To the Graduate Council:

I am submitting herewith a thesis written by Leslie F. Jones entitled "Evaluation of a Ruffed Grouse Restoration Attempt on the Western Highland Rim in Tennessee." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Wildlife and Fisheries Science.

Ralph W. Dimmick, Major Professor

We have read this thesis
and recommend its acceptance:

Accepted for the Council:

Vice Chancellor
Graduate Studies and Research

Thesis
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EVALUATION OF A RUFFED GROUSE RESTORATION ATTEMPT ON THE WESTERN HIGHLAND RIM IN TENNESSEE

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Leslie F. Jones

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ABSTRACT

Eighteen ruffed grouse (Bonasa umbellus) trapped in eastern Tennessee, were relocated to the Western Highland Rim, Cheatham County, Tennessee between August 1975 and May 1976. This thesis evaluates the first restoration attempt for ruffed grouse in Tennessee.

A total of 659 locations were made for 15 telemetered birds, 6 of which were alive at their last location. One untelemetered bird survived 26 months. The remaining 9 telemetered birds survived from 1/2 to 10 days.

Movements of the 9 longest-lived birds were analyzed based on change in mid-day location, home range size (based on 2 polygon methods) and dispersal from release sites. Birds had a mean change in consecutive mid-day location of 381 m, with greater movements indicated in the fall and winter. Home ranges of 9 birds determined by the convex polygon method varied from 8.1 to 458.6 ha. Dispersal of grouse from their release points exhibited a mean of 760 m with a maximum of 2688 m. Of the 6 grouse alive at their last location, 4 had maximum dispersals of over 1 km.

Apparent cover preference, nomadic behavior and prospect for restoration are also discussed.

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CHAPTER I

INTRODUCTION

The ruffed grouse (Bonasa umbellus) occupies an extensive range throughout the mixed deciduous and boreal forests of North America. In the eastern United States its range extends southward through the Appalachian Mountain chain where a combination of rugged topography and altitudinal temperature gradient produces areas with vegetative characteristics similar to some hardwood forests of the northeastern and north central United States.

To the west of the mountainous Blue Ridge Region of Tennessee, lie the Valley and Ridge, Cumberland Plateau and Eastern Highland Rim Regions, respectively. These latter three regions do not exhibit the extremes in relief of the Blue Ridge but the deeply incised valleys, especially of the Cumberland Plateau, produce microclimates that support localized vegetative assemblages which resemble those of the Blue Ridge Region.

Bump et al. (1947) indicated that in Tennessee the ruffed grouse attains its highest population densities in the Blue Ridge and Cumberland Plateau Regions with lesser and more localized populations occurring in the Valley and Ridge and Eastern Highland Rim Regions.

Schultz (1953), reporting on the results of a

statewide game survey, indicated the possible presence of the species in the Western Highland Rim Region. This area is similar to, but separated from, the Eastern Highland Rim by the Nashville Basin. Of the 30 grouse reports from this area of Tennessee, 22 were termed hearsay, 5 were personal observations by respondents and 3 were from farm respondents indicating the bird occurred on their farms. Schultz also stated that respondents in the northern counties of the Western Highland Rim reported the ruffed grouse as frequent to abundant in past years but scarce during the period of the study. Additionally, Schultz stated that the area superficially appeared to be ideal grouse habitat that--with proper restocking and protection--could be repopulated with the species.

The re-establishment of ruffed grouse in depleted ranges has been attempted in other states. The most notable attempt in recent years was a successful project in Missouri (Lewis et al. 1968). A total of 262 birds were wild-trapped in Ohio and Indiana and released on two separate areas in Missouri. Though grouse appear to be established on both areas, the authors stated that densities are low and occupancy of range beyond the release areas is limited. This successful release of wild-trapped birds followed an earlier failure in which pen-reared birds were released. The authors stated that Missouri is on the southwestern edge of the known ruffed grouse range and

that original populations were never as high or as uniformly distributed as those in more northern or eastern states.

In contrast, Moran and Palmer (1963) working in prime grouse range, introduced grouse on five of Michigan's Great Lakes islands where the birds were not found naturally. Release of wild-trapped birds was very successful with the populations exhibiting an irruptive build up to saturation levels in four breeding seasons. The release of disease-free, hand-reared birds on an additional island was an apparent failure.

The objective of this study was to re-establish grouse in the depleted ranges of the Western Highland Rim Region of Tennessee. Field reconnaissance and evaluations of climatic data for the Cumberland Plateau and selected areas of the Western Highland Rim indicated similarity between these physiographic regions in topography, vegetation and climate, supporting Schultz's belief that the latter region is capable of supporting populations of ruffed grouse.

CHAPTER II

DESCRIPTION OF THE STUDY AREAS

Ruffed grouse were trapped in two locations on the Cumberland Plateau and were released in one area on the Western Highland Rim. The two trapping locations were the Catoosa Wildlife Management Area, near Crossville, in Cumberland County and Fall Creek Falls State Park near Pikeville, which is located in eastern Van Buren and western Bledsoe Counties. The release site was on the Cheatham Wildlife Management Area near Ashland City in Cheatham County (Fig. 1).

I. GEOLOGY AND TOPOGRAPHY

Both the Cumberland Plateau and the Western Highland Rim Regions of Tennessee are underlain by sedimentary rock strata, though not by the same formations. The soils of both physiographic regions are generally less fertile than those in other regions of the state.

The Cumberland Plateau is bordered on the east by the Ridge and Valley and on the west by the Eastern Highland Rim. Both edges terminate in a steep escarpment capped by massive Pennsylvanian sandstones (Morris et al. 1948). The gently rolling surface of the Plateau is dissected by deeply incised young valleys producing local relief of 30.5-61 m. Elevations throughout the Plateau range from

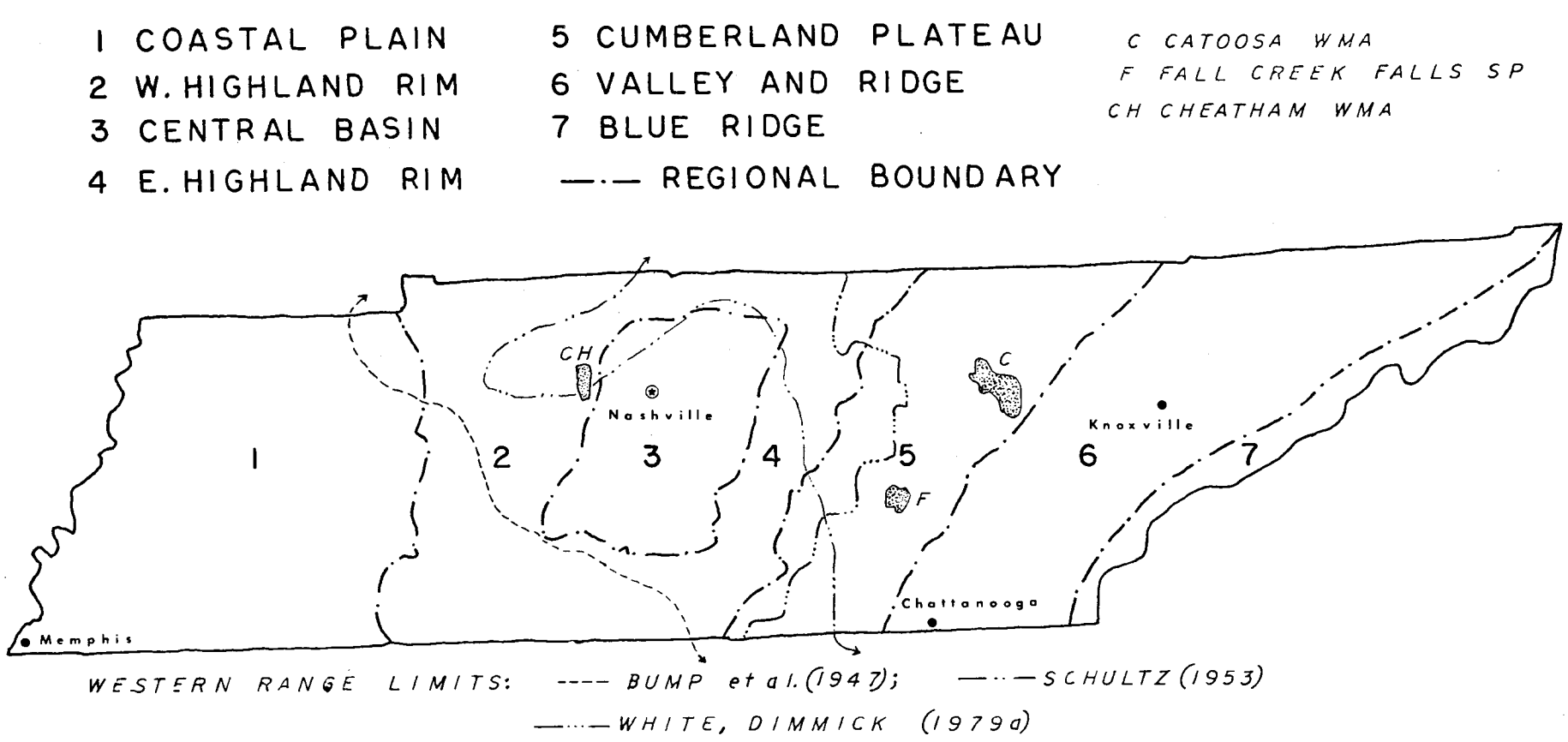


Fig. 1. Map of western range limits of ruffed grouse in Tennessee, physiographic regions and location of the study areas.

274.5-640.5 m above sea level (U.S.G.S. Topographic Map 1946).

The upland soils, derived from sandstone and shale parent materials, are generally thin and poor ranging from silty to sandy loams. Rocks of the Pennsylvanian Period, which underlie the Plateau contain several coal bearing formations which account for the majority of the coal mined in Tennessee. The predominate method of extraction is contour strip mining and the results of this industry are an obvious feature of the landscape (Hardeman 1966). Elevations on the Catoosa Wildlife Management Area range from 305-640 m. Local relief may reach 153 m but 15-61 m is more common. Slopes range from 0-66% with numerous vertical bluffs found along major watercourses. Catoosa is dissected by the Obed and Emory Rivers and by Clear and Daddy's Creeks. The uplands are gently rolling.

Fall Creek Falls State Park is very similar in topography with elevations from 305-549 m. The uplands are gently rolling with slopes of around 10%. Major watercourses are Fall, Piney and Cane Creeks. It is along these deeply incised streams that local relief is greatest with steep slopes and vertical bluffs forming a gorge nearly 153 m deep. Fall Creek plunges 78 m vertically into the gorge, making it the highest waterfall in the eastern United States.

The Western Highland Rim, bordered on the east by

the Nashville Basin and on the west by the Tennessee River, is capped by Mississippian Cherty Limestones. The escarpments on the eastern and western edges of the region are not as pronounced as those of the Plateau but are a noticeable feature of the region. Highest elevations of the region are 244-275 m above sea level. The mature dissected uplands exhibit sharp local relief of 61-92 m. The more level western half of the region has silty soils derived from the St. Louis Limestone which is more fertile than the poor cherty soils of the dissected eastern half derived from the Ft. Payne Chert (Cherry, unpublished manuscript).

The Cheatham Wildlife Management Area is located between the Cumberland and Harpeth Rivers in the area underlain by the Ft. Payne Chert and thus is characterized by poor cherty soils. The area is heavily dissected with narrow branching ridges and slopes of 0-60%, rendering it unsuitable for agriculture. It is drained by numerous small creeks.

II. CLIMATE

The climate of eastern and middle Tennessee is characterized by short mild winters and long warm summers (Matzek 1953). The growing season (140-210 days) is greatly influenced by a high, uniformly distributed, annual precipitation of 19.7-23.6 cm (Goldston and Getty 1956).

