 through August 1967, is of the social organization of the wild turkey (Melagris gallopavo intermedia Sennett). The Rio Grande subspecies of wild turkey is primarily a bird of grasslands or mesquite-grasslands and most often associated with riparian types for roosting.

A social system creates order among individuals. It may increase the efficiency of food utilization. Likewise, an organization may be more efficient than an individual in avoiding predation. An organization in which there are guards on the alert may minimize predation during times of high vulnerability, such as when birds leave cover in order to display and mate. Social behavior may be important in regulating population size. Many ecologists now believe that population regulating mechanisms other than food intervene before actual food shortage causes mortality. Important among these are behavioral changes that reduce breeding or survival as reviewed by Lack (1954, 1966), and Wynne-Edwards (1962). As birds become crowded they may respond behaviorally or physiologically: breeding is deferred, clutch size is reduced, hatchability and survival of young fall off (Kluijver, 1951). Some birds disperse from their areas because of increased aggression among males or females. Stress resulting from higher rates of interaction between birds may lower overall survival (Jenkins, 1957). Behaviorally

imposed restrictions which keep a portion of the population from breeding affect the gene pool. These genetic changes in the population, imposed by behavior, might have a role in population regulation (Chitty, 1967).

The objectives of the study were to: (1) determine the social organization of a population of unconfined, wild turkeys; (2) determine the time and manner of formation of the organization; and (3) determine how the social organization affects the opportunity for reproduction in males and females.

The study area in southern Texas was the 8,000 acres of the Welder Wildlife Refuge, plus the adjacent 4,000 acres to the north (Figure 1). Box (1961) has described the climate, soils and vegetation.

The sandy 3,500 acres of the Refuge along the Aransas River and adjacent sandy soil north of the river is a winter concentration area for hens and young. W. C. Glazener, assistant director of the Welder Refuge, and students have trapped and marked turkeys on the Refuge since 1960. By Trapping during the winter they have marked the resident and many of the migratory turkeys. In this study we trapped during fall and winter with cannon nets and the Texas turkey drop net (Glazener et al., 1964). Including recaptures, we handled 1150 turkeys during the two trapping periods. By the spring of 1967 we had placed individual patagial markers (Knowlton et al., 1964) on 99 percent of the resident adult males and on 91 percent of the females and young.

I made most observations of markers with the aid of a 20X or

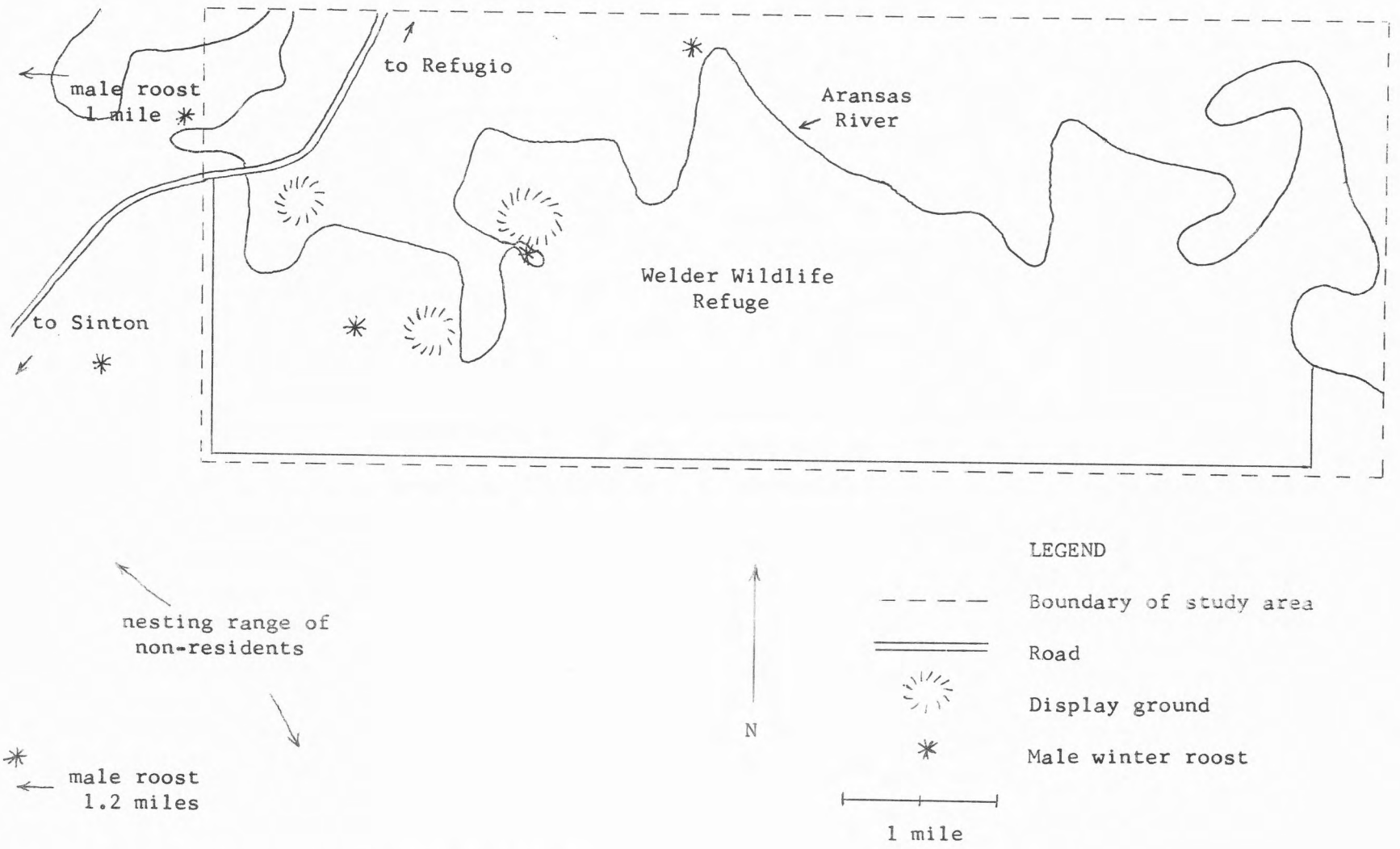

Figure 1. The study area near Sinton, Texas.

30X spotting scope. With this aid, I could recognize all markers up to 200 yards and some at 400 yards.

I tried several methods of observing the turkeys. Using my pickup truck as a mobile blind proved to be the most satisfactory. A quick reconnaissance from one of the numerous towers on the Refuge often facilitated the sighting of flocks, and then I drove closer for observation. Using this method I recorded approximately 25,000 observations of individually marked birds. The truck enabled me to make nearly continuous observations by moving ahead as the birds passed from sight. After several months the flocks habituated to my truck and I often drove within 20 yards of male flocks and 50 yards of female flocks without changing their course or activity.

During fall and winter I recorded the sex and individual composition of flocks along with their location, activity, and the time. Sexing birds in the field was no problem. Usually the overall general appearance of a larger bird, with barer neck and more leg showing beneath the breast outline was sufficient to distinguish males. Seldom would I have to check details such as feather color.

Recording the flock composition was a major objective, as it held the key to understanding social organization. In fall and winter I often recorded the individual composition of ten or more flocks each morning and evening. I could often record all flocks on the Refuge in one evening. The birds were at their roosts at dawn and dusk, but several flocks often converged near the roost with temporary mixing, thus confusing flock identity. For this reason, I seldom recorded composition near the roosts.

In some flocks all birds wore individual markers. In others there were one or more untagged birds. However, because of their tagged associates they usually could be recognized. In addition some birds lost wing markers. Periodically I confirmed their identity by reading the number of their aluminum leg bands with the aid of a 60X spotting scope.

In spring when flocks had nearly disintegrated, I put most effort into locating the birds and describing their activities. After the birds had spread out in the spring, I searched at least 3 days in every 2-week period on adjacent ranches. This was an incomplete coverage, but I did succeed in locating the majority of the turkeys which left the Refuge in the spring. In the spring I could advantageously study the turkeys at all hours of the day, and often many hours of the night.

I made an intensive effort to find all broods as soon after hatching as possible. Refuge personnel spending at least 50 man hours per day in the field helped record broods. We located few broods before they were 2 weeks of age, because before this time the hen and young did not come into the open. We made no effort to mark the rapidly growing poults, and identified broods only through the hen's tag.

The Turkey's Year

This section is an abbreviated life history of the Rio Grande turkey on the Welder Refuge. It gives a general understanding of turkey behavior and the descriptive terms which will aid in reading

this paper.

The earliest turkey nests hatched in April, with the peak of hatching a month or more later. These poults may remain with their mother until winter. This brood flock, however, often combined with other brood flocks to form composite brood flocks when the poults were a few weeks old. Hens not successful in rearing young combined into broodless flocks.

The juvenile males left the brood flocks in late fall or winter. They remained a distinct unit, the sibling group. These sibling groups attempted to join adult male flocks which were composed of older sibling groups. Most often the juvenile sibling groups were forced to join others their own age to form juvenile male winter flocks. Female flocks, after losing their juvenile males, combined with other female flocks to form large bands of up to 200 females.

Turkeys which both summered and wintered on the study area were considered residents. In both years of my study the pre-breeding number of residents was about 400. Between October and February, there was considerable movement of females and young to and from the winter area. This resulted in an increase of about 300 females and young, bringing the total number wintering on the study area to about 700. As spring arrived, birds returned to where they had spent the previous spring and summer. Adult males did not make seasonal movements to or from a winter range. Most remained year around in the areas in which they bred.

In spring the adult male flocks split into sibling groups for breeding. The sibling groups joined the female bands on display

grounds. Later in the breeding season the female bands split into their flocks and returned to former nesting areas. Resident flocks continued to use the display ground, but later broke up into nesting groups of 2-5 females localized near their nests. The male sibling groups accompanied the females from the display ground. Incubation or nest loss broke down the female nesting group. This in turn led to formation of brood flocks or broodless flocks of hens.

In fall and winter the turkeys usually left the roost 20-30 minutes before sunrise. On cloudy days, they left later. Almost immediately after landing, there was a period of preening. Next, they actively fed for 2-3 hours. The same feeding routes were used daily for several weeks, and within these routes were places in which the birds always stopped for a period of preening. The birds usually rested during mid-day, also at a predictable spot and fed back toward the roost for 2-3 hours before sundown. Weather, food conditions, predators and social interactions affected the exact timing of these activities, but the general pattern held true. Usually birds did not go beyond 0.6 of a mile from the roost, although I occasionally noted movements as great as 1.5 miles. By half an hour after sundown, they had fed back to the roost trees.

