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WILD TURKEYS IN ALLEGAN COUNTY, MICHIGAN

Thesis for the Degree of M. S.
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ABSTRACT

WILD TURKEYS IN ALLEGAN COUNTY, MICHIGAN

by James C. Lewis

In 1954, 202 wild turkeys were released in the Allegan State Forest, Allegan County, Michigan. The 1954 winter census indicated a minimum survival of 43 percent. The maximum known movement of a banded turkey from an Allegan Forest release site was 10 miles, and 22 banded turkeys were recovered an average of 2.5 miles from the release site. The maximum occupied habitat in the first summer following release was 195 square miles. The 1958-59 winter census indicated a population of 248 turkeys were occupying 233 square miles.

Census methods involved observation of live birds and their field signs. The winter census seemed to be potentially the more accurate, primarily due to tracking opportunities, and to restriction of flock movements by snow, factors which reduced the chance of repeat counting.

The daily home range of 21 flocks containing 132 wild turkeys was studied during the winter of 1957-58. The area of the daily home range seemed to vary inversely with snow depth and directly with temperature; however, positive relationships were somewhat obscured by other influencing factors. Twenty-nine measurements of the area contained within the limits of the daily movements of turkey flocks varied from 2 to 160 acres and averaged 49 acres. The home range used throughout the winter averaged 683

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acres for 8 flocks of gobblers only, 435 acres for 7 flocks of hens only, and 492 acres for 6 flocks of mixed sexes.

Flocks remained individually identifiable throughout the winter either by flock composition or the discreteness of flock ranges. The range of 86 percent of 132 turkeys bordered streams or lakes, and 74 percent of 19 winter roosts were found there. It was hypothesized that an efficient and economical census of turkeys in winter could be based on a search along streams and borders of lakes for turkeys and their signs in snow.

Areas with the highest turkey population densities, 6-10 and 3-5 turkeys per square mile, were characterized by well distributed streams and lakes, with their associated lowland hardwood timber types, and well dispersed clearings comprising about 10 percent of the total area. For 22 fields known to be used by turkeys, turkey use was greatest in those containing dense stands of grass and herbaceous plants and with tree and shrub reproduction scattered or absent. Fields larger than 6 acres seemed to receive the greatest variety of use by turkeys.

For five nests in which laying was thought to be complete the average clutch size was 13 eggs. For nine nests the hatching success was 33 percent. The average turkey brood size decreased from 10.2 poults in May to 6.0 in August. The population loss between summer and winter census averaged 57 percent and apparently reflected losses of poults as summer progressed.

A study of 41 droppings indicated that the Allegan flock was free from serious endoparasitic infections. Blackhead (Histomonas meleagridis)

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was the only disease known to cause losses in the flock. During the severe 1957-58 winter, close observation of 21 flocks and searches of major feeding and roosting areas failed to reveal dead birds or any reduction in the size of individual flocks.

Analysis of 860 turkey droppings revealed some important foods used by wild turkeys in the Allegan Forest. On the basis of volume, acorns(Quercus spp.) led the list along with grass seeds, berries, and insects. Winter field observations indicated that the most important food taken by turkeys during periods of deep snow was sumac (Rhus spp.) fruit.

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By

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INTRODUCTION

In March and September, 1954, wild turkeys were released by the Michigan Department of Conservation in Allegan County, southwestern Michigan. This was a portion of a program to reestablish the wild turkey in Michigan. The Allegan State Forest release area, including the Department of Conservation's 7,742 acre Swan Creek Wildlife Experiment Station lands, was the only one located in southern Michigan and the only one in which intensive studies were made.

The birds became established and increased during the 1954-1960 period. From June, 1957, to April, 1958, and from July to mid-September, 1958, I undertook field studies in the Allegan Forest in an effort to determine the habits and habitat requirements of these birds.

ACKNOWLEDGEMENTS

This was a cooperative study under the joint sponsorship of the Game Division, Michigan Department of Conservation, and the Department of Fisheries and Wildlife, Michigan State University.

I wish to express my gratitude to Charles E. Friley, Jr., Biologist in charge, to H. Lee Wilson, and to the other staff members of the Swan Creek Wildlife Experiment Station who gave their cooperation and assistance during the investigation. They provided field facilities and permitted the use of data obtained by them. I am grateful to the Game Division of the Michigan Department of Conservation also for financial assistance.

I wish to thank George A. Petrides, Professor, Department of Fisheries and Wildlife, Michigan State University, under whose guidance this investigation was undertaken. His helpful criticism during manuscript preparation is especially acknowledged.

Drs. B. H. ^gGrisby, H. T. Darlington, and John Beaman of the Department of Botany, Michigan State University, checked the identification of seeds collected during the food habits study. Dr. Rudolph A. Scheibner of the Department of Entomology identified insect remains. Dr. D. T. Clark of the Parasitology Department directed the endoparasite studies. The considerable assistance of all these persons is hereby acknowledged.

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HISTORY OF THE RELEASE AND ESTABLISHMENT

The original range of the eastern wild turkey (Meleagris gallapavo sylvestris Viellillot) included the southern portion of the lower peninsula of Michigan, largely south of a line from Saginaw Bay to Muskegon County (Leopold, 1931). Turkeys were fairly abundant within their Michigan range (Figure 1) until about 1875, after which they decreased rapidly. One shot in 1897 was the last recorded (Barrows, 1912).

Since the extermination of this largest of Michigan's upland game birds, there have been hopes that it could be reestablished. In 1919 and 1920, hand-reared wild turkeys were released by the Michigan Department of Conservation in Midland County. They were seen nearby until about 1925, but eventually disappeared. Private attempts to establish wild turkeys in Alcona, Oakland, Ogemaw, Livingston, Allegan, and St. Clair counties also failed (Ruhl, 1954).

In 1953, personnel of the Michigan Department of Conservation attempted again to determine the most promising location for a turkey restocking trial. They chose the Allegan State Forest because the habitat was similar to that recommended (Kozicky and Metz, 1948) for wild turkey management in Pennsylvania (Table 1). The 52,000-acre Allegan State Forest lies within 125,000 acres of commercial forest (Chase and Horn, 1950) in Allegan County, Michigan.