In order to compare the climates of the Cumberland Plateau and the Western Highland Rim, one weather station from each region was chosen and their data were utilized to construct climographs. Data from the Crossville Experiment Station represent the climate of the Catoosa and Fall Creek Falls areas on the Plateau. Cheatham Lock and Dam (formerly Neptune) data represent the climate of the Cheatham area on the Western Highland Rim.

For the period 1950-72, the mean annual temperature for the Plateau was 12.2° C with monthly means ranging from January's 0.8° C to 22.5° C in July. The average annual precipitation was 147.3 cm with monthly rainfall varying from 7.6 cm in October to 12.5 cm in March. Average snowfall was about 25.4 cm.

For the 17 years ending in 1972, the Western Highland Rim was generally warmer and drier than the Plateau. The mean annual temperature was 13.3° C. Mean monthly temperatures ranged from 0.8° C in January to 24.8° C in July. The average annual precipitation was 121.9 cm with monthly rainfall varying from 6.4 cm in October to 12.7 cm in March. Average snowfall was 20.3 cm.

The comparative climographs (Figs. 2 and 3) graphically depict the differences in temperature and precipitation of the two regions. It should be noted that while the weather was erratic during this period, the trend toward a cooler, wetter climate on the Plateau persisted.

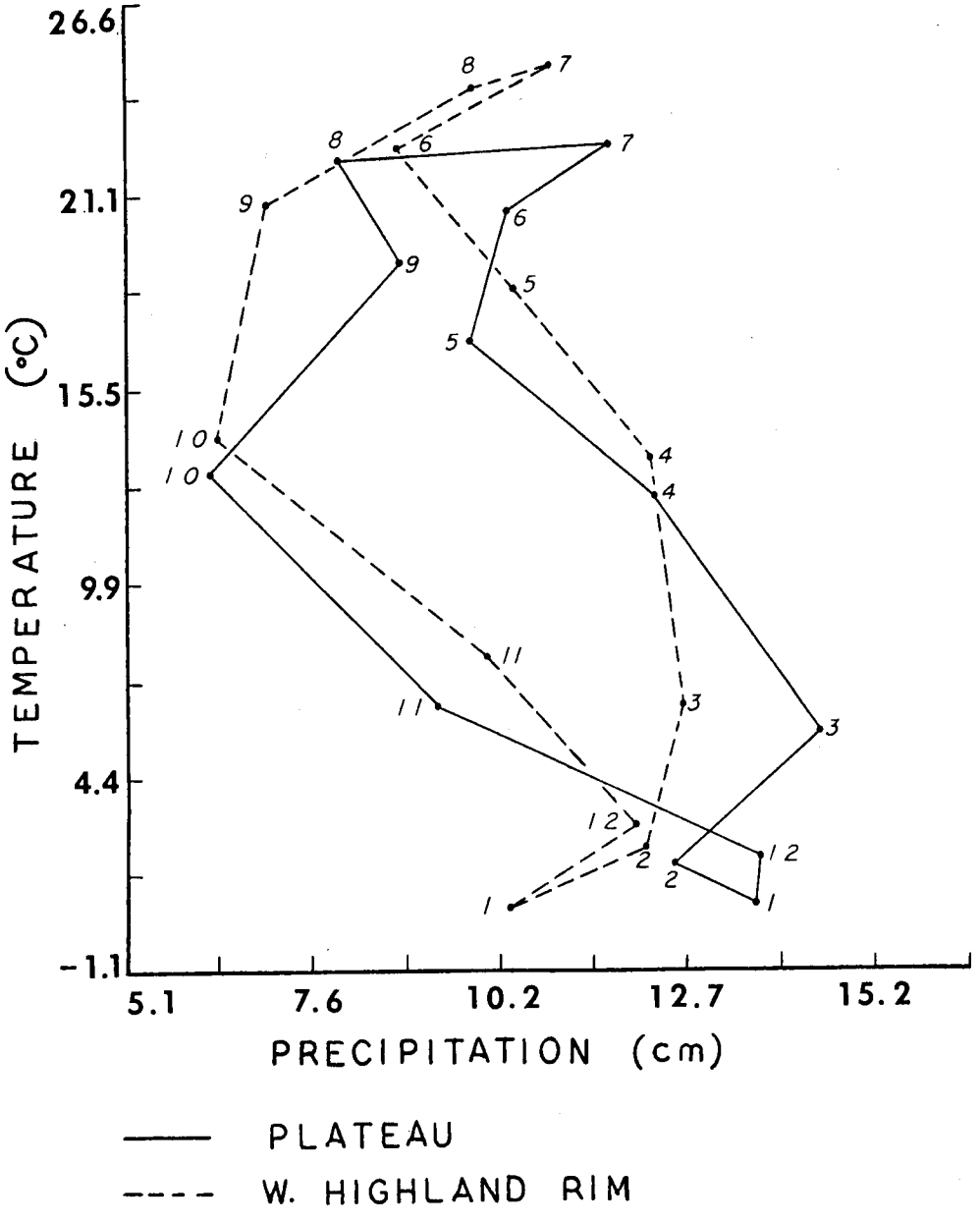


Fig. 2. Temperature-precipitation climographs for the release and capture areas. Monthly mean values are given at the number designating each month. Long-term data were recorded at Crossville Experiment Station (1950-1972) and Cheatham Lock and Dam (1955-1972). Source: U.S. Weather Bureau.

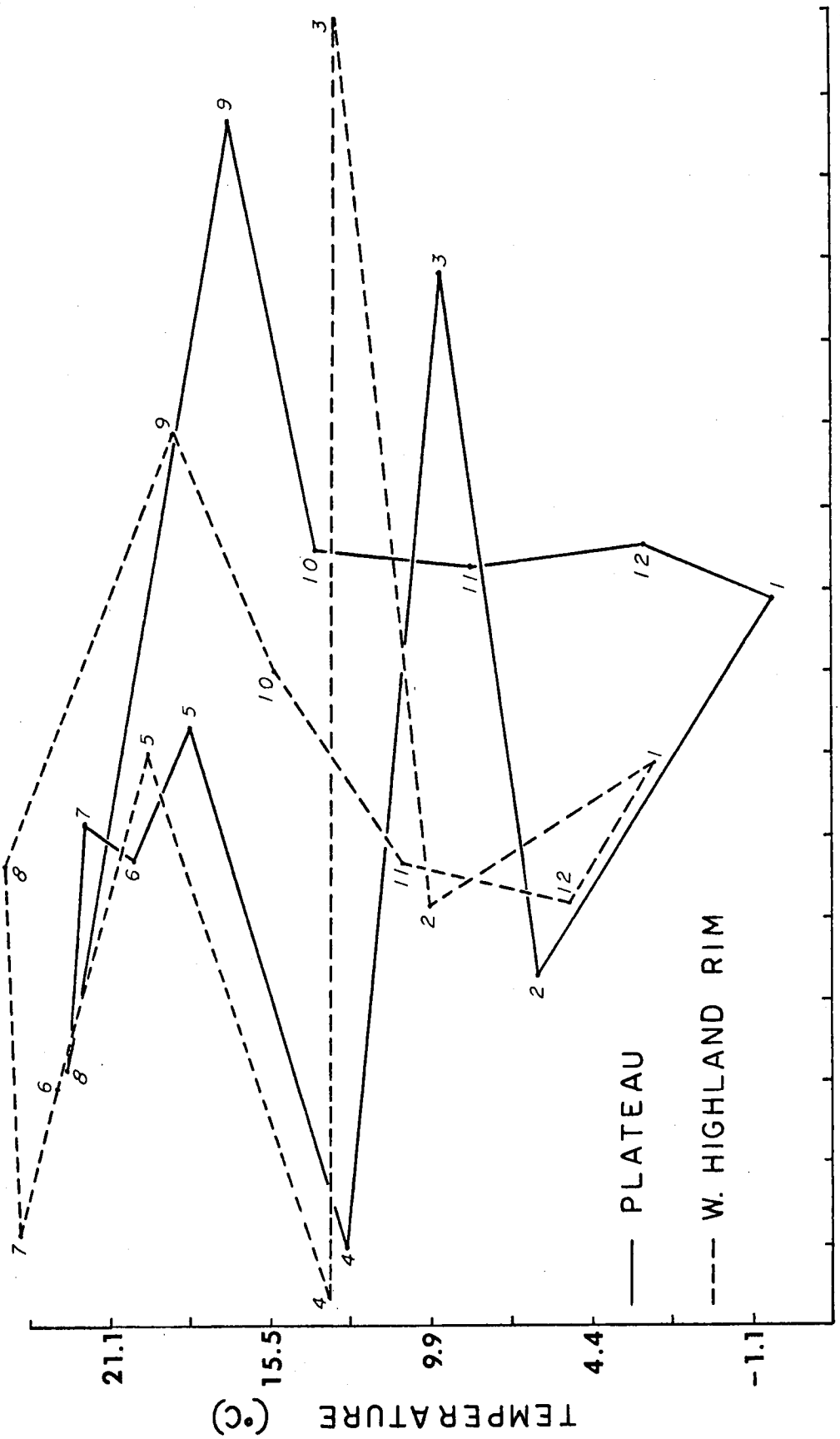


Fig. 3. Temperature-precipitation climographs for the release and capture areas during the year of the study (June 1975-May 1976).

The mean annual temperature on the Plateau for the period June 1975 to May 1976 was 12.8° C compared to 14.9° C on the Highland Rim. Total precipitation was 147.3 cm on the Plateau compared to 124.5 cm on the Highland Rim.

February, March and April of 1976 were abnormal for both regions. In February, average temperatures were 7.8° C warmer on the Highland Rim and 4.4° C warmer on the Plateau than the long-term averages. These elevated temperatures persisted through March in both regions and were accompanied by increased precipitation in that month. April temperatures were near normal for both regions but precipitation was well below normal with departures of nearly -10.2 cm for both regions.

III. VEGETATION

The forests of both regions have been harvested in the past with most of the commercial timber removed except that which was inaccessible. During this study, much of the present timber was just reaching maturity.

On the Cumberland Plateau throughout the Catoosa Wildlife Management Area, the dominant species are Virginia pine (Pinus virginiana) and shortleaf pine (Pinus echinata). Major hardwood species are chestnut oak (Quercus prinus), white oak (Quercus alba) and various hickories (Carya spp.). Generally, the more xeric south and west-facing slopes are dominated by pines while the moist north and east-facing

slopes are favored sites of the hardwoods. Moist lowland areas are typical sites of American beech (Fagus grandifolia), sweetgum (Liquidambar styraciflua) and sycamore (Platanus occidentalis). Eastern hemlock (Tsuga canadensis) occurs along the more deeply incised watercourses. Found in mixed stands and forming dense understories are mountain laurel (Kalmai latifolia) and rhododendron (Rhododendron maximum). Moving up slope, rhododendron is eliminated first, followed by mountain laurel at which time a variety of blueberries (Vaccinium spp.) become the dominant ground cover species. Understory tree species throughout the area include flowering dogwood (Cornus florida), eastern redbud (Cercis canadensis), sourwood (Oxydendrum arboreum) and various ashes (Fraxinus spp.) and maples (Acer spp.). Important ground species are greenbrier (Smilax rotundifolia), grape (Vitis spp.), blackberry (Rubus sp.), Christmas fern (Polystichum acrostichoides) and Japanese honeysuckle (Lonicera japonica).

Fall Creek Falls State Park is vegetated similarly to the Catoosa area. A major exception is the occurrence of virgin timber in the gorge which was not harvested due to its inaccessibility. The rim of the gorge is lined with Virginia and shortleaf pines with an understory of mountain laurel. Laurel occurs as a thin strip lining creeks in the upland areas. Hemlock is found in protected areas along creeks and in the gorge.