Usually all birds of a flock roosted in the same tree or two adjacent trees. Seldom, however, did a flock use the same tree within a roost 2 nights in a row. The roosts contained many trees, and the flocks alternated trees, often passing 2 weeks before returning to a particular tree. Particular perches within a tree were attractive and were always used when they returned to that tree.

CHAPTER II

FORMATION OF WINTER FLOCKS

Dalke et al. (1946) and most recent authors of turkey ecology, report that during the summer a hen and her young may join with another brood flock or an unsuccessful hen. In my study brood flocks did combine, but unsuccessful hens never joined brood flocks during the summer. The females formed two distinct types of summer flocks, the brood flocks and the broodless flocks.

Through these summer flocks, plus later intermediate steps, the turkeys on the study area eventually formed three social winter groups: bands of adult and juvenile females, juvenile males, and adult males (Figure 2). The female bands with up to 200 members fluctuated in number as flocks joined and left. The male winter flocks composed of sibling groups had a stable composition of no more than 28 members.

Female Flocks

Brood Flocks

Some brood flocks, when the poults were only a few weeks old, combined to form composite brood flocks. In this study, 21 of 46 brood flocks had a single hen, whereas the other 25 were composite brood flocks of two or more hens, each contributing young. Thomas (1955) in Oklahoma saw only 3 of 19 brood flocks with a single hen.

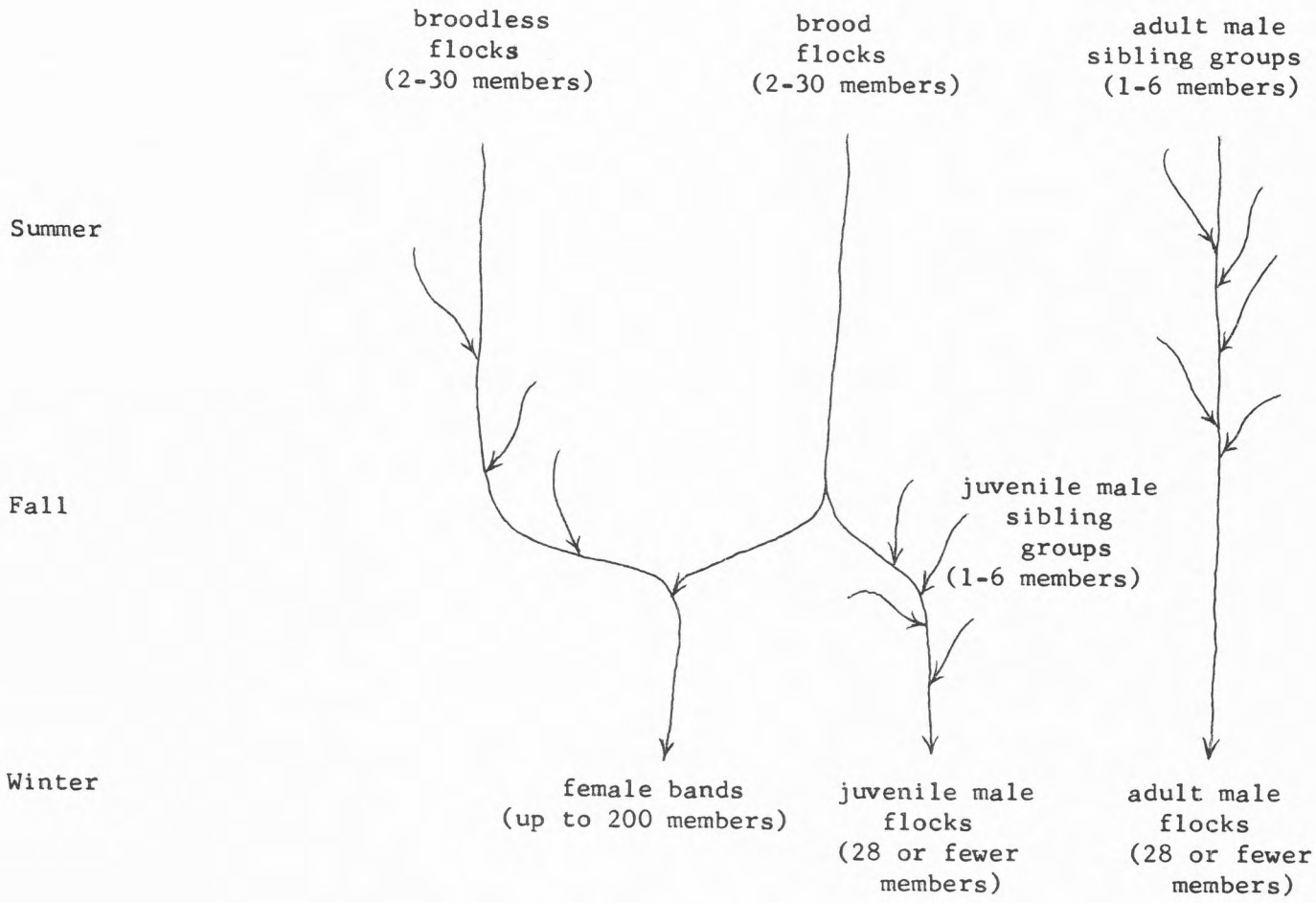

Figure 2. Winter flock formation in Rio Grande turkeys.

Because the female young of a brood flock almost always remained with the hen throughout the winter, some winter flocks had their origins at the time of hatching. Shuffling of poults among brood flocks when less than 1 month old (Chapter IV) was an exception. We did not trap or mark before September, thus there was the period from hatching until September when young birds were not recognizable as individuals. From the time of trapping until spring breakup, only 6 or 105 young females in 1967 and 6 of 132 in 1968 changed flocks. I attributed most of this shuffle to the disturbance of our trapping.

The pattern of winter flock formation shown by composite broods D and E in the fall of 1965 was typical. From late June to early December, flock D had 13 members and E had nine. In mid-December flock E with its two juvenile males joined a band of females that by mid-January contained 70-110 members. In November, juvenile males were dominant over all females except the adult hen or hens that came through the summer with the brood. Presumably because of its number of young males, flock D successfully repelled all potential joiners. Flock D remained an intact unit until its seven juvenile males left the flock in late January. At this time the females of the flock joined band A-F with 30-50 members. Later observations showed this to be the usual case: large brood remained intact until the juvenile males left and then the females joined bands. Both flocks D and E joined bands, but in some cases brood flocks became the nucleus of the winter bands rather than the joiners.

Juvenile Males

All juvenile males in the six resident flocks I watched in 1965 remained with the brood until the last of January, 1966. In the 1966-1967 winter, the first males left the resident broods during the second week of December. The male poults were about 7 months old at that time. The young males left the brood at the time they became dominant over the adult hens of their brood. W. C. Glazener (personal communication) feels that young males leave the broods earlier in years of higher density. This also occurs in pheasants (Stokes, 1954). Even though more than 100 juvenile males were on the Refuge in the winter of 1965-1966, males of the six resident broods tended to remain together rather than scattering into the many winter flocks of juvenile males from other areas. Figure 3 portrays this organization.

Broodless Flocks

During my study, hens unsuccessful in hatching or rearing a brood did not join a brood during the summer. Instead such hens joined other unsuccessful hens. These flocks of adult females were a substantial portion of the summer and fall flocks. In 1966, a good breeding year, 29 percent of the hens raised young. In 1967, only 4 percent raised young. These broodless flocks usually grew in size through the summer as more and more hens discontinued nesting or lost all young. The composition of these broodless flocks then remained static through late summer and early fall, but by November broodless flocks began combining into larger and larger bands.

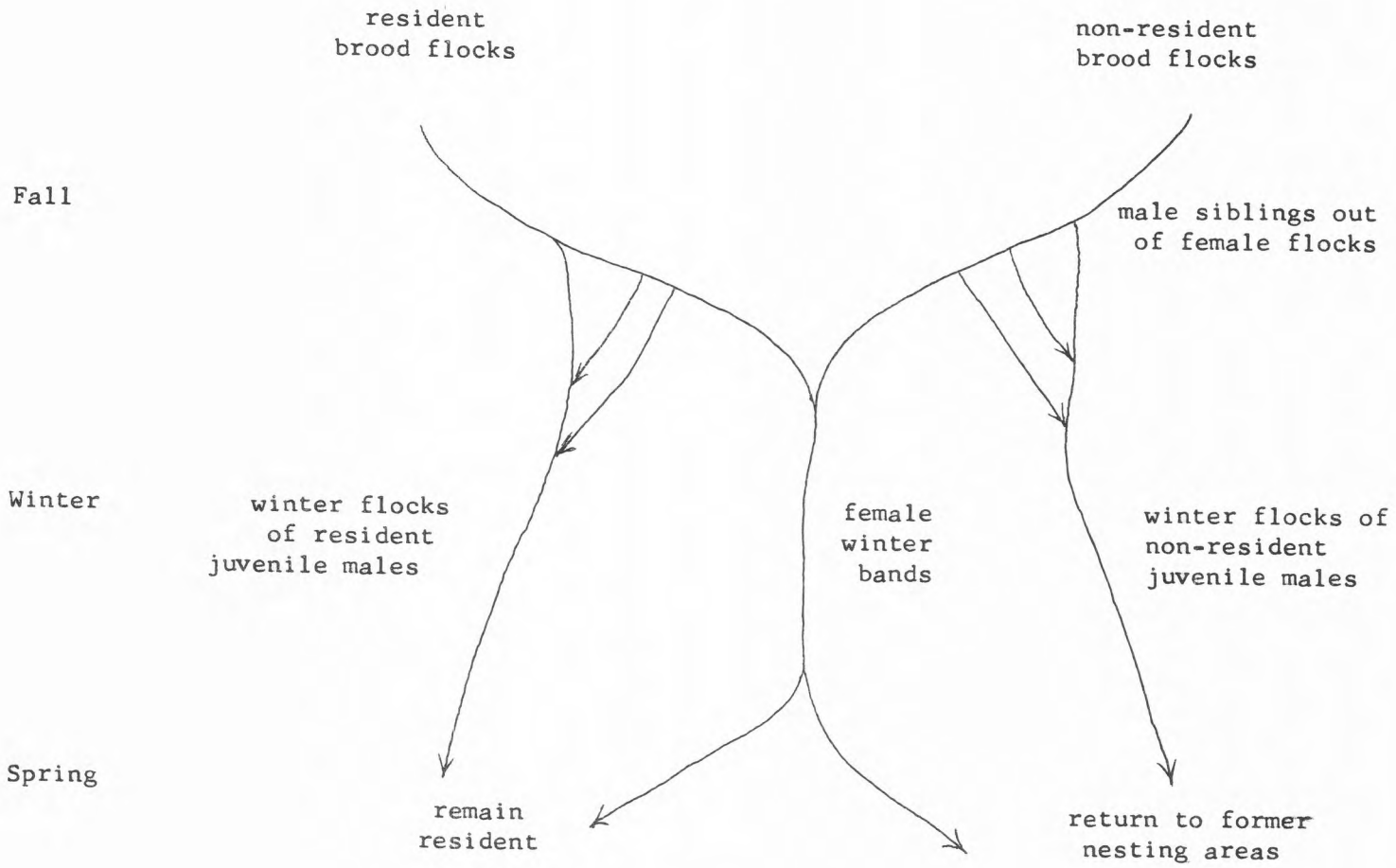

Figure 3. Organization of resident and non-resident females and juvenile males from fall through spring.