Oak-hickory (Anon., 1954:7) is the predominant timber type group in the uplands and associated types are white pine (Pinus strobus),¹ red

¹All scientific names of plants follow the eighth edition of Gray's Manual of Botany as revised by Fernald (1956).

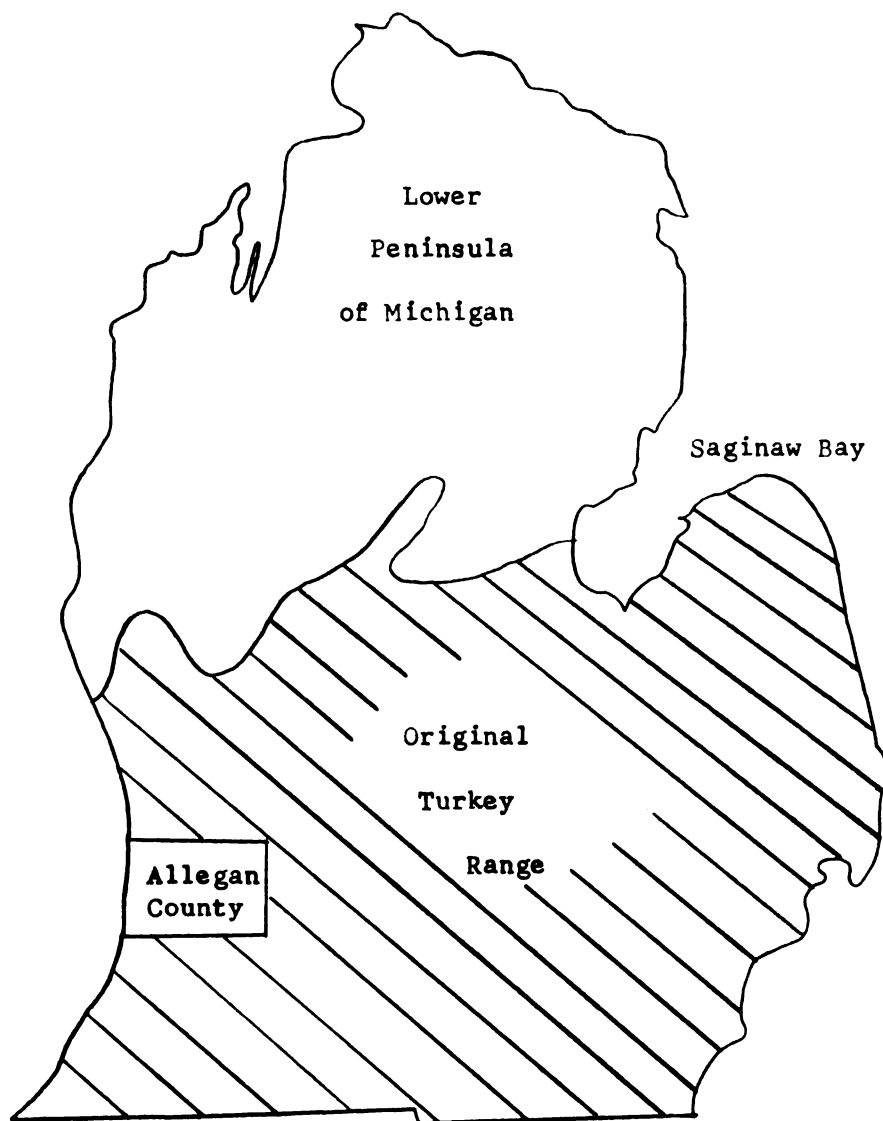


Figure 1. Original range of the wild turkey in Michigan and the Allegan County Release Area.

Table 1. A comparison of characteristics of wild turkey ranges in
 Pennsylvania (Kozicky and Metz, 1948) and Allegan Forest,
 Michigan, 1957

Criterion	Pennsylvania	Allegan Forest
Size of area	10,000 to 15,000 acres 3,000 minimum	50,902 acres state and private
Timber types	60 to 80% oak 10 to 15% pines 5 to 30% clearings	61% oak 10% pines 8% clearings 12% lowland hard- woods 9% miscellaneous
Timber size	4-12 inch red, black, white oak, 10-15% saplings for escape cover	27% 30%
Food	Oak, black cherry, beech, flower- ing dogwood, wild grapes, green- brier, grasses, and under marginal conditions field patches of corn, winter wheat, and red clover.	All those recom- mended plus a variety of other food plants of known value.
Water	Open creeks, springs	Kalamazoo River drainage system, lakes, and springs

pine (P. resinosa), and jack pine (P. banksiana). Cover types in the lowlands include aspen (Populus grandidentata), American beech (Fagus grandifolia)- sugar maple (Acer saccharum), and silver maple (Acer saccharinum)- American elm (Ulmus americana). The topography is slightly undulating except adjacent to the Kalamazoo River and streams, where steep slopes are common.

In March, 1954, 50 wild turkeys were purchased from the Allegheny Wild Turkey Farm of Julien, Pennsylvania. The birds were offspring of three-fourths wild hens which had mated with wild gobblers. They were banded and released promptly at six sites within a 26 square-mile area in the Allegan Forest. In June, 1954, 400 wild turkey eggs were purchased from the same source and sent to the State Game Farm at Mason, Michigan. From these eggs, 152 fourteen-week-old turkeys were raised, banded and released in the Allegan Forest in September, 1954.

Survival

Heavy losses characterized the immediate release period in the new location. Eighty-five turkeys were located by Game Division personnel during the 1954 winter census, indicating a minimum survival of 43 percent.

Twenty-two dead banded turkeys were recovered. These had survived an average of 7.5 months after release, but 59 percent of the total band recoveries occurred in the first three months following release.