On the Western Highland Rim, the vegetation of the Cheatham Wildlife Management Area is conspicuous by the reduction and absence of some species commonly found on the Plateau. Almost absent are Virginia and shortleaf pine. They occur in small isolated stands and are not major species on the area. Eastern redcedar (Juniperus virginiana) is found throughout the area as scattered individuals. Hemlock is completely absent as is mountain laurel and rhododendron. Three species of Smilax (Smilax spp.) occur and are the major ridge-top ground cover. Christmas fern is widespread but favors moist protected slopes. Stream-side vegetation is commonly eastern hop-hornbeam (Ostrya virginiana), American hornbeam (Carpinus caroliniana) and witch-hazel (Hamamelis virginiana). Chestnut oak, white oak and various hickories are dominant hardwoods on the ridge tops along with several species of red oaks. This overstory continues downslope on protected exposures where it is joined by American beech. Ground cover is very limited on these north and east-facing slopes and is composed chiefly of Christmas fern, low growth Vacciniums and scattered clusters of azalea (Rhododendron sp.). On the xeric south and west-facing slopes the overstory becomes stunted and breaks down on the poor, thin, rocky soils of the mid-slope elevations. In these areas, sourwood and black locust (Robinia pseudoacacia) attain equal height with the stunted oaks and hickories. The

canopy, which is often open, is sometimes entwined with greenbrier. Several Vacciniums, including tree sparkleberry (Vaccinium arboreum), reach maximum density on these sites and are joined by serviceberry (Amelanchier laevis) and two species of hawthorn (Crataegus spp.). It is these xeric sites which offer the best cover on the Cheatham area as the often dense stands of Smilax on the ridge tops are browsed heavily by white-tailed deer (Odocoileus virginianus) by late summer and early fall. The limited pockets of honeysuckle suffer the same fate and persist only above the browse level.

IV. PRESENT USE AND TRENDS

On the Cumberland Plateau, present hardwood stands are being converted to pine monocultures for the pulp and paper industry. Such conversions are at present restricted to the broad level uplands. Contour strip mining is an increasingly important regional industry, growing as the demand for coal continues. Additional losses of forest land occur as farm owners increase the acreage in crop and pasture lands (Stafford 1975).

On the Catoosa Wildlife Management Area many hectares of pine have been cut to check the spread of the southern pine beetle (Dendroctonus frontalis) whose recent outbreak has destroyed many hectares of pine forest in the state.

Fall Creek Falls State Park at 6,480 ha is the

second largest state park in Tennessee. It offers visitors a wide variety of outdoor activities. Because of the clustering of park facilities, thousands of hectares of land in the southern end of the park are undeveloped. Consideration is being given to open this area to limited hunting. At the present, the pines of the park have not suffered as much from the pine beetle as those on Catoosa, but a continuation of mild winters could be disastrous.

On the Western Highland Rim, more than 60% of the total land area is devoted to timber production. Much of the remaining land is farmed with beef cattle the predominant farm resource, followed by tobacco (Cherry, unpublished manuscript). Forests of the Cheatham Wildlife Management Area are stable with only minor land clearing occurring to create more openings. The area is losing some of its isolation, as forest land on its boundaries--particularly on the east--are converted to residential developments of the "mini-farm" type.

CHAPTER III

METHODS AND MATERIALS

I. TRAP CONSTRUCTION

The traps used to capture grouse were originally designed after the Cloquet or Lily-Pad trap described by Gullion (1965). It soon became apparent that this design lacked portability and therefore was unsuitable in areas where grouse population densities were low and frequent relocation of the traps was necessary.

Portability of the traps was enhanced by constructing collapsible catch baskets from 2.5 X 5 cm welded wire fencing cut into four sections to form the four sides (Fig. 4). The sides were then joined using hog rings. The inherent rigidity of the welded wire allowed the basket to stand with no additional support. When joining the sides of the baskets, the hog rings were not closed tightly against the welded wire, making it possible to collapse the sides on top of each other. The folded basket was the size of one side and less than 8 cm thick. The rest of the original design remained unchanged.

The interception leads were about 20 m long and the basket wings were generally 1 to 1.5 m long. Overall trap length was about 37 m but varied slightly to fit the trap site.

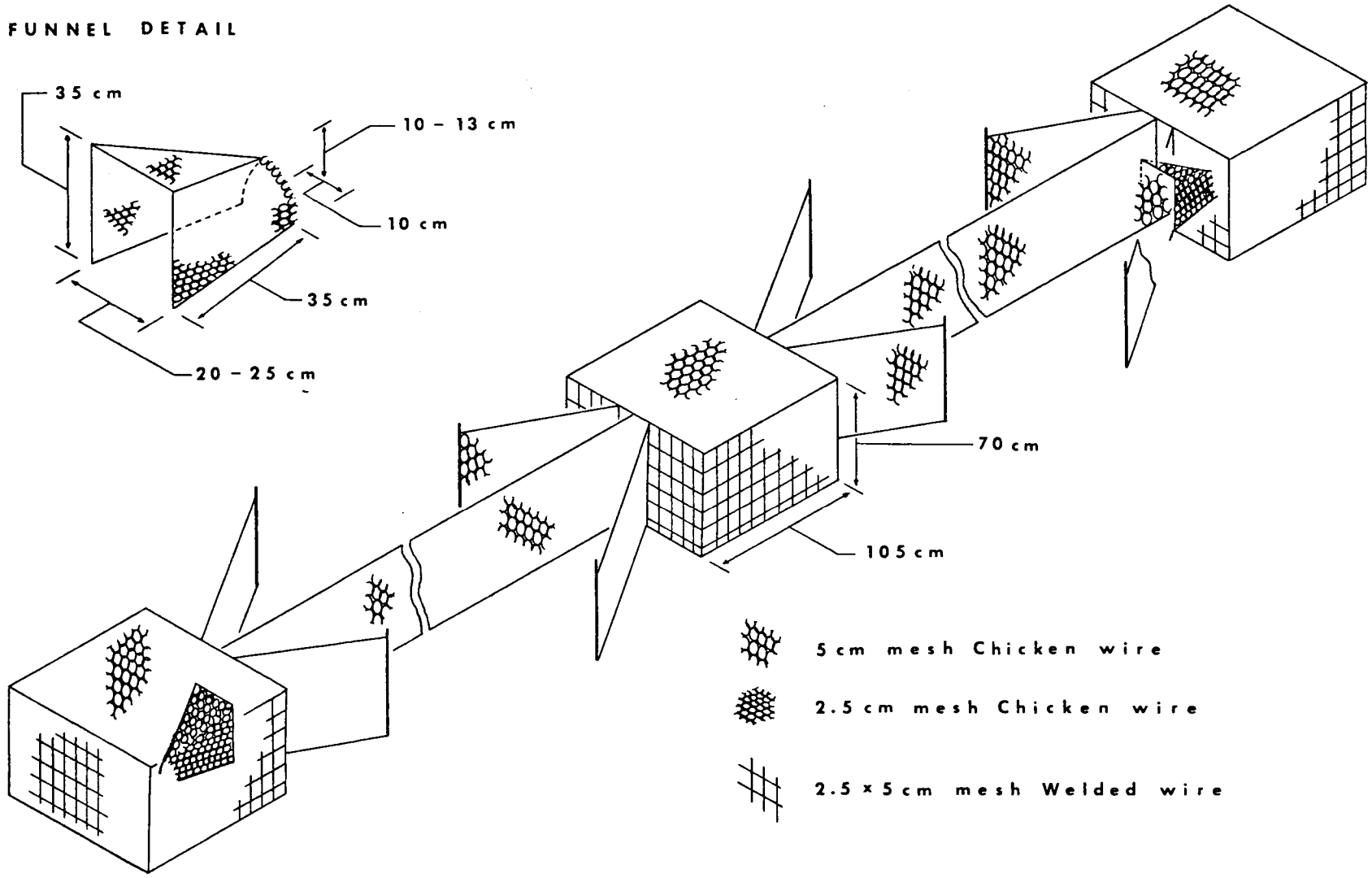


Fig. 4. Trap used to capture grouse on the Cumberland Plateau in Tennessee.

Interception leads, basket wings and tops were constructed of 0.6 m high chicken wire having a 5 cm mesh. Entrance funnels were built from chicken wire, but with a 2.5 cm mesh.

Supports for the wings and interception leads were made from 1 cm diameter solid aluminum or hollow steel rods cut into 1 m lengths. Aluminum tent pegs were used to anchor the wings, leads and baskets.

Construction of one trap from rough materials required approximately 6-7 man-hours. Initial set-up of a trap on site usually entailed about 3.5 man-hours. Disassembly required from 1.5-2.5 man-hours.

II. TRAPPING METHODS

Because of the low population density of ruffed grouse in this part of the bird's range, grouse were located before a trap site was selected. Walking through likely habitat, even with the aid of a pointing dog, proved unsuitable for locating birds. The most productive method proved to be driving roads in the early morning and late evening hours. Driving immediately after a period of rain also proved effective. Once a bird was located, the surrounding area was searched for the most suitable trap site.

On both trapping areas, it became apparent that the most productive trap sites were those associated with

mountain laurel, particularly when the laurel occurred in small creek drainages.

Traps were set perpendicular to the creeks with the leads winding through the laurel. On wide drainages, two and sometimes three traps were necessary to cover the area. While this trap site proved to be the most productive, some apparently suitable drainages were seldom used by grouse. Thus, it was important to observe a bird using a particular drainage in order to maximize trapping success.

Traps were checked twice daily, during mid-morning and shortly after dark to minimize trap and predator related injury and mortality. Captured birds were removed through the top of the catch basket and placed in a holding cage. Later they were sexed according to completeness of the tail band (Davis 1969) and rump feathers (Roussel 1975). Aging of the birds was based on the amount of wear to primaries 9 and 10 (Bump et al. 1947). Birds were then leg-banded, fitted with a transmitter and returned to their holding cage. They were then transported to the Cheatham area and released within 18 hrs after removal from the trap.

III. TELEMETRY EQUIPMENT AND METHODS

Sixteen of the 18 grouse captured were fitted with radio transmitter packages prior to their release on the Cheatham area. All transmitters were battery powered

(wt. = 27.5 g) designed and built by Wildlife Materials, INC., Carbondale, Il. The transmitters utilized in this study were slightly heavier than the 4% of the bird's body weight recommended by Brander and Cochran (1971). However, properly fitted transmitter packages appeared to present little problems to the grouse.

Initial life expectancy of the transmitter batteries was 90 days. Because several of the transmitters were recovered from dead grouse and placed on newly captured birds, the life expectancy of the radio package on some birds was less.

All transmitters emitted between 90 and 140 pulses per minute on frequencies between 150.872-151.149 Mhz. They were designed to be mounted dorsally on the bird with the antenna toward the tail. The base of the antenna was coated with 4 cm of plastic with the remaining 31 cm being bare, twisted wire. Rubber tubing, forming a loop around the base of each wing, secured the transmitter package to the bird.

It soon became apparent that knots tied in the tubing must be pulled very tightly as they had a tendency to fail if tied loosely. Two birds (0 and 14) lost their transmitters prior to battery failure. Additionally, the loops themselves could not be drawn too tightly to the base of the wings or the bird exhibited reluctance and difficulty in flying. To what extent this oversight contributed to

high mortality in the early stages of the study is not known but was probably significant.

Two portable receivers (Wildlife Materials, INC.) were used with a hand-held, 4-element yagi directional antenna. The first receiver used was a 12 channel model which utilized disposable batteries as the power source. The second was a 24 channel rechargeable unit. The latter proved to be heavier, bulkier and less reliable than the first. Battery failure with the 12 channel receiver was easily remedied by carrying spare batteries though they required only infrequent replacement. Early use of the 24 channel unit was hampered by a malfunctioning recharging unit. Even after this problem was overcome, the unit often failed or became unreliable before the end of a tracking day.