There was a strong cohesiveness among the females of the broodless flocks. This was evident in the year to year composition of particular flocks in late summer. Most hens of these broodless flocks apparently attempted to nest near a traditional roost. Each returned to this roost after giving up the nesting effort or losing all young. In this way nearly all survivors were in the same flock with the same associates as the previous year. Most changes in composition of broodless flocks from 1 year to the next were due to either death or a change in status to a brood hen. Broodless yearling females usually joined to maintain flock size. An example is a 1966 broodless flock of 22 marked hens. In 1967 this flock contained 23 marked birds. Twelve of the 1967 flock had been in the 1966 flock. Three others had been with young in that area in 1966 and not in 1967. Five were yearlings, none of which were raised in the area. Three of the 1967 flock had been in adjacent flocks in 1966.

Social Ranking of Females

Aggression

Aggression was obvious in birds one week old. The strutting posture, in addition to actual combat, functioned as an aggressive display as its homologous behavior does in many other Galliforms.

Several factors were important in the determination of dominance. Age or physical maturity appeared important as hens younger than 1 year usually were subordinate to older hens. In 190 encounters between juveniles and adults during the winter, juvenile hens won only 8 percent of the time. Residence on a particular area was also important. Resident juvenile hens won 28 percent of their encounters

with non-resident adults, whereas non-resident juvenile females won less than 1 percent of their encounters on the winter range.

Being conditioned as a winner was important. Summer broods often fought as a unit when encountering a new bird. For example, a brood with seven juvenile males and four juvenile females became dominant over all other broods and lone hens, primarily because of its number of young males. The four young females were conditioned to winning because of the dominance of the seven males. When the young males left the brood, these four females, who had seldom lost a fight, were dominant over all juvenile and most adult females in the area. Hens less than 1 year of age were never dominant over their mother.

Hierarchies

The social order within a flock was maintained by a learned dominant-subordinate relationship between any two birds. It was initially determined by a fight, and later maintained by lesser forms of aggression. This relationship was stable through all phases of the flock's activity, such as feeding, roosting and breeding. Dominance status changed with physical maturity and age but not with location.

There was a hierarchy within a brood flock which began long before I could recognize individuals. At 2 months the hierarchy was well established in one marked brood. Most broods were not trapped until at least 4 months old, but at that time they had a social hierarchy.

The composition of the large winter bands fluctuated as flocks

joined or departed. In these larger bands most birds were involved in several triangles of dominance. One band with about 50 regular members had several birds involved in 20 or more triangles. Some birds which ranked lower than fortieth in my alignment were dominant over one of the top five. Hence in large bands there was not a straight line hierarchy.

Summary of Female Flock Formation

Females formed two distinct types of summer flocks: (1) the flocks of broodless hens; and (2) the hens with young. The broodless flocks combined in late fall into large bands. Juvenile males left the brood flocks when 7 months old and at this time the hen and female young joined the broodless hens, forming larger bands of up to 200 females. Thus by winter, the two types of female summer flocks had combined into large bands of females, and juvenile males had formed distinct flocks.

Adult Males

Sibling Groups

Winter flocks of males were composed of sibling groups. Because of some shuffling of poults between broods, and broods combining at an early age, the siblings were not necessarily genetically related, but were raised together by one or more hens. In the two years of this study, all male poults raised by a single hen remained permanently together. The young males of composite brood flocks usually split into two or three sibling groups after leaving the hens. In contrast, the female young of a brood did not remain together as

sibling groups.

During the winter of 1965-1966, five adult male flocks, totalling 54 birds, could on the basis of behavior be divided into 32 sibling groups. Between October 1965 and August 1967 there was no change in the composition of these sibling groups other than by death. Of the 32 groups, 12 birds were in sibling groups of 4, 9 in groups of 3, 22 in pairs and 15 birds were lone survivors. The ages of all members in 12 of the 17 sibling groups having more than one member were equal, and there was no evidence indicating the other five differed. In nine of the sibling groups all members were trapped together as juveniles and were still together when my study ended. Again there was no evidence indicating the other sibling groups differed.

The size of a sibling group diminished with age, and lone birds were usually the sole remnants of larger sibling groups. Of the 15 lone males during the winter of 1965-1966, 13 were older than 3½ years and 10 of these older than 4½ years.

In 1967, 136 adult males under intensive observation were in 83 sibling groups. Of the 83, there were 4 groups of 4, 6 groups of 3, 29 pairs and 44 lone birds. From limited observation, it appeared that old birds remained a permanent part of the flock until so old they could no longer keep up with the rest of the flocks.

Flock Formation

The sibling groups of juvenile males, after leaving the brood, attempted to join established flocks of adult males, but seldom were successful. Subsequently they joined others their own age to

form flocks of juvenile males during their first winter. These juvenile male flocks did not break down until late in the following breeding season, when they separated into the original sibling groups. By the end of their second summer these groups of yearlings again attempted to join established adult male flocks, and many were successful at this time. Some yearling sibling groups did not become a permanent part of established winter flocks, but merely moved among them through the entire winter. Yearling sibling groups remaining alone for the winter were common in the winter of 1965-1966, but non-existent in 1966-1967 when heavy mortality reduced the sizes of adult male flocks. One winter flock made up predominantly of rejected yearling males formed in the winter of 1965-1966. This flock did not reform in 1966-1967, for its sibling groups joined established flocks at this time. Sibling groups that had not managed to become part of a flock as yearlings did so the following summer or fall when 2½ years old.

With virtually all males marked it was possible to follow the death rate. Because of the stability in composition of male flocks, I assumed that members disappearing from a flock had died. None of these males which I assumed to be dead ever reappeared during my 2 years of study. Considering both known and assumed dead there was 40 percent annual mortality among the males. The number of birds on the study area has remained fairly stable over the past 10 years (Glazener, personal communication). Therefore, recruitment must equal the 40 percent mortality. Table 1 shows 41 percent of the adults in October of 1966 were yearlings and 40 percent of the adults in October of 1967 were yearlings. Thirty-eight percent of

Table 1. The number and age structure[a] of male turkeys on the study area.

Date of count	Cohort of all birds hatched prior to 1965	Cohort hatched in 1965	Cohort hatched in 1966	Percent of total males which are juvenile	Percent of total adults which are yearlings
Oct. 1965	116	120[b]		51.1[b]	40.6
Mar. 1966	107	109[b]		50.5[b]	44.3
July 1966	86	58		40.3	--
Oct. 1966	75	50	118[b] (78)[c]	48.6[b] (38.4)[c]	40.0
Mar. 1967	61	40	108[b] (69)[c]	51.7[b] (40.7)[c]	39.6
July 1967	41	31	46	39.0	43.1

a. August, the end of hatching, is the hatching date for all members of each cohort.

b. Numbers include juveniles not resident on the study area. I could not distinguish all resident juveniles from non-residents in the fall of 1965. These figures in 1966 are given only for comparison.

c. Known residents in the fall of 1966.

all males were juvenile in October of 1966 and 41 percent of all males were juvenile in March of 1967.

The actual means by which the younger sibling groups joined a flock of older males deserves mention. They followed the flock they were to join, often for as long as 2 months. They were continually driven away by the older birds but eventually they were allowed into the flock, most often near the bottom of the hierarchy. Thus a flock lost individuals through mortality, but increased in size through addition of entire sibling groups. Accordingly, entirely new male flocks seldom formed.

Sibling groups of adult males began returning from spring breeding areas to the winter roost and to former acquaintances during April. As with the broodless female flocks, adult males joined with all surviving members of the previous year's flock. Several male flocks shared each roost. Thus the sibling groups were not merely returning to a roost site, but returning to particular individuals. In 1966 only 2 of 54 males I watched closely since 1965 had changed flocks. In 1967 I watched all adult males and only 3 of 136 changed flocks. Some adult male winter flocks completely formed by late summer, whereas others did not form until December.

Social Ranking of Males

Aggression and Hierarchy within the Sibling Group

Annual combat determined the dominance relationships among the siblings. There was a linear hierarchy among the individuals of each sibling group. The fights to determine rank within sibling groups took place after winter flock formation was under way. I observed

most of these fights in the fall. I failed to see any fighting among members of a sibling group during the spring. Two changes in dominance within a sibling group, thus indicating a fight, did occur during the two mating seasons of this study.

Fights to establish dominance within the sibling group were the most obvious of turkey fights. Such fights often lasted longer than 2 hours. The birds fought to a state of exhaustion. It was only in these fights among sibling that I observed the form of fighting known as "wrestling" (Figure 4). Most intra-sibling group fights began soon after daylight, some before the birds left the roost trees. After such fights the birds recuperated for a few hours and reunited as a peaceful unit by evening. I could detect very little aggression among members at any time after this annual fight. To determine rank I often baited members of a sibling group. This procedure sometimes failed to increase aggression as they often took turns pecking from a pan of sorghum that covered an area about the size of a silver dollar. The behavior of subordinates in avoiding the dominant was often the only detectable sign useful in assigning rank. At times the dominant gave a "T" display (Figure 5) to intimidate the more subordinate birds. However, the "T" display was more commonly used to intimidate members of another sibling group.

