Habitat at Ruffed Grouse Capture Sites in Kentucky

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Abstract: Habitat structure and composition were measured at 51 ruffed grouse (*Bonasa umbellus*) trap sites in a mixed-mesophytic forest in eastern Kentucky. High midstory stem density, low herbaceous stem density, high abundance of dead wood at ground level, and high abundance of evergreen herbs, greenbriars (*Smilax* spp.), and pines (*Pinus* spp.) contributed significantly to prediction of ruffed grouse captures. A discriminant model was tested on independent data and correctly classified 70% of 50 capture sites but misclassified 60% of 48 non-capture sites as capture sites. Nineteen of 23 sites that captured 2 or more grouse were classified correctly.

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Reestablishment of ruffed grouse in Missouri (Hunyadi 1984), Iowa (Little and Sheets 1982), southern Indiana (Backs 1984), southern Illinois (Woolf et al. 1984), Arkansas (M. Pledger, pers. commun.), and western Tennessee (White and Dimmick 1979), has been attempted with varying degrees of success. All attempts have relied on the success of capturing ruffed grouse where they are abundant and transporting the birds to unoccupied habitat. Interception traps are used almost exclusively (D. Major, pers. commun.). The Kentucky Department of Fish and Wildlife Resources has captured grouse in eastern Kentucky for transport to locations in central and western Kentucky. Although grouse trappers are provided instruction in placement and setting of traps prior to trapping, few guidelines are available regarding identification of the habitat in which traps should be set to optimize the probability of capture. Setting traps in early seral stage hardwoods and pine-hardwoods,

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edge of hardwood clearcuts, and old-field succession areas with flowering dogwood (*Cornus florida*), sumacs (*Rhus* spp.), sassafras (*Sassafras albidum*), eastern red-cedar (*Juniperus virginiana*), grapes (*Vitis* spp.), brambles (*Rubus* spp.), greenbriars, and young pines has been suggested (S. E. Backs, pers. commun.). Backs also suggested that trappers should spend 7 to 10 days visiting the trapping areas to select trap sites prior to setting traps. Gullion (1965) noted that interception traps should be set in brushy areas or edges prior to snowfall but to move the traps to coniferous cover after snowfall. Bonney (1984) indicated that young clearcuts, old surface mines, old homesites, and other early seral stage areas containing evergreens (particularly Christmas fern [*Polystichum acrostichoides*] and ebony spleenwort [*Asplenium platyneron*]), greenbriars, avens (*Geum* spp.), Japanese honeysuckle (*Lonicera japonica*), flowering dogwood, and grapes were potential trap sites.

Specific guidelines describing the structure and composition of habitat at good trap sites are generally unavailable. Specific guidelines could be used to trap grouse more efficiently in states currently conducting grouse relocation programs. Objectives of this study were: to identify the habitat characteristics that differed between capture vs. non-capture sites; to develop a habitat-based discriminant model that could be used to predict if a trap would be successful; and to test the model on independent data collected during a subsequent year of trapping.

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Study Area and Methods

The study was conducted on a 3,600-ha portion of the University of Kentucky's Robinson Forest in Breathitt and Knott counties, Kentucky. The Forest is a mature, mixed mesophytic forest. Disturbance in the mature forest consists of scattered clearcuts (18 ha), intermediate cuttings (20 ha), herbicide plots (11 ha), wildlife clearings (20 ha), pine plantations (10 ha), surface mine edges along the perimeter, and selective harvest of trees along roadsides. Early seral stage habitat is patchy. Dominant vegetation has been described by Carpenter and Rumsey (1976) and Overstreet (1984). Robinson Forest is within the center of the Cumberland Upland Avifaunal Region as described by Mengel (1965) and centrally located within the current range of ruffed grouse in eastern Kentucky.

Modified lily-pad traps (243 single sets) were set on Robinson Forest where grouse had been observed or where the habitat appeared to the trappers to be suitable for grouse. Traps were set between August 1985 and March 1986 for 34 to 199 days.

Table 1. Trap-site characteristics measured at ruffed grouse capture and non-capture sites, Robinson Forest, Kentucky, 1985–86.

