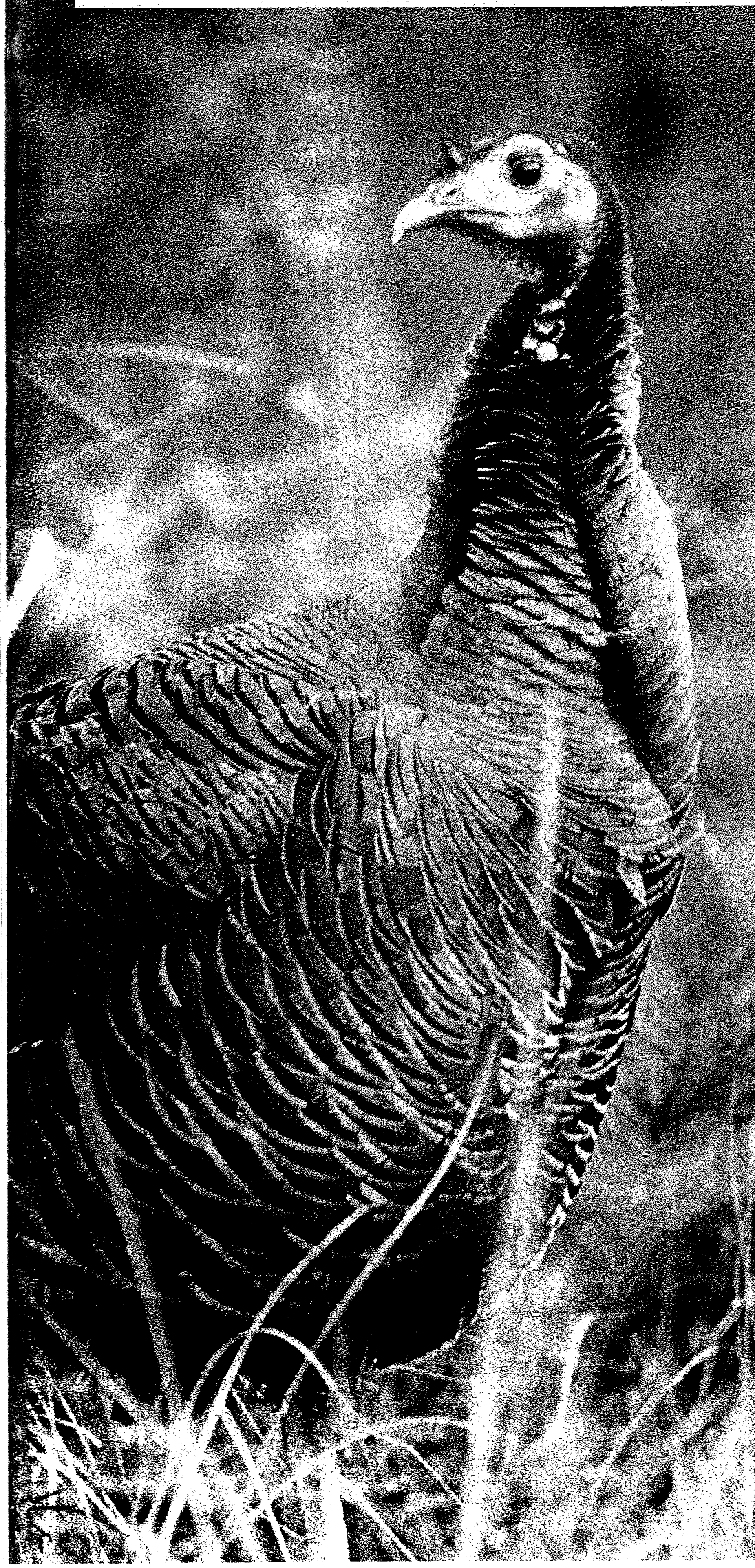

ARIZONA GAME AND FISH DEPARTMENT

RESEARCH BRANCH
TECHNICAL REPORT #9

HABITAT SELECTION AND USE BY MERRIAM'S TURKEY IN NORTHCENTRAL ARIZONA

A Final Report

CHERYL M. MOLLOHAN
DAVID R. PATTON
BRIAN F. WAKELING
October 1995

FEDERAL AID IN WILDLIFE RESTORATION PROJECT

Arizona Game and Fish Department Mission

To conserve, enhance, and restore Arizona's diverse wildlife resources and habitats through aggressive protection and management programs, and to provide wildlife resources and safe watercraft and off-highway vehicle recreation for the enjoyment, appreciation, and use by present and future generations.

Arizona Game and Fish Department
Research Branch

Technical Report Number 9

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CONTENTS

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Habitat Selection and Use by Merriam's Turkey in Northcentral Arizona

Cheryl M. Mollohan, David R. Patton, and Brian F. Wakeling

Abstract: Vegetative and topographic components of habitat believed to be important to Merriam's turkey (*Meleagris gallopavo merriami*) were identified through a literature review and expert opinion survey. Between 1986 and 1989, these components were measured as key variables in a habitat selection study on the Chevelon study area in northcentral Arizona. Measurements of habitat components were made at use sites (sites occupied by visually-located or radio-telemetered turkeys) and at random plots; measurement differences between use sites and random plots were used to infer selection for or against specific habitat conditions. Turkey behavior at each use site was categorized as nesting, feeding, loafing, or roosting. Nesting turkeys selected steep slopes, typically in canyons, that had more shrubs and greater overhead and horizontal cover than random plots. Feeding turkeys sought out forest openings averaging 0.25 ac in size created mainly by logging; feeding hens with poults selected sites with higher herbaceous cover and species richness than were found in random plots. Feeding sites were typically surrounded by structurally diverse areas that provided adequate escape cover. For loafing, turkeys selected dense pole stands that contained higher volumes of large downed timber than did random plots. Turkeys roosted selectively in high-basal-area stands of large ponderosa pine (*Pinus ponderosa*) trees, often in association with a drainage. Results from our study, from expert opinion, and from published literature were used to develop a preliminary model for identifying Merriam's turkey habitat suitability. Management implications of this research are discussed.

Key Words: Arizona, brood, habitat selection, habitat use, loaf, *Meleagris gallopavo merriami*, Merriam's turkey, nest, roost.

INTRODUCTION

Merriam's wild turkey is 1 of 6 subspecies of the wild turkey native to North America (Hewitt 1967). The historical range of Merriam's turkey included parts of Arizona, New Mexico, and Colorado. During the past 50 years, Merriam's turkeys have been successfully introduced into all of the western and several of the midwestern states (Natl. Wild Turkey Fed. 1986).

In Arizona, wild turkeys historically occupied ponderosa pine, mixed-conifer, and pinyon-juniper (*Pinus edulis-Juniperus* spp.) forests from the New Mexico border south of the Mogollon Rim northwest to the Hualapai Indian Reservation in western Arizona (Brown 1989). Turkeys also occurred in forested mountains in southeastern Arizona and in riparian forests of the Gila, San Pedro, and Santa Cruz river drainages. There is considerable disagreement among taxonomists about whether these southeastern Arizona turkey populations were Merriam's or Gould's (*M. g. mexicana*) subspecies. The latter occurs in similar habitats in New Mexico and south into Mexico (Hewitt 1967, Brown 1989).

Based on archaeological evidence, Merriam's turkeys may be a relatively recent arrival to Arizona. Rea (1980) hypothesized that they descended from turkeys kept by the prehistoric Anasazi and Mogollon cultures, which had extensive trade networks to both the south and east. These cultures declined sometime before 1450 A.D., at which time the birds may have escaped to the wild.

Turkey populations in Arizona's forests were abundant in early historic times but began to decline in the early 1920s. Ligon (1946) notes: "During that time, all limiting factors, both natural and man-induced, seemed to overtake the birds everywhere; habitat breakdown, hunting, predation, and seasonal disorganization appeared to combine to overthrow the bird's normal life and resistances." Most wild turkey populations south of the Gila River had disappeared by the late 1920s (Davis 1982).

Turkey populations were low through 1940, except on the Fort Apache Indian Reservation (Shaw 1986). Birds from that reservation were subsequently used as stock for transplants within and outside historical turkey range in Arizona (Brown 1989). Today, Merriam's turkeys occur throughout most of the state's forests but are no longer found in most riparian habitats (Fig. 1).

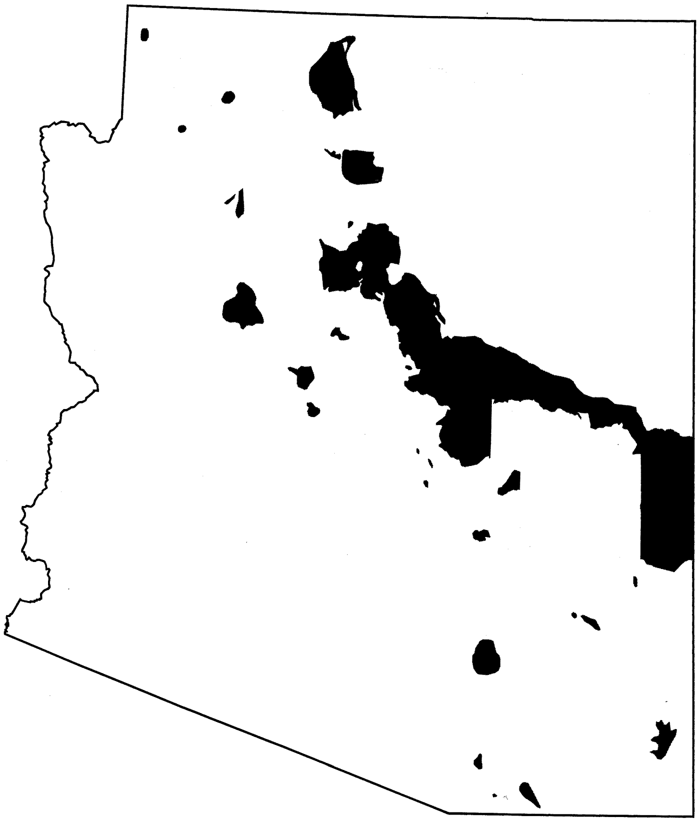


Figure 1. Current distribution of Merriam's turkey in Arizona, excluding Indian reservations.

A number of research studies in Arizona and New Mexico have provided valuable information on habitat use by Merriam's turkey. Most of these studies were completed prior to the advent of radio telemetry and drew inferences mainly from visual observations of unmarked birds and their sign. Habitat selection is difficult to quantify by such methods.

On the Mogollon Rim in central Arizona, Reeves (1950) found that turkeys used open parks or cienegas in the ponderosa pine type near adequate food and cover. Other areas of apparently suitable habitat but lacking available water were not used.

On the Fort Apache Indian Reservation, almost half the turkeys observed by Scott and Boeker (1975) were in meadows within 146 ft of cover. Turkeys used thick cover for nesting, brooding, loafing, and escape. Roosts were typically groups of overmature ponderosa pine trees with flat horizontal branches (Boeker and Scott 1969). Turkeys generally roosted on ridgetops or canyon slopes where there was easy access from above and an opening below.

Turkeys in the South Kaibab National Forest near Williams, Arizona, fed during spring, summer, and fall in small openings, at the edges of larger openings, and in drainage bottoms within ponderosa pine and pine-oak (*Quercus* spp.) associations (Phillips 1980, 1982). These turkeys also used fairly open, mixed stands of ponderosa pine saplings, poles, and intermediate-sized trees for feeding. The birds seldom ventured more than 300 ft from cover, and midday locations were almost always in dense stands of timber. Thick cover seemed important; the turkeys used "very thick pole and sapling pine stands or dense pine-oak associations for loafing, escape cover, and protection from weather extremes" (Phillips 1982). Roost sites in the Williams area averaged 27 usable trees per site and had an average basal area (BA) of 94 ft^2/ac. A typical roost tree was a ponderosa pine >20 in diameter at breast height (DBH) with horizontal branches.