Aggression and Hierarchy between Sibling Groups

Fights between sibling groups for dominance in the winter flock also were observed most frequently in late summer and fall. Seldom were fights between sibling groups severe. The siblings fought as a group; thus the presence of an extra male might turn a potential

Figure 4. Two wrestling males from a sibling group of five.

Figure 5. Dominant male in background giving "T" display.

fight into a short chase. Seldom were members of each side so well balanced, even if numbers were equal, that a fight lasted over 4 or 5 minutes.

These fights between sibling groups brought about a linear hierarchy among the sibling groups of a winter flock. Siblings fought as a unit, and moved up and down in the flock hierarchy as a unit. Figure 6 shows the ranking within Flock 3 from October 1965 through January 1966. The numbers listed below the diagonal indicate the number of times the individuals in the column were dominated. Identities which include a numeral are sibling groups having more than one member. It shows one triangle involving sibling group 4-B plus a permanent change in dominance involving L-R. The size of a sibling group appeared important in determining its rank within the flock. Sibling groups 2½ or 3½ years of age were usually dominant. The 1½ year old sibling groups were of course usually the largest, but these birds were not physically mature. It appeared that sibling groups returning to their winter flock after an absence of up to 4 months tended to assume the same rank in relation to other sibling groups as they had held the previous winter. Often the death of members altered the dominance of a sibling group. All the male flocks studied attained a straight line hierarchy of dominance among their sibling groups, with only an occasional triangle.

Aggression and Hierarchy between Winter Flocks

Winter flocks fought when they met. There was a linear peck order among the winter flocks of a roost. The sibling groups of the flock formed a united front against the approaching flock. Violent

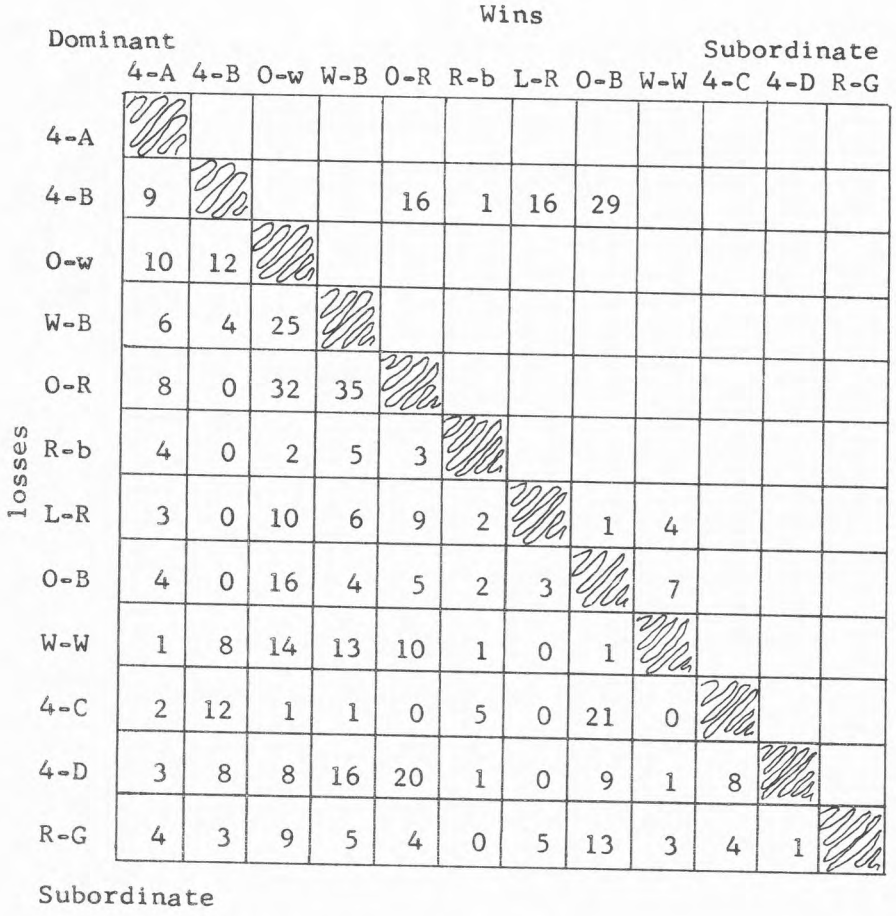

Figure 6. Hierarchy in male flock 3 from October 1, 1965 to January 31, 1966. The numbers in the column below each individual identification are the number of encounters this individual dominated the turkeys to the left of each row.

battles followed, but encounters of this sort were rare once the flock peck order was established. I based flock peck orders almost wholly on avoidance behavior. The timing into and out of roosts was such that flocks seldom met, even in the roost with five male flocks.

Distribution

The adult males on the winter range were permanent residents, and no adult males from surrounding areas moved to winter there. The 109 resident adult males in the winter of 1965-1966 stayed in two roosts, 1.2 miles apart. One contained 67 birds in five flocks and the other had 42 birds in four flocks. Males of the smaller roost shared their roost with hens and young, whereas the larger roost was, and has been since at least 1958, an all male roost. In 1966-1967, the 136 adult males (eight flocks) resident on the winter range were in two permanent roosts and one temporary roost.

Over the years, the winter roost near the Refuge headquarters has had 60-70 males using it (Glazener, personal communication). Additional males were rejected once this number was reached. Most often the rejected males were juveniles, although in some years yearling sibling groups were also rejected. Because of high mortality in the winter of 1966-1967 the adult males in the flocks using the roost near the Refuge headquarters dropped from the expected 60-70 birds to only 49. Three sibling groups of juvenile males, eight birds, succeeded in joining adult flocks, thus raising the total to near the expected number. In the two winters of this study this was the largest of eight male roosts under observation. Male roosts were spaced over available habitat in areas both on and surrounding

the winter range (Figure 1).

The females from the areas covered by the flocks of these eight roosts of males combined into two large bands at only two roosts, both on the winter range. There was little overlap in ranges of adult male winter flocks from different roosts. The daily movements of adult male flocks in winter was about 0.6 mile from the roost site and no two male roosts were closer than twice this distance. It is possible that the roosts were spaced just beyond hearing range of each other, as a human located beneath a winter roost can seldom hear turkeys in the next winter roost, and the hearing range of turkeys is quite like that of humans (W. M. Schleidt, personal communication).

Discussion

Male and Female Distribution

Male flocks are non-migratory and remain spaced over available habitat, whereas females move to a wintering area and gather into large bands. There are several possible explanations for the differential winter spacing of males and females. Turkeys are not hunted on the Refuge and the major immigration coincides with the start of the hunting season outside the Refuge. However, turkeys are very lightly hunted outside the Refuge and only males are taken. One would expect hunting to cause the males rather than the females to move.

When aggression between males and females occurs, males are always dominant. If we could assume winter food shortages in the surrounding areas, the more dominant males might drive females away,

thus forcing females to move to the Refuge. However, I failed to see male flocks chase female flocks.

It takes a large roost to hold a band of 200 females, and few suitable roosts of this size exist except on the winter range and along the Aransas River adjacent to the winter range. Perhaps by joining flocks, the female bands outgrow their summer roosts.

The following seems the most plausible explanation for differential spacing. It is within the definition of territory (Nice, 1943), to say there are winter territories of males, with a roost containing one or more flocks as the center point of each territory. The flocks of a roost independently defend the territory. This territoriality spaces males over available habitat. The Refuge has traditionally been a wintering area for turkeys, likely because of its favorable mixture of habitat. Non-resident males can not take advantage of the winter area because it is within the territories of males resident on the winter area. These resident males are too aggressive to allow other males to use it. The female bands, in contrast, are not territorial during the winter and are able to combine into large bands on the most favorable winter habitat.

The Hierarchy

A learned dominant-subordinate relationship is the foundation of the social system for both male and female flocks. The social system of turkeys with few exceptions is a straight line hierarchy. Dominance functions at the level of individuals in hens, as it does in all other reported species. There is a hierarchy among

individuals of a brood flock and probably also among the hens of summer broodless flocks. As female flocks combined into larger winter bands, I could not assign rank because of the large number of triangles of dominance. There were no reversals of dominance even where triangles were involved. One individual dominant over another was always dominant even though in my arrangement the dominant bird was number 46 and the subordinate number one. The dominant-subordinate relationship between any two individuals, the basis of a hierarchy, seems just as permanent in the large bands as in the well defined flock.

The male flocks are composed of sibling groups. The siblings fight as a unit against other sibling groups and move up or down in the flock rank as a unit. Thus in male turkey flocks, ranking is between sibling groups, not only the individuals, as it is with the hens.

The amount of aggression within a flock, which is dependent on the ability to recognize individuals or groups of individuals, appears to set an upper limit on the size of a male flock. A male flock composed of sibling groups rather than individuals allows at least 28 members to live together.

CHAPTER III

THE MATING SEASON

The first signs of winter breakup of flocks occurred as early as the last week of January. In 1966, some flocks of females began leaving the winter roosts in late January. The resident male flocks began separating into their component sibling groups in the first week of February, and by the last week in February had completely broken down. Thomas (1955) found that this subspecies in Oklahoma initiated breeding behavior at this time also.