Grouse were located by radio from 1 to 12 times per day during tracking periods. Triangulation of a bird's azimuth from two to four known map positions revealed the bird's location when plotted on 1:24,000 scale U.S. Geological Survey (U.S.G.S.) topographic maps. In order to minimize location error due to bird movement, bearings were taken in the shortest possible time, usually 5-15 minutes, depending on the distance between known monitoring positions. Directions were determined by audible signal peaks using a hand compass and signal strength as indicated by a built-in meter on the receiver. Low power out-put of

the transmitters, coupled with the dissected topography, necessitated subjectivity in some of the locations. Homing in on the birds until they flushed or were seen was a common practice to verify their location and determine their condition.

IV. ANALYSIS

Each time a telemetered grouse was flushed or located by triangulation, its position was recorded along with date, time and means of location. Cover type descriptions were noted when a bird was flushed. Additional cover types were evaluated by field reconnaissance of areas which telemetry revealed a bird had used. Positions and cover types were plotted on 1:24,000 scale U.S.G.S. topographic sheets (7.5 min quadrangle). Supplementary details such as weather, sunrise, sunset, etc., were also recorded.

Locational data were used to evaluate three aspects of grouse mobility. Dispersal of a bird from its release point was based on three measurements. Mean dispersal was the distance between the release point and the average of all other locations. Maximum dispersal was defined as the straight-line distance between the release point and a bird's farthest known location. Terminal dispersal was the straight-line distance between the bird's release point and its final location.

While most of the birds were located several times

each day, the number of locations per bird per day and the length of time between locations were highly variable. Therefore, the analysis of grouse movement is based on a bird's change in consecutive mid-day location (CML) expressed in meters. This distance is obviously less than the total distance covered by a bird in any given day. It does, however, eliminate variation caused by unequal numbers of observations. Mid-day locations two or more days apart were not used in the analysis. Cumulative linear movements based on consecutive radio locations are used narratively to amplify the movement analysis.

Night movement was based on the distance a bird was observed to move between the end of evening twilight one day and the beginning of morning twilight the next day. Evening twilight is that period between the time the sun is at the horizon (sunset) and the time it is 18° below the horizon. The reverse describes morning twilight. All night movements that could have been due to locational error were discarded.

Home range boundaries and areas were calculated by two graphical methods: convex polygon and minimal polygon. The convex polygon is simply the straight-line connection of a bird's outermost radio locations. Home range size for this method is the area contained in the resultant polygon as measured by a compensating polar planimeter.

The second home range estimation was used to delineate

the area a bird used frequently during its tracking period. In cases where a bird used one area then moved to another, the radio locations between the two or more areas were omitted from the minimal polygon.

CHAPTER IV

RESULTS AND DISCUSSION

I. COLLECTION, SURVIVAL AND MORTALITY

During the period July 1975 to May 1976, 18 ruffed grouse were captured from the Catoosa Wildlife Management Area and the Fall Creek Falls State Park and released on the Cheatham Wildlife Management Area. A total of 1,078 trap days were required to collect these 18 birds (birds/trap day = 0.02). On the Catoosa area, 248 trap days from July to September resulted in 5 captured grouse. On the Fall Creek Falls area 830 trap days from mid-October to the end of May were required to capture 13 birds. Though birds were captured on two separate areas, each was caught in traps located in or very near mountain laurel thickets.

There were two instances of multiple capture, one at Catoosa (adult male, adult female, juvenile female) and one at Fall Creek Falls (adult male, adult female). On several occasions, grouse were flushed near traps while they were being checked. On two occasions, in the spring, a male grouse was seen displaying to a captured female.

Also captured in the interception traps were: 3 eastern box turtles (Terrapene carolina), 2 cottontail rabbits (Sylvilagus floridanus), 1 raccoon (Procyon lotor),

1 striped skunk (Mephitis mephitis) and 1 unidentified songbird. Additionally, four unknown animals had entered the baskets but had escaped by digging out.

The first 16 grouse captured (birds 0-15) were equipped with transmitter packages to monitor survival and movements. Birds 16 and 17 were released near the end of the study without transmitters but were leg-banded.

Six of the 18 grouse released were alive when last located (Table 1). Maximum survival times could not, however, be determined for these birds because of failure of transmitter packages (5 battery, 1 harness). Minimum survival times for 6 telemetered birds alive at last location ranged from 16 to 86 days. One untelemetered grouse (bird 17) was released in late spring of 1976 and was recovered 26 months later when it flew into a fence and was killed.

The cause of death was determined for 10 birds. Nine grouse, released in the late summer and fall of 1975 and winter of 1976, died or were killed within 1/2 to 10 days of their release. In one case, death was accidental (bird 17) and not related to experimental technique. Two birds died shortly after release of shock caused by trap-related injuries. Predators accounted for the remaining 7 deaths. Avian predation was known or suspected in four cases, while the predator was unknown in the remaining three. Though no remains were found of one bird, the rubber harness had been

Table 1. Survival and disposition of 18 ruffed grouse released in Cheatham County, Tennessee.

Bird	Released (D/M/Y)	Age	Sex	Survival (Days)	Terminal Disposition
0	14/08/75	A	F	UNK	Lost transmitter at release
1	20/08/75	J	F	1.6	Dead--Trap-related injury
2	20/08/75	A	F	9	Dead--Avian predator
3	20/08/75	A	M	1.1	Dead--Red-tailed hawk
4	27/08/75	J	F	9	Dead--Avian predator
5	29/10/75	A	F	0.7	Dead--Trap-related injury
6	31/10/75	A	M	86	Alive--Battery expired
7	01/11/75	A	F	25	Alive--When last located
8	23/11/75	A	F	10	Probably dead--Transmitter found on 10th day
9	27/11/75	A	F	6	Dead--Avian predator
10	15/12/75	A	F	81	Alive--Battery expired
11	23/01/76	A	F	16	Alive--When last located
12	27/02/76	A	M	0.5	Dead--Predator unknown
13	27/02/76	A	M	0.5	Dead--Predator unknown
14	20/03/76	A	M	71	Alive--Transmitter lost, harness failed
15	21/04/76	A	F	40	Alive--When last located
16	01/05/76	A	M	UNK	Untelemetered
17	01/05/76	A	F	796	Untelemetered--Dead--Flew into a fence and was found July 7, 1978

chewed and the transmitter bore tooth, talon or beak marks.

A red-tailed hawk (Buteo jamaicensis) was flushed from the remains of one bird. In another instance, a red-tailed hawk was observed very near and only moments before, the remains were discovered.

During the late summer, accipitor hawks were commonly seen on the Cheatham area in addition to the buteos. Some deaths may have been by accipitors. By October they appeared to have migrated from the area and observations became infrequent.

The remains of 6 grouse were found in four types of coverts. Two were found in sparse sparkleberry, 2 in the edge of open woodlands, 1 in young hardwoods and 1 in an invaded old field.

II. DISPERSAL FROM RELEASE POINTS

Dispersals (mean, maximum and terminal) were calculated for 9 telemetered grouse and 1 terminal dispersal was recorded for 1 untelemetered grouse (bird 17) (Table 2).

Following release, birds which survived the initial period of 3 to 10 days post-release, began dispersals that were often dramatic. Bird 7 was located 2 km from its release point on the fifth day following its release and on the fourteenth day it was 2.6 km from the release point.

Of the 6 birds known to be alive at their last location, 2 exhibited dispersals of over 1 km in the first

Table 2. Dispersal of 9 telemetered and 1 untelemetered ruffed grouse from their release points on the Cheatham WMA, Cheatham County, Tennessee.

Bird	Sex	No. Loc.	Survival (Days)	Dispersal in Meters		
				Mean	Maximum	Terminal
7	F	55	25	1204	2688	840
14	M	219	71	936	1954	883
6	M	94	86	724	1944	624
15	F	96	40	607	977	960
10	F	37	82	504	1128	600
11	F	16	16	463	756	753
8*	F	13	10	593	696	346
4*	F	14	9	343	564	413
2*	F	34	9	139	264	77
Means:						
All birds		64	39	760	1219	611
Alive at last location		86	53	822	1575	777
Dead at last location		20	9	231	508	279
Dispersal of 1 untelemetered grouse						
17*	F	-	796	UNK	UNK	1440

*Dead at last location.

2 weeks following release. While 4 of the 6 birds eventually had maximum dispersals of over 1 km, the majority of the birds tended to return toward their release points. Only 2 birds (11 and 15) had terminal dispersals nearly equal to their maximum dispersal. The mean terminal dispersal of the other 4 birds was 737 m. Additionally, these 4 had convex polygons which included their release points.

One untelemetered grouse was found dead 1.4 km from its release point 26 months after release.

The small sample size precluded analysis concerning dispersal differences between male and female grouse or between seasons.

III. HABITAT UTILIZATION

The habitat utilization of the five most frequently located grouse was examined to determine which coverts available on the Cheatham area were the most attractive to grouse. White and Dimmick (1979b) recognized five broad cover types used by grouse transplanted into their study area in Benton County, Tennessee. In their study, shrubby thickets (composed of laurel and/or sparkleberry), open understory, dense understory, fields and viny or herbaceous thickets were used by grouse. The most important cover type (based on the number of radio locations) in their study was the shrubby thicket with 42% of the locations occurring in this type.

While laurel and sparkleberry did occur in mixed thickets on the above study area, they also occurred as thickets composed of one or the other. White (1978), on the same area, found that 44% of the telemetered grouse used laurel thickets extensively "(high cover type fidelity)." The short daily movements and small home ranges of these birds were second only to birds which used viny and herbaceous thickets. The latter two cover types, however, lost their attractiveness to grouse when the vegetation died back in the fall. Birds which used predominantly sparkleberry thickets had larger home ranges and longer daily movements than those which used laurel thickets.

Laurel was completely absent on the Cheatham area. The most widespread of the denser cover types was the sparkleberry thickets. This 1-2 m high shrub was the predominant species on the steep, rocky slopes and attained maximum density on the more xeric south to west-facing mid-slopes. These thickets often contained hawthorne, Smilax and sapling size hardwoods. At ground level, these thickets were usually open with a scattered ground cover of sedges (Cyperaceae) providing suitable travel lanes for grouse while offering overhead protection from avian predators.

Down slope from a sparkleberry thicket the cover graded into a creek bottom composed of various species, the most prevalent being witch-hazel, hophornbeam and American

hornbeam. This covert typically included sparse to dense stands of various sapling size hardwood species with a herbaceous layer dominated by ferns.

Up slope from a sparkleberry thicket, the ground cover was typically dominated by 0.5 m high bushy Smilax and low Vaccinium with a dogwood understory. The overstory was various oak and hickory species.

Open woodlands, with essentially no ground cover, were found on many of the ridge tops and extended down slope on the more protected north to east-facing slopes.

Viny thickets, composed of low growth locust and sourwood entwined with greenbrier and grape (Vitis sp.) vines, were very limited in size and frequency of occurrence on the area.

The type of covert was determined for 501 locations obtained from 5 grouse (birds 6, 7, 10, 14 and 15). Sparkleberry was the most frequently selected cover type. Of the 501 locations, 232 (46%) were in a sparkleberry thicket (Table 3). The next most attractive cover type was the creek bottom with 114 locations (23%). Vaccinium, open woodlands and viny thickets received nearly equal use (9, 10 and 10%, respectively).

As previously stated, sparkleberry thickets were the most widespread of the denser coverts. Birds did not attach themselves to a particular thicket but rather moved from one to another during normal foraging activities.

Table 3. Cover selection of ruffed grouse in Cheatham County, Tennessee.