If band recoveries were a representative sample (Table 2), those birds that wandered greater distances died earlier than those which remained near the release site. Turkeys that moved further from the release

Table 2. Recovery times and distances from release points of wild turkeys recovered dead, Allegan County, Michigan, 1954-58

Days Since Release	Distance in Miles from Release Site					Totals
	0-2	2.1-4	4.1-6	6.1-8	8.1-10	
0-200	7	4	1		1	13
201-400		3		1		4
401-600	1		1			2
601-800	1					1
801-1,000		1				1
1,001-1,200	1					1
Totals	10	8	2	1	1	22

point apparently found less favorable habitat or were otherwise more susceptible to poaching, predation and accidents.

Increase of Range Occupied by Turkeys

The maximum known movement of a banded turkey from an Allegan Forest release site was 10 miles. However, 22 banded turkeys were recovered an average of 2.5 miles from the release site. Band recovery points seemed to reflect a movement of released turkeys along the Kalamazoo River and its tributaries. Agricultural areas bordered by timbered slopes and bottomlands are common along this river system.

To determine the area of occupied habitat, all turkey observations were mapped. Circles of 2 mile radius were plotted around each sighting point and the outermost points circumscribed. The 2 mile distance was the flock cruising radius as observed in Virginia (Mostly and Handley 1943: 207).

On this basis, the maximum occupied habitat in the first summer following release was 195 square miles. In the next four years, this area increased by only 38 square miles (Table 3). The summer population counts indicated population densities which increased from 1.0 bird per square mile in 1955 to 2.3 in 1959. The winter census indicated an increase from 85 turkeys in 1954-55 to 248 in 1958-59.

CENSUS METHODS

Techniques

Our census periods were relatively long, extending from May 6 to August 19 and November 23 to March 31. In order to avoid repeated counting

**Table 3. Areas of wild turkey occupied habitats, population estimates,
and population losses between summer and winter censuses,
Allegan County, Michigan**

	Year					
	1954	1955	1956	1957	1958	1959
Occupied Summer						
Range (Square Miles)	152	195	216	226	233	233
Total Populations:						
Summer	30	200	250	370	460	547
Winter	85	75	112	145	248	
Percentages of Population						
Lost between Summer and Winter		63	55	61	48	

of the same birds, observations were plotted on a map and flock composition recorded. Sexes, ages, and numbers of turkeys were noted and attempts made to delineate the range of each flock. Most groups were individually identifiable by unique characteristics of sex and age composition, range, roosting areas, or unusual tracks. In the Allegan Forest, individual flocks of turkeys were identified by observing turkeys and by measuring tracks (Mosby and Handley, 1943:108; Williams, 1959) and droppings (Bailey, 1956:220).

Some of the Allegan Forest summer census data was provided by co-operators who reported observations of turkeys. The cooperators included rural mailmen, forestry employees, county road employees, and forest residents. They were given postcards addressed to the Experiment Station and were asked to report the date, time, location, sex, and age of turkeys observed. To retain their interest, they were also contacted periodically.

Observations made by Michigan Game Division personnel were an important part of the summer census, especially for the remote forest areas. These included observations of turkeys, turkey tracks in sandy areas along trails and fields, and other turkey signs.

The winter census was judged, by the author, to be potentially the more accurate. This was due to tracking opportunities and restriction of flock movements by snow, each of which reduced the chance of double-counting.

A Systematic Winter Survey

What may prove to be an economical census became apparent when the winter movements of turkey flocks were examined on a map of the county (Figure 2). The daily home range of most flocks bordered lakes or streams.

