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HABITAT SELECTION OF MERRIAM'S TURKEY *(MELEAGRIS GALLOPAVO MERRIAMI)* HENS WITH POULTS IN THE BLACK HILLS, SOUTH DAKOTA

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ABSTRACT.--We studied habitat selection patterns of' Merriam's Turkey (*Meleagris gallopavo merriami*) hens with poults in a ponderosa pine (*Pinus ponderosa*) ecosysem. Thirty-six radio-marked hens produced 19 broods, and we obtained 230 locations of' hens with poults. We described vegetation of' habitats using criteria from the Rocky Mountain Region, U.S. Forest Service, for determining effects of forest management and monitoring of wildlife populations. Most habitat units were 432 ha and corresponded to third-order habitats as described by Johnson (1980).Hens with poults selected large meadows and rarely selected dense ponderosa pine habitats. Younger poults used meadows more frequently than did older poults. Implementation of the Black Hils National Forest Land and Resource Management Plan in ponderosa pine habitats will not negatively impact hens with poults. Grazing by livestock reduces herbaceous biomass necessary for invertebrate food items of poults and cover for poults. Habitat selection patterns of hens with poults should be evaluated by age categories of poults.

Key words: Merriam's Turkeys, Meleagris gallopavo merriami, *poults, habitat selection, forest management, invertebrates, meadows, radio telemetry, grazing.*

Merriam's Turkeys *(Meleagris gallopavo merriami* historically ranged as far north as southern Colorado when settlers moved into the southwestern United States (MacDonald and Jantzen 1967). In 1948, 1950, and 1951, wild turkeys were transplanted to the Black Hills of South Dakota in three separate releases of 8,15, and 6 birds, respectively (Petersen and Richardson 1973). By 1952, estimated turkey populations in the Black Hills of South Dakota and Wyoming were 1000 birds, and by 1960 population estimates were 5000-7000 birds (Petersen and Richardson 1973), suggesting excellent reproductive potential in habitats of this region.

Current pressures from society and statutory mandates (e.g., National Forest Management Act, Renewable Resources Planning Act, National Environmental Policy Act) require that the effects of management activities such as grazing and timber harvest on the various wildlife species be considered in management decisions. Recently, the value of ponderosa pine has increased, placing greater demands for logging in the Black Hills (G. Gire, silviculturist, Black Hills National Forest, personal communication). Increased value of timber resources, emphasis on old-growth timber values, and improvements in technology of harvesting timber have renewed concern for the habitat requirements of Merriam's Turkeys (Shaw 1986). In addition to loggers, other users also are increasing their awareness and use of national forest lands.

The objective of this study was to describe habitat requirements of turkey poults in a ponderosa pine ecosystem at the same resolution level as that used by the U.S. Forest Service in making management decisions and monitoring the effects of those decisions on wildlife.

METHODS

Study Area

This study was conducted in the central Black Hills of South Dakota, approximately 16 km west of Rapid City Most of the land is under management of the Black Hills National Forest, Pactola Ranger District, although private holdings associated with ranch operations and several private homes and cabins exist in the study

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Vegetation in the study area is primarily pure ponderosa pine forest (84%). Meadows and aspen (*Populus tremulides*)/birch (*Betula papyrifera*) habitats occur in drainages, but some monotypic aspen habitats also occur on north exposures. Bur oak (*Quercus macrocarpa*) and white spruce (*Picea glauca*) constitute less than 1% of the study area. Climax vegetation or potential natural communities include the following: *Pinus ponderosa/Symphoricarpos albus*, *P. ponderosa/Arctostaphylos uva-ursi*, *P. ponderosa/Juniperus communis*, *Populus tremuloedes/Corylus cornuta*, *Quercus macrocarpa/Ostrya verginiana*, *Q. macrocarpa/S. albus*, and *Picea glauca/Linnaea borealis* types as described by Hoffman and Alexander (1987).