Bird	Covert[a] (Number Locations/Percent Use)					
	Spkby	Crkbt	Vaccn	Opnwd	Vnytk	Edge
6	41/44	26/28	2/2	18/19	3/3	4/4
7	15/27	14/25	10/18	3/6	13/24	0
10	26/70	7/20	3/8	1/2	0	0
14	113/52	41/19	30/14	25/11	10/4	0
15	37/39	26/27	0	5/5	21/22	7/7
Totals/ Percent	232/46	114/23	45/09	52/10	47/10	11/02

[a]Spkby = Sparkleberry/Hawthorne
Crkbt = Creek Bottom
Vaccn = Vaccinium/Smilax
Opnwd = Open Woodlands
Vnytk = Viny Thickets
Edge = Herbaceous Edge

Creek bottoms received much use from grouse probably because they provided adequate cover and were in close proximity to sparkleberry thickets.

The limited use of viny thickets (10%) is more reflective of their limited extent rather than their importance to the grouse. Each bird that encountered a viny thicket spent several days in it. One particular thicket which was located next to a field, herbaceous edge, sparkleberry thicket and creek bottom was an activity center for 1 bird, accounting for 22% of its locations (bird 15). Another viny thicket, similarly located in close proximity to other favored coverts, was apparently becoming an activity center for bird 6 before his transmitter expired.

Stafford and Dimmick (1979) listed 14 important plant species or genera used as food by grouse in eastern Tennessee and western North Carolina. Of particular importance to grouse in this part of its range were greenbrier (20% of the diet), mountain laurel (15%) and Christmas fern (11%). There were regional variations in diet. Dogwood was important on the Cumberland Plateau but not in the Valley and Ridge or Blue Ridge regions. Honeysuckle, more common in the Valley and Ridge region than mountain laurel, became an important food (second only to greenbrier) in that region. In their study, it was also noted that grouse selected green leafy material (63% of the diet) from the

lower strata of the forest. They felt that plants which offered both food and protective cover ("particularly mountain laurel and honeysuckle") were very important components of winter grouse habitat in this part of the bird's range.

On the Cheatham area, laurel was absent. Honeysuckle and greenbrier were browsed heavily by white-tailed deer from late summer through winter. The absence of laurel and the scarcity of honeysuckle and greenbrier indicated a lower quality habitat on the Cheatham area and was reflected by the movement behavior of grouse (to be discussed later).

IV. MOVEMENT

During the period 20 August 1975 through 30 May 1976, 15 transmitter equipped grouse were located 659 times in 156 monitoring days. Movement data for the 9 longest-lived birds were obtained from 578 locations in 143 successful monitoring days. Two grouse were found by aircraft after several days of ground search proved unsuccessful. Two other birds could not be located from the air or ground though the projected battery life of their transmitters had not been exceeded.

Grouse were very mobile in the fall and winter but appeared to move much less in the spring (Table 4). One measure of mobility is the change in consecutive mid-day

Table 4. Change in consecutive mid-day location (CML) for 9 telemetered ruffed grouse released on the Cheatham WMA, Cheatham County, Tennessee.

Bird	Sex	Season of Release	No. CMLs	CML in Meters Mean	Range
6	M	F	21	615	96-1488
7	F	F	7	529	36-1438
14	M	Sp	38	362	48-1008
15	F	Sp	18	289	0- 708
10	F	W	8	361	46- 545
11	F	W	3	181	58- 389
4	F*	LS	3	242	48- 434
8	F*	F	3	191	146- 235
2	F*	LS	8	153	77- 264
Means:					
All birds			12	381	0-1488
Alive at last location			16	411	0-1488
Dead at last location			5	180	48- 434

*Dead at last location.

location (CML). This movement parameter is the measured straight-line distance between a bird's consecutive mid-day radio locations. A total of 109 mid-day locations was usable.

Following their release, birds frequently moved very little and remained in the general area of their release from 3 to 9 days. Following this initial "shock period," their movements became much more pronounced as they wandered through a variety of cover types often moving long distances in short periods of time. One bird, an adult female, remained within 120 m of the release point for 3.5 days before beginning a dispersal in which she moved a straight-line distance from the release point of 1,680 m in 1.5 days. During this movement period, the combined linear movements of 9 consecutive radio locations was 2,986 m.

There was a marked tendency for short movements to be followed by a series of long movements. Bird 6, an adult male, paused in one small hollow for a period of 4 days, then began a large circle covering 5,928 m (total of 18 consecutive locations) in 3 days, at which time he was located 1,488 m from the hollow he had left 3 days before. Six days later, he had returned to this hollow.

Although the small sample size of this study does not allow definitive analysis of grouse movements, some general observations of grouse movements were based on

consecutive mid-day locations. Data from 4 birds were examined based on their change in CML and the differences verified by one-tailed t tests.

It appeared that birds released in the fall moved more than those released in the spring. Mean CML for 28 fall locations was 594 m, while that for 56 spring locations was 338 m ($P < 0.005$). Like comparisons may be drawn based on sex and season of release. The fall release male had a mean CML of 615 m, while the spring released male had a mean CML of 362 m ($P < 0.01$). This tendency toward increased fall movement was also indicated by 2 female grouse. The fall female mean CML was 529 m; the spring female 289 m ($P < 0.10$). Also, the 2 females moved less than the 2 males (356 vs. 452 m, $P < 0.15$) with the spring released female showing the least movement of the 4 birds.

The tendency toward greater fall movement is supported by the difficulty experienced in locating fall released birds. Even after adjustment for a possible transmitter failure, the 2 fall-released grouse were not located on 20 monitoring days, though their transmitters later proved to be operative. The 2 spring-released grouse were located on every monitoring day.

Movements were reflective of cover type and density, the latter varying with the season of the year. Birds generally appeared to select the most dense cover type

available immediately after release. In the majority of cases, this covert was composed of sparkleberry and hawthorne. It was more widespread than any of the other denser types and was used 46% of the time (Table 3, page 33). Birds did not remain in a particular sparkleberry thicket, but rather moved along contour until the thicket graded into a less dense covert and then moved until they encountered another area of dense cover. Birds tended to avoid open woodlands and moved through them quickly. Twenty-one (40%) of the 52 locations recorded in this cover type were associated with a dispersal movement.

Viny thickets, composed mostly of low growth locust entwined with greenbrier and grape vines were used by grouse but these coverts were so small in size and few in number that they were only used for brief periods. Bird 7 encountered such an area 5 days after her release. She remained there for 3 days moving very little. The average movement of 13 radio locations during this 3-day period was 46 m. She then moved 960 m to a new sparkleberry thicket.

Invaded old fields, field edges and creek bottoms were also used by grouse on the Cheatham area as indicated by both flushing and radio location. Grouse 6 encountered an area containing each of these coverts plus a sparkleberry thicket, a greenbrier tangle and a bicolor lespedeza (Lespedeza bicolor) strip on 10 December but moved on

through the area. Twenty days later, he returned to the area and was located there consistently until the battery of his transmitter expired on 24 January.

Fields, herbaceous edges and creek bottoms were also used by grouse in the spring. Grouse 15 (female) used a field extensively along with the herbaceous edge around it. Use of the field began shortly after her release in the spring when it was plowed and seeded to grass (Poaceae) and clover (Trifolium sp.). After the grass, clover and low weeds became established, the bird continued to use the field. Fifty meters to the west of the field was a low-growth sourwood and locust thicket entangled with greenbrier and bordered by sparkleberry and a dense stand of sapling size hardwood species. The stunted trees in the area had tangles of greenbrier and grape in their crowns. Radio telemetry locations of grouse 15 revealed this area to be an activity center for the bird. She was located there one-third of the time and generally returned to the area after brief exploratory movements westward. She was found roosting in the tangled crowns on several occasions.

Night Movements

Early in the radio tracking phase of the restoration attempt, it became apparent that some of the grouse did not cease moving at sunset and begin again at sunrise. Occasionally it was evident that a bird had moved sometime

between the two. On several occasions a bird was located at some period of time after sunset and radio tracking of that bird for that day ended. When monitoring of the same bird resumed at or before sunrise the following morning, the bird was not located in the same place or even the same area. For example, on 10 December grouse 6 was located 1/2 hr after sunset. The following morning, 1 hr before sunrise, no signal could be heard from the bird at the same location. He was finally located at 0800 540 m away. This was repeated the next 2 days with an overnight displacement of 672 m and 600 m, respectively.

Other birds occasionally exhibited the same behavior. The maximum overnight displacement was exhibited by bird 7. Between sunset 4 November and 0900 5 November (when she was finally relocated), she had moved a straight-line distance of 1,162 m.

By mid-winter 1976 it was obvious that birds were moving between sunset and sunrise. It was not known, however, how long after sunset they continued moving or how long before sunrise they began moving. When the same behavior was noted in spring released birds, considerable attention was given to documenting these infrequent night movements.

It was apparent that the period between sunset and sunrise was not adequate to define night movements since this period includes considerable minutes of twilight when

it is still light enough for a bird to move without difficulty. A more restrictive definition of night movement is that movement observed between the end of evening twilight and the beginning of morning twilight. Evening twilight is defined by the U. S. Naval Observatory as that period of time between sunset and when the sun is 18° below the horizon. In like manner, morning twilight begins when the sun is 18° below the morning horizon and ends at sunrise. The length of both twilight periods varies with the season of the year and location of the observer but is generally 1-1/2 hrs long ($\pm$ 10 min.) in the Nashville area. Thus, when morning and evening twilight periods are added to day length, there is an additional 3 hrs per day when movements may be defined as day movements.

In the spring of 1976, five instances of movement after evening twilight were observed for 2 birds (birds 14 and 15). Between the end of evening twilight and 2200 15 April, bird 14 moved a total of 622 m. The majority of this movement (475 m) was accomplished after a full moon rose at 2050. When relocated 1 hr after sunrise the following morning, he had moved an additional 696 m.

Following evening twilight on 12 May both number 14 and 15 were monitored until midnight. Number 14 moved 358 m while number 15 moved 199 m. Two additional night movements were noted following evening twilight in late May. Bird 14 moved 192 m while bird 15 was observed to move 156 m.

During the spring, both birds showed a tendency for early morning and late evening movements. Maximum overnight displacements observed for bird 14 were 996 m, while those for bird 15 were 600 m. While these latter two displacements are not strictly night movements, they do indicate considerable movement during late evening, night and early morning hours.

V. HOME RANGE

In many telemetry studies, a major component of movement data is an analysis of home range. One aspect of home range is size. Godfrey (1975) found that the mean home range size for 6 ruffed grouse broods in Minnesota was 12.9 ha (range 6.3-18.9 ha). Maxson (1978) described the relationships between home range size and reproductive stages for 15 female ruffed grouse during the breeding season in Minnesota. Mean home ranges varied from 0.9 to 12.1 ha depending on the stage of reproduction. Archibald (1975), working with 3 females and 10 males during the spring, found home ranges to vary from 3.5 to 20 ha (mean = 10.7 ha).

Very little information is available for the estimation of home range size for grouse in the southern part of its range. White (1978) using juvenile grouse captured in Michigan and Wisconsin and released in Benton County, Tennessee, evaluated home range size by three methods:

convex polygon, minimal polygon and 95% confidence region. The latter yielded the largest home range sizes (4.4-739.3 ha; mean = 250.9 ha), followed by the convex polygon (1.5-497.2 ha; mean = 102.4 ha). The minimal polygon method produced the smallest estimation of home range size (.8-105.4 ha; mean = 30.1 ha). Though larger home range sizes are thought to be indicative of reduced range quality, White felt that inflated home ranges in his study were the result of brood break-up behavior and the displacement into unfamiliar habitat. White also found that there were definite relationships between cover type use and home range size.

Only 2 juvenile birds were used in this study. One lived for 39 hrs moving only 18 m. The other was killed by a predator 9 days after release. Because of the short survival time for these 2 birds, brood break-up behavior played no role in the analysis of home range in this study. Currently, there is no information available concerning home range size and movements of ruffed grouse in their native Tennessee habitats, thus it is impossible to describe what effect, if any, transplanting has on these two aspects of grouse behavior.