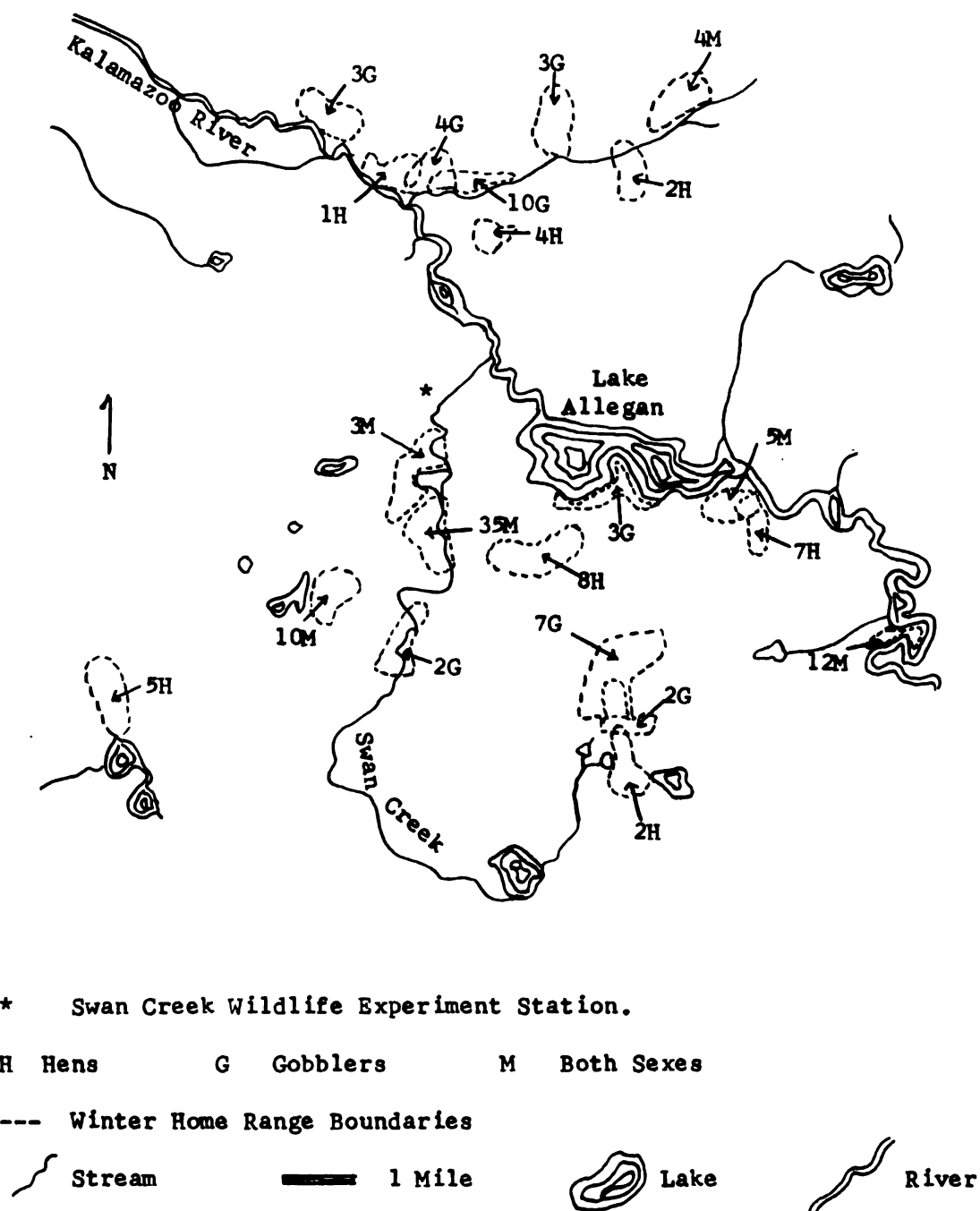


Figure 2. Wild turkey winter home ranges, Allegan County, Michigan,
December 24, 1957 to March 1, 1958.

Census lines along stream and lake borders would intersect most daily flock ranges.

Biologists in Pennsylvania and West Virginia noted the importance of streams and springs as a part of winter feeding and/or roosting habitat (Glover, 1948:427; Kozicky and Metz, 1948:27; Bailey, et al., 1951:15; Latham, 1959:415).

On the Allegan County study area, a streamside type of survey would require only 75 miles of linear census. Five to 10 miles might be completed per man day, depending on the number of flocks encountered. Occupied turkey habitat could be censused in this manner wherever snow remains on the ground for several weeks. This census could be designed as a total count or simply as an index to population trends. The systematic winter census would determine population size, with presumably more accuracy than at other seasons, and sex and age composition which could not be obtained as easily or accurately at other seasons.

Two conditions must be met before such a census would be reliable and practical. First, a majority of the flocks in a census unit, preferably a known percentage, must range along a stream or lake. Eighty-six percent of the Allegan turkeys were found to range along stream and lake borders. Field observations indicated that the turkeys spent 34 percent of their time in the mixed hardwood forest in the lowlands, and 74 percent of 19 winter roosts were found along streams. When storms and deep snows further restricted the size of daily home range, flock activities were centered around lowland habitat for both feeding and roosting. During fair weather the turkeys increased their home range by traveling more in upland areas.

Consideration should be given to the possibility that at higher population densities more of the flocks might be forced into the upland away from the choice habitat along streams. This would require study over a longer period than was available to the author.

The second condition for a systematic winter census is that each flock must remain identifiable from other flocks, either by flock composition, or by distinctly separate home ranges. Data from Allegan County indicated that this condition would also be met. In two cases flocks occasionally fed or roosted together where their home ranges overlapped. A flock of 35 turkeys sometimes broke up into smaller groups but remained within the same home range. Each flock remained within a particular habitat unit throughout the winter and retained its identity in spite of occasional mixing of flocks. There is a possibility that the ranges would be less discrete at high population levels.

FLOCK PRODUCTIVITY

Clutch Size and Nesting Losses

In the Allegan Forest, five turkey nests were seen in which laying was thought to be complete. In these nests the average clutch size was 13 eggs. In ~~West~~ Virginia, (Mosby and Handley, 1943:124) the average clutch was 11 eggs.

Of nine turkey nests found in the Allegan Forest, four were broken up by unknown predators and two were destroyed by farming operations. Hatching success ^{of} nests was 33 percent. In Virginia, McDowell (1956:12)

found a statewide nesting success of 35 percent. In Missouri, Dalke, et al. (1946:50) recorded a nesting success of 38 percent among 29 nests.

Brood Size

The average brood size decreased from 10.2 poults in May to 6.0 in August (Table 4). In Virginia, a larger series of similar observations (McDowell, 1956:16) showed a less pronounced but evident decline from 10.9 poults in May to 8.5 in August.

During the 1957 and 1958 summer census and the 1957-58 winter census, 124 gobblers and 137 hens were observed, indicating a sex ratio of 48:52 on the Allegan area.

DAILY HOME RANGE

Daily Winter Home Range

Intensive turkey tracking studies were undertaken in the winter of 1957-58 by the author and the primary purpose of these observations was to determine daily range and other winter habits. A systematic search of the 233 square miles of occupied range was not attempted; however, 21 flocks containing 132 turkeys were located and most of the forest area was checked for other flocks. Thirteen additional turkeys were reported by cooperators but were not personally observed. Eight percent of the maximum occupied habitat was known to be utilized by turkeys in winter.

The area included within the limits of a day's movement by a flock was measured on 29 occasions. This daily range acreage varied from 2 to

Table 4. A comparison of complete wild turkey broods in Virginia
(McDowell, 1956) and Allegan County, Michigan, 1955-59

Month	Virginia		Allegan County	
	Number of Broods	Average Brood Size and Standard Error	Number of Broods	Average Brood Size and Standard Error
May	29	10.9 $\pm$ 4.1	4	10.2 $\pm$ 4.6
June	124	10.8 $\pm$ 4.4	31	8.4 $\pm$ 4.1
July	95	9.2 $\pm$ 3.6	67	7.9 $\pm$ 3.7
August	76	8.5 $\pm$ 3.9	52	6.0 $\pm$ 3.1

160 acres, and flocks walked a maximum of 4 miles daily. The average daily home range size observed was 49 acres. Allowance must be made for the fact that more observations were made when the snow was deepest.

Daily home range size generally decreased when snow depths exceeded 10 inches and temperatures dropped below 20°F. The correlation ratios for temperature versus range acreage and snow depth versus range acreage were low, indicating that other factors, such as flock composition, food availability, and perhaps wind velocity, also influenced range size.