Geologic material is predominantly Precambrian and Cambrian granite, schists, and metasediments (Hoffman and Alexander 1987). Elevation ranges from approximately 1300 to 1800 m. Climate is continental, with cold winters and warm summers (Orr 1959). January is typically the coldest month, with mean temperature extremes of – 11-2°C; July and August are the warmest, with mean temperature extremes of 15-29°C. Average annual precipitation is 50-55 cm, of which 70-80% falls between April and September (South Dakota Climatological Summary, No. 20-39-6, U.S. Weather Bureau). Snowfall averages 84 cm but may range from 25 to 200 cm.

Trapping and Locations

We trapped wild Merriam's Turkeys during late February or early March of 1986, 1987, and 1988 with rocket nets and drop nets over corn bait piles. Thirty-six females were fitted with backpack radio transmitters weighing approximately 108 g. Radio transmitters were attached to hens with 15.2-cm bungee cords looped under the wings.

Hen turkeys were monitored until behavior or a constant signal pulse suggested the hen had initiated a nest. After eggs hatched, radio-marked hens were located three times each week; we attempted to obtain one location in each of three time periods (sunrise to 0959, 1000 to 1359, 1400 to sunset) each week. Turkey locations were determined by plotting bearings from known locations on USGS 1:24,000 contour maps in the field; bearings were usually taken from positions within 300 m of the estimated location. Universal Transverse Mercator coordinates were recorded to the nearest 100 m for each location. Only one location was recorded for each bird on any given day. We considered observations of more than one radio-marked bird at a location as one observation to assure independence among observations (Alldredge and Ratti 1986). Each location of a hen with poults was assigned to a corresponding compartment and stand (see Habitat Descriptions below). We collected habitat use data of hens with poults over a three-year period, 1986-1989 during the months of June-September.

Habitat Descriptions

Habitats were determined by U.S. Forest Service criteria and assigned to numerically identified geographical units. Boundaries were defined by watershed topography (ridges and drainages) or distinct changes in vegetation type. Private lands in the study area were assigned to habitats based on interpretation of aerial photographs; boundaries of adjacent habitats were extended if the vegetation type was continuous. New boundaries were assigned if changes in vegetation were apparent. Typically, these habitats are 4--32-ha land units, although smaller-size habitats (inclusion habitats) were delineated if distinct vegetation types could be identified on 1:24,000 aerial photographs. Inclusion habitats were riparian areas, meadows, aspen/birch draws, and monotypic aspen communities. Five hundred thirteen habitat units encompassing 4380 ha were delineated on the study area.

Vegetative descriptions of each habitat unit were obtained from five plots uniformly assigned to each habitat unit and marked on 1:24,000 contour maps in the laboratory Plots in each habitat unit were then located using these maps. Diameter breast height (dbh) of trees and tree basal area were estimated at each plot using a 10-factor prism (Sharpe et al. 1976). When habitat units were too small to effectively place five plots, fewer plots were used.

Habitat assignments were made based on dominant species of vegetation (DSV) and overstory canopy cover (OCC) (Buttery and Gillam 1984). Criteria for describing habitats allowed for further stratification by dbh, but the most useful resolution level in determining habitat selection patterns of turkeys included DSV and OCC (Rumble and Anderson 1992). DSV categories were ponderosa pine, aspen/birch, oak,

Table 1. Use and selection of habitats by Merriam's Turkey hens with poults in the central Black Hills, South Dakota. Habitats selected less ($P \leq .10$) than expected are indicated by —, and those more than expected by ++.