Near the south rim of the Grand Canyon in northern Arizona, both hens and gobblers selected areas with much (>30%) ground cover but avoided areas with well-developed shrub layers (Shaw and Smith 1977). Winter precipitation, through its effect on the availability of free water and the abundance of forbs and ground cover, was the major factor affecting turkey numbers and distribution.

In the mixed-conifer vegetation type in the White Mountains of eastern Arizona, turkey broods and adult turkeys selected sites that had a greater-than-average abundance of forb and grass species (Green 1990). Adult turkeys without broods selected sites that had taller grasses than the sites selected by broods (females with young), and both adults and broods selected sites where grasses were taller than average. Turkeys selected mixed-conifer cover types but avoided meadows.

On the Kaibab National Forest in north-central Arizona, nest sites typically had greater vegetative cover than did surrounding areas (Crites 1988). Seventy-five percent of the nests occurred in a combination of conifer, oak thickets, and slash; half of the nests were located at the base of a tree on the uphill side. Successful nests were surrounded by more cover, more slash, and more dead-and-down wood than were unsuccessful nests.

In mixed-conifer forests of the Sacramento Mountains in New Mexico, hens selected steep slopes for nesting (Jones 1981, Goerndt 1983, Schemnitz et al. 1985). Canopy cover above nest sites and ground cover <1 ft high at the nest site were greater than in the surrounding area. Horizontal cover at the nest site was provided by slash, shrubs, downed logs, or topographic irregularities. Hens with broods selected small logged openings, heads of canyons, and edges of larger meadows for feeding. Broods were never observed more than 98 ft from cover. Winter roosts were used for extended periods; they were larger in area and closer to water than were summer roosts. In both summer and winter, turkeys roosted almost exclusively in dominant and co-dominant Douglas-fir (*Pseudotsuga menziesii*) and white fir (*Abies concolor*) trees.

Phillips (1980, 1982) developed management recommendations for timber harvesting and livestock grazing in turkey habitat. These recommendations provided wildlife and land managers with guidelines for managing Merriam's turkey habitat in the ponderosa pine forest.

Two habitat models have been developed for Merriam's turkey. The Southwestern Region of the U. S. Forest Service developed the R03WILD wildlife habitat capability model (Byford et al. 1984), which evaluated the capability of an area to support turkeys and other species. It is based on vegetation type, structure, and condition, as well as road densities. This model relied on expert opinion and scientific literature. Another model (Lindzey and Suchy 1985) considered only brood and winter habitat requirements. This model lacked information on loafing, nesting, and cover requirements for Merriam's turkeys. Neither of these 2 models allows a manager to assess a given area for all of the habitat needs of Merriam's turkey.

Our study was designed to develop a habitat model that would more adequately evaluate turkey habitat. To accomplish this goal, the following objectives were established:

- Identify important components of turkey habitat based upon a literature review;
- Define and describe structural characteristics of Merriam's turkey habitat in Arizona; and
- Develop a habitat model, or scorecard, for use by wildlife biologists and land managers to assess turkey habitat.

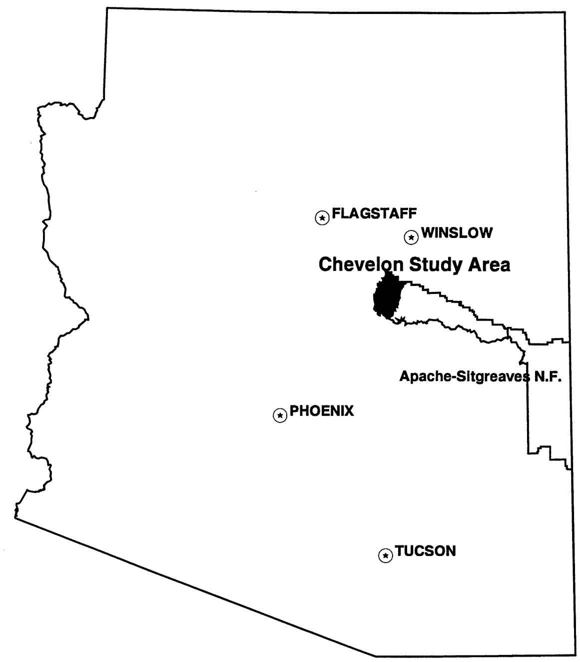


Figure 2. Location of the Chevelon study area in northcentral Arizona.

All data in our study were recorded and reported in English units. The rationale for this is that data on forested ecosystems are conventionally recorded in English units by the U.S. Forest Service.

STUDY AREA

The Chevelon study area (CSA) was located in the Chevelon Ranger District of the Apache-Sitgreaves National Forests in north-central Arizona about 40 mi south of Winslow (Fig. 2). This area was chosen because wildlife and forest managers had voiced concern about the perceived decline of its turkey population (Shaw 1986) and because it contained 3 major forest cover types (Laing et al. 1989) where turkeys occur in Arizona: ponderosa pine, mixed-conifer, and ponderosa pine-alligator juniper (*Juniperus deppeana*).

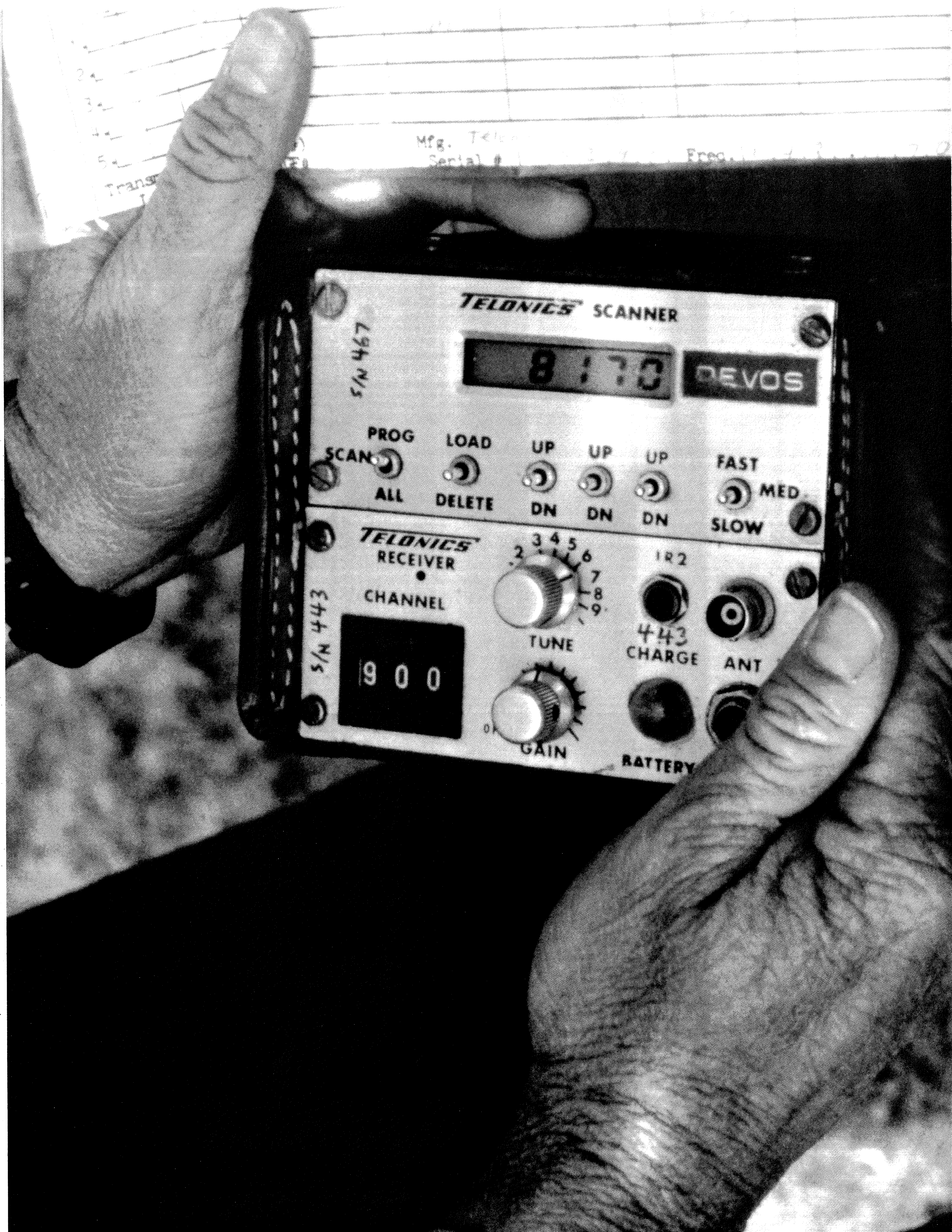
The CSA sits atop the Mogollon Rim, a geologic uplift running from east to west across north-central Arizona. Elevations on the CSA range from 4,900-7,800 ft. Soil parent material of the area is dominated by Kaibab limestone and Coconino sandstone (Darton 1965).

Precipitation in past years on the CSA averaged 18.6 in annually, much of it falling as snow in winter (Sellers and Hill 1974, Natl. Oceanic and Atmos. Admin. 1990). Summer rains usually began in early July and continued through August as local thunderstorms. Winter precipitation usually began in early November and continued through March. April through June, September, and October were the driest months. Temperatures ranged from just below 0 F to about 93 F (Natl. Oceanic and Atmos. Admin. 1990).

Plant communities on the CSA were the Rocky Mountain Montane Conifer Forest and the Great Basin Conifer Woodland (Brown et al. 1979). Ridgetops below 6,800 ft supported primarily pinyon pine and alligator juniper, with ponderosa pine on the west-facing slopes of major canyons and mixed-conifer on the east-facing slopes. Forests on ridgetops between 6,800 and 7,600 ft in elevation were dominated by ponderosa pine with Douglas-fir and white fir occurring in small patches. On ridgetops higher in elevation than 7,600 ft, Douglas-fir, white fir, limber pine (*Pinus flexilis*), Rocky Mountain maple (*Acer glabrum*), and aspen (*Populus tremuloides*) were common. On canyon slopes, mixed-conifer dominated; it was intermixed with ponderosa pine on warmer sites and with Gambel oak (*Quercus gambelii*) along canyon bottoms.

Logging and grazing have been the major commercial land uses on the CSA. Cutting of fuel wood, particularly in the pinyon-juniper type, has increased over the past 2 decades. Logging began in the late 1930s, and most ponderosa pine stands on level terrain have been logged at least once. However, little logging has occurred on steeper slopes in larger canyons. Prior to the 1960s, sheep were the primary livestock on the CSA, but cattle, grazing in summer, have predominated since then.

The advent of radio telemetry technology greatly improved our knowledge of Merriam's turkey life history.



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METHODS

Database Development

Data from studies published after 1967, especially studies of radio-telemetered birds, were compiled into a database using relational software (RBASE 2.0, Microrim, Inc., Bellevue, Wash.). The database was designed to systematically document the nature and arrangement of habitat structural features important to turkeys. Scientific literature that pertained to habitat requirements of, or use by, turkeys in North America was reviewed. Measures of vegetation structure rather than measures of species composition or vegetation type were assembled because the latter factors are not readily comparable from place to place. Parameters measured, conclusions reached, and recommendations made were entered into the database. Data from early or anecdotal publications were included if they seemed relevant to the study objectives. Information from 53 publications of the 138 reviewed were entered into the relational database. This database was then queried to look for patterns in feeding, nesting, roosting, and loafing habitat and to identify potential questions for an expert opinion survey.