Home range, as generally used, is expressed as that part of an animal's range which it knows well and uses regularly (Wilson 1975). In this context, home range is probably not applicable to the birds of this study with

perhaps one exception (bird 15). Convex polygon home ranges were constructed for several birds by connecting their outermost locations with straight-lines and then determining the area of the enclosed polygon with a compensating polar planimeter. Minimal polygons were similarly constructed except that only areas showing frequent or extended use were enclosed (Table 5).

Convex polygon estimation of home range sizes tended to be inflated beyond the area which birds used regularly. The minimal polygon method was believed to yield the best estimation of the more classical definition of home range, at least during the relatively short period in which an individual bird could be monitored (90 days maximum).

The birds of this study tended to wander about widely as indicated by the size of their convex polygons (Appendix). The size of their minimal polygons and their proximity within the larger convex polygons indicate that the birds moved until they encountered a seasonally suitable covert where they remained for short periods before continuing their explorations. Because of the time limitations dictated by battery life of the transmitters, it is not known if the birds "settled down" to a "typical" home range or continued their periodic wanderings from one suitable covert to another thus establishing a large atypical home range which is utilized periodically, however infrequently. Indeed, since foraging is a part of grouse behavior and

Table 5. Home range size for 9 telemetered ruffed grouse released on the Cheatham WMA, Cheatham County, Tennessee.

Bird	Sex	Number Locations	Survival (Days)	Home Range in Hectares	
				Convex Polygon	Minimal Polygon
6	M	94	86	458.6	154.1
14	M	219	71	336.0	167.9
7	F	55	25	143.9	68.4
10	F	37	82	69.5	42.3
15	F	96	40	34.2	19.1
11	F	16	16	22.0	11.6
4*	F	14	9	11.6	7.0
2*	F	34	9	8.7	5.8
8*	F	13	10	8.1	8.1
Means:					
All birds		64	39	121.4	53.8
Alive at last location		86	53	177.4	77.2
Dead at last location		20	9	9.5	6.9

*Dead at last location.

little is known about the birds in this part of their range, perhaps inflated home ranges are typical and indicative of a reduced quality habitat in this part of the range.

Because of the absence of mountain laurel and the sparsity and limited extent of alternate coverts on the Cheatham area, it is felt that the nomadic movements exhibited by the grouse of this study are perhaps typical of grouse in this type of habitat, at least in the fall and winter.

It was apparent that the advent of spring and the resultant vegetative changes on the area had a moderating effect on grouse movements and thus home range sizes. Grouse 15 exhibited a drastic change in both daily movements (mean CML = 289 m) and home range size (convex polygon = 34.2 ha) from the earlier released birds. She was located 96 times in 40 days in this home range which included an activity center composed of a field, herbaceous edge, viny thicket, creek bottom and sparkleberry thickets. Her exploratory movements away from this area were short (maximum CML = 708 m). Unlike the study area described by White, the ridge tops of the Cheatham area were typically open woodlands, a covert avoided by number 15 and most of the other birds of this study. Thus, her wanderings would characteristically take her along creek bottoms and mid-slope contours to the head of a hollow

where the vegetation would grade into open woodlands with only sparse ground cover of stunted Smilax and low Vaccinium bushes. She would then return to the more favorable cover of the mid-slopes.

The moderating influence of spring vegetative changes was also indicated by adult male grouse 14 released on 20 March 1976. In the 31 days between his release and 20 April he exhibited the typical nomadic movements of his fall and winter released counterparts, moving widely (CML = 472 m; maximum = 1,008 m) and establishing a series of minimal polygons (5.6-29 ha) where he would remain from 1 to 4 days. Then from 4 to 30 May, he was located 92 times in two minimal polygons totaling 45.2 ha (19.7 and 25.5 ha). During this latter period, his reduced mobility was also indicated by a reduction in the magnitude of change in mid-day location (CML = 227 m; maximum = 528 m). Activity centers and use of the two polygons changed chronologically from creek bottom/sparkleberry to sparkleberry/hawthorn/Vaccinium.

CHAPTER V

SUMMARY AND CONCLUSION

I. MOBILITY AND HABITAT

The ultimate goal of this study was to re-establish ruffed grouse in one area of the bird's historical range in Tennessee. More important, however, than just the physical re-establishment of the species was the need for basic biological data of the bird in this part of the range. It was thought that trapping in native populations and telemetry of released grouse would allow the maximum chance of survival and at the same time yield valuable information on which to base future restoration attempts in other areas.

Early in the study, the importance of mountain laurel to grouse in the capture areas became apparent. This particular cover type was entirely absent on the Cheatham area. The cover type most closely resembling laurel, structurally, on the release area was sparkleberry. The majority of the birds were observed to choose this cover type soon after release.

The high mobility of grouse as indicated by home range size, dispersal and change in consecutive mid-day location was unexpected. The inflated values of these parameters are possibly due to three factors.

First, the majority of the introduced birds were

adults and probably carried learned cover preferences (for laurel) with them to the release area. Thus it can be postulated that the high mobility was partly due to exploration for this familiar covert.

Secondly, birds were released into an area devoid of grouse. Grouse territories in established populations are occupied and defended year around (Gullion 1970). Such behavior tends to limit movement and thus home range size. The absence of established territories would allow increased movement as encroachment disputes were eliminted.

Finally, reduced habitat quality as reflected by vegetation density and preferred food items may have necessitated an increased mobility and adversely affected survival. White and Dimmick (1979b) illustrated the association between cover type use and home range size of introduced grouse in western Tennessee. Stafford and Dimmick (1979) indicated the importance of winter evergreen foliage which provides both food and cover in this part of the grouse's range.

As previously stated, mountain laurel is absent on the Cheatham area and is probably a serious loss. While several birds in both White's (1978) study and this one were able to survive without laurel, the importance of this species to grouse in this part of the range should not be underestimated. The importance of laurel to grouse is two-fold. It provides excellent fall and winter cover and

at the same time is an important food item. While its loss as a food item may be offset by a change in diet (Stafford 1975 listed 66 plant species used by grouse as food), its loss as a dense evergreen food and cover species in the fall and winter is serious, particularly when there is no equally dense alternate cover.

Spring vegetative changes on the Cheatham area were reflected in reduced grouse mobility. The lower magnitudes of movement exhibited by 2 grouse as measured by 2 parameters probably resulted from increased vegetative density and availability of food items, thus negating the need for extended searches for adequate combinations of food and cover.

II. PROSPECTS FOR RESTORATION

Of the 18 ruffed grouse released on the study area, only half of these birds could have possibly been alive during the breeding season. The sex ratio of this group was 6 females to 3 males. Throughout late winter and spring of 1976, an effort was made to discover drumming males and females with nest or broods. No evidence of reproduction was noted. Two birds with active transmitters were followed during part of the breeding season. One male was monitored from 20 March to 30 May 1976 with no drumming activity heard. One female, released 21 April was tracked until 30 May, with no nesting behavior or broods noted.

On the last day of their location they were as close together as they had ever been observed to be during their overlapping tracking periods (600 m).

High mortality, coupled with low numbers of introduced grouse and the resultant lack of reproduction, mark this restoration attempt an apparent failure.

The absence of mountain laurel and the scarcity of other major fall and winter food and cover species, coupled with the sparsity of alternate assemblages, was seen as the major obstacle to a successful restoration attempt on the Cheatham area.

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APPENDIX

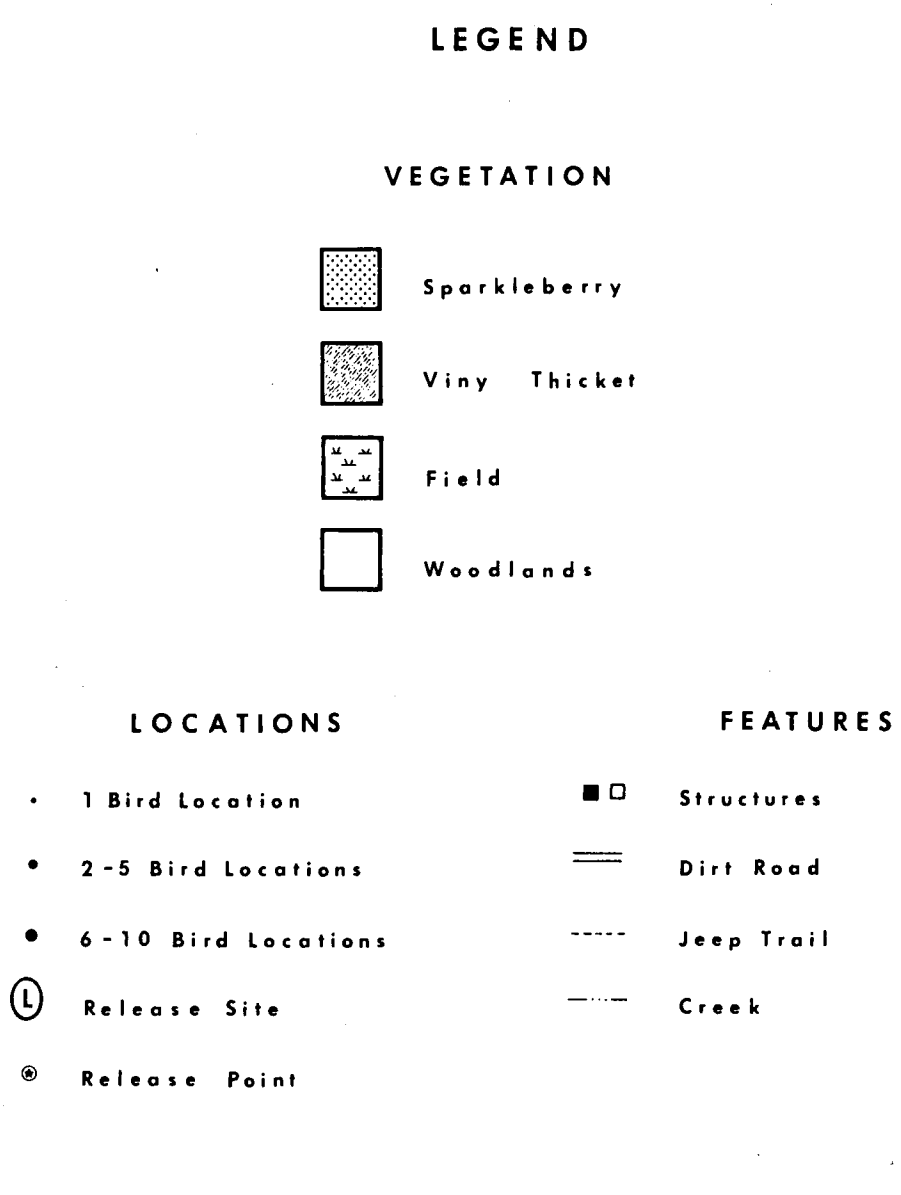


Fig. 5. Legend for Figs. 6, 7, 8, 9, 10 and 11.