In Allegan County and in Virginia (Mosby and Handley, 1943:232), turkeys stayed on the roost during snowstorms and when the snow was deep and soft. In West Virginia, Glover (1948:422) found ". . . the birds flew or traveled through the trees from their roosting sites to the feeding areas." during the periods of deep snow.

Seasonal Winter Home Range

The winter home range was considered to be the area over which a flock roamed during the period, December 24, 1957 to March 1, 1958. Winter home range size is a composite of all maps of the daily movements of individual flocks. For each flock this included observations of one or more entire day's activities plus several mappings of a portion of the flock's daily habits.

When sizes of home ranges in winter were tabulated, there appeared to be differences which were related to flock composition (Table 5). In winter, home ranges of flocks composed entirely of gobblers averaged 683

Table 5. Winter home range of wild turkeys, Allegan County, Michigan,
December 24, 1957 to March 1, 1958

Composition of Flock	Number of Turkeys Observed	Number of Flocks Observed	Winter Home Range (Acres)	
			Minimum- Maximum	Mean $\pm$ Standard Error
Gobblers Only	34	8	440-1200	683 $\pm$ 82
Hens Only	29	7	230-745	435 $\pm$ 58
Mixed Sexes	69	6	310-640	492 $\pm$ 46

acres; for flocks containing both sexes it was 492 acres; and for flocks containing only hens 435 acres. The t test indicates a significant difference between the winter home range of gobblers and hens at the 5 percent level. For this sample size the t test indicates no significant difference between the range size for mixed flocks and hens or between mixed flocks and gobblers. There was no apparent relationship between flock size and the range acreage they traversed.

Leopold (1944) indicated that segregation by sex in winter flocks was characteristic of native wild turkey stock and only weakly present in the hybrid strain. Michigan turkeys apparently group socially like native wild turkeys in other states.

While no specific study of the ranging habits of the wild turkey in winter was found in the literature, several authors have reported general observations on ranging habits. On one West Virginia study area (Glover, 1948:418) the advent of cold weather and snowstorms was attended by a reduction in daily movement to about a three-quarters of a mile radius, and flock movements were further restricted as the depth of snow increased. On another area Glover reports (1948:422) ". . . the flocks reduced their daily range to a radius of about one-half mile. A spring or run, a hemlock or spruce thicket, and a beech flat were usually found in the home range of each flock."

In discussing winter home range in Missouri, Dalke, et al., (1946: 25) noted that, ". . . movements may vary from a broadly elliptical area of four or five square miles to a long narrow area embracing one or two ridges. . .". In Alabama, the home range in early winter was thought to be less than 400 acres when food was abundant (Wheeler, 1948:22).

Summer Daily Home Range

Observations in the Allegan Forest also gave an indication of the area wild turkeys may traverse daily in summer. A flock of six gobblers was observed in the same locality throughout the season, alternately roosting in areas one and one-half miles apart. The gobbler's daily home range encompassed about a 2 square-mile radius.

HABITAT CHARACTERISTICS AND CARRYING CAPACITY

The locations of turkeys observed in summer, 1958, were plotted on vegetation maps. Three possibly distinct types of turkey range were delineated by plotting turkey population densities of 0-2, 3-5, and 6-10 birds per square mile.

Four sample areas, each of nine square miles, were chosen within these density regions (Figure 3) to determine what habitat conditions in the Allegan Forest were associated with low, medium, and high turkey populations. The type of habitat of each sample block was determined from a timber type map and by field observations.

The study of winter range indicated that open streams and springs were an important part of winter habitat. The maximum diameter of daily winter range observed by the author was 1 mile, hence this was used as a radius to measure water availability.

Sample areas 1 and 2 (Table 6) representing high and medium turkey densities, respectively, were characterized by well dispersed clearings comprising only about 10 percent of the total area and water, with its

