WILDLIFE SESSION

SURVIVAL AND HABITAT USE OF NORTHERN RUFFED GROUSE INTRODUCED INTO WEST TENNESSEE

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Abstract: Sixty ruffed grouse (*Bonasa umbellus*) trapped in Michigan and Wisconsin were released in Benton County, Tennessee. Trapping, transporting and releasing were accomplished in late August and early September, 1976 and 1977. A total of 567 radio locations were made of 20 telemetered birds, 8 of which survived past their last radio location (1 surviving beyond 14 months). Shrubby thickets of laurel (*Kalmia latifolia*) and farkleberry (*Vaccinium arboreum*) were heavily used for cover. By 2 mo. after release, 10 of 14 grouse dispersed more than 1 km from their release sites. Maximum dispersal was 4.4 km. Home range sizes for 11 grouse varied from 2 to 497 ha. Home range size was influenced by the predominant cover type selected.

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The western boundary of the range of ruffed grouse in Tennessee has receded eastward significantly during the last 4 decades (Schultz 1953, White and Dimmick 1978). Probably a major factor causing extirpation of the species was persistent loss of its essential woodland habitat. More recently, however, in parts of west Tennessee abandoned marginal agricultural lands have succeeded to old fields and young forests, justifying an effort to restore grouse to their formerly occupied range. Successful similar reintroductions have been made in Missouri (Lewis et al. 1968) and on certain Michigan islands (Amman and Palmer 1958). A portion of west Tennessee, designated the Western Highland Rim physiographic province, is comprised of large areas of contiguous hilly forested lands roughly approximating habitat conditions occupied by ruffed grouse in eastern Tennessee. Within this province, Nathan Bedford Forrest State Historical Area (NBFSHA) in Benton County, combining features of excellent habitat, faunal protection and good access, was selected for an experimental restoration attempt.

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THE STUDY AREA

Nathan Bedford Forrest State Historical Area comprises 534 ha of hills and bluffs overlooking the western shore of Kentucky Lake. It lies some 200 km west of the present westernmost populations of ruffed grouse in the state. Topography ranges from stream

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terraces and undulating land to highly dissected, steep faced hills with reliefs of 30 to 90 m. Soils in the hilly sections are cherty, very acidic, leached, and excessively well drained (Odom et al. 1953). Colluvial and alluvial soils in the valleys and hollows are richer but limited in extent.

The vegetation is a mosiac of successional stages resulting from a history of repeated timber cutting and clearing of most level tracts for agriculture. The woodlands are primarily composed of oak and hickory with chestnut oak (*Quercus prinus*), blackjack oak (*Q. marilandica*), post oak (*Q. stellata*) and shagbark hickory (*Carya ovata*) dominating the upland areas. Farkleberry, a 1 to 2 m shrub with stiff divergent branching, is a common understory plant on south facing slopes. Bands of mountain laurel thickets are found just below the ridgeline on some of the more open slopes. The flora in the low land areas is typically more diverse than that in the hilly sections. Pines (particularly *Pinus echinata* and *P. strobus*) and red cedar (*Juniperous virginiana*) are scattered throughout the area but rarely, if ever, appear to be dominant.

Five broad cover types were recognized on the study area, patterned after the successional stages used by Bump et al. (1947) but with more emphasis placed upon structural differences in the understory. The 5 cover types were: (1) *Shrubby thickets* – dense patches of laurel and/or farkleberry; overstory trees low and sparse. (2) *Open understory* – mature woodlands with understories relatively open and clear of woody and herbaceous growth. (3) *Dense understory* – mature woodlands with understories densely populated with hardwood saplings and/or farkleberry. (4) *Fields* – abandoned fields in early stage of succession, including the band of relatively dense woody shrubs comprising the field edge. (5) *Viny or herbaceous thickets* – dense patches of climbing or trailing vines and herbaceous vegetation, usually in small woods openings or edges.

METHODS

Handling grouse.

Ruffed grouse were captured with interception traps during late August and early September in Missauke County, Michigan and Vernon County, Wisconsin in 1976 and 1977, respectively. Capture boxes were constructed of welded wire with continuous capture funnel throats; interception leads utilized woven wire (see White 1978 for complete description). The grouse were primarily in late brood-rearing phase at this time; all but 2 birds were juveniles, and many multiple captures were achieved. The birds were held in wire cages cushioned inside with burlap, fed locally harvested natural foods for a few days, then transported to the release site by air or surface vehicle. A few grouse died from shock during various stages of trapping and handling, but most birds adapted well to the process, feeding readily upon the succulent fruits provided them.