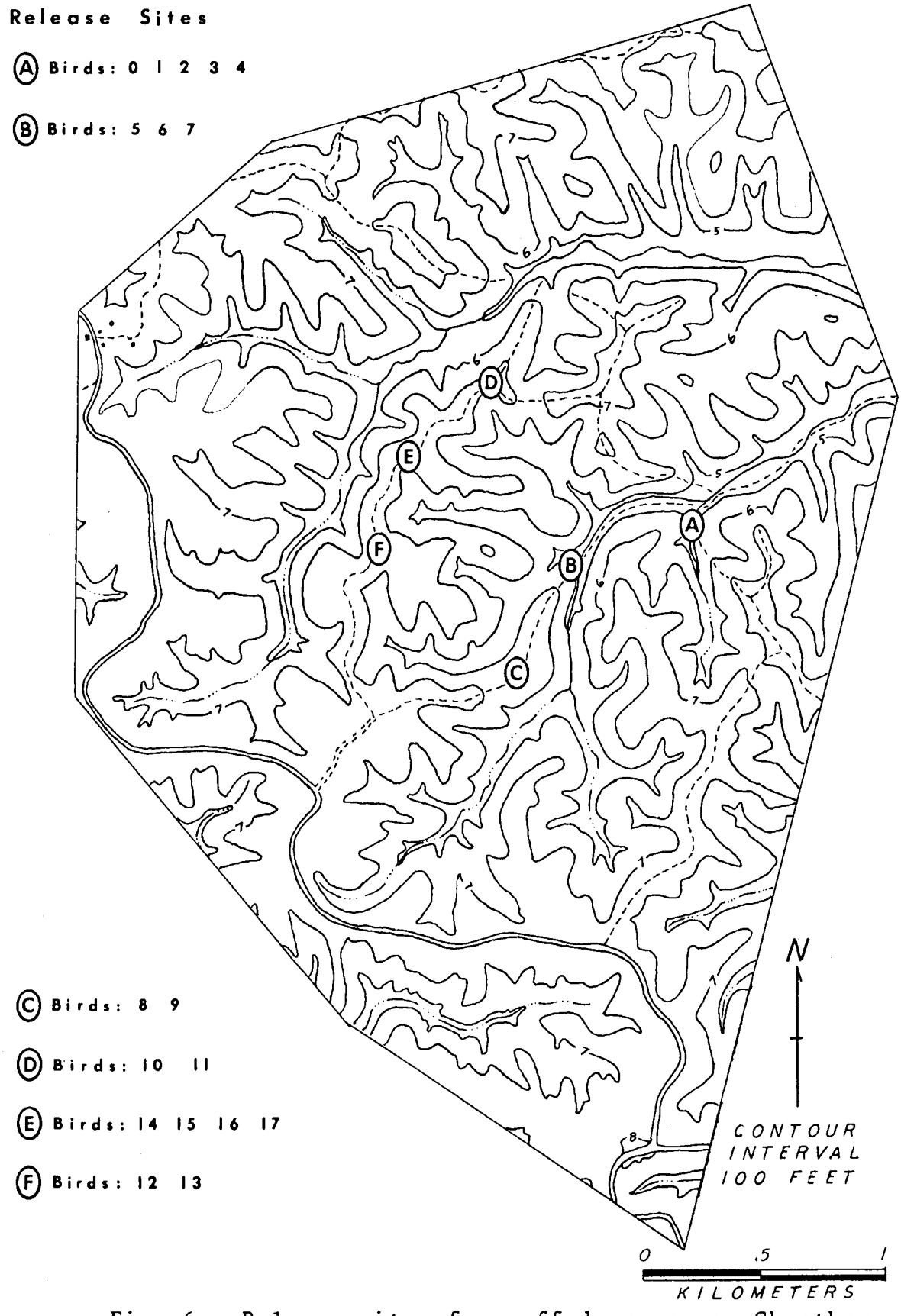


Fig. 6. Release sites for ruffed grouse on Cheatham WMA, Cheatham County, Tennessee.

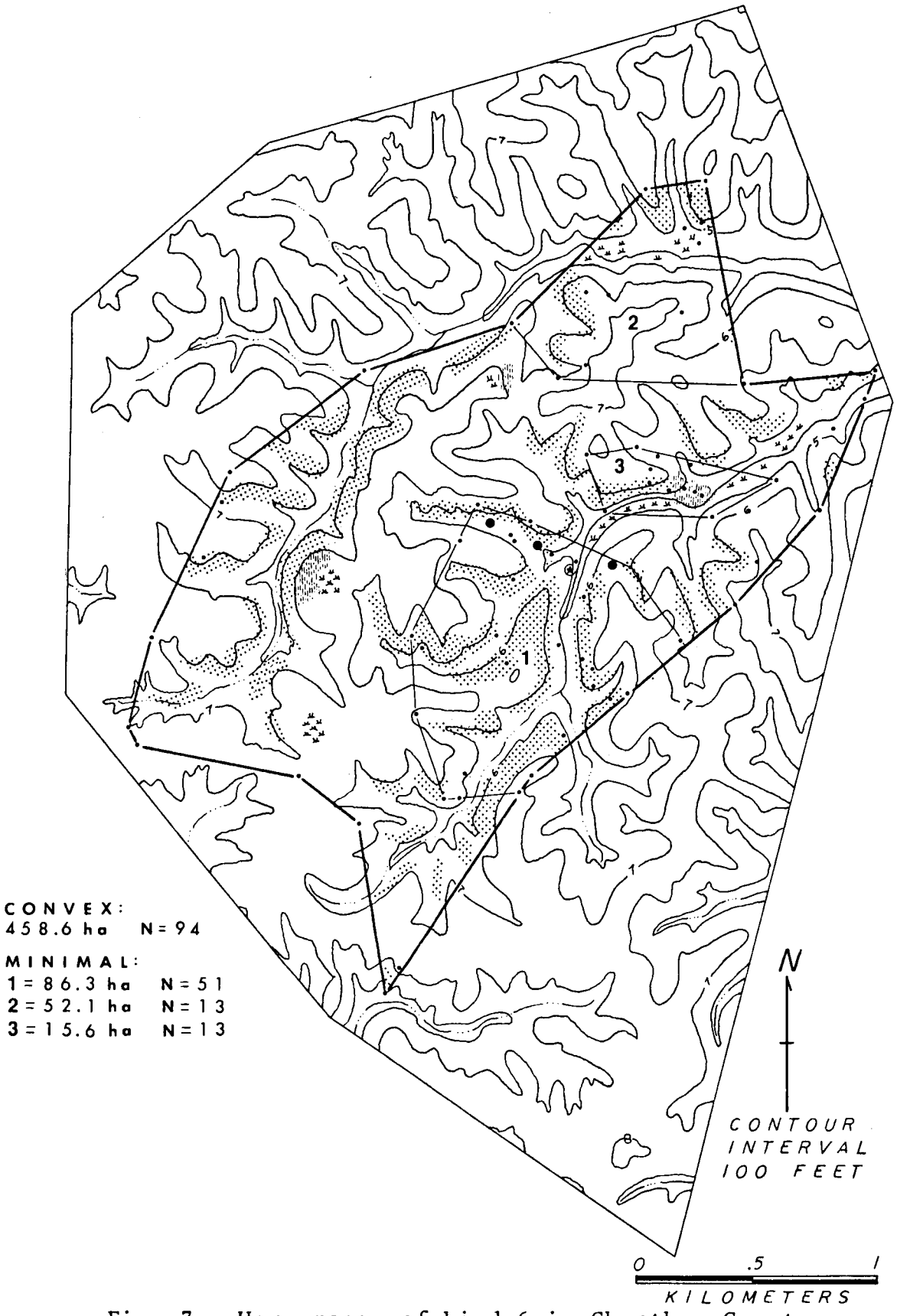


Fig. 7. Home range of bird 6 in Cheatham County, Tennessee.

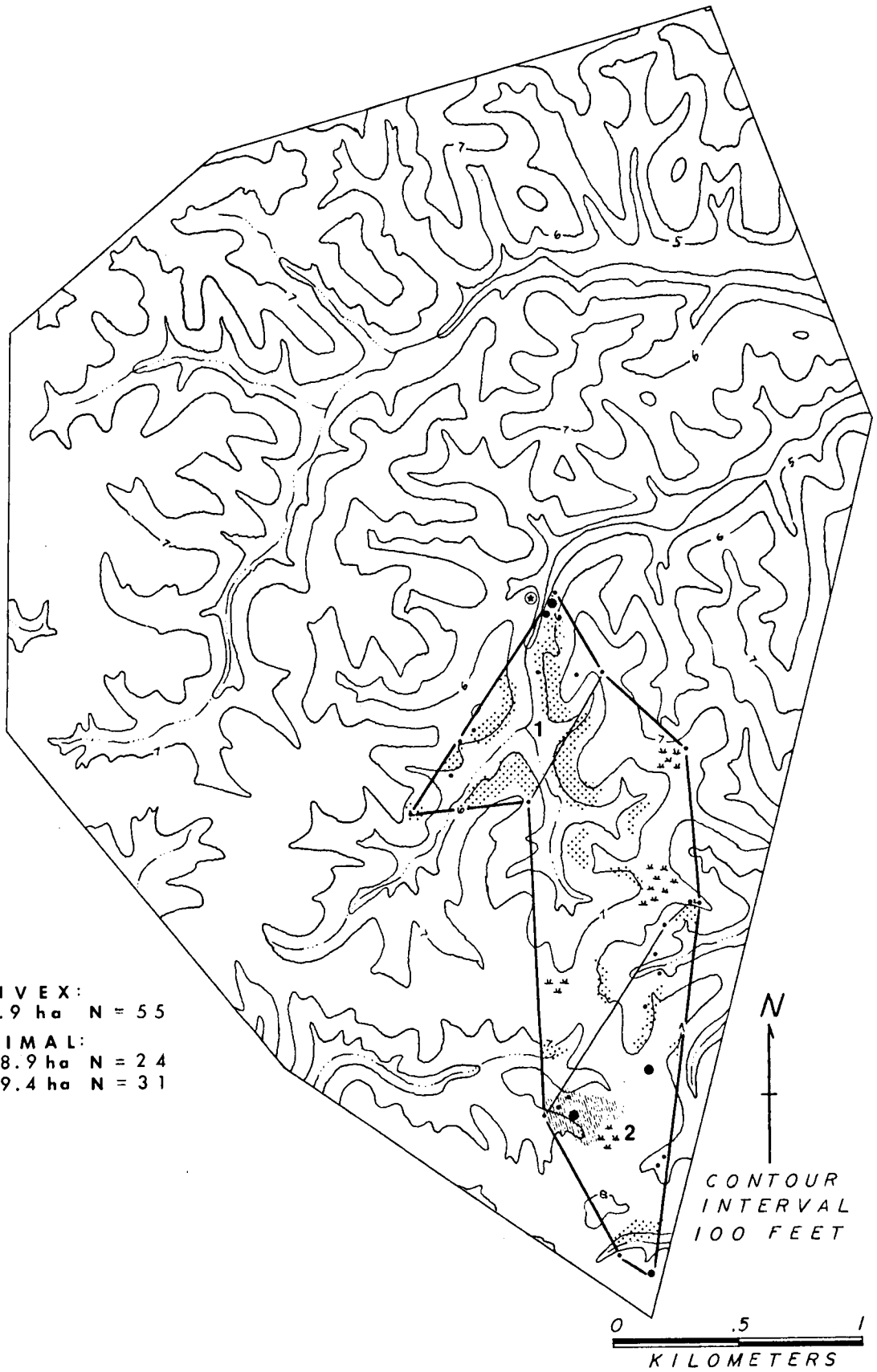


Fig. 8. Home range of bird 7 in Cheatham County, Tennessee.