An expert opinion survey was designed according to guidelines suggested by Schuster et al. (1985) and Starfield and Bleloch (1986). Questions were written specifically to obtain information about the relative utility to turkeys of different structural arrangements of habitat components. These questions were developed from the literature review and with assistance from the Arizona Game and Fish Department Turkey Research Coordinator and the Chairman of the Turkey Work Group. Twenty-five professionals with experience in turkey research and management in Arizona were contacted by an introductory letter and 2 follow-up letters.

Capture and Telemetry

One hundred thirty-one turkeys were captured on the CSA during 3 winters: 1986-87; 1987-88; and 1988-89. Turkeys were baited with whole oats and captured with drop nets, rocket nets, or box traps (Wakeling 1991). Birds were tagged with backpack radio transmitters (AVM Electronics, San Francisco, Calif., or Telonics, Mesa, Ariz.). Turkeys were released at the capture site and subsequently monitored using a telemetry receiver (Telonics TR2, Mesa, Ariz.) and hand-held H antenna. We generally monitored turkeys from the ground, but periodic aerial telemetry flights were used to locate transmitter frequencies that could not be detected from the ground.

Habitat Measurements

We measured habitat variables at sites used by turkeys (use sites) and at random plots. The objective was to compare the 2 sets of measurements to investigate selection for or against specific habitat components and further describe turkey habitat.

From May 1988 through November 1989, use sites were located by finding radio-telemetered turkeys or physical evidence of their activity following a proximate triangulation. Occasional visual observations of birds without radio units were accepted. We tried to obtain an equal number of locations within each of 3 periods: sunrise to 1000 hours, 1000-1400 hours, and 1400 hours to sunset. Use sites were described as to (1) season (nesting-early brood [May 1-June 30], late brood [July 1-September 1] and fall [September 1-December 1]); (2) bird behavior (roosting, nesting, feeding, loafing); and (3) sex and age composition of flocks (hens, hens with poults, gobblers, or unknown). Use sites were marked and left undisturbed; they were measured later, usually within 5 days after birds abandoned sites.

One hundred forty-one random plots were selected by computer-generated random Universal Transverse Mercator (UTM) coordinates and later located on the CSA. A subset of locations was randomly selected to be measured during each week.

All Sites. Specific measurements of slope, landform, and vegetation were made at use sites and random plots. Measurements at use sites were made at the flock center, if observed, or at the center of the sign present; those at random plots were made at UTM locations as nearly as could be determined. Percent slope was measured with a clinometer. Slope aspect was determined with a compass. Landform was classified as minor canyon, major canyon, ridgetop, or draw. Height to first tree canopy above the site center was estimated.

The vegetation association at each site was classified according to Larson and Moir (1986) because of the ease of using their dichotomous key. Brown et al. (1979) was useful when examining statewide vegetational relationships and Laing et al. (1989) identified potential vegetation on the CSA based on soils classification.

The vegetation at each site was subjectively classed by structural criteria. Vegetation understory and overstory were classified as either clumped or even in horizontal distribution. The canopy structure was classified as single-storied, multiple-storied, or multiple and patchy (uneven-aged appearance). Date of last logging entry was estimated as within 5 years, 5-20 years ago, >20 years ago, or unlogged. Treatment of logging slash was noted, as was average height, size, and distribution of woody fuels on the ground. Woody fuels volume was estimated using a photo key (Fischer 1981).

Ground cover was measured by 2 50-ft line-intercept transects that bisected each other at right angles at the site center; the compass orientation of this right-angle cross was randomly selected. Along these 2 transects, the percent of ground covered by grasses, forbs, rocks, litter, dead-and-down wood, conifer trees, deciduous trees, and shrubs was measured in each of 3 height categories (0-18, 18.1-36, and 36.1-72 in).

Two measures of horizontal visibility were made using as sighting axes the 4 line-intercept bearings. The first measure employed the use of a commercial turkey silhouette placed at the site center. The distance to the point where the entire silhouette was obscured from the vision of a standing observer was estimated. The second measure of horizontal visibility was the distance at which a standing person was entirely obscured from the vision of a person kneeling at the site center. The 4 data points for each visibility measure were averaged to provide 1 turkey silhouette visibility measure and 1 human visibility measure for each site.

Woody plant density, basal area, and canopy cover were measured at each site (Fig. 3). Deciduous tree seedlings (<1 in DBH), saplings (1-4.9 in DBH), and adults (≥5 in DBH), and all shrubs, were counted within a 0.01-ac circular plot. Coniferous and Gambel oak trees were counted, and the DBH of those >1 in measured, within a 0.1-ac circular plot; the DBH measures later were used to calculate the basal area of the site. Canopy cover was determined from a spherical densiometer (Strickler 1959) read at the 4 points where the line-intercept axes intersected the circumference of the 0.1-ac plot. A mean canopy cover was calculated for each site.

We also classified the forest stand at each site according to categories from the R03WILD model (Byford et al. 1984). The R03WILD model habitat classes were based on size class and canopy cover of trees. Number codes for presence and size classes of conifer trees were: (1) grass-forb (no trees), (2) trees <5 in, (3) trees 5-11.9 in, (4) trees 12-15.9 in, (5) trees 16-23.9 in, and (6) trees ≥24 in. Codes for overhead canopy cover are: (A) 10-40%, (B) 40-70%, and (C) 70-100%. Thus, a stand that was classified as 3B had a dominant diameter size class of 5-11.9 in and an overhead canopy cover of 40-70%.

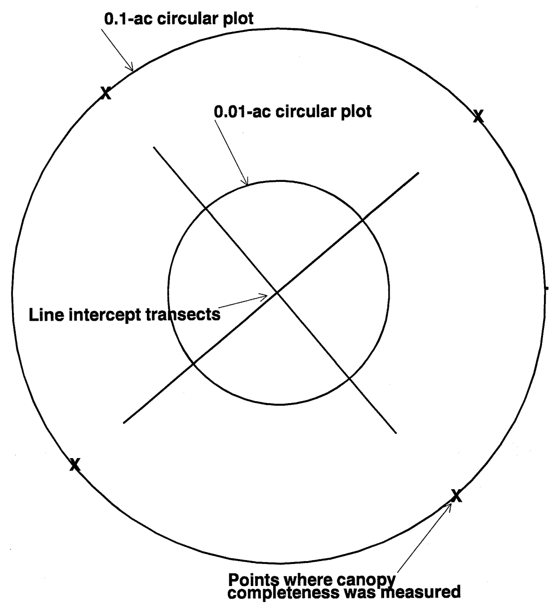


Figure 3. Arrangement of line-intercept transects, circular plots, and canopy cover sampling points used for sampling vegetation on the Chevelon study area, Arizona, 1988-1989.

Additional measurements were made at all use sites. Specific measurements made at nesting, feeding, loafing, and roosting sites are indicated below.

Nesting Sites. At each nest site, we described brood lanes and nest microhabitat. Brood lanes are visible paths that broods may use to leave the nest (Lockwood 1986). If a brood lane was present, we described its location and measured its length and width. The location of the nest was described and classified as uphill side of a tree, downhill side of a tree, against a tree, against a rock, or in slash. The presence, height, and type (e.g., tree limb, rock) of cover directly above the nest bowl were recorded, and the crown completeness of that cover was estimated using a spherical densiometer held directly above the bowl.

Feeding and Loafing Sites. At feeding and loafing sites we described the herbaceous vegetation, any openings present, and hiding cover. We measured the average height of herbaceous vegetation and the species richness of forbs and of grasses on the 0.1-ac plot. If an opening was within 100 ft, we measured the distance from the site to the opening. The length and width of the opening were estimated, and the opening was classified as natural, reseeded logging road, result of logging, or fire-induced. The distance to and composition of the nearest hiding cover was also recorded. Hiding cover was defined as vegetation, slash, slope, or topography that obscured 100% of an adult turkey from the view of a standing person at the site center.

Roosting Sites. At roost sites we measured roost trees and their distance from hiding cover. The number of trees used for roosting (based upon visual observation of turkeys or the presence of droppings) was recorded. Roost trees were characterized by species, DBH, and crown class (open grown, dominant, co-dominant, intermediate, overtopped, or suppressed). Height to first limb was ocularly estimated and the presence or absence of horizontal limbs was noted. The distance to hiding cover from the site center was estimated.

Data Analysis

Data sets collected at random plots and use sites were compared to evaluate habitat differences between and among sites. Tests and comparisons used depended on whether the data represented points on a continuum (e.g., tree DBH) or categories (e.g., landform).

One-way analysis of variance (ANOVA) (Stat. Anal. Systems Inst. 1985) was used to test for differences among sets of continuous data. Tukey's studentized range test (HSD) was used to separate means when a difference was found among sites. All tests were considered significant if $P \leq 0.05$.

Nesting, feeding, loafing, and roosting sites were compared with random plots for all categorical data. Chi-square contingency table analysis (Zar 1984) was used to determine if any habitat categories were used selectively. Bonferroni simultaneous confidence intervals (Neu et al. 1974, Byers et al. 1984) were used to determine which habitat categories turkeys selected or avoided. Chi-square contingency tests were considered significant if $P \leq 0.05$; Bonferroni confidence intervals were constructed at $P = 0.1$.

Word Model Development

Data from the expert opinion survey, from the literature review, and from measurements of use site characteristics were used to develop a word model that identified the potential suitability of a given habitat for turkeys. Where quantifiable data were lacking from our study or published literature, subjective descriptions were used. Similarities among literature sources, expert opinion, and our study were used to identify important habitat variables. The model was designed to be descriptive in nature, focusing on southwestern turkey habitat.

RESULTS

Information Database

Sixteen of the 25 individuals invited to participate in the expert opinion survey responded by returning the questionnaire. Respondents included representatives from the Arizona Game and Fish Department's Research Branch, Game Branch, and Field Operations Division; the U. S. Forest Service's Regional, Forest, and District offices; and Arizona's universities. Three individuals involved in Merriam's turkey research in New Mexico also responded. The individuals contributing to the survey had in total 275 years of experience in wildlife management and research (Appendix 1).

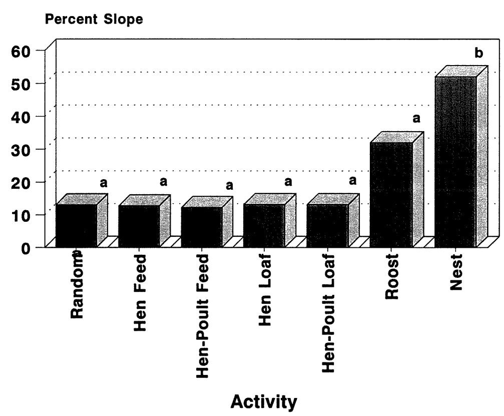
Habitat Use and Selection

Two hundred twenty-three habitat use sites were identified by locating 55 different radio-telemetered birds from May 1988 through August 1989. Fifty-three hens (both adults and juveniles) contributed 220 of the locations and 2 gobblers accounted for 3 locations. Forty-eight additional use sites were identified by locating unradioed birds. One hundred ninety-two (70%) of all use site locations were based on visual detection of birds; the remainder were from radio triangulations combined with a search for fresh sign after the bird had abandoned the site, or from sign alone.