The mating season began while females were still in large winter bands. Daily, the bands began feeding and resting in open areas near their roosts. These open areas became display grounds as male sibling groups spaced themselves within or near the female band. Non-resident female flocks soon left the winter bands and returned to their nesting areas off the Refuge. The resident females remaining on the display ground began dividing into smaller groups and visiting nesting areas. Male sibling groups accompanied each female group. The decrease in female group size, thus increase in number of groups, continued as the females spread over available nesting areas. As nest sites were selected the display ground was abandoned. Females with adjacent nest sites remained together during most of each day before incubation began. I call this group, usually containing 2-5 members, a nesting group. Usually each female nesting group was accompanied by a male sibling group. Figure 7 diagrammatically shows

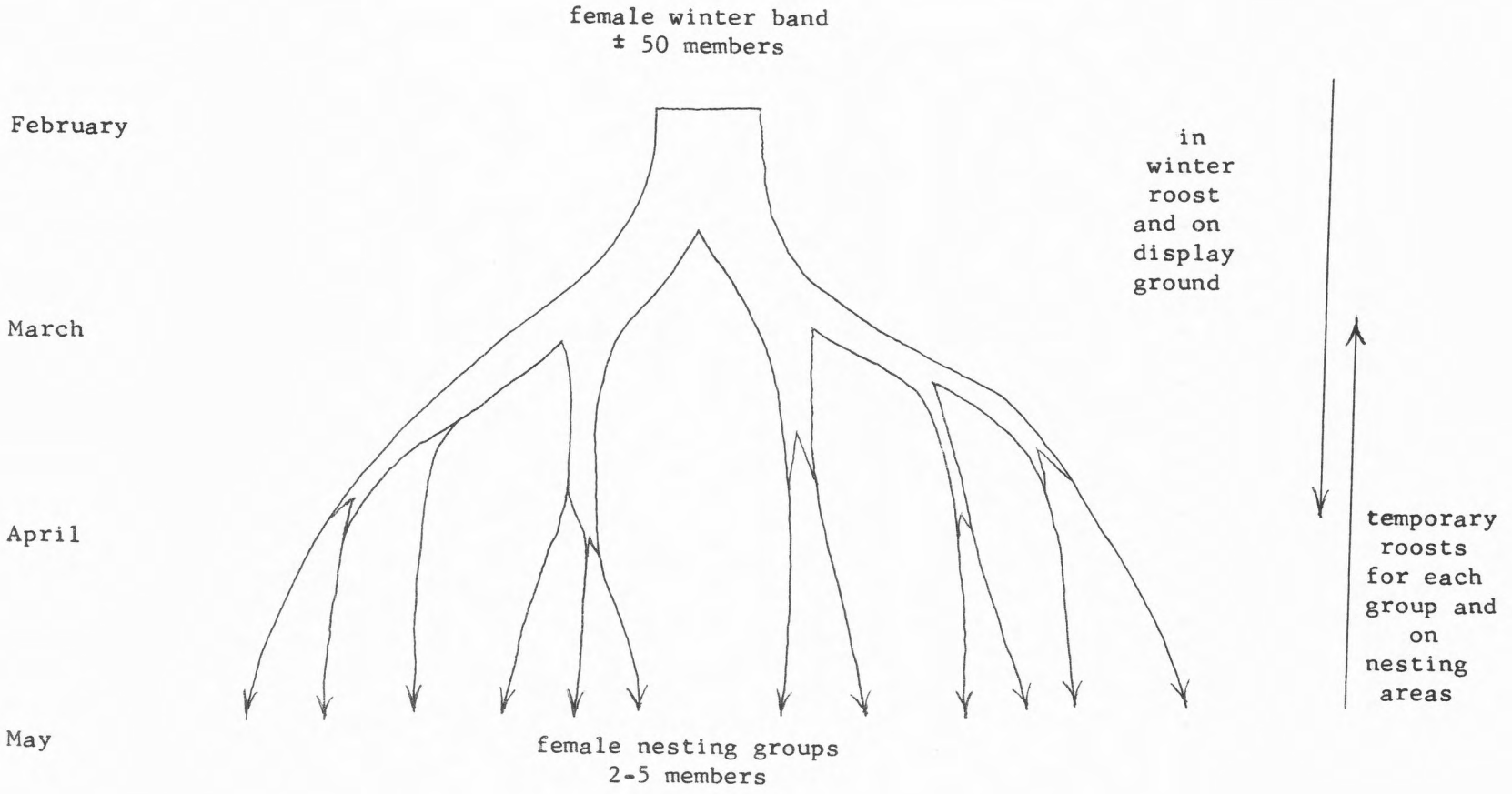

Figure 7. Social organization of females during the spring.

female social organization through the mating season.

Display Grounds

Traditional display grounds were located near the female winter roosts. Each band of wintering females used one of the three and sometimes four display grounds on and adjacent to the Refuge, (Figure 1). At daybreak the females flew from their roost to the nearby display grounds. Movement to the display grounds by males involved no movement outside their normal winter range. Initially, males roosting at a distance from the display ground travelled to the hens on foot, often at a run. Within a few days after the initiation of the display ground, all but the most subordinate sibling groups of males abandoned their winter roosts and roosted with the hens. Dominant sibling groups accompanied the females to the display ground, whereas more subordinate sibling groups of males arrived either before or after the females.

Members of a sibling group usually strutted more or less synchronously, seldom spread out more than a few yards, and in most cases nearly touching each other. Figure 8 shows three male sibling groups, two pair and a lone one, strutting to a lone hen. The sibling groups maintained a spatial arrangement about the females on the display ground. The dominant sibling group of males positioned itself within the ranks of the females. All subordinate groups, often as many as 20 from several winter flocks, stayed at the periphery of the females. Figure 9 shows three sibling groups, a lone male, a pair at the periphery and a group of four among the hens. Figure 10 diagrammatically shows the positions of males and

Figure 8. Male sibling groups strutting to a lone hen.

Figure 9. Male sibling groups with a female band.

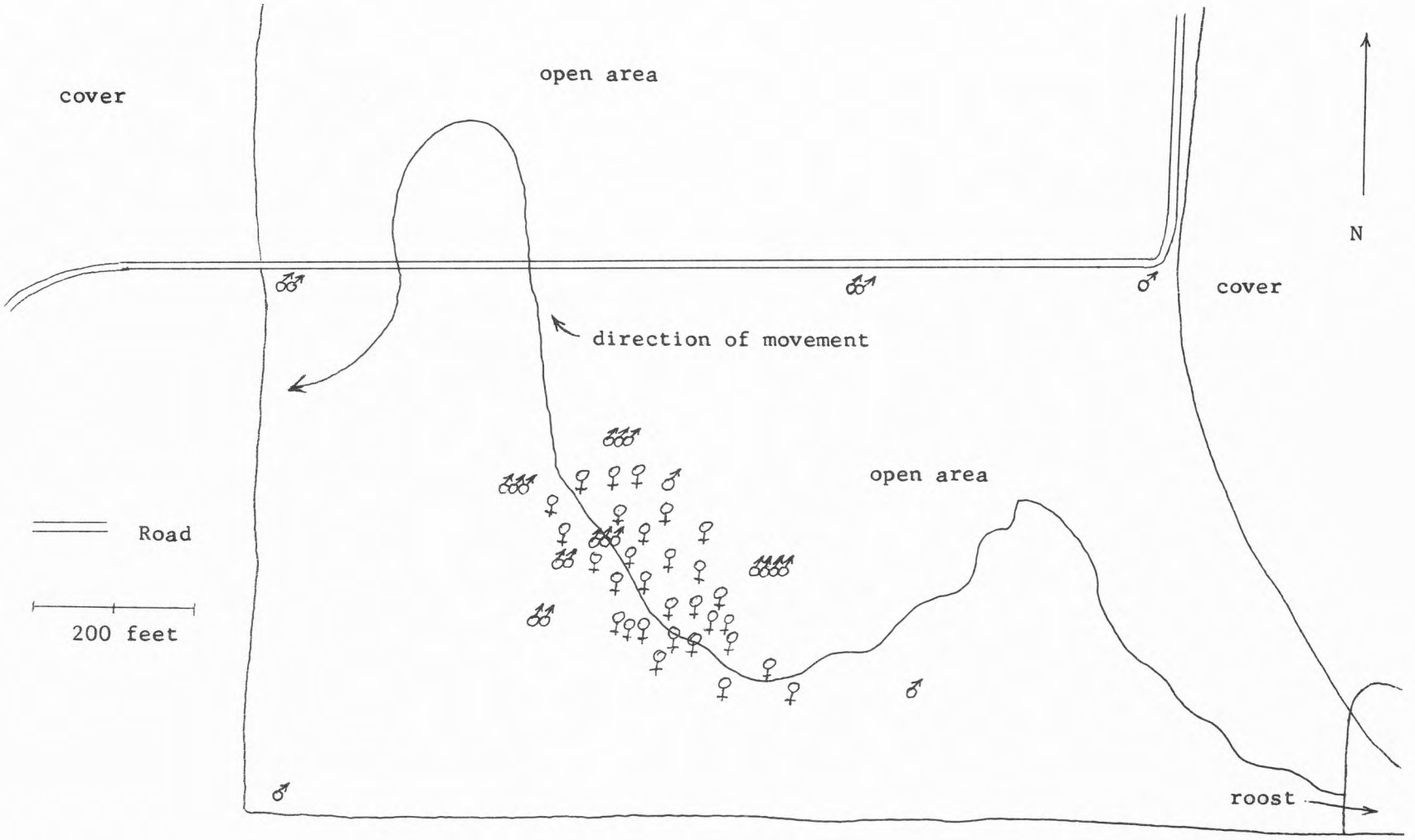

Figure 10. The distribution and movement of turkeys on the display ground during a typical morning in mid-March.

females upon the display ground. There was no site attachment in this spatial arrangement of males. Instead the arrangement was with respect to the females, wherever they moved upon the display ground. The spatial arrangement of the peripheral males shifted as more dominant groups moved to take advantage of the direction of female movement. I saw very little fighting among sibling groups from the same winter flock. Most male fights on the display ground involved sibling groups belonging to different winter flocks.

Copulation

An understanding of copulatory behavior in turkeys is essential to understanding behavior seen on the display ground. The males of a sibling group courted females showing the rhomboid posture (Figure 11) described by W.M. Schleidt (personal communication). A female when ready to mate would lie down, often only to bounce up as the large male strutted up to her. A female sometimes repeated this bouncing up and down several times before the male could successfully mount. Roadways or barren ground seemed particularly attractive to females ready to mate. On one morning the females fed on the display ground 1½ hours without mating. After coming to a paved road I observed five copulations in 30 minutes, all on the pavement.

The sequence of events leading to successful copulation was much the same as for domestic turkeys, described in detail by Schein and Hale (1961). The minor differences can probably be attributed to differences in anatomy and to previous mating experience. When lying down a hen sleeked all feathers and retracted the head, giving the appearance of having almost no neck. The male mounted, oriented

to the head (Schein and Hale, 1957) and trod upon the back and shoulder region of the hen with his feet. As the male mounted, the female lifted her head 8-10 inches, with the neck extended vertically. A female often, but not always, braced her wings upon the ground for balance. The male, standing upright, alternately trod and rested and at this time the beards of some males just touched the heads of the hens. The breast of the male was usually about 10 inches from the head of the female, in contrast to domestic turkeys in which there is contact. After 3-4 minutes the female began to lift her tail and as it touched the male, he lowered his tail below hers and dropped to his tarsi on her back. As the female's tail came up, her head and neck extended straight out upon the ground. After ejaculating the male stepped off and resumed strutting. The female jumped up, vigorously shook her feathers and loosely held wings, and ran to catch up with the other females.