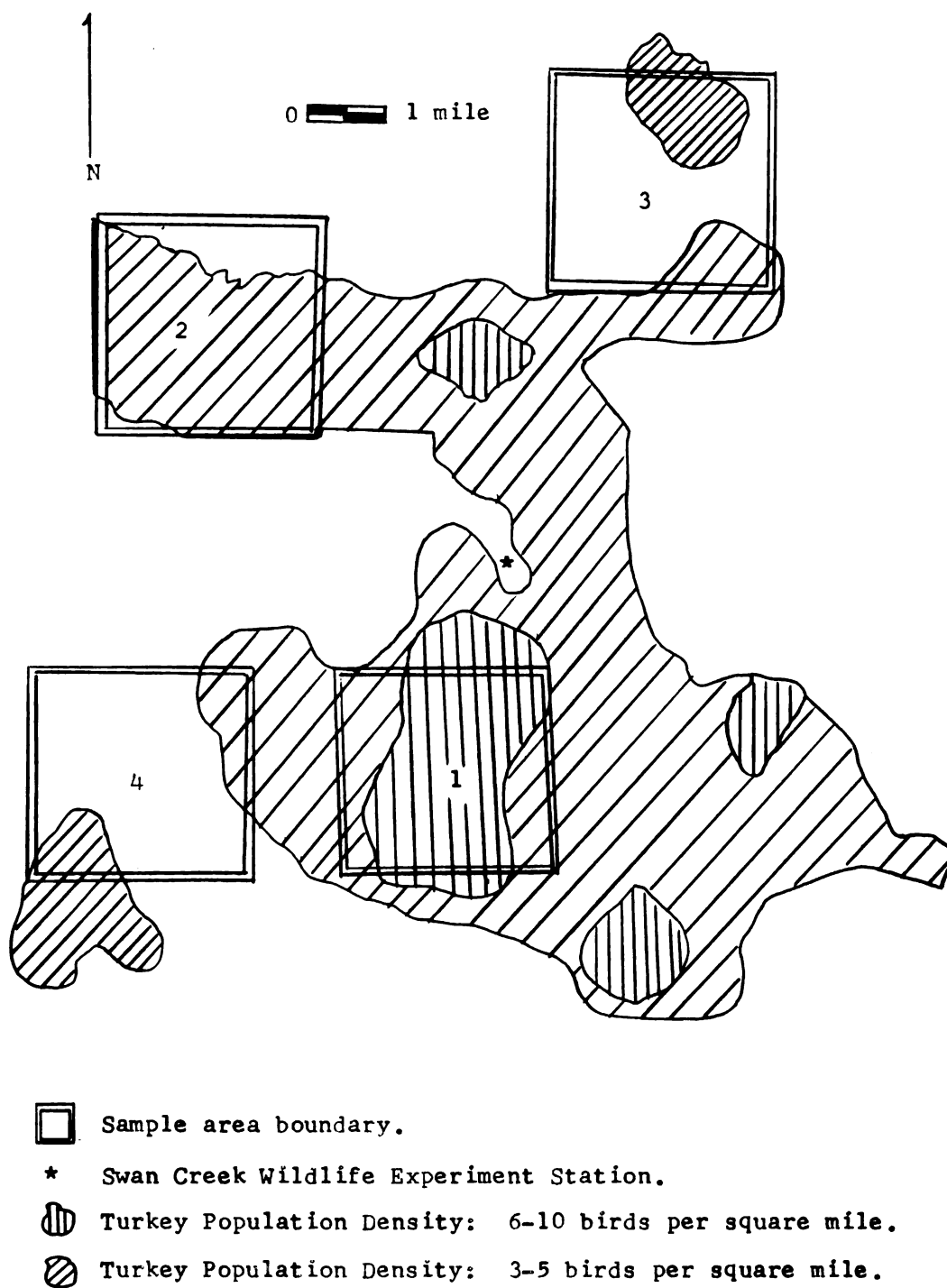


Figure 3. Wild turkey summer population densities and habitat study units, Allegan County, Michigan, 1958.

Table 6. Turkey population densities and associated habitat characteristics for four sample areas, Allegan Forest, Michigan, 1958

	Percentage Composition for Each Nine-Square Mile Area			
	Sample Area 1	Sample Area 2	Sample Area 3	Sample Area 4
Estimated Turkeys				
Per Square Mile	6-10	3-5	0-2	0-2
Percent of Area More Than				
One Mile From Water	8	3	33	50
Cover Type:				
Oak (9-16" dbh)	19	17	41	17
Oak (0-9" dbh)	44	37	27	23
Pine	9	2	2	5
Lowland Mixed Hardwoods	7	23	2	5
Aspen (<u>Populus</u> spp.)	9	9	5	17
Marsh	2	2	0	2
Clearings	10	10	23	33

associated lowland hardwood timber types, within 1 mile of nearly all the area. Conversely, low turkey population densities in sample areas 3 and 4 were associated with 23 and 30 percent clearings, and 33 percent of the area was over 1 mile from water and the associated lowland hardwood timber types.

The factors in areas 3 and 4 which made them less attractive as turkey range were thought to be insufficient water, a scarcity of lowland mixed hardwood habitat, and excessive open fields.

There was no apparent relationship between turkey population densities and soil types on the study area. Plainfield sand covered approximately 70 percent of the forest (Veatch, 1953) and 80 percent of 70 turkey observations were made on this soil (Wilson, 1958).

ROOSTING HABITAT

Ten turkey roosting sites were studied in summer and 19 in winter. Oak in the uplands contained 74 percent of the winter and 90 percent of the summer roosts. Twenty-one percent of the winter roosts were in pine, and 5 percent in lowland hardwoods. Hardwoods in the lowlands contained 10 percent of the summer roosts. Roost trees averaged 9 inches d.b.h. (trunk diameter at breast height) approximately 4.5 feet from the ground.

USE OF FIELDS BY TURKEYS

For 22 clearings known to be used by turkeys, vegetation density was studied on random square yard plots. The percent of ground covered by foliage, when viewed from directly above, was compared with observations of turkeys and tracks.

Use by turkeys was greatest in fields containing dense stands of grass and herbaceous plants and with tree and shrub reproduction scattered or absent. It appears that clearings being managed for turkeys should be kept free of most tree and shrub reproduction.

Fields were used by turkeys for dusting, nesting, feeding, and brooding. Fields larger than 6 acres seemed to receive a greater variety of use by turkeys than smaller fields.

MORTALITY

In Michigan (for 1955-1958) the average population loss between the summer and winter census amounted to 57 percent. These population decreases seemed to reflect reductions in average brood size as the summer progressed because, the summer census figure is the maximum recorded size of each brood and; between May and August brood sizes decreased 41 percent.

Weather and Mortality

Weather extremes reportedly cause turkey losses at two seasons. Wild turkey poults have been found to be vulnerable to cold and rainy weather during the first few weeks of their life (Latham, 1956). Severe winters also have caused losses estimated at 30 to 80 percent of some flocks in West Virginia (Glover, 1948:427).

The 1957-58 winter in the Allegan Forest was more severe than other winters following the release. Snow remained 26 inches deep for extended

periods and temperatures dropped to -17° Fahrenheit. However, close observation of 21 flocks and searches of major roosting and feeding areas revealed no dead birds or any reduction in the size of individual flocks. Glover (1948:426) reported that West Virginia's major winter turkey losses occurred in the beech-birch-maple-hemlock forest at high altitudes. The Allegan Forest habitat provided sufficient cover and winter food to support its wild turkey flock in good condition despite extreme winter weather.

Predation

No special effort was made to study turkey predators in the Allegan Forest but the animals reported important as turkey predators in Virginia (Mosby and Handley, 1943:132), the crow (Corvus brachyrhynchos), raccoon (Procyron lotor), opossum (Didelphis virginianus), striped skunk (Mephitis mephitis), and various hawks and snakes, were present in the Allegan Forest.

Turkey hunting has been prohibited since the birds' release. One poacher was apprehended and another chased. Several of the banded turkeys recovered had died of shot wounds. Most illegal turkey hunting is probably incidental to the hunting of other game species.