Nesting Sites. The 40 nest sites located were largely associated with steep slopes and canyons. Slope averaged 53%, which was higher ($P < 0.001$) than at roosting, feeding, loafing, and random sites (Fig. 4). Hens avoided slopes of 0-20% and selected slopes >40% for nesting (Table 1). More than 82% of nest sites were in association with a canyon compared with only 20% of random plots. Hens avoided ridges and draws and selected major and minor canyons for nesting (Table 1). Twenty-nine percent of nests were on the upper third of the canyon slope, 27% on the middle third, and 44% on the lower third. We detected no selection by aspect for nesting.

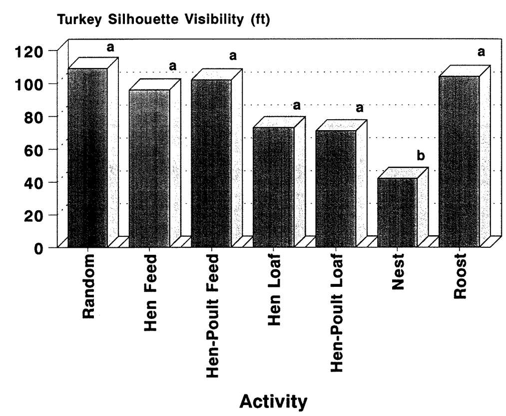
Rocks, cliffs, slash, and dense cover commonly characterized the immediate vicinity of a nest. Thirty-nine percent of nests were located against a rock or cliff. Seventeen percent occurred in slash and 14% were found on the uphill side of a tree. Only 13% of the sites had a brood lane. Canopy cover averaged 50.4% on the 0.1 ac surrounding the nest. The nest bowl had a mean canopy cover of 94.6%. Four ft above the nest bowl, the canopy cover averaged 76%. Height of cover above the nest averaged 6.8 ft. Turkey visibility at nest sites averaged 44.2 ft, a distance that was lower than for all other use sites and random plots ($P < 0.0001$, Fig. 5).

Nesting turkeys also tended to select dense ground cover and shrubs, which helped account for the low horizontal visibility at nests. Total percent cover 0-18 in from the ground was greater at nest sites than at loafing sites ($P < 0.0001$) but did not differ from that at random plots or feeding sites (Fig. 6). Nest sites averaged 13% cover 18.1-36 in above ground, which was greater than at



[ab] Classes with the same letter do not differ ($P > 0.05$) from each other.

Figure 4. Mean slope on random plots and activity sites on the Chevelon study area, Arizona, 1988-1989.



[ab] Classes with the same letter do not differ ($P > 0.05$) from each other.

Figure 5. Mean turkey silhouette visibility on random plots and activity sites on the Chevelon study area, Arizona, 1988-1989.

Table 1. Habitat selection by nesting turkeys, Chevelon study area, Arizona, 1988-1989. The proportions of nests found (observed) in each habitat component are compared with the proportional area (availability) of each component. Chi-square contingency table values (X^2) and Bonferroni confidence intervals ($P = 0.1$) provide the basis for estimating selection (S) among habitat components.

Component	Proportion observed	Proportion available	S[a]	Confidence Interval
Landform[b]				
Main Canyon	0.400	0.064	+	0.226<x<0.574
Minor Canyon	0.425	0.136	+	0.250<x<0.600
Ridgetop	0.075	0.564	-	-0.018<x<0.168
Draw	0.100	0.236	-	-0.006<x<0.206
n	40	140		
Slope[c]				
0-20%	0.075	0.757	-	-0.014<x<0.164
21-40%	0.225	0.186	=	0.084<x<0.366
>40%	0.700	0.057	+	0.546<x<0.854
n	39	139		
Canopy Structure[d]				
Single	0.000	0.158	-	0.000<x<0.000
Multiple	0.282	0.432	=	0.129<x<0.435
Clumped	0.728	0.410	+	0.565<x<0.871
n	39	140		
Overstory[e]				
Even	0.300	0.479	-	0.146<x<0.454
Clumped	0.700	0.521	+	0.545<x<0.854
n	40	141		

[a] + denotes selection, - denotes avoidance, and = denotes use consistent with availability.
[b] $X^2 = 57.401$, $P < 0.0001$.
[c] $X^2 = 88.439$, $P < 0.0001$.
[d] $X^2 = 13.927$, $P = 0.0009$.
[e] $X^2 = 4.028$, $P = 0.0447$.

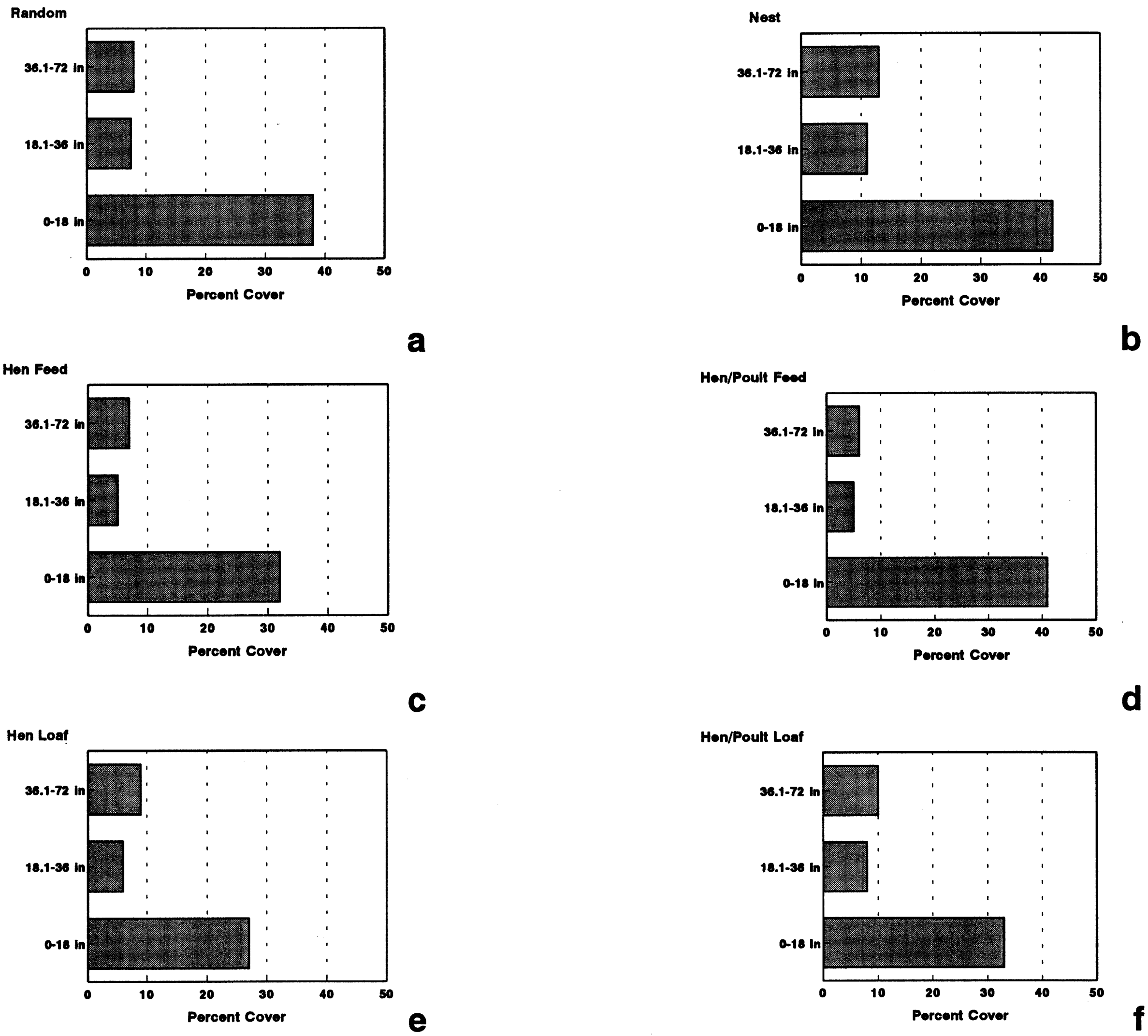
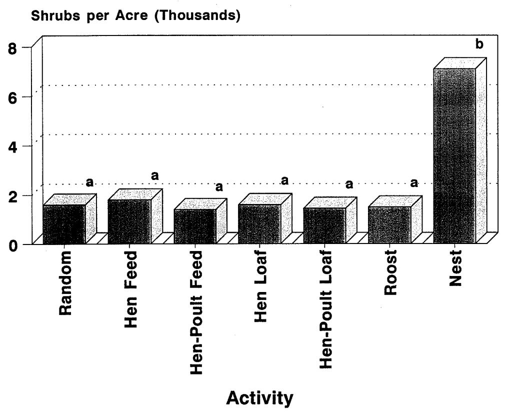


Figure 6. Mean profile of vegetative cover on (a) random plots; (b) nest sites; (c) hen feeding sites; (d) hen-poult feeding sites; (e) hen loafing sites, and (f) hen-poult loafing sites on the Chevelon study area, Arizona, 1988-1989.

other use sites or random plots ($P < 0.0001$). Percent cover 36.1-72 in above ground averaged 14.4%, which was greater than that which occurred at random plots or feeding sites ($P < 0.0001$). Nest sites also had more shrubs/ac than other use sites and random plots ($P < 0.0001$, Fig. 7).

Thirteen of the 32 vegetation associations sampled on the CSA were used for nesting. Sixty-two percent of the nests were found in mixed-conifer dominated associations and 38% in ponderosa pine dominated associations. Almost half of the nests occurred in either Douglas-fir-Gambel oak (35%) or ponderosa pine-Gambel oak (14%), but only 15% of the random plots fell into these 2 categories. Forty-six percent of nest sites occurred in unlogged areas.

Coniferous vegetation characteristics seemed to have little effect on nest site selection. Conifers >1 in DBH averaged 248 trees/ac at nest sites, which was less than conifer density at loafing sites ($P < 0.0001$) but not different from that at



[ab] Classes with the same letter do not differ ($P > 0.05$) from each other.

Figure 7. Mean shrub density on random plots and activity sites on the Chevelon study area, Arizona, 1988-1989.

feeding sites or random plots. Conifer regeneration and slash volume, height, and size class were not significantly different from the values at random plots or other use sites (Appendix 2).

Nesting hens selected uneven-aged stands with clumped canopies. They avoided sites with single-storied canopy structures and selected sites with clumpy, uneven-aged canopy structures (Table 1). Seventy-two percent of nest sites had clumped understories and 70% of nest sites had clumped overstories. Hens avoided sites with even overstory and selected sites with clumped overstory.

Feeding Sites. One hundred twenty-eight feeding sites were located. Hens (including mixed-adult groups) occupied 79 of these sites and hen-poult groups occupied 49. Comparisons of landform, vegetation, and logging-history characteristics of feeding sites with those of random plots suggested that components of each influenced feeding-site selection to some extent.

Feeding turkeys tended to avoid some landform components but selected for others. Turkey hens avoided draws (Table 2). Hens with poults avoided ridges and selected minor canyons (Table 3). Main canyons were used by both of these turkey groups in proportion to their availability, as were all slope categories.

Turkey silhouette visibility at feeding sites did not differ between hen and hen-poult groups nor from visibility at random plots (Table 4, Fig. 5). But for both groups, visibility at feeding sites was significantly greater than that at loafing and nesting sites ($P < 0.0001$, Fig. 5).