I studied mating in detail using models much as described by Schein and Hale (1958) for domestic birds. Initially I used a stuffed female turkey, with head and neck vertical and tail lying on the ground. I placed it on the paved road about 200 yards from a sibling group of two males without females. I parked 20 feet from the model and imitated a hen call. The males immediately ran to the dummy, interrupted only by several stops to make a fast strut. After 5 minutes of strutting around the dummy, the dominant bird oriented and mounted. He trod about 4 minutes, dismounted, and began strutting again. The dominant moved to the blind side of my truck and the subordinate immediately mounted and trod. The dominant strutted out from behind my truck, saw the subordinate, ran, and

knocked the subordinate approximately 10 feet into the borrow ditch. The dominant again mounted the dummy and trod 15 minutes before becoming "impatient". He began low intensity vocalizations and gently pecked at the head of the dummy. The experiment ended when he pulled the head off the mount. At no time did the male lower his tail for copulation. I substituted a wooden platform 4 inches high, 6 inches long and 4 inches wide for the hen body, because the original body was unstable. The wooden platform was hinged at both ends and attached to a head with neck, and a tail. With strings I could manipulate the height of either the head or tail. In only two of four tries could I induce a male to mount the new model. In both cases the males trod for more than 10 minutes. Ejaculation was elicited only by lifting the tail of the model until it touched the male. These observations emphasize the coordination of the pair of birds, and the prerequisite components necessary for each step toward a successful copulation just as Schein and Hale (1958) have shown for domestic turkeys.

Mating on the Display Ground

Only the dominant male of the dominant sibling group copulated during the phase of the breeding season when hens used the display grounds.

The time required to complete the copulation in turkeys explains the lack of copulations by subordinate groups. Of the 59 complete copulations I observed, the time lapses from mounting to dismounting exceeded 4 minutes. This lengthy copulation prevented either rape or hurried attempts by subordinates, thus allowing the dominant group

to tend all females. Dominant males, spotting the fluttering wings and treading movements of a copulating male, came at a run, often from more than 100 yards, to displace subordinates.

Seldom did a hen being trod by a subordinate go unmated after the male was displaced. In most cases she continued to lie down, or moved only a few feet, and was mated by the alpha male of the alpha sibling group. Only if two females, widely separated in the group, were ready to mate simultaneously did the dominant male of a subordinate sibling group successfully mate. However, I observed this only once in the two mating seasons. Copulations by the dominant male of the alpha sibling group were seldom interrupted. The subordinate siblings of his group fought off any intruders as he mated. Sibling groups from the dominant male's winter flock never challenged him, even when two hens were simultaneously receptive. In addition, an interflock hierarchy of sibling groups on the display ground was rapidly learned. Of the three interruptions of a dominant group which I observed, two were by winter flocks of juvenile males which did not strut to the hens.

Almost invariably, subordinates had a mock mating (Figure 12) just before or after a mating by the dominant male. The body movements were quite similar, although more hurried than an actual copulation. They mounted and trod a dried pile of cow manure or a log if present, but neither was essential. The male fluttered and lowered his tail and then stepped off and resumed the full strut. Mature birds do ejaculate during these mock matings (W. M. Schleidt, personal communication). This behavior first arose in juvenile males in November, when 7-8 months old, and it was most unlikely

Figure 11. Female in rhomboid posture.

Figure 12. Mock mating by the male on the left.

that ejaculation occurred at that age.

Breakup of the Display Ground

In 1966, 4 weeks after breeding began, all non-resident flocks of females had returned to their nesting grounds. Some of the females leaving the winter area had already been mated by the resident males. There was a steady decrease of females on the display ground, until only resident females remained. In 1967 this period was compressed to 3 weeks, presumably because it started 1 month later. The sex ratio of residents was 116 males per 100 females in the spring of 1966 and 115 per 100 in 1967. These figures include the non-breeding 1 year old males.

The hens left on the display ground began splitting into smaller groups at about the time all non-residents were gone. These groups wandered over available nesting areas, each accompanied by a dominant sibling group of males and several subordinate male groups. There appeared to be very little overlap of resident adult male sibling groups with sibling groups from other winter areas. In the spring of 1966, 44 of 54 individually marked adult males under study stayed within 1 mile of their winter roost site, thus not moving out of their winter range. At this stage the dominant males of possibly three or four sibling groups were mating with portions of the resident female band from a particular display ground. This breakdown of the female winter band continued until nesting groups of 2-5 hens, which no longer returned to the display ground or winter roost, were formed.

Nesting Groups

The nesting groups used temporary roosts, often a single tree, for most of the nesting period. When males accompanied the group, they also used this roost. There was almost a complete shuffle of the old female brood flock as sibling sisters or mothers never ended up in the same nesting group, although they were often in the same nesting area.

When the females divided into these nesting groups of 2-5 members, there developed the opportunity for all male sibling groups even those of lone males to be the only, thus dominant, sibling group with a particular nesting group of hens. The dominant male of every sibling group, including the sibling group of a lone male, thus mate at this season of the year. I observed 59 copulations during the two springs, and all 59 were by the dominant bird of a sibling group. Dominance within a sibling group was stable for the entire mating season, as in only 2 of 78 cases did dominance change, giving two birds of a sibling group the chance to mate in one season. Non-breeders, the subordinates within a sibling group, made up 43 percent of the spring population of adult males in 1966 and 39 percent in 1967. In addition to this non-breeding percentage I did not observe juvenile males mating. The juvenile males made up 41 percent of all males in the spring of 1967. Therefore less than 40 percent of all males were observed to copulate.

While the nesting group of females was localized at a nesting area, accompanied by a male sibling group, it gave the appearance that a territorial system of a sibling group with its harem had been achieved. This was not so. The hierarchial system of the males was

maintained and a subordinate sibling group never defended an area or females against a more dominant group. When females of a group were unreceptive, the male sibling group usually moved to the next nesting area, where it acquired hens from a more subordinate group or continued moving if meeting a more dominant group. Several of the most subordinate lone males were more localized than other sibling groups. It was not unusual for one male to stay day after day in a very restricted area of a few square yards in which females passed through, but never stayed. Seldom were these females unaccompanied by other males. As incubation and subsequent nest losses commenced, the composition of the nesting group of females likewise changed. Incubating birds would disappear and birds losing nests often moved some distance, and joined another nesting group before renesting. Thus not only was the male composition on particular areas changing, but likewise the composition of the "harem" changed.

Discussion

During the early weeks of the breeding season, the social structure of the Rio Grande turkey appears analogous to that of the "lek" species of grouse. All adult male turkeys display on a traditional ground but few actually mate on the grounds. The social organization of male turkeys on this display ground is governed by the previous winter flock hierarchies. The turkeys were not territorial on the display ground. Studies dealing with the social organization of lek species of grouse during the fall and winter might conceivably aid in a more complete understanding of the grouse lek. Why, for instance, are a few male grouse the exclusive breeders

in a territorial situation? My data do not indicate what percentage of the females are mated in the various stages of the breeding season from display ground stage through the nesting group stage. Thus I cannot state what percentage of all females are mated by the alpha male, the one doing all the mating on the strutting ground. I believe this percentage would be approximately the same as that for the grouse "master cocks".

To my knowledge, all authors discussing the breeding systems of wild turkeys in the United States report the males to be territorial. The male turkeys on my study area were not territorial during the breeding season. Having all my males marked, thus knowing individuals at all times, may have given me a unique opportunity to interpret observations. However, no reports on other subspecies discuss the obvious assemblages on display grounds that I observed. I feel there may be a real difference between the turkeys I observed and others, not just a matter of interpretation of observations.

D. E. Davis (1958), while working with mice, showed density may alter the social system, and that it is a continuum from a territorial to a hierarchial system. Turkeys are not randomly distributed over their range. Densities vary when considering roost area, feeding areas, breeding range or entire range. Comparative figures of density on the particular area which should influence the social system are not available. Comparing densities of large non-uniformily used areas, for which figures exist, seems of little use. Davis's density dependent continuum may explain why the social system of my turkeys differs from other, but I cannot support or refute it.

J. H. Crook (1964) correlates differences in the social systems of weaver finches with differences in vegetation. The social system has evolved as the most efficient means of exploiting the food resource. Much of the range of the Rio Grande turkey is currently invaded by brush. Historically much of the range of this turkey was grassland, interrupted by riparian growth and occasional islands of trees. The other subspecies of wild turkeys in the United States are forest birds. I believe the differences in distribution of food, roosting or nesting sites between forest and grassland has influenced the types of social systems seen in turkeys. The similarity of breeding systems between the Rio Grande turkeys and the prairie grouse of North America adds further support to the influence of vegetation in shaping the social system.

The individuals of a sibling group display together rather than as individuals, and the subordinate males within a sibling group were not seen mating. In the 59 copulations observed, only the alpha bird of a sibling group mated. In only 2 of 78 cases did dominance within a sibling group change during the breeding season, thus giving a second member the chance to mate. Thus, subordinate males of the alpha group have less chance of breeding than do lone individuals, who are subordinate to all sibling groups of the flock. It is difficult to visualize a selective advantage to being a non-breeding subordinate of a group while more subordinate lone birds are breeders. Advantages to the breeding dominant and to the population are numerous. The presence of the non-breeding sibling guards, always on the alert in the presence of the breeder, should reduce the danger from predation at this critical time. The non-

breeding siblings guarantee the alpha male freedom from disturbance during the extended period of copulation, thus enhancing the fertility of hens.

I never observed juvenile males mating, even when opportunity arose. It is possible that juvenile males might mate late in the season, after May or June, with those hens attempting to renest. Adult males were leaving the females and returning to their winter flocks by late April. The juvenile sibling groups, having just separated from their previous winter flock at this time were often alone with particular females, and strutting. Considering the non-breeding adults and the juveniles, 65 percent of all males did not breed. There was no indication that this resulted in females going unmated. Although 35 percent of the males could have bred, the few dominants on the display grounds were the most active breeders. Thus in any one year, a small percentage of the actual male gene pool is passed on.