Habitat	Percent canopy cover	Proportional area	Age			
			0–3 weeks (N = 106) [a]	4–7 weeks (N = 65)	8–12 weeks (N = 59)	0–12 weeks (N = 230)
Aspen/birch	0–40	0.0148	0	1	1	2
Aspen/birch	40–70	0.0191	2	1	0	3
Aspen/birch	70–100	0.0177	4	0	2	6
Oak	0–100	0.0044	3	0	0	3
Spruce	0–100	0.0056	1	0	0	1
Meadows		0.1016	36++	17++	9	62++
Ponderosa pine	0–40	0.1199	16	7	5	28
Ponderosa pine	40–70	0.3760	31	32	29	92
Ponderosa pine	70–100	0.3412	13—	7—	13	33—

[a]Sample sizes reported are the number of radio locations of hens with poults by age category.

spruce, and meadows. OCC categories were 0–40%, 41–70%, and 71–100% and were estimated based on the following equation: OCC(%) = 0.51*BASAL AREA(FT^2/AC) − 1.94 (Bennett 1984). Nine habitat categories were determined. These habitats correspond to third-order habitats as described by Johnson (1980).

Analyses

Chi-square tests for independence were used to test the hypotheses that (1) habitat use patterns by hens with poults were similar among age categories of poults and (2) habitat use patterns by hens with poults were similar among time periods of the day. An evaluation of chi-square residuals with a G standardization to a critical Z statistic (Mosteller and Parunak 1985) was used to determine significant differences of habitat use among age categories of poults.

Chi-square goodness-of-fit tests corrected for continuity (Cochran 1963) were used to test the hypotheses that habitat selection patterns of hens with poults were similar to random expected use for (1) all hens with poults and (2) three age categories of poults. Confidence intervals around proportional use were used to determine habitats selected more or less than expected (Neu et al. 1974, Byers et al. 1984). Bonferroni-corrected Z statistics were compared to the standardized chi-square residual (Mosteller and Parunak 1985:198) to determine if habitat selection deviated from expected random use when <5 observations occurred in a habitat. Statistical significance for all tests was $\alpha = .10$.

We assured correct classification of the habitat at turkey locations in several ways. Habitat boundaries were marked on field maps. When the location of a hen with poults was near the habitat boundaries, we verified field location by walking around the radio-marked bird while continuously monitoring changing directions of the signal, and/or by obtaining visual locations without disturbing the bird. More than half of the 230 data points used for analyses were visual locations.

The term *habitat use* will be used when habitats in which turkeys were observed were not compared to availability; *habitat selection* will be used when habitats in which turkeys were observed were compared to availability (Thomas and Taylor 1990).

RESULTS

Thirty-six radio-marked hens in this study produced 19 broods from which habitat use and habitat selection patterns were evaluated. A total of 230 independent observations of habitat use were made. Smaller sample sizes of older age categories of poults (Table 1) were due to mortality and movements out of the defined study area.

Habitat use differed among age classes of poults ($P \leq .001$). Ponderosa pine habitats with 71–100% overstory canopy cover were used more by hens with 8- to 12-week-old poults than by younger poults. Ponderosa pine habitats with 0–40% overstory canopy cover were used relatively more by poults younger than 8 weeks than by older poults.

Habitat selection patterns of hens with poults differed significantly ($P \leq .001$) from random use patterns. Summed across all age categories, hens with poults selected meadow habitats more than expected, but rarely were observed in ponderosa pine habitats with >70% overstory cover. Habitat selection patterns of hens with poults younger than 8 weeks old were identical to those for all poults. No significant patterns of habitat selection were apparent for hens with poults 8-12 weeks old ($P \leq .11$).

Habitat use did not vary ($P = .51$) among the three daily time periods for all hens with poults. Nor did habitat use patterns vary ($P \geq .30$) among daily time periods when evaluated for individual age categories of poults. Meadow habitats selected by hens with poults were more than two times larger ($\bar{x} = 36 \pm 4$ ha, $P \leq .02$) than the average ($x = 16 \pm 7$ ha) within the study area.

DISCUSSION

Edges of Kentucky bluegrass meadows best characterized habitats selected by hens with poults. Open ponderosa pine habitats with extensive understory vegetation were selected to a lesser degree. Hens with poults selected dense ponderosa pine habitats infrequently except as escape or occasional loafing cover. Hens with poults in meadows were seldom observed more than 10 m from the forest-meadow edge.