Radio-tracking.

Twenty grouse were fitted with radio transmitters before release. Both solar powered (wt. 18.5 g) and battery powered (wt. 26.5 g) transmitters were used. A complete evaluation of transmitters was presented by White (1978). Radio-tracking was conducted continually from release through mid December, and sporadically thereafter. Daily midday radio locations (90% made between 0945 and 1715 hr CDT) were made by triangulation using a hand held receiver and antenna. Birds were flushed on about 21% of the locations to determine survival.

Three aspects of grouse mobility were evaluated. *Mean dispersal* was defined as the distance between the release point and a point representing the average of all subsequent locations. *Maximum dispersal* was the straightline distance between the release point and the single location farthest from that point. *Home range* was delineated by planimetric measurement of the area of a convex polygon formed by connecting the outermost radio-locations. While this method introduces certain biases related to the number of locations (Jennrich and Turner 1969), the errors caused by these biases were believed insignificant

for the interpretations presented here. A more detailed discussion of home range data was presented by White (1978).

RESULTS AND DISCUSSION

Survival and Mortality

Sifty ruffed grouse trapped in Michigan (1976 – 33 birds) and Wisconsin (1977 – 27 birds) were released on the study area. To monitor survival times and causes of death, transmitters were placed on 9 birds in 1976 and 11 birds in 1977.

Survival of each telemetered cohort was roughly comparable to the 45% fall-to-spring juvenile survival rate reported by Gullion and Marshall (1968) for established boreal grouse populations. However, the 2 estimates are not strictly comparable because our radiotracked birds were observed for time periods nearly always shorter than the 6 month interval used by Gullion and Marshall (1968) to calculate juvenile mortality.

Known survival times of 8 birds that were alive when last radio contacted were sufficient to suggest that the study area could support grouse at least during fall and winter. Six grouse survived for a period of at least 1 to 4 months, another lived for a minimum of 6 months, and 1 bird was alive more than 14 months before radio contact was lost. Maximum survival was not measured due to loss and/or failure of transmitters.[a]

The specific or approximate cause of death was determined for 10 birds carrying radios. Four deaths were induced by the experimental methods; 3 birds were taken by predators after their antennas became entangled in vegetation, and 1 bird died from shock soon after release. One of the birds whose antenna became entangled had survived in apparent good health for 5 months. Six other birds were killed by predators in circumstances where experimental methods were not directly implicated as a contributing factor to their demise. Three of these deaths occurred within 14 days following release, and 3 others within 3 to 8 weeks. For 2 birds, radio contact was lost within 24 hours after release.

Cover selection – Fourteen grouse were located often enough (10-85 daily locations) to delineate cover use patterns (Table 1). Eight of these birds used *shrubby thickets* as centers of activity, with 40 to 80% of all observations for each bird occurring in this cover

Table 1. Cover type utilization by 14 introduced ruffed grouse on NBFSHA, Benton County, Tennessee, based on number and percentage of radio locations in 5 cover types.

Cover Type	*Year of Release* 1976 No. (%)	1977 No. (%)	Total No. (%)
Shrubby Thickets	54 (32)	182 (46)	236 (42)
Dense Understory	47 (28)	100 (25)	147 (26)
Viny, Herbaceous Thickets	31 (19)	50 (13)	81 (14)
Open Understory	25 (15)	27 (7)	52 (9)
Fields	10 (6)	41 (10)	51 (9)
Total	167 (100)	400 (100)	567 (100)

[a]Addendum: On 17-18 April 1979, 2 mature grouse were flushed on the study area. It could not be determined if these birds were survivors of the initial releases, or offspring from those birds.