CHAPTER IV

THE NESTING AND REARING SEASON

Rio Grande turkeys nested and reared their young on the study area. It was difficult to determine the exact number of hens using the area during the nesting period. Ground vegetation was high and the birds were seldom visible except when on the roads or in openings. Hens were wary through this period, usually crouching to hide when they were approached. This combination of behavior and environment forced me to base most of my data for the nesting and rearing season on the numbers present in mid-August. Although I saw a majority of the birds periodically throughout the summer period, I do not consider that I had a complete count until mid-August. The number of young alive in August is considered to be the number of young raised.

Nesting

Nesting Period

Nesting activity began in late February in 1966. Hens were mating, and behavior indicated some were laying eggs. In 1967 it began one full month later. The wild turkey lays one egg each 25 hours during the daylight hours. The first clutch averages about 14 eggs, and is completed in 15 or 16 days. Incubation period requires another 28 days (Latham, 1956).

I aged the poults in the field and determined dates for nesting by back-dating. The first brood hatched during the third week of

April in 1966. Very few nests survived the flooding in late April and early May in 1966. As a result the peak of hatching, both numbers of young and number of broods occurred at the beginning of the third week of June (Figure 13). Very few nests hatched between late April and this time.

Renesting

Allowing for an adjustment in physiology, laying, and incubating, it seems evident that the peak of the 1966 hatch was a result of renesting after the flood. Turkeys are not commonly reported to renest. One hen incubated a clutch of 18 eggs for 27 days before losing her nest to predators. This hen made a second unsuccessful attempt, and possibly more. The last renesting attempts hatched in early August. Hatching thus covered a five-month period in 1966.

Nesting Statistics

In mid-August there were 124 hens in the population in 1966, and 105 in 1967. At this time in 1966, 75 percent of all adult hens on the study area had tags and in 1967, 90 percent had tags. About 200 hens began each nesting season on the study area. Several factors contributed to the decrease between the beginning and the end of nesting. Many hens moved to adjacent areas after the first nesting attempt. Likely the 200 included some late nesting non-residents which left the study area before nesting. Further, the nesting period would be expected to be a high mortality period for hens. Since 40 percent annual mortality can be expected, many ot the birds must have died between early spring and mid-August.

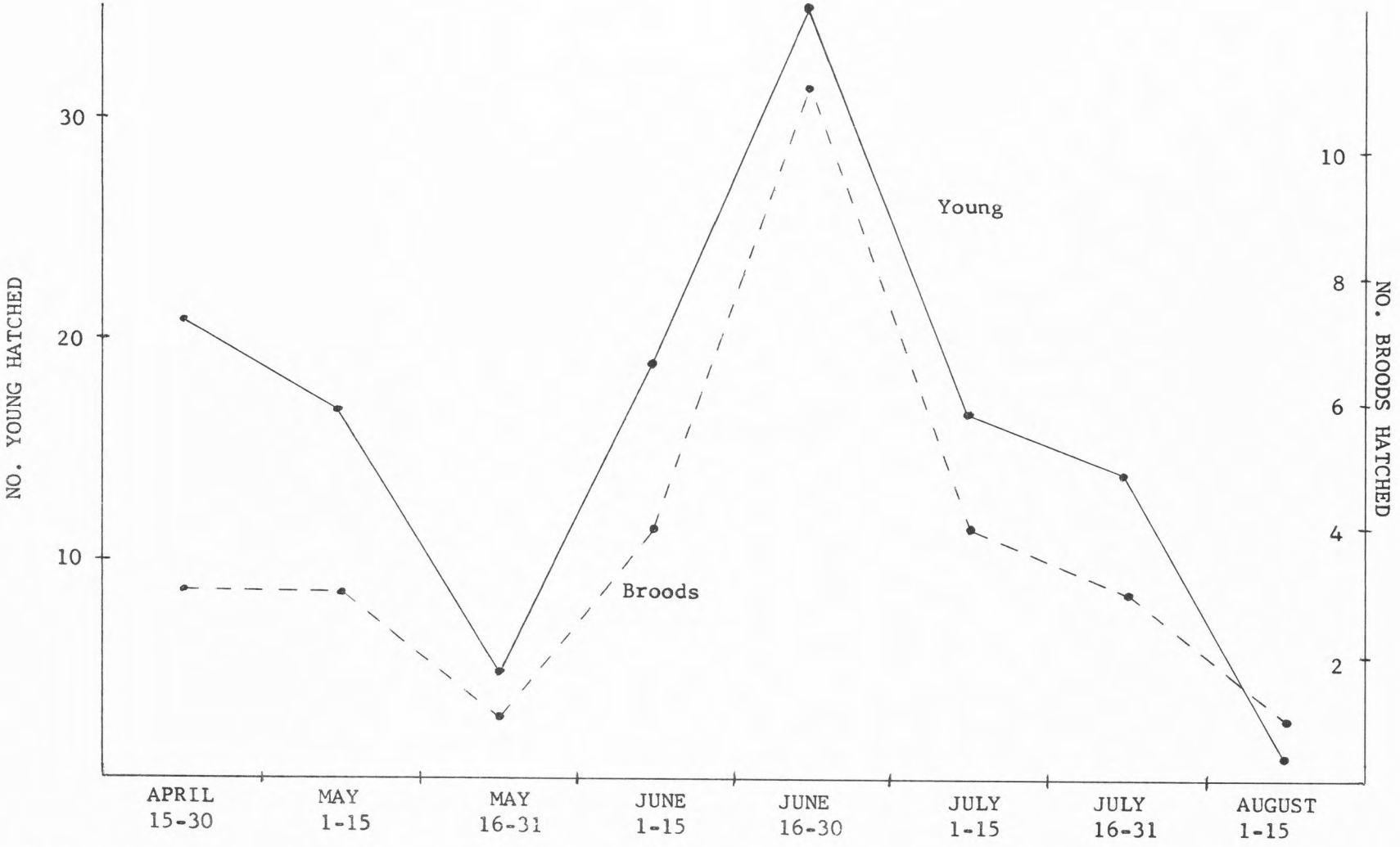

Figure 13. Number of broods and young hatched during 15-day periods in 1966.

In 1966 all females showed nesting behavior. A hen observed alone on a particular area on more than one occasion or a hen missing from a nesting group more than once was considered as showing nesting behavior. In most cases I did not find the nest.

The importance of the first and second year age classes to the productivity of the population is shown in Table 2. Twenty-two percent of the females with young were 1 year old and they produced 22 percent of the young. Thirty-three percent of the females with young were 2 years old and they produced 31 percent of the young. One year old birds comprised 34 percent of the total female population, whereas the 2 year old birds made up only 18 percent. Only 19 percent of the 1 year old females were successful in rearing young to August, whereas 55 percent of the 2 year old birds were with young. I feel that a smaller percentage of the 1 year old birds persisted in renesting, based on nesting behavior, thus explaining why only 19 percent of the age class were with young. Conclusions are based on 36 marked hens with young. The only flocks considered are those where I know that all hens with the flock contributed young. In three composite broods where the actual number of young contributed by each hen was unknown, the hens were given an equal share of the total.

As in other birds (Lack, 1954), brood size late in the season was smaller than that for earlier broods. Broods which hatched before June 30 had $5.5 \pm .43$ poults per hen and those after June 30 had $2.6 \pm .44$ poults per hen. The difference in brood size was significant ($P < .01$). This again was based upon the numbers surviving in mid-August, thus the difference in clutch size may have been even

Table 2. Ages of hens with young and the number of young produced in 1966.

	Age Class		
	1	2	over 1, but age unknown
Percent of all hens in population	34.4	17.6	48.0
Number of hens with young	8	12	16
Number of young produced	32	46	69
Percent of all hens with young	22.2	33.3	44.4
Percent of the young produced by each age class	21.8	31.3	46.9

greater if I had considered poults of equal age.

In 1966, a better-than-average year for reproduction, the population produced 1.4 poults per hen. The sex ratio of 180 poults on September 1 was 47 percent males to 53 percent females (no statistical difference).

In 1967 only 4 or 105 hens had young. As determined by winter weights the birds began the 1967 season in poorer condition than in 1966. This was a reflection of the dry winter conditions. A large percent of the hens showed no nesting behavior in 1967. Few yearlings showed nesting behavior and few of any age class appeared to renest.

Rearing

Flocks Combining

After hatching, brood flocks of about equal age and using the same area often combined into composite brood flocks with more than one hen (Chapter 2). Contact among broods was not as uncommon as might be expected, because of the fact that a majority of the broods concentrated in certain areas. Females used most of the 8,000 acres of the Refuge for nesting. But soon after hatching hens and young moved off the clay soil, which covered one-half of the area, onto sandier soil. This was virtually the only season of the year that turkeys used the vegetation types on the clay soil. Of the 12,610 observations of individuals, covering 12 months, only 160 were on clay soil. Much of the movement to the sand was explained by the difference in availability of preferred foods between the soil types. Insects, particularly grasshoppers, were presumably an important

part of the young birds' diet, and they appeared far more plentiful on sandy soil. In addition to the young concentrating on the sandy soil they also concentrated at roost sites, which they used regularly once they were 2 weeks old. This likely facilitated the formation of composite broods.

Flock Mixing and Loss

During the first 6 weeks of life, flock mixing was not uncommon. The number of poults in several brood and composite brood flocks varied 20 percent from day to day. Also, a number of hens that successfully hatched young failed to raise them because they were partially or entirely lost to another brood. This was particularly true when a hen had only one poult. The poult joined another brood and it depended upon the compatability of the two females whether the mother joined or not. I recorded three cases of a hen losing all her poults to another brood and three additional situations where a portion were permanently lost. It appeared that after 6 weeks of age the number of poults in a flock remained stable, excluding death, and continued so until winter.

Males

Some adult males began returning to their winter roosts in April. They often accompanied female nesting groups during the day, but gave up roosting with the females.

