

Merriam's Turkey Distribution in Relation to the U.S. Forest Service Recreational Opportunity Spectrum Forest Classification and Road Proximity in North-Central Arizona

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Abstract. We studied male Merriam's turkey (*Meleagris gallopavo merriami*) summer distribution in relation to the U.S. Forest Service Recreational Opportunity Spectrum (ROS) habitat classifications and road proximity to determine if the potential indices of disturbance influenced turkey habitat and roost site use. The ROS habitat classification proved of limited use, but turkeys avoided habitats <200 m from roads for both total locations and roost site locations. Improved high-traffic roads seem to negatively influence turkey habitat use, although turkeys were often found in association with unimproved, low-traffic roads. We did not ascertain what level of road use turkeys found unacceptable.

Key words: Arizona, disturbance, habitat, *Meleagris gallopavo merriami*, Merriam's turkey, roads, ROS

Habitat use by many wildlife species is influenced by human-related activities including vehicular and pedestrian traffic, although the magnitude of that influence is rarely quantified. For example, turkeys avoided habitats surrounding paved roads with >70 vehicles/hr (McDougal et al. 1990). Little is known about turkey response to lesser-traveled roads and habitats receiving varying degrees of recreational use. Understanding the factors that influence disturbance, and turkey response, is useful when planning for the recreational demands of Arizona's growing population.

Because human disturbance was identified as an important factor influencing turkey distribution at a recent turkey management workshop (Holland et al. 1996), we studied the summer distribution of male Merriam's turkeys in a habitat receiving substantial summer recreational activity. Our objective in this study was to determine how turkey distribution and habitat selection varied in relation to ROS classification and road proximity. Further, we wanted to be able to infer from these data how disturbance influenced turkeys during summer high-recreational-use periods.

STUDY AREA

We conducted our study in the Coconino National Forest south of Flagstaff, Arizona, in Game Management Unit (GMU) 6A. Precipitation averages 47 cm annually. Summer temperature highs range from 21–32°C, rarely exceeding 35°C, with summer average daily temperature at 12°C (National Oceanic and Atmospheric Administration 1997).

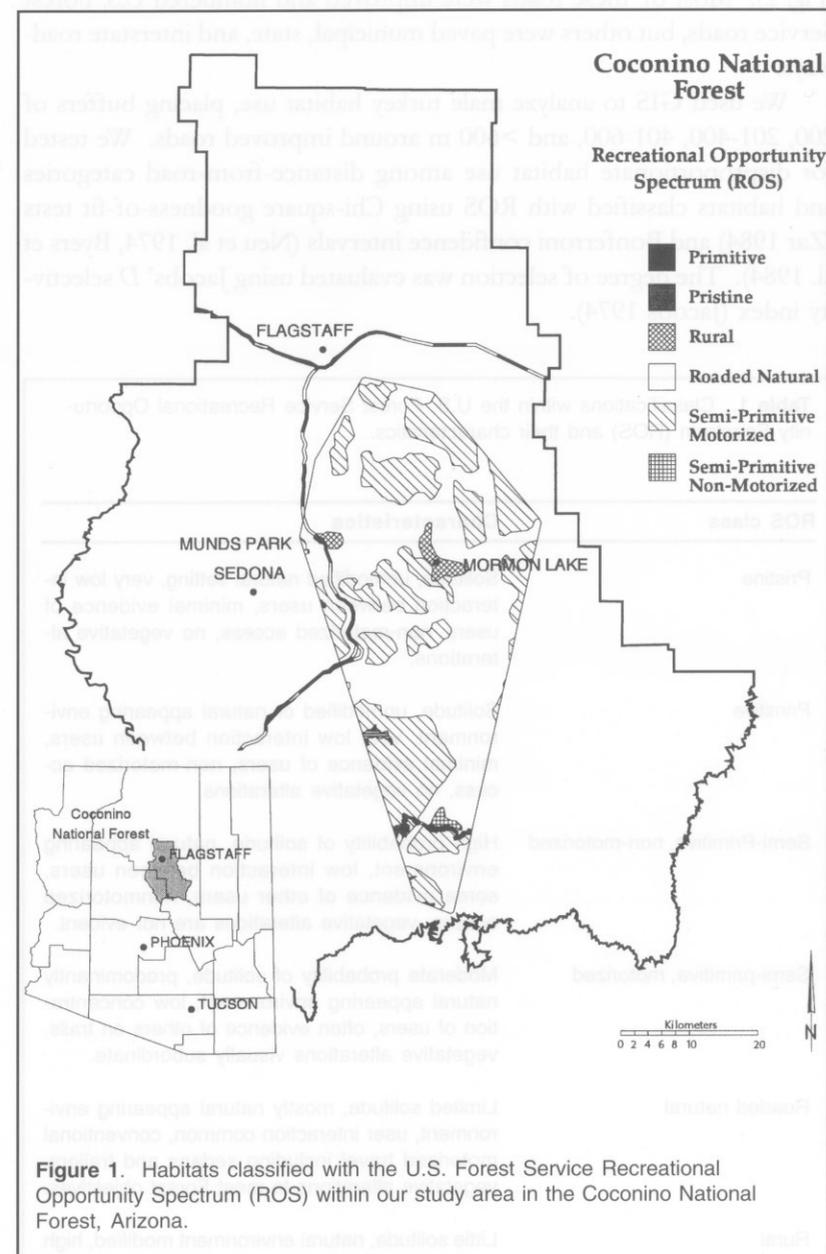
The study area encompassed 1,655 km² delineated by a minimum convex polygon with a 0.5 km buffer around all summer-time male turkey locations. Elevations ranged from 1,829 m in the south to >2,440 m in the north. Vegetation communities included pinyon (*Pinus edulis*)-juniper (*Juniperus* spp.) with scattered grasslands at lower elevations to ponderosa pine (*P. ponderosa*)-Gambel oak (*Quercus gambelii*) at mid-elevations and mixed-conifer habitats at higher elevations. Improved road density on our study area averaged 0.82 km/km². Most improved roads received greatest traffic during the summer months.