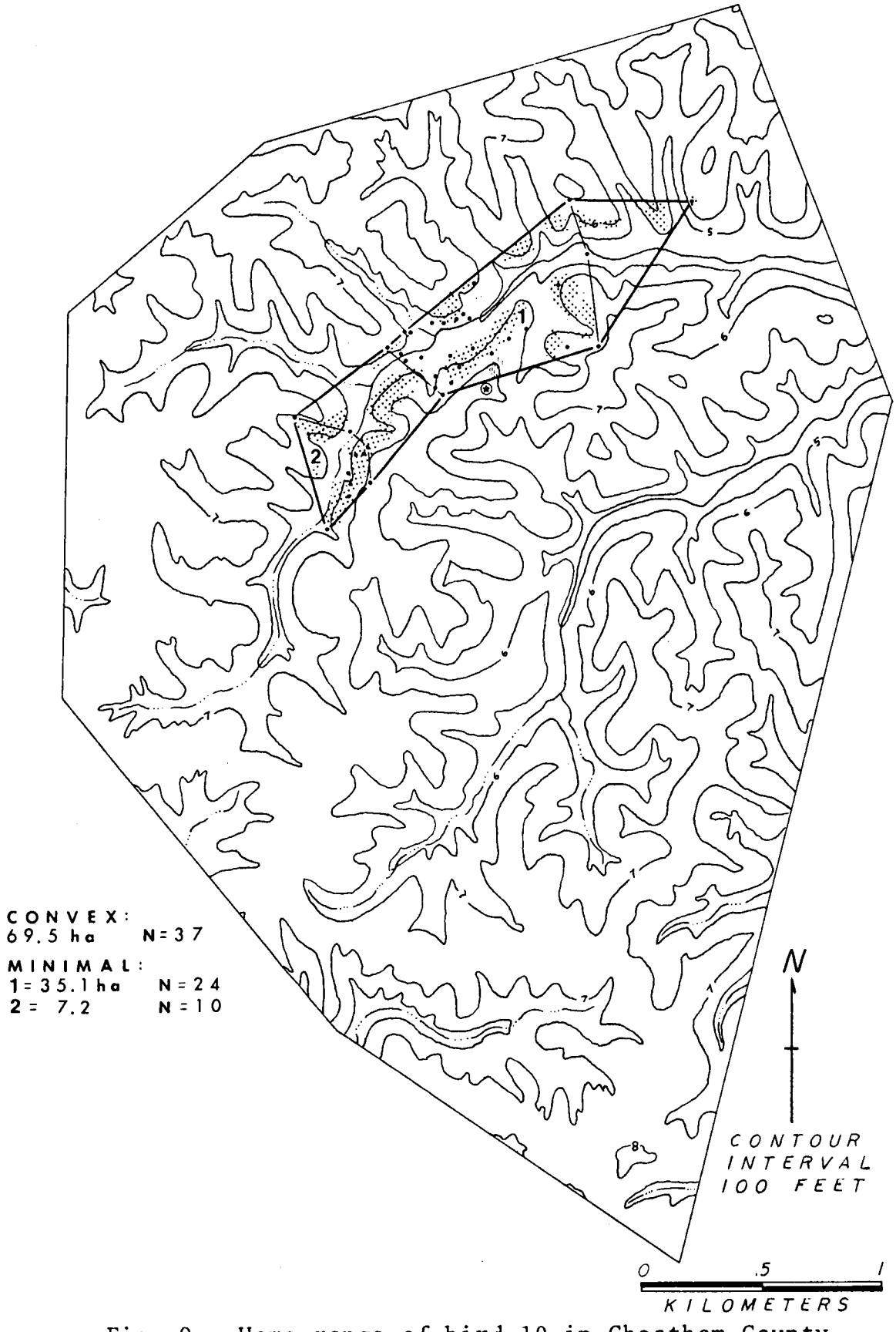


Fig. 9. Home range of bird 10 in Cheatham County, Tennessee.

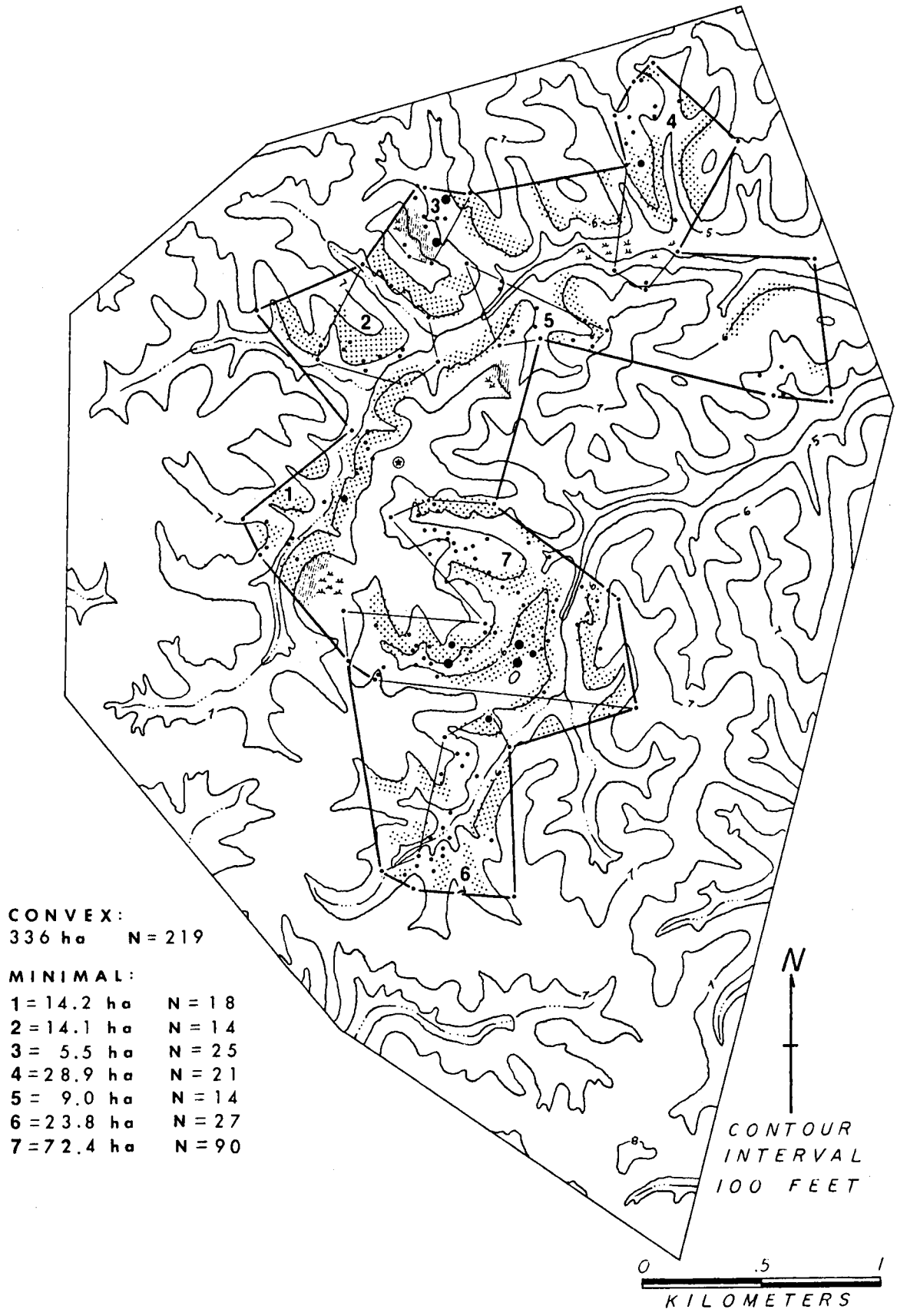


Fig. 10. Home range of bird 14 in Cheatham County, Tennessee.

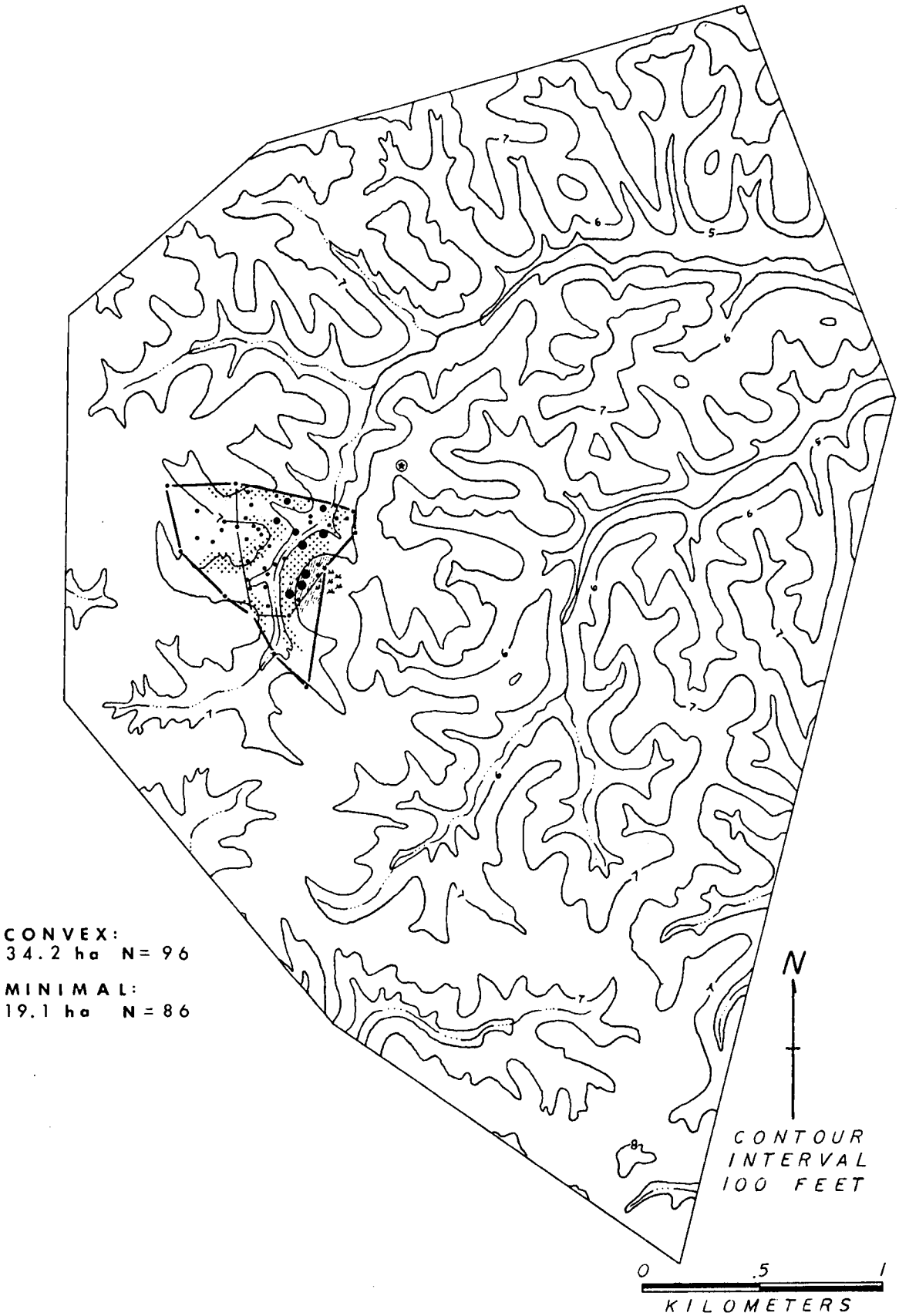


Fig. 11. Home range of bird 15 in Cheatham County, Tennessee.

VITA

Leslie F. Jones was born in Pineville, Kentucky, on February 25, 1946. The son of a Naval Officer, he attended numerous schools in the United States and England. He was graduated from Southwest Miami High School, Miami, Florida in 1964. In 1969 he received a Bachelor of Science degree in Geology from The University of Tennessee, Knoxville.

Following graduation, he was commissioned an Ensign in the United States Navy Reserve where he served on destroyers until 1972, attaining the rank of Lieutenant (jg).

Upon completion of active duty, he joined the inactive Navy Reserve and returned to The University of Tennessee, Knoxville where he received a Bachelor of Science degree in Forestry. He entered The Graduate Program at The University of Tennessee, Knoxville and accepted a Research Assistantship with the University's Department of Forestry, Wildlife and Fisheries. He received a Master of Science degree in Wildlife and Fisheries Science in August 1979.

He is now a Wildlife Officer with the Tennessee Wildlife Resources Agency and has been selected for promotion to the rank of Lieutenant Commander in the Navy Reserve.

He resides in Athens, Tennessee with his wife Sue Anne and his two sons, Frederick Lee and Christopher Trever.