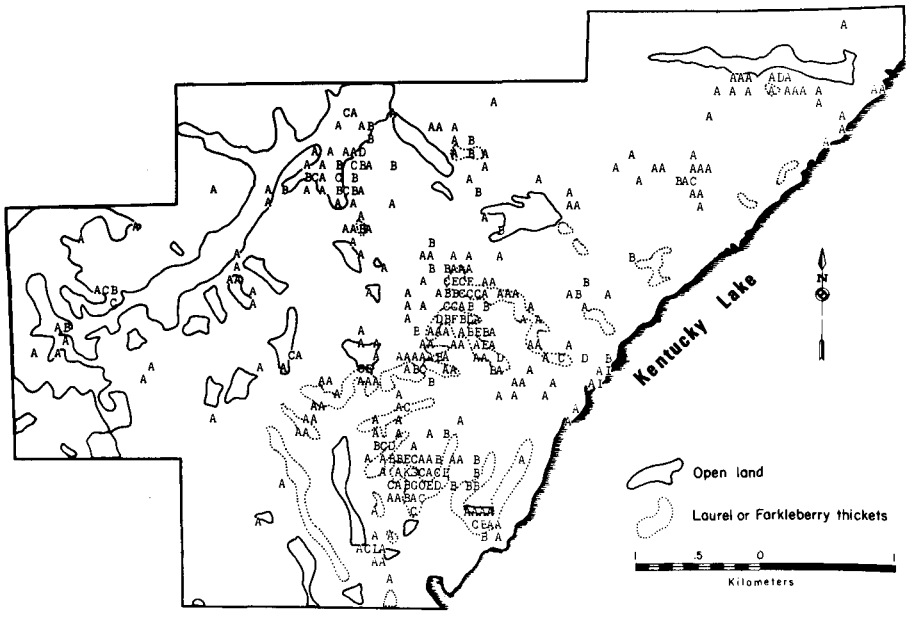

Fig. 1. Numbers of grouse locations recorded in 0.6 ha rectangles during 2 autumns and their relationship to important habitat features (N = 567). A = 1 location, B = 2 locations, etc.

type. Two species of plants were particularly important to grouse in this cover: (1) mountain laurel, occupying dry upper slopes, and (2) farkleberry, either alone or with mountain laurel or hardwood saplings (Fig. 1). Grouse occupying these thickets spent most of their remaining time in woodlands immediately adjacent to the thickets.

Laurel provided particularly dense protective cover for the grouse. Leaves and buds of laurel, a major food of grouse in east Tennessee (Stafford and Dimmick 1979), were likely used as food for birds associated with these thickets. Farkleberry fruits, though edible by grouse (Short and Epps 1976), were not abundant or persistent. However, the stiff, branching growth form of the bushes provided an important structural component of the habitat, serving primarily as protective cover.

Four birds utilized *dense understories* as their primary cover type (35-40% of locations). Two of these birds occupied *shrubby thickets* initially, then dispersed to areas where that cover type was lacking. The other 2 birds apparently did not encounter *shrubby thickets* initially or in subsequent dispersal.

Two birds occupied *viny or herbaceous thickets* during early fall. One of these was killed in September, and the other departed from this cover type when frost and leaf fall sharply reduced cover density.

The native habitats of ruffed grouse from Michigan and Wisconsin differed markedly. Michigan grouse were captured in alder thickets (*Alnus rugosa*), and woodlands of aspen (*Populus spp.*) and paper birch (*Betula papyrifera*) with dense ground layers of bracken ferns (*Pteridium aguilinum*). By contrast, the "driftless area" of southwestern Wisconsin more closely resembled eastern Tennessee with its hardwood forest of oaks (*Quercus spp.*), sugar maple (*Acer saccharum*), willow (*Salix spp.*) and elms (*Ulmus spp.*). Despite the dissimilarities, however, selection of cover types in their

introduced range was quite similar for the 2 groups of birds (Table 1). Thus it appears that the shrubby thickets and dense understories in Tennessee woodlands, though comprised of different species, sufficiently resemble the alder, willow and prickly ash (*Zanthoxylum americanum*) thickets of their native ranges to provide acceptable cover.

Topographic features – Topography in the study area is highly dissected; slopes of all aspects are approximately equally distributed, and presumably equally available for utilization by grouse. Despite this wide variety of slopes and associated vegetation types, 27% of all grouse locations were on the upper half of southwesterly facing slopes steeper than 30%. These features combined with cherty soils to produce xeric sites populated with stunted, sparse trees and relatively dense understories of laurel and farkleberry. The attraction of these areas to grouse was probably their vegetative rather than topographic characteristic.

Patterns of dispersal

During the first 2 weeks after release, 3 of 14 grouse dispersed more than 1 km from their release sites, each displaying initial movements greater than the maximum dispersal for any of the remaining 11 birds. After 1 month, 5 of 12 surviving birds had travelled more than 1 km from release, and at the end of 2 months all birds had reached their maximum dispersal. The greatest distance travelled from release was 4.4 km, and the shortest movement was less than 0.6 km (Table 2). Despite their tendency to disperse rather widely from release points, the birds were not difficult to follow when their radios functioned properly. Comparative performances of the various transmitters was

Table 2. Home ranges and dispersal characteristics of 11 ruffed grouse, each with more than 20 daily radio-locations.