METHODS

Using rocket nets, we captured and radio-marked (Telonics, Inc., model LB400, Mesa, AZ) male Merriam's turkeys during the winters of 1995-96 through 1996-97 at sites baited with whole oats. All birds were released at the capture site.

Between 1 June and 10 September 1996 and 1997, we located turkeys once per week from the ground using a hand-held telemetry unit (Telonics, Inc., model TR-2, Mesa, AZ). All relocations were plotted on 7.5' USGS topographic maps and the Universal Transverse Mercator coordinates were recorded then transferred to an ARC/INFO Geographic Information System (GIS).

We obtained a GIS file from the Coconino National Forest documenting ROS classifications of habitats within our study area (Fig. 1). The classifications within ROS described the characteristics that visitors



could expect in these habitats (Table 1). USGS Digital Line Graphs (DLG) were then used to identify improved roads within our study area (Fig. 2). Most of these roads were improved and numbered U.S. Forest Service roads, but others were paved municipal, state, and interstate roadways.

We used GIS to analyze male turkey habitat use, placing buffers of 200, 201-400, 401-600, and >600 m around improved roads. We tested for disproportionate habitat use among distance-from-road categories and habitats classified with ROS using Chi-square goodness-of-fit tests (Zar 1984) and Bonferroni confidence intervals (Neu et al. 1974, Byers et al. 1984). The degree of selection was evaluated using Jacobs' *D* selectivity index (Jacobs 1974).

Table 1. Classifications within the U.S. Forest Service Recreational Opportunity Spectrum (ROS) and their characteristics.

ROS class	Characteristics
Pristine	Solitude, unmodified natural setting, very low interaction between users, minimal evidence of users, non-motorized access, no vegetative alterations.
Primitive	Solitude, unmodified or natural appearing environment, very low interaction between users, minimal evidence of users, non-motorized access, no vegetative alterations.
Semi-Primitive, non-motorized	High probability of solitude, natural appearing environment, low interaction between users, some evidence of other users, nonmotorized access, vegetative alterations are not evident.
Semi-primitive, motorized	Moderate probability of solitude, predominantly natural appearing environment, low concentration of users, often evidence of others on trails, vegetative alterations visually subordinate.
Roaded natural	Limited solitude, mostly natural appearing environment, user interaction common, conventional motorized travel including sedans and trailers, vegetative alterations to meet Forest objectives.
Rural	Little solitude, natural environment modified, high user interaction, excellent vehicular access.