Most turkeys fed near or in small forest openings (Table 5). Openings averaged 0.31 ac at hen feeding sites, 0.25 ac at hen-poult feeding sites, and 1.8 ac at random plots. Seventy-four percent of hen-poult feeding sites, 65% of hen feeding sites, and 42% of random sites were located in openings. At sites located near but not in openings, distance to nearest opening averaged 5.2 ft for hen-poult sites, 10.3 ft for hen sites, and 7.5 ft for random plots.

Most openings had been created by logging activities and three-fourths or more of the openings in which turkeys fed had resulted from logging (Table 5). Only 4% of hen-poult feeding sites and 17% of hen feeding sites occurred in natural openings. Hens selectively fed in sites logged within 5 years, and both hen and hen-poult feeding groups avoided unlogged sites and sites logged more than 20 years previously (Tables 2 and 3).

Ground cover profiles at feeding sites of hens and hen-poult groups were similar, though hen-poult sites had greater cover 0-18 in above ground (Fig. 6). Total cover averages were not significantly different between feeding sites and random plots.

Feeding turkeys showed only 2 instances of selection or avoidance of habitat components related to canopy cover, distance to cover, shrub density, or volume, size class, or height of slash and dead-and-down wood (Fig. 7, Appendix 2). Slash volume at hen feeding sites was less ($P < 0.0001$) than at random plots. Average size class of slash and dead-and-down wood at hen-poult feeding sites was higher than at random plots ($P = 0.0033$).

Canopy structure of overstory and understory influenced the distribution of feeding turkeys. Hens avoided single-canopied sites. They avoided evenly distributed understories and overstories and selected understories and overstories that were clumped in distribution (Table 2).

Herbaceous plants influenced selection of feeding habitat by turkeys. Percent cover of forbs was significantly higher at hen-poult feeding sites than at all other sites including hen feeding sites (Fig. 8). Percent cover from grasses was significantly higher at hen-poult feeding sites than at all other turkey use sites and random plots except hen feeding sites (Fig. 9). Herbaceous height was not significantly different between feeding sites and random plots, but was

Table 2. Habitat selection by feeding hen turkeys, Chevelon study area, Arizona, 1988-1989. The proportions of feeding sites found (observed) in each habitat component are compared with the proportional area (availability) of each component. Chi-square contingency table values (X^2) and Bonferroni confidence intervals (P = 0.1) provide the basis for estimating selection (S) among habitat components.

Component	Proportion observed	Proportion available	S[a]	Confidence Interval
Landform[b]				
Main Canyon	0.156	0.064	=	0.063<x<0.249
Minor Canyon	0.156	0.136	=	0.063<x<0.249
Ridgetop	0.636	0.564	=	0.513<x<0.759
Draw	0.052	0.236	-	-0.004<x<0.109
n	77	140		
Canopy Structure[c]				
Single	0.052	0.158	-	-0.002<x<0.105
Multiple	0.340	0.432	=	0.225<x<0.455
Clumped	0.558	0.410	+	0.437<x<0.679
n	77	139		
Logging History[d]				
<5 yrs	0.205	0.072	+	0.107<x<0.302
6-20 yrs	0.500	0.424	=	0.379<x<0.621
>20 yrs or unlogged	0.295	0.504	-	0.185<x<0.405
n	78	140		
Understory[e]				
Even	0.167	0.319	-	0.084<x<0.250
Clumped	0.833	0.681	+	0.750<x<0.916
n	78	141		
Overstory[f]				
Even	0.231	0.479	-	0.129<x<0.333
Clumped	0.769	0.521	+	0.667<x<0.871
n	78	141		

[a] + denotes selection, - denotes avoidance, and = denotes use consistent with availability.
[b] X^2 = 14.721, P = 0.0021.
[c] X^2 = 7.22, P = 0.0271.
[d] X^2 = 13.107, P = 0.0014.
[e] X^2 = 5.997, P = 0.0143.
[f] X^2 = 12.931, P = 0.0003.

Table 3. Habitat selection by feeding hen-poult turkey groups, Chevelon study area, Arizona, 1988-1989. The proportions of feeding sites found (observed) in each habitat component are compared with the proportional area (availability) of each component. Chi-square contingency table values (X^2) and Bonferroni confidence intervals (P = 0.1) provide the basis for estimating selection (S) among habitat components.

Component	Proportion observed	Proportion available	S[a]	Confidence Interval
Landform[b]				
Main Canyon	0.146	0.064	=	$0.031 < x < 0.260$
Minor Canyon	0.292	0.136	+	$0.145 < x < 0.439$
Ridgetop	0.396	0.564	-	$0.238 < x < 0.554$
Draw	0.167	0.236	=	$0.046 < x < 0.288$
n	48	140		
Logging History[c]				
<5 yrs	0.143	0.072	=	$0.036 < x < 0.250$
6-20 yrs	0.551	0.424	=	$0.400 < x < 0.702$
>20 yrs or unlogged	0.306	0.504	-	$0.166 < x < 0.446$
n	49	140		

[a] + denotes selection, - denotes avoidance, and = denotes use consistent with availability.
[b] $X^2 = 10.473$, $P = 0.0149$.
[c] $X^2 = 6.408$, $P = 0.0406$.

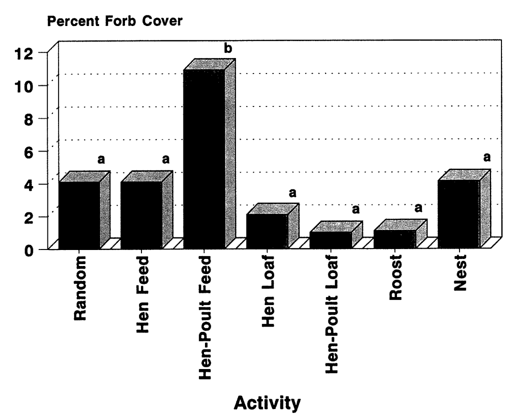
Table 4. Mean horizontal visibility for standing human and for turkey silhouette, Chevelon study area, Arizona, 1988-1989.

	Turkey Silhouette Visibility			Human Visibility	
Site type	*n*	$\bar{x}$	SD	$\bar{x}$	SD
Random	141	107.5[a]	49.3	154.2[a]	67.2
Nesting	40	44.2[b]	22.1	75.1[b]	46.1
Hen Feeding	76	96.4[a]	39.6	140.4[a]	50.4
Hen-Poult Feeding	49	103.3[a]	44.0	153.4[a]	58.6
Hen Loafing	45	73.4[a]	24.5	110.4[a]	39.5
Hen-Poult Loafing	23	71.4[a]	30.2	107.9[a]	44.7
Roosting	31	104.0[a]	42.8	139.2[a]	49.5

[ab] Means with the same letter are not significantly different ($P > 0.05$) from each other.

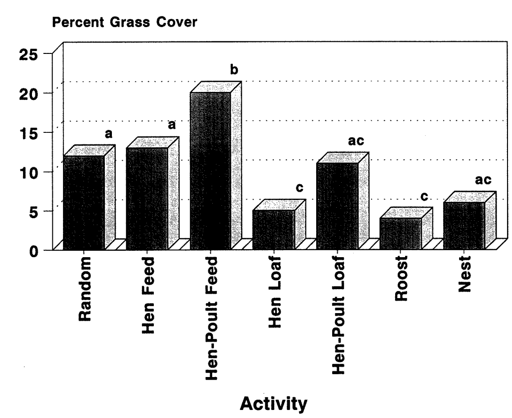
Table 5. Turkey use of forest openings, Chevelon study area, Arizona, 1988-1989. Observations of turkeys in each of 4 activity classes are partitioned according to presence-absence, type, and size class of opening.

	Hen Feeding		Hen-Poult Feeding		Hen Loafing		Hen-Poult Loafing	
Characteristic	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)
Presence of Opening								
Yes	76	(96.2)	47	(95.9)	45	(95.7)	26	(100.0)
No	3	(3.8)	2	(4.1)	2	(4.3)	0	(0.0)
Total	79	(100.0)	49	(100.0)	47	(100.0)	26	(100.0)
Type of Opening								
Logged	56	(74.7)	38	(79.2)	32	(74.4)	20	(76.9)
Reseeded Road	4	(5.3)	4	(8.3)	2	(4.7)	2	(7.7)
Burn	2	(2.7)	4	(8.3)	1	(2.3)	0	(0.0)
Natural	13	(17.3)	2	(4.2)	8	(18.6)	4	(15.4)
Total	75	(100.0)	48	(100.0)	43	(100.0)	26	(100.0)
Opening Size in ac								
≤0.25	54	(71.1)	35	(76.1)	39	(86.7)	22	(88.0)
0.26-0.5	12	(15.8)	4	(8.7)	5	(11.1)	2	(8.0)
0.51-1.0	4	(5.3)	5	(10.9)	0	(0.0)	1	(4.0)
1.1-5.0	6	(8.0)	2	(4.3)	1	(2.2)	0	(0.0)
>5.0	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)
Total	76	(100.0)	46	(100.0)	45	(100.0)	25	(100.0)



[ab] Classes with the same letter do not differ ($P > 0.05$) from each other.

Figure 8. Mean forb cover on random plots and acitivity sites on the Chevelon study area, Arizona, 1988-1989.



[abc] Classes with the same letter do not differ ($P > 0.05$) from each other.

Figure 9. Mean grass cover on random plots and activity sites on the Chevelon study area, Arizona, 1988-1989.

significantly higher at feeding than at loafing sites ($P < 0.0001$, Table 6).

Herbaceous plant cover and species richness were sometimes greater at hen-poult feeding sites than at hen feeding sites (Table 6). Percent cover of forbs was significantly higher at hen-poult sites than at hen sites during 1988 ($P < 0.0001$) but not 1989 ($P = 0.0505$). Percent grass cover was higher at hen-poult sites in 1989 ($P = 0.0077$) but not in 1988 ($P = 0.3205$). Forb species richness was higher at hen-poult sites in 1988 ($P = 0.0222$) but not in 1989 ($P = 0.5366$).

Density of conifer trees and regeneration (seedlings) had little influence on the distribution of feeding turkeys (Figs. 10 and 11); neither did the basal area of trees (Fig. 12). None of these measures differed between turkey feeding sites and random plots. Tree basal area was lower at feeding sites than at loafing and roosting sites (Fig. 12).

Loafing Sites. Sixty-nine loafing sites were located. Adult hens, mixed flocks, or birds of undetermined sex or age were present at 46 of these sites; hens with poults occupied 23 sites.

Loafing hen turkeys avoided draws (Table 7) but used other landforms and slope components in proportion to their availability. Slope averaged 17% at hen loafing sites and 16% at hen-poult sites. Data from all loafing sites showed slope to be less than at nesting and roosting sites but not different from slope at feeding or random plots (Fig. 4). Fifty percent of hen loafing sites (Table 7) and 61% of hen-poult loafing sites were in association with a canyon or draw.

Turkey visibility averaged 73 ft at hen loafing sites and 71 ft at hen-poult loafing sites (Table 4, Appendix 2). Hen and hen-poult loafing sites did not differ in mean turkey visibility. The average visibility at hen and hen-poult loafing sites was lower than that at feeding and roosting sites and random plots, but greater than that at nesting sites (Fig. 5).

Ninety-six percent of hen loafing sites and 100% of hen-poult loafing sites were within 100 ft of an opening (Table 5). The distance between loafing sites and the nearest forest opening averaged 26 ft for hen groups and 30 ft for hen-poult groups. Over 45% of loafing sites were within 20 ft of openings and over 75% were within 40 ft of an opening.