Use of forest meadows or forest-meadow ecotones by hens with broods is common for nearly all subspecies of turkeys (Jonas 1966, Hillestad and Speake 1970, Williams et al. 1973, Scott and Boeker 1975, Speake et al. 1975, McCabe and Flake 1985, Day et al. 1991). Hens with poults in this study selected the largest Kentucky bluegrass meadows (2-188 ha) and rarely selected small clearings in the forest or upland dry meadows. Small openings and upland dry meadows are common on the study area, often occurring within 200 m of Kentucky bluegrass meadows selected by hens with poults. These upland dry meadows in the Black Hills are less productive than Kentucky bluegrass meadows (Hamm 1973). Healy and Nenno (1983) found that poults prefer natural clearings in the forest over artificial openings. Findings from this study contradicted results reported for Merriam's Turkeys in other regions; Schemnitz et al. (1985) and Mackey (1986) both noted poults using small openings (less than .25 acre). Hengel (1990) reported hens with poults in Wyoming using riparian areas and meadows. In this study several hens with poults 24 days old moved long distances to large meadows. One hen took her brood 5.6 km (3.5 miles) in less than 4 days to a large meadow, and another moved approximately 1.8 km in less than 2 days to the same meadow. The longest movement by a hen with poults was more than 23.4 km over a 6-week period. They went to the same large Kentucky bluegrass meadow as the previous two. Day et al. (1991) reported direct movements of up to 3.5 km from nests to centers of habitat for turkey broods.

Hens with poults select meadows or other habitats because herbaceous vegetation supports an abundance of invertebrates. Invertebrates are necessary in diets of young gallinaceous birds for proper growth and survival (Johnson and Boyce 1990). Invertebrate abundance in this study area was greater in meadows than in other habitats (Rumble 1990). Poults have high protein requirements during the 4 weeks after hatching (Robbins 1983, Hurst and Poe 1985). Based on changes of habitat selection patterns presented here, use of meadow habitats and subsequent feeding on invertebrates continued through 7 weeks of age. Grazing by livestock reduces the herbaceous cover and associated invertebrate abundance. Habitat selection and survival of poults are correlated with abundance of herbaceous cover (Metzler and Speake 1985). Therefore, excessive grazing by livestock would be detrimental to poults less than 7 weeks old.

Habitat selection patterns of poults changed as the poults became older. Proportional use of meadows declined from 34% for poults less than 4 weeks old, to 26% for poults 4-7 weeks old, and 15% for poults older than 8 weeks. Similar trends in habitat selection patterns have been noted for Merriam's Turkeys and other subspecies of wild turkeys (Pack et al. 1980, Healy and Nenno 1983, McCabe and Flake 1985, Campo et al. 1989). Increased selection of forested habitats may be related to lower requirements for protein following feather development (Robbins 1983). Increased selection of forested stands with >40% overstory canopy cover by poults older than 7 weeks is within the range of overstory canopy cover management of ponderosa pine directed in the Black Hills National Forest Land and Resource Management Plan (Forest Plan). The Forest Plan calls for

ment of pine stands to 60 or 80 growing stock level (GSL). GSL is the basal area of a stand projected to 25 cm dbh trees (Boldt and Van Duesen 1974).

Because of changing habitat selection patterns of hens with age of poults, habitat requirements of wild turkey hens with poults should be assessed by age categories of poults. Including poults older than 8 weeks in analyses of younger poults can obscure some habitat relationships.

MANAGEMENT IMPLICATIONS

Because hens with poults selected meadows during critical growth and development phases of poults (<7 weeks), and because older poults selected forest stands with >40% overstory canopy cover, managing ponderosa pine stands to 60 or 80 GSL would not negatively impact habitats of hens with poults. However, dense ponderosa pine stands (>100 ft^2/ac basal area) should be left along meadow edges to provide escape and loafing cover for hens with poults. Grazing by livestock reduces the standing biomass of herbaceous vegetation in meadows; excessive grazing would also reduce the abundance of invertebrates and cover necessary for growth and development of poults.

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