Habitat feature	Description
Overstory stem density/0.04 ha[a]	Density of woody stems ≥5 cm dbh/0.04-ha circular plot, recorded by species.
Large overstory stem density/0.04 ha	Same as overstory density except ≥25 cm dbh.
Medium overstory stem density/0.04 ha	Same as overstory density except ≥10 cm dbh and <25 cm dbh.
Small overstory stem density/0.04 ha	Same as overstory density for trees ≥5 cm and <10 cm dbh.
Overstory species diversity	Shannon-Weaver species diversity, Log_{10} (Brower and Zar 1984:155–156).
Overstory species equitability	Shannon-Weaver equitability, Log_{10} (Brower and Zar 1984:159).
Midstory stem density/88 m^2 [b]	Density of woody stems >2 m tall and <5 cm dbh encountered with outstretched arms along 4 perpendicular 11-m transects at each site, recorded by species.
Midstory species diversity	Shannon-Weaver species diversity, Log_{10} (Brower and Zar 1984:155–156).
Midstory equitability	Shannon-Weaver equitability, Log_{10} (Brower and Zar 1984:159).
Understory stem density/13 m^2 [c]	Number of woody stem contacts of a 1-m rope rotated about a point 6 m from plot center on each of 4 perpendicular transects, recorded by species.
Understory species diversity	Shannon-Weaver species diversity, Log_{10} (Brower and Zar 1984:155–156).
Understory equitability	Shannon-Weaver equitability, Log_{10} (Brower and Zar 1984:159).
Slash stem density/13 m^2	Same as understory density except number of dead woody stems.
Evergreen herb cover (%)	Number of hits/20 × 100 made with an ocular sighting tube at 5 locations on each of 4 perpendicular 11-m transects per site, recorded by species (James and Shugart 1971).
Herb cover (%)	Same as evergreen herb cover except for live non-evergreen herbaceous plants.
Dead herb cover (%)	Same as evergreen herb cover except for dead stems.
Dead wood cover (%)	Same as evergreen herb cover except for logs and slash.
Slope	Average slope of the trap fence, in degrees.
Aspect	Compass direction in which the slope faced, 0–360°, sine transformed (Beers et al. 1966).
Trap days	Number of days the trap was operational.

[a] Stem density values/0.04 ha for the following taxa were included as separate values in model development following vegetation composition analysis: pines (*Pinus* spp.), sourwood (*Oxydendrum arboreum*), eastern hemlock (*Tsuga canadensis*), sweet birch (*Betula lenta*), winged sumac (*Rhus copallina*), and dead stems.

[b] Stem density values/88 m^2 for the following taxa were included as separate values in model development following vegetation analysis: greenbriar (*Smilax* spp.), hazelnut (*Corylus americana*), grapes (*Vitis* spp.), flowering dogwood (*Cornus florida*), eastern hemlock, American beech (*Fagus grandifolia*), and dead stems.

[c] Stem density values/13 m^2 for the following taxa were included as separate values in model development following vegetation analysis: blueberry (*Vaccinium* spp.), flowering dogwood, hazelnut, and poison-ivy (*Toxicodendron radicans*).

Characteristics of the structure and composition of the habitat, thought to be important to grouse based on a previous study (Bonney 1987), were measured at each trap that caught at least 1 grouse, and at 32 traps on 19 randomly selected sites that did not catch grouse (Table 1). Plots were centered on the middle of the drift fence, and transects radiated at 45° angles to the fence. Student's *t*-test was used to compare characteristics between capture and non-capture sites. A subset of characteristics that differed ($P < 0.20$) between capture and non-capture sites was subjected to stepwise discriminant function analysis (DFA) to develop a discriminant model to separate capture sites from non-capture sites. A $P < 0.20$ was used to reduce the risk of deleting a variable which might contribute to the classification model in the multivariate context. Refinement of this model was accomplished by retaining only those characteristics that were not correlated ($r > 0.40$), and by weighting capture sites based on the number of captures. The model was tested on data collected at a random sample of 50 capture sites and 48 non-capture sites at Robinson Forest; Big Black Mountain, Harlan County; Cave Run Lake Area, Bath County; Grayson Lake WMA, Carter County; and Carr Fork Lake Area, Knott County. Traps were set at these sites by 10 different trappers. Data were collected from July 1986 through March 1987.

Results and Discussion

Model Development

Twenty-eight grouse were captured in approximately 7,000 trap-days. Traps at capture sites were not set significantly ($P > 0.10$) longer ($\bar{X}$ = 112 days; SE = 10.1) than traps set at non-capture sites ($\bar{X}$ = 89 days; SE = 9.1). One to 5 birds were captured at each capture site. Capture sites were dominated by red maple (*Acer rubrum*) (103 stems/ha), yellow-poplar (*Liriodendron tulipifera*) (78 stems/ha), sourwood (*Oxydendrum arboreum*) (70 stems/ha), shortleaf pine (*Pinus echinata*) (63 stems/ha), and flowering dogwood (58 stems/ha) in the overstory; greenbriar (673 stems/ha), American hornbeam (*Carpinus caroliniana*) (650 stems/ha), and red maple (598 stems/ha) in the midstory; and poison-ivy (*Toxicodendron radicans*) (6,000 stems/ha), strawberry-bush (*Euonymus americanus*) (4,090 stems/ha), greenbriars (3,750 stems/ha), and blueberries (*Vaccinium* spp.) (3,500 stems/ha) in the understory. Greenbriar was more ($P < 0.05$) abundant in the midstory at capture sites than at non-capture sites (Table 2). Overstory sweet birch (*Betula lenta*) and midstory eastern hemlock (*Tsuga canadensis*) were less ($P < 0.05$) abundant at capture sites than at non-capture sites. High density (>6 contacts along 4 perpendicular 11-m transects with outstretched arms) of greenbriars would indicate a potential trap site likely to catch grouse. Total midstory stem density was also higher on capture sites than on non-capture sites ($P < 0.05$). Evergreen herb cover (primarily Christmas fern and ebony spleenwort) was higher ($P < 0.05$) at capture sites than at non-capture sites. Bonney (1987) found these 2 species to be a significant portion of grouse diets in Kentucky. Understory dead herb cover,

Table 2. Average habitat characteristics that differed ($P < 0.05$) between ruffed grouse capture ($N = 19$) and non-capture ($N = 32$) sites, Robinson Forest, Kentucky, 1985–86.