Most loafing sites had been logged, and three-fourths of the openings at loafing sites had been created by logging (Table 5). Loafing hens avoided unlogged sites and sites that had been logged >20 years ago and selected sites that had been logged in the past 5 years (Table 7).

Ground cover at hen loafing sites was often low. Loafing sites had less ground cover <18 in high than nesting and hen-poult feeding sites and random plots ($P < 0.0001$, Fig. 6). Loafing-site cover at the 18-36 in height level was less than at nesting sites but did not differ from that at other turkey use sites or random plots. Loafing site cover at the 36-72 in height level did not differ from that at other turkey use sites or random plots.

Shrub density at loafing sites was similar to that at most other use sites (Fig. 7), but canopy cover and slash characteristics were sometimes different. Loafing sites had denser canopies than did feeding sites or random plots (Fig. 13). Hen loafing sites had more slash than hen feeding sites ($P < 0.0001$) and larger slash than random plots ($P < 0.0001$, Appendix 2).

Loafing sites often were located in heavily forested stands of small-to-moderate diameter trees. They had more conifers per ac (Fig. 10) and higher tree BA (Fig. 12) than did feeding or nesting sites or random plots. They had more conifer trees than did roosting sites (Fig. 10) and higher conifer regeneration than did feeding sites or random plots (Fig. 11). Only 28% of hen and 37% of hen-poult loafing sites occurred in single or 2-storied stands.

Roosting Sites. Thirty-one turkey roost sites were located. Twenty-one of these were used in summer only (summer roosts) and 10 were used in summer although they were located within the winter range (year-long roosts).

Turkeys selected steep areas for roosting. Slope at roosts was significantly greater than at feeding, loafing, or random plots, but was significantly less than at nest sites ($P < 0.0001$, Fig. 4). Seventy percent of year-long roosts and 100% of summer roosts were in association with a canyon or drainage. Turkeys selected major and minor canyons and avoided ridges (Table 8). Of the sites in association with a canyon, 52% occurred on the upper third of the canyon wall, 30% occurred on the middle third and 18% occurred on the lower third.

Eighty percent of roosts had some type of travelway by which turkeys arrived and departed. Typically travelways were along topographic prominences, such as ridges, that provided

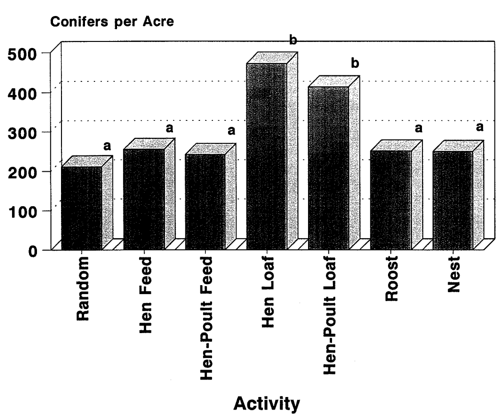
Table 6. Characteristics of herbaceous vegetation at random plots, hen feeding sites, and hen-poult feeding sites, Chevelon study area, Arizona, 1988-1989.

Characteristics		Random (n = 141) $\bar{x}$	Random SD	Hen Feeding (n = 76) $\bar{x}$	Hen Feeding SD	Hen-Poult Feeding (n = 48) $\bar{x}$	Hen-Poult Feeding SD
Herbaceous vegetation height (in)	Total	9.1	5.7	8.9	4.6	9.8	8.3
	1988			11.0	4.9	11.3	4.4
	1989			6.8	2.9	8.9	5.7
Herbaceous vegetation height in nearest opening (in)	Total	9.9	5.7	9.9	5.1	10.3	5.2
	1988			12.7	5.6	12.0	3.6
	1989			7.3	3.1	9.3	5.8
Forb species richness on 0.1-ac plot	Total	8.6	3.3	8.2	3.4	9.4	2.9
	1988			8.1	3.5	10.2	2.7
	1989			8.5	3.2	9.0	2.9
Grass species richness on 0.1-ac plot	Total	2.8	1.0	3.5	1.5	3.4	1.1
	1988			3.8	1.6	3.7	1.3
	1989			3.4	1.3	3.1	0.9
Percent forb cover in nearest opening	Total	5.4	6.4	5.7	6.8	11.0	9.2
	1988			6.1	7.7	15.7	10.5
	1989			4.4	5.0	7.1	5.8
Percent grass cover in nearest opening	Total	12.4	10.9	12.7	10.2	19.2	13.9
	1988			16.4	16.1	20.4	12.5
	1989			9.8	7.8	17.7	14.9
Percent total herbaceous cover in nearest opening	Total	49.3	24.0	50.5	24.4	66.2	24.2
	1988			58.7	23.4	74.5	16.3
	1989			42.8	22.3	62.5	25.9

Table 7. Habitat selection by loafing hen turkeys, Chevelon study area, Arizona, 1988-1989. The proportions of loafing sites found (observed) in each habitat component are compared with the proportional area (availability) of each component. Chi-square contingency table values (X^2) and Bonferroni confidence intervals (P = 0.1) provide the basis for estimating selection (S) among habitat components.

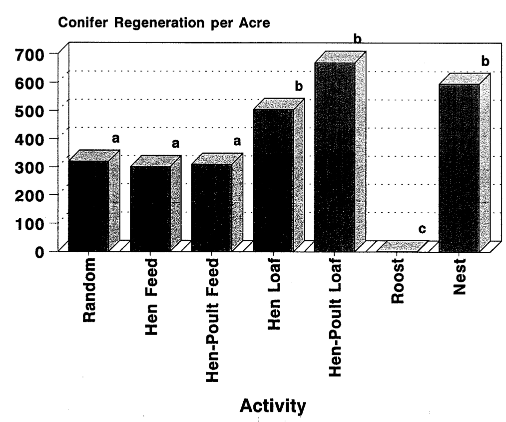
Component	Proportion observed	Proportion available	S[a]	Confidence Interval
Landform[b]				
Main Canyon	0.174	0.064	=	0.049<x<0.299
Minor Canyon	0.283	0.136	=	0.134<x<0.432
Ridgetop	0.500	0.564	=	0.335<x<0.665
Draw	0.043	0.236	-	0.024<x<0.110
n	46	140		
Logging History[c]				
<5 yrs	0.289	0.072	+	0.145<x<0.433
6-20 yrs	0.511	0.424	=	0.352<x<0.670
>20 yrs or unlogged	0.200	0.504	-	0.073<x<0.327
n	45	140		

[a] + denotes selection, - denotes avoidance, and = denotes use consistent with availability.
[b] X^2 = 15.956, P = 0.0012.
[c] X^2 = 20.67, P < 0.0001.



[ab] Classes with the same letter do not differ (P > 0.05) from each other.

Figure 10. Mean conifer density on random plots and activity sites on the Chevelon study area, Arizona, 1988-1989.



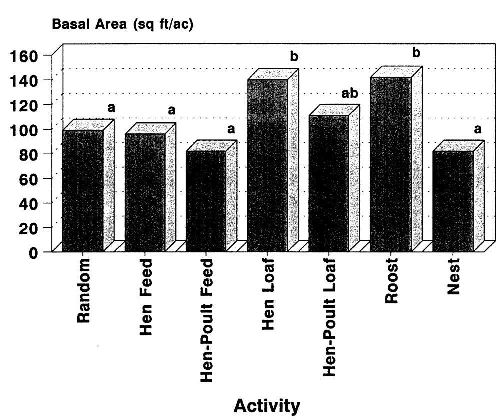
[abc] Classes with the same letter do not differ (P > 0.05) from each other.

Figure 11. Mean density of conifer regeneration on random plots and activity sites on the Chevelon study area, Arizona, 1988-1989.

Table 8. Habitat selection by roosting turkeys, Chevelon study area, Arizona, 1988-1989. The proportions of roosting sites found (observed) in each habitat component are compared with the proportional area (availability) of each component. Chi-square contingency table values (X^2) and Bonferroni confidence intervals (P = 0.1) provide the basis for estimating selection (S) among habitat components.

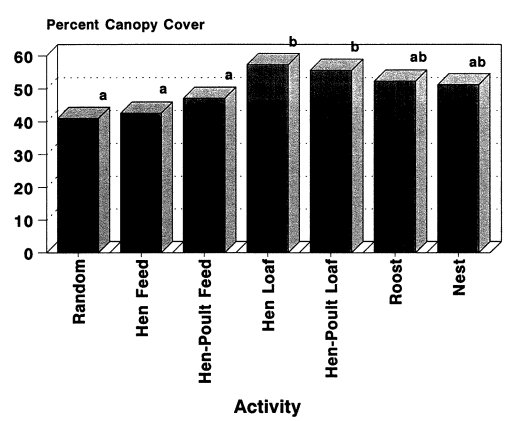
Component	Proportion observed	Proportion available	S[a]	Confidence Interval
Landform[b]				
Main Canyon	0.355	0.064	+	0.162<x<0.548
Minor Canyon	0.387	0.136	+	0.191<x<0.583
Ridgetop	0.097	0.564	-	-0.022<x<0.216
Draw	0.161	0.236	=	0.013<x<0.309
n	31	140		
Understory[c]				
Even	0.065	0.319	-	-0.022<x<0.152
Clumped	0.935	0.681	+	0.848<x<1.023
n	31	141		
Overstory[d]				
Even	0.129	0.479	-	0.001<x<0.257
Clumped	0.871	0.521	+	0.742<x<0.999
n	31	141		

[a] + denotes selection, - denotes avoidance, and = denotes use consistent with availability.
[b] X^2 = 39.367, P < 0.0001.
[c] X^2 = 8.297, P = 0.004.
[d] X^2 = 12.771, P = 0.0004.



[ab] Classes with the same letter do not differ (P > 0.05) from each other.

Figure 12. Mean basal area on random plots and activity sites on the Chevelon study area, Arizona, 1988-1989.



[ab] Classes with the same letter do not differ (P > 0.05) from each other.

Figure 13. Mean canopy cover on random plots and activity sites on the Chevelon study area, Arizona, 1988-1989.

topographic and vegetative cover. Topographic cover was noted at 87.5% of all roost sites.

Forest characteristics at roost sites differed from those at random plots. Seventy-seven percent of roosts had clumpy, multi, or uneven canopy structure, whereas only 57% of random plots had these qualities. Roosting turkeys avoided areas of even understory and overstory for roosting and selected sites with clumped understory and overstory (Table 8). Thirty percent of roost sites were in unlogged sites, compared with only 14% of random plots that remained unlogged. Seventy-four percent of roost sites were dominated by trees in the 2 largest diameter R03WILD categories, those >16 in DBH. In comparison, only 15% of random plots were classified in either of these categories (Table 9). The selection by roosting turkeys for mature sawtimber was the only R03WILD category selected by turkeys for any activity (Table 10).

Trees at roost sites had several noteworthy qualities. Roost sites were comprised of multiple roost trees in a clump. Among 205 roost trees measured, 96% were ponderosa pine, even though 29% of roosts occurred in areas dominated by white fir and Douglas-fir. Ninety-seven percent of trees at roost sites were ≥16 in DBH and 86% of trees were ≥20 in DBH; on random plots only 4% of the trees were ≥16 in DBH (Fig. 14). Tree basal area at roost sites (Fig. 12) was greater than at random plots ($P < 0.0001$). Most roost trees were either dominant or co-dominant in the tree canopy. Ninety-eight percent of trees had horizontal branches. Height to first limb averaged 24 ft (range 6-70 ft).