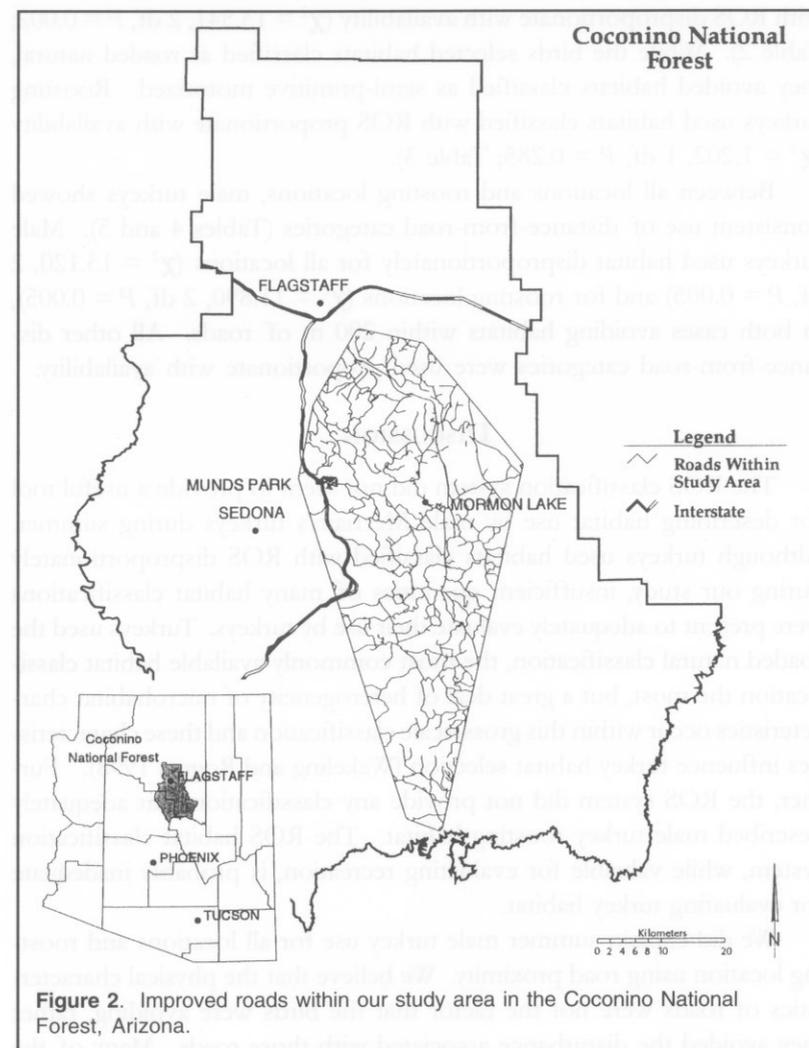


Figure 2. Improved roads within our study area in the Coconino National Forest, Arizona.

RESULTS

We obtained 114 locations from 32 marked and seven unmarked male Merriam's turkeys, with 89 locations used in our analysis. Twenty-five locations were eliminated because multiple marked birds were located together simultaneously. No single turkey contributed >7.9% (9) of locations. Twenty-one roost sites were also located and used in our analysis.

When considering all locations, male turkeys used habitat classified

with ROS disproportionate with availability ($\chi^2 = 13.541$, 2 df, $P = 0.002$; Table 2). While the birds selected habitats classified as roaded natural, they avoided habitats classified as semi-primitive motorized. Roosting turkeys used habitats classified with ROS proportionate with availability ($\chi^2 = 1.202$, 1 df, $P = 0.285$; Table 3).

Between all locations and roosting locations, male turkeys showed consistent use of distance-from-road categories (Tables 4 and 5). Male turkeys used habitat disproportionately for all locations ($\chi^2 = 13.120$, 2 df, $P = 0.005$) and for roosting locations ($\chi^2 = 11.890$, 2 df, $P = 0.005$), in both cases avoiding habitats within 200 m of roads. All other distance-from-road categories were used proportionate with availability.

DISCUSSION

The ROS classification system did not seem to provide a useful tool for describing habitat use by male Merriam's turkeys during summer. Although turkeys used habitats classified with ROS disproportionately during our study, insufficient quantities of many habitat classifications were present to adequately evaluate their use by turkeys. Turkeys used the roaded natural classification, the most commonly available habitat classification the most, but a great deal of heterogeneity of microhabitat characteristics occur within this gross-scale classification and these characteristics influence turkey habitat selection (Wakeling and Rogers 1998). Further, the ROS system did not provide any classification that adequately described male turkey roosting habitat. The ROS habitat classification system, while valuable for evaluating recreation, is probably inadequate for evaluating turkey habitat.

We did explain summer male turkey use for all locations and roosting location using road proximity. We believe that the physical characteristics of roads were not the factor that the birds were avoiding, rather they avoided the disturbance associated with those roads. Many of the locations occupied by male turkeys were in close proximity to closed or low-grade roads not noted on the USGS DLG maps.