Bird	*Sex*	*No. loc.*	*Survival (days)*	*Cover type*[a]	*Home Range (ha)*	*Mean dispersal (m)*	*Maximum dispersal (m)*
T-1977	M	82	133	A-1	497	1030	2860
K-1977	M	46	55	B	230	470	1340
M-1977	M	85	102	A-1	143	800	1700
C-1976	-[b]	43	111	B	123	2760	4390
P-1977	M	51	56	B	122	1080	2180
S-1977	F	23	29	B	88	900	1700
I-1976[c]	M	24	437	A-2	72	810	1150
B-1976	F	36	79	C	68	800	1320
E-1976	-[b]	32	172	A-2	59	730	1250
L-1977	-[b]	74	88	A-2	56	170	580
J-1977	F	21	23	C	2	700	800
Mean					133	932	1735

a - cover types:
A = Shrubby thickets
1 = farkleberry
2 = laurel
B = Dense understory
C = Viny, herbaceous thickets

b - sex undetermined

c - bird located during 2 autumns

dis. ussed in detail by White (1978). Briefly, however, all birds fitted with battery powered transmitters in 1977 provided data until their death or loss of transmitter. Transmitters used in 1976 were less effective, though 1 solar transmitter provided intermittent data for 14 months.

Once grouse were established on home ranges they continued to be highly mobile. The birds exhibited a mean daily change in location of 250 m. More than 12% of 426 daily changes in location were greater than 500 m. Juvenile grouse typically display exaggerated movements during their first autumn; these have been attributed to break-up of the brood and dispersal from the brood range (Godfrey and Marshall 1969). It may be that this apparent high degree of mobility may be a function of the grouse' state of maturation as well as an effort to locate suitable living space in their new habitat. We detected, however, no sex related differences in dispersal or mobility patterns, though such has been reported elsewhere (Rusch and Keith 1971, Chambers and Sharp 1958).

Home Ranges

Home range areas were estimated for 11 grouse which were located 21 to 85 different days (Table 2). These birds survived a minimum of 1 month to more than 14 months.

The home range area was a highly variable characteristic of individual birds ranging from 2 to 497 ha (Table 2). This variability was influenced by the predominant cover type used by each bird (Table 2), and by inherent differences in dispersal and daily movement patterns. Since home range was being measured during an exploratory phase, time and distance necessary to locate suitable habitat would obviously influence the range measured in this study. Birds which found it necessary to continue to search for acceptable living space for long periods of time likely would appear to have large home ranges. Thus, home range areas expressed for these introduced birds are more correctly considered indicators of the extent to which each bird "explored" its new home rather than an expression of its habitat utilization.

Despite these complicating factors of dispersal patterns, marked relationships existed between cover use and home range area (Table 2). Birds using farkleberry thickets and mature woodlands with dense understory generally exhibited the largest home ranges; the 3 birds using laurel thickets consistently used much smaller areas. Grouse occupying herbaceous or viny thickets had much the smallest home ranges; 1 bird used only 2 ha, and another bird (B-1976, Table 2) used only 1.5 ha until it left the herbaceous thicket for another cover type.

PROSPECTS FOR RESTORATION

The introduced ruffed grouse found several types of cover acceptable for survival during fall and winter. Considering the negative aspects of trauma associated with being trapped, transported and fitted with radio and antenna, and released into an alien environment at an early age, the grouse survived well in comparison with survival rates of juvenile birds reported elsewhere.

Over the 2 years of field work, no evidence was found to indicate that birds attempted to reproduce. Several days were spent each spring listening for drumming grouse; none was heard. Also, no broods were reported during summer by visitors or workers in the study area. Though survival was believed to be reasonably good, small numbers were released each year, and consequently few birds were present each spring on the study area. The marked tendency for birds to disperse may have separated breeders, rather than merely "shuffling" them as would occur in an established population occupying a wide range. Counteracting this propensity for dispersal, however, may be a concentrating effect of habitat preference. Grouse in eastern Tennessee selected upper slope areas for drumming sites (Taylor 1976). On our study area, these slopes often are vegetated with

laurel and/or farkleberry thickets, quite attractive to grouse. Consequently, if enough birds survive to breeding season, then these areas may provide clusters of birds in sufficient proximity for mating to occur.

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