Summer roosts had fewer roost trees and fewer trees ≥16 in DBH than year-long roosts. They were also smaller in area (Table 11).

R03WILD Habitat Classes. Patterns in turkey use of the R03WILD habitat classes reflected the relative habitat class availability in most cases (Table 9). For example, pole timber occurred on about half the CSA, as indicated by its presence on 53% of the random plots, and about half of all turkey feeding and loafing occurred in pole timber. Likewise, immature saw timber occurred on slightly more than 20% of the CSA, and 20 to 30% of turkey nesting, feeding, and loafing occurred in this type.

A few instances of selection against or for R03WILD habitat classes were evident (Table 10). Nesting and roosting turkeys selected against the seedling-sapling type, and roosting turkeys selected against pole timber. The only statistically valid selection for any habitat class was selection for mature sawtimber by roosting turkeys.

Word Model

The word model (Appendix 3) enables managers to evaluate forest stand, vegetative, and physiognomic characteristics of a site and thereby rate its capability for meeting turkey requirements. The model leads the user through an evaluation of the potential of a site for nesting, feeding, loafing, and roosting.

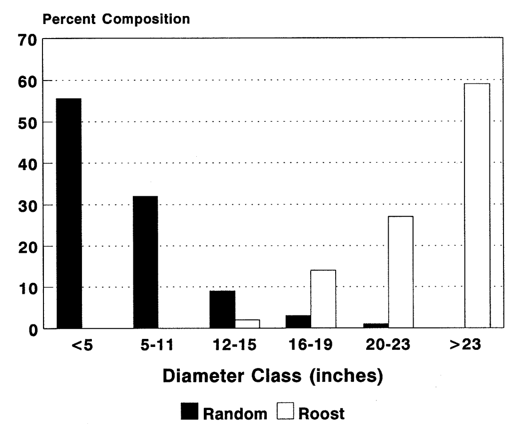


Figure 14. Percent composition of trees by size class on random plots and roost sites on the Chevelon study area, Arizona, 1988-1989.

Table 9. Distribution of random points and turkey use sites among R03WILD habitat classes (Byford et al. 1984), Chevelon study area, 1988-1989.

	Random		Nest		Hen Feed		Hen-Poult Feed		Hen Loaf		Hen-Poult Loaf		Roost	
R03WILD Class	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)
Grass-Forb	0	(0.0)	0	(0.0)	1	(1.3)	1	(2.1)	0	(0.0)	0	(0.0)	0	(0.0)
Seedling-Sapling	15	(10.7)	1	(2.0)	5	(6.6)	3	(6.3)	1	(2.2)	4	(17.4)	0	(0.0)
Pole Timber	74	(52.9)	14	(28.6)	38	(50.0)	28	(58.3)	29	(64.4)	10	(43.5)	5	(16.1)
A	62	(44.3)	10	(20.4)	31	(40.8)	21	(43.8)	14	(31.1)	3	(13.0)	3	(9.7)
B	12	(8.6)	3	(6.1)	7	(9.2)	6	(12.5)	14	(31.1)	7	(30.4)	1	(3.2)
C	0	(0.0)	1	(2.0)	0	(0.0)	1	(2.1)	0	(0.0)	1	(4.3)	0	(0.0)
Immature Saw Timber	30	(21.4)	10	(20.4)	15	(19.7)	16	(33.3)	11	(24.4)	8	(34.8)	3	(9.7)
A	21	(15.0)	6	(12.2)	11	(14.5)	12	(25.0)	6	(13.3)	3	(13.0)	3	(9.7)
B	9	(6.4)	3	(6.1)	4	(5.3)	3	(6.3)	5	(11.1)	4	(17.4)	0	(0.0)
C	0	(0.0)	1	(2.0)	0	(0.0)	1	(0.0)	0	(0.0)	1	(4.3)	0	(0.0)
Mature Saw Timber	12	(8.6)	10	(20.4)	15	(19.7)	0	(0.0)	4	(8.9)	0	(0.0)	17	(54.8)
A	10	(7.1)	7	(14.3)	12	(15.8)	0	(0.0)	4	(8.9)	0	(0.0)	14	(45.2)
B	2	(1.4)	3	(6.1)	3	(3.9)	0	(0.0)	0	(0.0)	0	(0.0)	3	(9.7)
C	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)
Old Growth	9	(6.4)	4	(8.2)	2	(2.6)	0	(0.0)	0	(0.0)	1	(4.3)	6	(19.4)
Total	140	(100.0)	39	(100.0)	76	(100.0)	48	(100.0)	45	(100.0)	23	(100.0)	31	(100.0)

Table 10. Selection of R03WILD habitat classes (Byford et al. 1984) by turkeys on the Chevelon study area, Arizona, 1988-1989, based on Chi-square contingency table analysis and Bonferroni confidence intervals (P = 0.1).

	Nest	Hen Feed	Hen-Poult Feed	Hen Loaf	Hen-Poult Loaf	Roost
R03WILD	S[a]	S	S	S	S	S
Grass-Forb	=	=	=	=	=	=
Seedling-Sapling	-	=	=	=	=	-
Pole Timber	=	=	=	=	=	-
Immature Saw Timber	=	=	=	=	=	=
Mature Saw Timber	=	=	=	=	=	+
Old Growth	=	=	=	=	=	=

[a] + denotes selection, - denotes avoidance, and = denotes use consistent with availability.

Table 11. Characteristics of turkey roosts on the Chevelon study area, Arizona, 1988-1989.

	Summer roosts (n = 21)		Year-long Roosts (n = 10)		All Roosts (n = 31)	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Number of trees >16 in DBH within roost clump	18.0	8.0	38.0	24.0	24.0	18.0
Number of roost trees within roost clump used for perching	5.0	4.5	10.9	6.7	6.8	5.0
Roost size (ac)	0.6	0.4	5.2	3.0	1.8	2.6
Percent slope	38.0	17.0	21.0	14.0	32.0	18.0

Turkeys select specific characteristics for nest sites.

DISCUSSION

Nesting Sites

Chevelon study area hens nested on canyon slopes that were steeper ($\bar{x}$ = 53%) than reported for turkeys elsewhere. Another northern Arizona turkey study (Crites 1988) and a Washington study (Mackey 1984) showed nest sites to have an average slope of about 32%. Nesting turkeys in a New Mexico study used slopes averaging 46% and avoided gentle slopes (Goerndt 1983). As in our study, Wyoming turkeys used steeper than average slopes for nesting (Hengel and Anderson 1990).

Nesting turkeys in our study did not demonstrate any selection for slope aspect. Merriam's turkeys in New Mexico selected mesic slopes for nesting (Goerndt 1983), as did eastern turkeys in Minnesota (Lazarus and Porter 1985).

Most nest sites in our study were located near or within landscape features: 39% were against a rock or cliff, 17% were on the uphill side of a tree, and 14% were in slash. In another northern Arizona area, 50% of nests were located on the uphill side of a tree (Crites 1988). In New Mexico, 53% of nests were located at the base of trees or stumps, 29% were in brushy cover, and 18% were in slash piles (Goerndt 1983). In South Dakota, rocks and rock outcrops were used for first nestings, but as shrubs developed phenologically nesting attempts shifted to shrub patches in meadows (Rumble 1990).

Nest sites in our study had greater canopy cover, particularly directly above the nest, than did the surrounding area. Another northern Arizona study (Crites 1988) and 1 in New Mexico (Goerndt 1983) also reported greater than average canopy cover at nest sites. The presence of overhead cover in Minnesota was associated with high nest success (Lazarus and Porter 1985).

Nest sites on the CSA had low horizontal visibility because of screening provided by shrubs, deciduous and coniferous tree regeneration, slash, and dead-and-down wood. Likewise, horizontal screening at nest sites in New Mexico was consistently high 1 ft above ground (Goerndt 1983). Nest sites in Minnesota had relatively high horizontal cover in the ground layer and higher than average stem densities and herbaceous cover in the understory layer (Lazarus and Porter 1985). Nesting Rio Grande turkeys in Texas avoided heavily grazed pastures with relatively little herbaceous cover (Ransom et al. 1987). Merriam's turkeys in Oregon nested in thinned mixed-conifer stands that had relatively high densities of pole-sized trees and an abundance of slash that the hens used for nest cover (Lutz and Crawford 1987).

Some of the apparent selections for habitat features were probably not cause-effect relationships. For example, statistics showed selection by nesting turkeys for unlogged sites, but the turkeys might have been selecting for steep slopes (which were seldom logged) rather than for unlogged areas *per se.*

Nests in mixed-conifer forests were not only typically in more mesic environments than those in ponderosa pine forests, they were often closer to hen-poult feeding and loafing habitat that turkeys used following nest abandonment by hens with poults. Hens that nested in the mixed-conifer type often used feeding and loafing habitat within 1 mi of the nest site. Several hens nesting within the ponderosa pine type moved broods more than 1 mi to feeding and loafing habitat, even though apparently suitable habitat was available near the nest.

Feeding Sites

Topography, the presence of openings and cover, and the nature of the herbaceous vegetation strongly influenced selection of feeding sites. Hens alone and hens with poults typically fed on gentle (0-20%) slopes in small (<0.25 ac) openings created by logging. Turkeys, especially hens with poults, made little use of large natural meadows. Most hen feeding sites were located on ridgetops; hen-poult sites were found on ridgetops and in small canyons, draws, and drainageways. Hens with poults selected areas, including the edges of a power line right-of-way, with high plant species diversity and cover from herbaceous plants.

Hens and hens with poults in our study fed on slopes that were not as steep as those used for nesting but not different from average slope. Hens with poults in New Mexico likewise fed on gentle slopes; as with turkeys in our study, they frequented ridgetops, saddles, heads of canyons, and borders of larger meadows (Goerndt 1983). In Washington, young broods fed in oak forests with gentle slopes (Mackey 1982).

We saw almost no feeding in large natural openings by hens with poults. These birds fed either within the forest canopy or in small openings usually created by individual tree- or group-selection logging. Turkeys in eastern Arizona likewise selected against large meadows, preferring to feed in forests opened by logging

(Green 1990). In northern Arizona turkeys used small openings and drainage bottoms as well as open forest stands (Phillips 1982).

All sizes of meadows and natural openings have long been considered important hen-poult feeding habitat on the Mogollon Rim. Heavy use of large and small openings for feeding has been reported in eastern Arizona (Scott and Boeker 1977). In habitat similar to our study area, open parks or cienegas in the ponderosa pine forest were optimum brood habitat because they provided water (which usually occurred naturally in parks or meadows) and abundant food surrounded by adequate cover. Areas of otherwise adequate habitat without water were not used (Reeves 1950).

Early researchers may have overestimated turkey preference for meadows because most early work was based on visual observations, and turkeys are more visible in openings. We believe that broods on the CSA fed within the forest canopy because they were less vulnerable to predators there than in large openings. The creation of small openings within the forest through logging practices and the development of water sources since the early research was conducted may have made large openings less attractive to hen-poult groups.

Cover seemed invariably to be an important component of feeding habitat. Birds did not feed in areas of low tree density or low basal area where adequate cover did not exist. Slash, dead-and-down wood, conifer regeneration, topography, and overstory canopy provided cover at many feeding sites.