Disease and Parasites

Three diseased wild turkeys, exhibiting weakness and lethargy, were captured in the Allegan State Forest. They were autopsied at the Michigan Game Division Pathology Laboratory, East Lansing, Michigan, and yellow liver lesions typical of blackhead (Histomonas meleagridis) were observed.

Other diseases reported in wild turkeys (Latham, 1956) are fowl pox, aspergillosis, coccidiosis, and avian monocytosis.

In Pennsylvania wild turkeys, Wehr and Coburn, (1943) found tapeworms (Raillientina ransomi), cropworms (Capillaria contorta), gapeworms (Syngamus trachea), turkey ascarids (Ascaridia dissimilis), gizzard worms (Cheilospirura sp.), and a malaria-like blood protozoan (Leucocytozoon sp.).

In the summer of 1958 turkey droppings from the Allegan Forest revealed five percent of 22 refrigerated samples to contain eggs of caecal-worm (Heterakis spp.) and nine percent to contain cropworm (Capillaria annulata) eggs. All infections were pathologically insignificant. In 19 collections preserved in poly-vinyl alcohol and stained in an attempt to locate protozoan parasites, none were found. Apparently the Allegan flock was free, at that time, from serious endoparasitic infections.

FOOD HABITS

Droppings Analysis

Wild turkey droppings were collected in 1957 and 1958. They were dried and stored in bags. Later, the contents of 860 droppings were identified and an ocular estimate made of the volume percentage of the materials in each.

Food habits studies by dropping analysis cannot be used to learn the relative amounts of foods eaten. Jensen and Korschgen (1947) found that even the portions of foods in a bird's crop differs appreciably

from that eaten and yet that droppings gave as reliable an indication of the proportions of foods consumed as did stomachs. Dalke (1935) determined the seasonal food habits of ringnecked pheasants (Phasianus colchicus torquatus) in Michigan by examining droppings, and he found the results of dropping analysis to be very similar to those from crop analysis.

On the basis of volume, acorns led the list of important food items (Table 7) in the droppings. Other important foods were grass seeds, berries, and insects, all of species usually found in clearings. The value of clearings, as a necessary part of turkey habitat, must be emphasized. Droppings analyses of this study were similar to those in Pennsylvania (Kozicky, 1942) (Table 8).

Turkey Foods from Crops

Crops of five turkeys from the Allegan Forest were examined. The food items found which had not been identified in the droppings study were clover (Trifolium spp.) leaves, grass (Bromus spp.) seeds, grass (Cerastium spp.) seeds, bitterweed (Ambrosia artemissifolia) seeds, horse nettle (Solanum carolinense) fruit, stink bug (Euchistus variolus), butterfly (Hymenoptera spp.), crustacea (Porcellio spp.), and unidentified snail and bone fragments.

Field Observations of Feeding

Field observations of winter feeding activities showed that the birds spent the majority of their time feeding on acorns (Quercus spp.), greenbrier (Smilax spp.) berries and leaves, sumac (Rhus spp.) fruit,

Table 7. Wild turkey dropping contents, volume percentage, and numerical occurrence by seasons,

Allegan Forest, Michigan, 1957, 1958

Plant Group	Parts Eaten ²	Volume Percentage and (Numerical Occurrence) ¹				Annual Average
		Winter	Spring	Summer	Fall	
Oaks (<u>Quercus</u> spp.)	s	68.6 (239)	45.5 (165)	3.8 (89)	25.5 (26)	35.8 (519)
Grass family (<u>Gramineae</u> spp.)	s, l	tr. (40)	21.1 (153)	20.8 (230)	27.5 (52)	17.5 (475)
panic grass (<u>Panicum</u> spp.)	s			9.7 (215)	16.0 (37)	6.4 (252)
wheat (<u>Triticum aestivum</u>)	s, l		9.9 (60)		8.0 (9)	4.5 (69)
meadow grass (<u>Poa</u> spp.)	s		tr. (16)	1.6 (37)		tr. (53)
(<u>Agropyron</u> spp.)	s			tr. (1)	tr. (16)	tr. (17)
foxtail (<u>Setaria</u> spp.)	s			1.5 (13)		tr. (13)
quackgrass (<u>Agropyron repens</u>)	s			tr. (1)	tr. (7)	tr. (8)
catchfly (<u>Leersia lenticularis</u>)	s			tr. (5)	tr. (16)	tr. (21)
Rose family (<u>Rosaceae</u>)	s	tr. (32)	4.6 (86)	26.9 (176)	27.3 (73)	14.8 (367)
chokecherry (<u>Prunus virginiana</u>)	s		tr. (7)	7.5 (127)	17.5 (56)	6.4 (190)
southern dewberry (<u>Rubus trivialis</u>)	s			12.9 (166)		3.2 (166)
black cherry (<u>P. serotina</u>)	s	tr. (20)	2.0 (70)	tr. (13)	8.9 (17)	3.0 (120)

Table 7. Continued

Plant Group	Parts Eaten ²	Volume Percentage and (Numerical Occurrence) ¹				Annual Average
		Winter	Spring	Summer	Fall	
blackberry (<u>Rubus</u> spp.)	s		1.8 (16)	5.2 (64)	tr. (11)	1.8 (91)
climbing rose (<u>Rosa setigera</u>)	s	tr. (21)	tr. (30)	tr. (5)		tr. (56)
raspberry (<u>Rubus occidentalis</u>)	s		tr. (20)	tr. (26)		tr. (46)
Unidentified leaves			21.2 (110)	30.9 (170)	4.4 (11)	14.1 (291)
Sumac (<u>Rhus</u> spp.)	s	19.7 (113)	tr. (8)	1.1 (14)	tr. (6)	5.4 (141)
Insect (<u>Insecta</u> spp.)	b		tr. (9)	5.6 (120)	8.5 (27)	3.7 (156)
beetles (<u>Coleoptera</u> spp.)	b		tr. (9)	1.0 (61)	5.3 (26)	1.7 (96)
grasshopper (<u>Melanops</u> spp.)	b			tr. (30)	tr. (3)	tr. (33)
strawberry root weevil (<u>Brachykinus ovatus</u>)	b			1.8 (27)		tr. (27)
(<u>Calasoma scrutator</u>)	b			tr. (8)	1.5 (10)	tr. (18)
ants	b			tr. (6)	tr. (7)	tr. (13)
Grit (sand, gravel)		1.1 (99)	3.4 (152)	4.0 (93)	1.7 (51)	2.5 (395)
Smartwood (<u>Polygonum</u> sp.)	s		tr. (6)	5.4 (157)	1.7 (21)	1.9 (184)
Legumes (<u>Leguminosae</u> spp.)	s	1.7 (34)		1.2 (18)	1.6 (20)	1.1 (72)