The number of males remaining on the winter area throughout the breeding season varied. I followed 83 marked adult males through the spring of 1966. Figure 14 shows the number not on the winter range

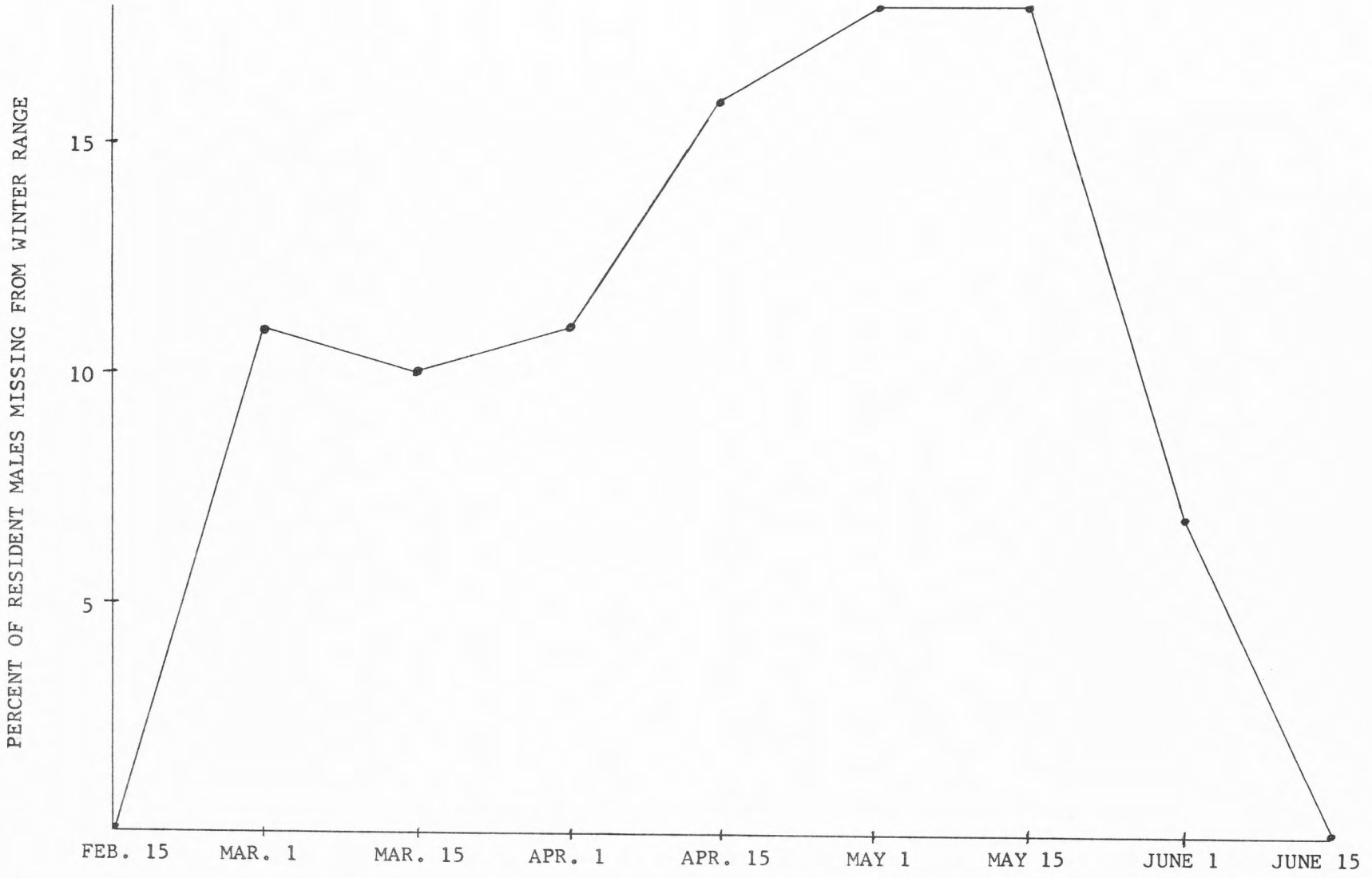

Figure 14. Movement of adult male turkeys from their winter range during the 1966 breeding season.

during various periods. Ten percent left the winter range while the display grounds were active and this increased to 20 percent as hens spread out into nesting groups. As is evident, 80 percent of all males did not leave the winter range during the entire breeding season. Subordinate, usually younger males returned latest. It is likely that these males, possibly even the one year old males, were the breeders for late renesting hens.

Discussion

The importance of social behavior in population regulation of turkeys cannot be adequately answered by a 2-year study. Some aspects of behavior as they affect natality, mortality and dispersal are worthy of mention.

I consider those turkeys that both bred and wintered on the study area to be a population. In both years the pre-breeding number was about 400. W. C. Glazener (personal communication) feels the number of turkeys on the study area varied little from 1958 to 1967. I will discuss only those factors influencing the fluctuations about the mean of 400, and not the long term regulation which balanced the population at 400 instead of at say 50 or 1000.

The clutch size of each female is about 14 eggs. Fewer than two young per female per year need survive to maintain the population balance. I believe this difference between clutch size and needed survival would mask the importance of any minor changes in clutch size caused by changes in the density of breeding adults.

All the receptive females were bred, regardless of age or rank. Thus the hierarchial imposed limitations on the number of males

breeding did not affect the population directly by leaving females unmated. The genetic implication created by only 35 percent of the males passing on genes is not understood. This may likely be the major influence of social behavior in population regulation of turkeys.

The most important factor affecting natality was not behavior, but climate. Only 4 of 109 hens successfully hatched a brood in 1967. In 1967, the absence of rainfall as it affected vegetation growth for food and perhaps nesting cover appeared to reduce natality. Breeding was delayed, likely reducing clutch size. Yearling females did not breed, eliminating 35 percent of the potential breeders. There was no renesting of any age class, a factor responsible for the bulk of reproduction in 1966, a year of favorable rainfall. I did not collect females to check if the failure to produce young in 1967 was actually due to not producing eggs, or just excessive mortality of nests and small young because of lack of cover.

I have little data covering mortality of nests or small young. Mortality during this phase was great. In 1966, when all females appeared to breed and nest, only 1.35 young per female were present in the population in August. Because numbers of adults were nearly equal during the two years of my study I cannot compare changes in adult density to changes in mortality.

Table 1 shows 40 percent of all males are juvenile, and that 40 percent of all the adults are yearlings. In a balanced population this 40 percent must also equal the annual mortality rate as it does in my calculations of mortality. Forty percent may seem a very high mortality rate for such a large bird. Mortality must be great to

compensate for the large genetically determined clutch size of turkeys.

Mortality figures for females are based wholly on the fact that mortality must equal recruitment in a balanced population. In the summer of 1966, 34 percent of the females were yearlings. In the winter of 1966-1967, 39 percent were yearlings. These figures do not vary much from the 40 percent of males, thus mortality rate is likely quite similar to that of the males. I cannot directly relate social behavior to changes in mortality. Some areas surrounding the study area are unfavorable habitat, and an increase in mortality may accompany any dispersal into this habitat.

Adult males aggressively force juvenile males to disperse during the spring breeding season. This statement is made on the basis of individual flock behavior rather than on total population numbers. There is dispersal only if there are more juvenile males than are needed to maintain numbers. There was little dispersal from my total population in either year because the population numbers had adjusted to the mean density by spring. As there is dispersal from the areas of individual flocks I see no reason that it would not have happened at the population level in years of higher survival. I do not know what factors are important in the dispersal of juvenile females based on my two years of study.

Both lower natality and increased mortality act to push the potential numbers, created by a clutch size of 14 eggs, down to the mean density. I feel that the minor changes in natality and mortality due to changes in population density, as reported for some bird species, could not be of major importance in regulating a population

where fewer than two young of a potential of 14 are needed to maintain balance. The climatic affects on natality and mortality are of such magnitude that it alone may erase all recruitment in some years. Only if lowered natality and increased mortality, chiefly affected by climate, fail to push the number to the mean will behavior have an obvious role in limiting the population. Based on flock behavior, adults would cause dispersal of one-year old birds during the breeding season. In both years of my study the population had been reduced to the mean before the breeding season and there was little dispersal from the population.

SUMMARY

After hatching, most poults remained with their mother as a brood flock until winter. Some brood flocks combined with other brood flocks to form composite brood flocks when the poults were a few weeks old. In several cases the hens were not compatible and only the poults joined another brood flock, thus resulting in a hen losing her brood. More often than a hen losing an entire brood was the shuffling of only some of the poults among broods. Hens not successful in rearing young combined with other unsuccessful hens to form broodless flocks.

The juvenile males left the brood flocks in late fall or winter. The males of each brood flock remained a distinct unit, the sibling group. These juvenile sibling groups joined others their own age to form juvenile male winter flocks. Female flocks, after losing their juvenile males, combined with other female flocks to form large winter bands of up to 200 females.

Adult male flocks were composed of sibling groups, and a hierarchy existed among these sibling groups. The males suffered 40 percent annual mortality. Survivors of a flock remained with flock members from the previous winter, and young sibling groups, usually yearlings, joined in summer or fall, thus maintaining flock numbers.

In spring the adult male flocks split into sibling groups for breeding. The sibling groups joined the female bands on display grounds. The social system at this time appeared quite similar to

that of lek species of grouse, with only the dominant male of the dominant sibling group mating on each display ground. Later in the breeding season the female bands split into flocks and returned to nesting areas where they later broke up into nesting groups of 2-5 females localized near their nests. The male sibling groups accompanied the females from the display ground. While the females were in nesting groups, the dominant male of each sibling group had opportunity to mate. I did not observe territoriality among the males during the breeding season. About 40 percent of all adults were subordinates within sibling groups, thus did not mate in any one season. These subordinates, plus the non-breeding juvenile males gave a total of about 65 percent non-breeders. Incubation or nest loss resulted in the disbanding of the female nesting group. This in turn led to formation of brood flocks or broodless flocks of hens.

The importance of social behavior to population regulation during the 2 years of this study was minimal. It seems that climatic effects of natality and mortality would regulate this turkey population in most years.

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VITA

Charles Robert Watts

Candidate for the Degree of

DOCTOR OF PHILOSOPHY

Dissertation: The Social Organization of Wild Turkeys on the Welder Wildlife Refuge, Texas

Major Field: Wildlife Biology

Biographical Information:

Personal Data: Born at Whitehall, Montana, August 10, 1940, son of Charles E. and Wanda Watts; married Nancy Hoenstine June 13, 1964.

Education: Graduated from Whitehall High School, Whitehall, Montana in 1958; received Bachelor of Science degree from University of Montana, with a major in forestry, in 1962; received Master of Science degree from Pennsylvania State University, with a major in wildlife management, in 1964.