Habitat characteristics[a]	Capture site $\bar{X}$	Capture site SE		Non-capture site $\bar{X}$	Non-capture site SE
Midstory stem density/88 m^2	55.1	5.7	[b]	41.3	3.2
Evergreen herb cover (%)	3.8	1.0	[b]	1.4	0.4
Dead herb cover (%)	3.8	0.7	[b]	2.2	0.4
Dead wood cover (%)	10.5	1.1	[c]	6.7	2.6
Sweet birch overstory density/0.04 ha	0.2	0.1	[b]	1.2	0.4
Greenbriar midstory density/88 m^2	5.9	2.1	[b]	1.2	0.4
Hemlock midstory density/88 m^2	0.8	0.3	[b]	3.1	1.2

[a]Definitions presented in Table 1.
[b]Means differ, $P < 0.05$.
[c]Means differ, $P < 0.01$.

understory standing dead stem cover, and understory dead wood cover were more abundant ($P < 0.05$) on capture sites than on non-capture sites. These features probably serve as isolated cover on the forest floor for grouse.

Habitat features that differ between capture sites and non-capture sites can provide clues to the suitability of a trap site for capture of grouse, but more likely a combination of habitat features influence the likelihood that a grouse would be captured at 1 site and not at another. The following variables were added to a DFA model, in order of stepwise inclusion ($R^2 = 0.76$, $p < 0.001$): understory dead wood, midstory stem density, midstory greenbriar density, evergreen herb cover, understory herb cover, understory dead herb cover, midstory hazelnut (*Corylus americana*) density, overstory pine density, and midstory dead stem density. Several of these variables were highly correlated ($r > 0.40$; $P < 0.01$), which could result in an inflated R^2 simply by adding additional correlated variables to the model. Consequently, a subset of 6 of these 9 variables were retained to develop a discriminant model that was nearly as strong ($R^2 = 0.70$) as the 9-variable model. The 6-variable DFA model with unstandardized discriminant coefficients is:

DF = midstory density (0.033) − herb cover (0.082) + evergreen herb cover (0.225) + dead wood cover (0.215) + overstory pine density (0.077) + midstory greenbriar cover (0.080).

DF is the response variable used to classify a site as likely or unlikely to capture grouse. If DF < 5.0 the site is classified as a non-capture site (unlikely to capture grouse); if DF > 5.0 the site is classified as capture site (likely to capture 1 or more grouse). This model correctly classified all non-capture sites as non-capture sites. The model correctly classified 58% of capture sites as capture sites; 42% of capture sites were incorrectly classified as non-capture sites (Table 3).

Model Testing

The model correctly classified capture sites at 60% to 90% of the trap sites on the 5 test areas (70% overall) (Table 3). Non-capture sites were misclassified at high

Table 3. Results of testing a discriminant model to predict ruffed grouse captures in eastern Kentucky, 1986–87.

Site	Captures predicted correctly	Non-captures predicted correctly	Captures predicted as non-captures	Non-captures predicted as captures
Robinson Forest[a]	11/19	32/32	8/19	0/32
Black Mountain	7/70	4/8	3/10	4/8
Cave Run Lake Area	6/10	5/10	4/10	5/10
Grayson Lake WMA	9/10	2/10	1/10	8/10
Carr Fork Lake Area	7/10	5/10	3/10	5/10
Robinson Forest	6/10	3/10	4/10	7/10
Total	35/50 (70%)	19/48 (40%)	15/50 (30%)	29/48 (60%)

[a]Original data used in model development; not included in total.

rates on all sites (50% to 80%). Nineteen of 23 trap sites that caught 2 or more birds (multiple capture sites) were classified correctly. The model may have been ineffective at classifying non-capture sites for several reasons. First, not all habitat capable of supporting ruffed grouse will actually have grouse present. If the model is used to screen habitat for potential trap sites, then grouse flushes, droppings, dusting spots, and other indications of grouse use should be used in addition to the discriminant score to provide evidence for trap site suitability. Second, grouse may be present in the habitat, but the orientation of the drift fence and the size of the funnel entrance may preclude capture. Third, the shape of the habitat may influence the probability of grouse capture. A long, narrow strip of habitat can be more effectively trapped than a large block of suitable habitat.

An inexperienced trapper could evaluate a potential trap site by measuring 6 habitat characteristics and classifying the site as potential capture site or not. Because misclassification of some non-capture sites is likely, this information should be used in conjunction with observations of other grouse sign and careful trap placement to increase the efficiency of a grouse trapping program and reduce the cost per bird moved to new habitat.

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