Avoidance of roads by turkeys has been attributed to roads associated with open habitats, fences, or specific topographic features (Eichholz and Marchinton 1975, McDougal et al. 1990). In our study, the heterogeneity of these associations limited the probability of such a relationship. Increased habitat use by turkeys in Arizona summer habitats is usually associated with areas of greater horizontal cover (Mollohan et al. 1995, Wakeling and Rogers 1998). Burbridge and Neff (1975) noted that vehicles moving rapidly on roads were less disturbing than vehicles

Table 2. Male Merriam's turkey summer use (all turkey locations) of habitats classified with the U.S. Forest Service Recreational Opportunity Spectrum (ROS) in north-central Arizona, 1996-1997. Overall $\chi^2 = 13.541$, 2 df, $P = 0.002$.

ROS Class ^a	Area (km ²)	Locations	Observed Proportion	Expected Proportion	Expected Locations	Bonferroni Confidence Intervals	Selection ^b	Jacobs' D
PM-SPNM	14.9	3	0.033	0.009	0.8	-0.012-0.078	=	
SPM	561.0	18	0.202	0.348	31.0	0.100-0.304	-	-0.357
RNA	1037.8	68	0.764	0.643	57.2	0.656-0.872	+	0.285

^a ROS classes include primitive-semiprimitive non-motorized (PM-SPNM), semi-primitive motorized (SPM), and roaded natural (RNA).
^b Classifications may be selected (+), avoided (-), or used as available (=).

Table 3. Male Merriam's turkey summer roosting use of habitats classified with the U.S. Forest Service Recreational Opportunity Spectrum (ROS) in north-central Arizona, 1996-1997. Overall $\chi^2 = 1.202$, 1 df, $P = 0.285$.

ROS Class ^a	Area (km ²)	Locations	Observed Proportion	Expected Proportion	Expected Locations	Bonferroni Confidence Intervals	Selection ^b	Jacobs' D
SPM	561.0	5	0.238	0.351	7.4	0.030-0.446	=	
RNA	1037.8	16	0.762	0.649	13.6	0.554-0.970	=	

^a ROS classes include semiprimitive motorized (SPM), and roaded natural (RNA).
^b Classifications may be selected (+), avoided (-), or used as available (=).

Table 4. Male Merriam's turkey summer use (all turkey locations) of distance-from-road categories in north-central Arizona, 1996-1997. Overall $\chi^2 = 13.120$, 2 df, $P = 0.005$.

Distance from Road (m)	Area (km ²)	Locations	Observed Proportion	Expected Proportion	Expected Locations	Bonferroni Confidence Intervals	Selection ^a	Jacobs' D
0-200	470.4	12	0.135	0.284	25.3	0.044-0.0225	-	-0.435
201-400	363.5	26	0.292	0.220	19.6	0.173-0.410	=	=
401-600	272.4	22	0.247	0.165	14.7	0.134-0.361	=	=
>600	547.2	29	0.326	0.331	29.5	0.203-0.448	=	=

^a Distance-from-road categories may be selected (+), avoided (-), or used as available (=).

Table 5. Male Merriam's turkey summer roosting use of distance-from-road categories in north-central Arizona, 1996-1997. Overall $\chi^2 = 11.890$, 2 df, $P = 0.005$.

Distance from Road (m)	Area (km ²)	Locations	Observed Proportion	Expected Proportion	Expected Locations	Bonferroni Confidence Intervals	Selection ^a	Jacobs' D
0-200	470.4	1	0.048	0.284	6.0	-0.069-0.165	-	-0.774
201-400	363.5	4	0.190	0.220	4.6	-0.024-0.404	=	=
401-600	272.4	9	0.423	0.165	3.5	0.153-0.693	=	=
>600	547.2	7	0.333	0.331	7.0	0.076-0.590	=	=

^a Distance-from-road categories may be selected (+), avoided (-), or used as available (=).

moving slowly, although less often, on lower quality roads. Our study does not negate this possibility, but suggests that the disturbance associated with improved roads is sufficient to dissuade turkey use. However, turkeys have demonstrated the ability to habituate and acclimate with certain types of vehicular disturbance (Wright and Speake 1975).

Vehicular and other associated disturbance that occurs along roads may be a critical factor influencing turkey distributions in Arizona, as male Merriam's turkeys apparently avoid habitats within 200 m of high-traffic roads. In habitats supporting turkey populations below habitat potential, resource managers should carefully evaluate open road quality and density. We suggest that closing high traffic roads may favor turkey populations in habitats that receive a substantial amount of recreational disturbance. On the other hand, the closure of low-traffic, low-quality roads may not be as beneficial for turkeys. Further research into quantity and composition of road-related disturbance sufficient to displace turkeys is warranted.

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