Table 7. Continued

Plant Group	Parts Eaten ²	Volume Percentage and (Numerical Occurrence) ¹				
		Winter	Spring	Summer	Fall	Annual Average
vetch (<u>Vicia</u> spp.)	s	1.4 (29)		tr. (2)	tr. (5)	tr. (36)
alfalfa (<u>Medicago sativa</u>)	s			tr. (16)	tr. (13)	tr. (29)
black medick (<u>M. lupulina</u>)	s		tr. (3)			tr. (3)
Dogwood (<u>Cornus</u> spp.)	s	2.0 (80)	tr. (14)	tr. (5)		tr. (99)
Rootlets, unidentified	s		1.8 (48)	tr. (11)	1.1 (7)	tr. (66)
Greenbrier (<u>Smilax</u> spp.)	s	tr. (40)	tr. (16)			tr. (56)
Pine (<u>Pinus</u> spp.)	n	2.5 (17)				tr. (17)
Basswood (<u>Tilia americana</u>)	s		tr. (3)		tr. (11)	tr. (14)
Grape (<u>Vitis</u> spp.)	s			tr. (3)	tr. (10)	tr. (13)
Moss (<u>Bryophyta</u> spp.)	stipe			tr. (13)		tr. (13)
Plantain (<u>Plantago</u> spp.)	stipe		tr. (9)			tr. (9)
Spikenard (<u>Aralia racemosa</u>)	s	2.0 (9)				tr. (9)
Dock (<u>Rumex</u> spp.)	s			tr. (9)		tr. (9)
Labiatae (<u>Labiatae</u> spp.)	s			tr. (5)		tr. (5)

Table 7. Continued

Plant Group	Parts ² Eaten	Volume Percentage and (Numerical Occurrence) ¹				Annual Average
		Winter	Spring	Summer	Fall	
Wintergreen (<u>Pyrola</u> sp.)	s			tr. (5)		tr. (5)
Mountain ash (<u>Sorbus americanus</u>)	s			tr. (4)		tr. (4)
Nightshade (<u>Solanum dulcamara</u>)	s			tr. (2)		tr. (2)

¹ tr. = trace; ² l = leaves; s = seeds; n = needles; b = body.

Table 8. Important seasonal turkey foods in Pennsylvania (Kozicky, 1942) and Alleghen Forest,

Michigan, 1958, based on droppings analysis

Kind of Foods	Volume Percentage by Seasons					
	Spring		Summer		Fall	
	Alleghen Pennsylvania (208) ¹	Alleghen Pennsylvania (90)	Alleghen Pennsylvania (305)	Alleghen Pennsylvania (140)	Alleghen Pennsylvania (75)	Alleghen Pennsylvania (273)
Acorns	45.5	62.8	3.8	11.4	25.2	56.9
Misc. Veg.	34.2	19.5	38.9	35.9	9.0	17.5
Finger Grass				1.0		3.6
Sedge seeds				1.0		
Grass seeds			12.8	6.1	16.0	
Corn, wheat	9.9	7.3			8.0	18.4
Cherry	2.0	3.4	7.5	3.5	26.4	0.2
Grape		1.1	tr.	11.7	tr.	5.5
Insect	tr.	0.7	5.6	6.9	8.5	6.2
Grit	3.4	5.2	4.0	3.0	1.7	1.6
Huckleberry				15.1		3.0
Black gum				1.1		
Blueberry				2.3		

Table 8. Continued

Kind of Foods	Volume Percentage by Seasons					
	Spring		Summer		Fall	
	Allegan (208) ¹	Pennsylvania (90)	Allegan (305)	Pennsylvania (140)	Allegan (75)	Pennsylvania (176)
Buckwheat				1.4		
Dewberry			12.9			
Blackberry			5.2			
Sumac			1.1			19.7
Smartweed			5.4		1.7	
Legume			1.2		1.6	1.7
Dogwood					tr.	2.4
Pine						2.0
Spikenard						2.5
						2.0

¹Number of droppings examined.

black locust (Robinia pseudoacacia) seeds, white pine (Pinus strobus) needles, wintergreen (Pyrola spp.) leaves and berries, bittersweet (Solanum dulcamara) berries, jack pine (Pinus banksiana) seeds, moss (Lycopodium sp.) leaves, and grape (Vitis spp.) berries.

Based on field observations, the most common food taken by turkeys during periods of deep snow was sumac. Sumac fruit remained in clusters on the plant above the snow and were plentiful in and around forest openings. Greenbrier berries are persistent and were eaten by turkeys when available above the snow. White pine needles were a main item in the diet of two flocks when turkey movements were restricted by deep snows.

MANAGEMENT RECOMMENDATIONS

1. Turkey restoration releases should include enough birds to insure that sufficient breeding stock will remain after 50 percent losses during the first months following release.
2. Summer census work could be concentrated in July instead of throughout the May 6 to August 19 period. This would allow counting of late broods and avoid the greater ranging habits apparent when poults are larger, thereby reducing the chance for repeat counting. The winter census could be limited to January and February, when the snow is usually of sufficient depth to restrict turkey flock movements and allow a systematic tracking census.
3. Maintenance of pine stands for winter roosting near streams and lakes would seem to be desirable.

4. Approximately 10 percent of the area should be in fields, 6 acres or larger in size and free from trees and brush.

5. Sumac is an important winter turkey food and should be encouraged along trails and field borders.

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