Hens without poults selected different feeding habitats than hens with poults. Height of herbaceous cover, diversity and percent cover of forbs, and percent cover of grasses were all consistently higher in our study at hen-poult sites than at hen sites. Height of herbaceous cover and percent cover in nearby openings were also consistently higher at hen-poult feeding sites. Though canopy cover in our study was similar at hen-poult sites and hen sites, in eastern Arizona canopy cover at hen-poult sites averaged more than at hen sites (Green 1990).

Annual differences in plant growth and availability of food and water caused differences in habitat use patterns between 1988 and 1989. In summer, 1988, herbaceous cover and water were abundant because of above-average precipitation the preceding winter and spring. Hens with and without broods seemed to feed primarily on green forbs and grass seedheads as they became available. The fall of 1988 provided a limited acorn crop and an abundant ponderosa pine seed crop. Turkeys seemed to use acorns as available and rely heavily on pine seeds through the winter and spring. Precipitation in the winter and spring of 1989 was below normal, thus in summer, 1989, herbaceous food and cover were reduced and water distribution was not as good as previously. Throughout the summer of 1989, adult hens appeared to continue utilizing pine seeds and frequently fed within the forest canopy rather than in openings. Hens with poults continued to feed in openings that were often near ponderosa pine trees; apparently they were seeking pine seeds. If adequate cover was available, hens with poults consistently selected areas with the greatest forb species richness, the highest percent grass cover, and the tallest herbaceous vegetation available.

Loafing Sites

Turkeys on the CSA often loafed within forest stands that were used for feeding. Most loafing sites were located on a ridgetop, on the lip of a canyon, or in a small canyon or draw. Loafing sites were usually small (<1 ac) clumps of high-density saplings or pole-sized trees associated with an opening and with slash or dead-and-down wood. Snags that had been cut down were frequently used as loafing sites. Birds often sat on logs or other larger slash while loafing; this provided them with excellent fields of view and made them difficult to see. Turkeys also loafed in oak and juniper thickets and clumps of conifer regeneration. Visibility into loafing sites from outside the stand was relatively low, second only to that at nest sites.

Merriam's turkey loafing sites have been described in general by several other researchers. Phillips (1982) found that turkeys in northcentral Arizona used areas of thick pole-and-sapling pine stands or dense pine-oak stands for loafing. Rumble (1990) reported that turkeys in the Black Hills of South Dakota loafed in "doghair" thickets of ponderosa pine.

Roosting Sites

Topographic characteristics of turkey roost sites on the CSA did not differ dramatically from those of Merriam's turkey roosts described by other researchers. Summer roosts were on steeper slopes than were year-long roosts. Both summer and year-long roosts were in association with a canyon or drainage. Most were located on the upper third of the slope, as Goerndt (1983) found in New Mexico. We saw no specific selection for slope aspect on the CSA; turkeys in winter in New Mexico roosted mainly on eastern exposures (Goerndt 1983).

Birds on the CSA typically selected large (>20 in DBH) ponderosa pines for roosting. Almost all ponderosa pine stands that occurred on less than 30% slopes had been extensively logged and few large trees remained. Thus, the association of roosts with canyons, as noted above, might have been influenced by the relative abundance of large trees in canyons.

Turkeys we studied typically flew into a roost from above and exited into a small opening or into the usually sparse understory below the roost. Turkeys in Colorado typically roosted at or near the edge of an opening, presumably because this gave them easy access to the roost (Hoffman 1968). Boeker and Scott (1969) noted that turkeys usually left roosts in the morning by sailing into an opening. Mackey (1984) reported that turkeys on his Washington study area flew into the roost from under the tree canopy.

Roosting turkeys in our study selected forest stands with high BA. Stand BAs at roosts consistently exceeded 90 ft^2/ac, similar to BAs reported for roosts in other southwestern studies (Scott and Boeker 1977, Phillips 1982). Turkeys may abandon roost sites if timber treatments reduce tree BA (Scott and Boeker 1977). Even in the second-growth timber in the Black Hills of South Dakota, roosting turkeys selected stands with larger than average BA (Rumble 1992).

Summer roost clumps on the CSA averaged 18 trees ≥16 in DBH and averaged 0.6 ac in size; summer turkey flocks occupied an average of 5.0 trees per night. Year-long roost clumps averaged 38 trees ≥16 in DBH in roost clump and 5.2 ac in size; 10.9 roost trees were used per night (Table 11). In northern Arizona, winter roosts encompassed 0.94 ac and averaged 27 roost trees per clump (Phillips 1982). Winter roosts in Wyoming averaged 6.2-7 roost trees per site and summer sites averaged 1.5-2 roost trees (Hengel and Anderson 1990). New Mexico winter roost sites encompassed 0.21 ac and averaged 8 roost trees per site; summer sites covered 0.05 ac and averaged 2 roost trees per site (Goerndt 1983). Roost sites in Washington ranged from 1-24 roost trees per site, but roosts with the most trees (14, 17, 24 trees) were used most frequently (Mackey 1984).

Most roosts on the CSA, including summer roosts, were used repeatedly. Goerndt (1983) reported that New Mexico winter roosts were used repeatedly but that summer roosts were rarely used more than once. Wakeling and Rogers (1995) found that turkeys concentrated their daily activities within 1 mi of winter roosts and speculated that food availability influenced roost site selection.

Thirty percent of the roosts on the CSA were unlogged and only 3% of roosts had been logged within 5 years. Because roosts were usually located on the upper third of the slope, often just under the break of the ridge, it was not unusual for the upper part of a roost to have been removed by logging. Past and some current timber harvest practices allow tree removal on the upper part of a slope that can be reached without the use of cable logging techniques.

Ninety-six percent of roost trees on our study area were ponderosa pine, although 29% of roosts occurred in areas predominated by white fir or Douglas-fir. Douglas-fir was used for roosting at 1 mixed-conifer roost. One extensively used roost was comprised entirely of old growth limber pine.

Roost trees on the CSA were usually large (24.9 in average DBH) dominant or co-dominant ponderosa pine with horizontal branches. The smallest tree used was 11.6 in DBH; 97% of roost trees were ≥16 in DBH and 86% of trees ≥20 in DBH (Fig. 14). Height to first limb averaged 24 ft. This description of roost trees resembles that reported by Boeker and Scott (1968) in eastern Arizona, Hoffman (1969) in Colorado, Phillips (1982) in northern Arizona, and Hengel and Anderson (1990) in Wyoming.

Birds roosting on the CSA showed a strong selection for the largest trees available, and did not use the more abundant and widespread smaller trees. Hens with poults in Wyoming avoided trees <16 in DBH, but hens without poults used trees as small as 10 in DBH (Hengel and Anderson 1990). Rumble (1990) reported that an introduced population of Merriam's turkeys in South Dakota roosted in ponderosa pine trees 7.9-9 in DBH more often than they used trees greater than 19.7 in DBH. However, the trees used had the wide spacing of branches characteristic of roost trees in Merriam's native range. The rainfall regime in the Black Hills of South Dakota may facilitate faster growth of ponderosa pine and thus produce young trees with characteristics typical of older trees farther south.

R03WILD Habitat Classes

Although the turkeys we studied often showed selection for specific habitat features, seldom could these selection patterns have been discriminated by using the R03WILD habitat classification system. The only R03WILD habitat class turkeys used more commonly than would have been predicted by chance alone was mature sawtimber, which turkeys selected for roosting. Nesting, feeding, and loafing turkeys showed no selection for any R03WILD habitat categories. Implications are that habitat quality for turkeys cannot be accurately portrayed by the R03WILD model used by the U.S. Forest Service.

Summary and Conclusions

Turkeys on the Chevelon study area often selected specific habitat features or types for nesting, feeding, loafing, or roosting. The habitat components selected often were different for each of these 4 types of use. Patterns of habitat selection and use often, but not always, paralleled those found in turkey populations in other areas.

Nesting habitat selection in our study resembled in general that reported elsewhere. Birds selected steep slopes, often in canyons and small drainages, but showed no preference for slope aspect. Nests often were closely associated with landscape features--tree trunks, rocks, cliffs, and slash. Nest sites had relatively high canopy and ground cover, thus relatively low visibility.

The structural nature of feeding habitat often paralleled that found by other researchers. Hen groups and hens with poults typically fed on gentle slopes on ridgetops or in drainage bottoms, selecting small openings created by logging. In contrast with what some other workers have found, hens with poults avoided large natural meadows. Cover in the form of herbaceous vegetation, overstory canopy, conifer seedlings, or slash was more common at feeding sites than at random locations. Between-year differences in food and cover availability affected feeding habitat use and selection.

Turkeys usually used loafing sites that were within forest stands used for feeding. Most loafing sites were in canyons or small drainages, often near the upper lip of the slope. A typical loafing site occupied a dense stand of small trees near an opening and centered around a log or other down-and-dead wood. Other biologists also have observed turkey loafing sites to be associated with young, dense stands of trees.

Roosting sites in this study usually had large ponderosa pine trees in which the turkeys roosted. All roosts were in canyons or small drainages, perhaps partly because most unlogged stands of pines were in these places, and most roosts were on the upper one-third of the slope. Forest stands at roost sites were typically clumps of trees that had a relatively high basal area. The lower boles of roost trees often were limbless and the upper trunks typically had horizontal branches. Small forest openings or a sparse understory were typically associated with roost sites. Roosts in other areas were generally similar except that South Dakota turkeys roosted in relatively young ponderosa pines.

Turkeys showed little selectivity among the R03WILD habitat classes. This contrasted with the high levels of selectivity shown for some of the microscale habitat components we measured at turkey use sites.

In general conclusion, Merriam's turkeys on the CSA used a wide diversity of habitat types and habitat structural features. Many instances of selection for specific habitat components were documented; the components selected depended on whether the turkeys were nesting, feeding, loafing, or roosting. Few differences in selection were exhibited between hens with and without poults. Because habitat selection often appears to be at the microsite level and not at the timber stand level, the utility of using only the R03WILD habitat classes as the basis for a habitat model is questionable.

All known roost trees should be permanently marked and protected from timber harvest.

MANAGEMENT IMPLICATIONS

In this section we describe land management options that may be used to improve habitat for Merriam's turkeys. Each option is described in general terms, and local conditions may preclude its use or modify its applicability. Further, because turkey habitats are subject to other uses, some of which are in conflict with turkey management, the options we present may not always be attainable in practice.

The habitat suitability model (Appendix 3) developed in this study describes habitat types and components selected by turkeys on the CSA. Although the model does not describe the influence of habitat spatial scales or juxtapositioning, it has considerable utility to the manager desiring to know the variables important to turkeys for 4 main functions--nesting, feeding, loafing, and roosting. The model is based upon the best available information from our study and from the literature. It is based largely on habitat selection by females and young, and may not always be applicable to the adult male segment of the population.

Turkey habitat in the Southwest commonly supports timber harvesting and grazing. These 2 uses usually have the greatest impacts on turkey habitat.

Timber Management

In general, timber treatments that improve within-stand structural diversity, retain clumped characteristics of woody vegetation, and maintain high cover availability help maintain suitable turkey habitat. Uneven-aged management or group-selection cuts tend to provide these characteristics. If even-aged management must be used, it is best if stand units not exceed 20 acres. Specific suggestions for maintaining or improving habitat for nesting, feeding, loafing, and roosting turkeys follow.

Nesting. Nesting takes place mainly on steep slopes, especially in canyons and other drainageways. Suggested timber management practices to reduce impacts on nesting turkeys include:

- Timber harvests on slopes >30% will adversely impact nesting habitat. Logging operations should stop at slope breaks and not reach into steep canyons.

- Logging operations in or near nesting habitat should be avoided between April 15 and June 15. Hens lay and incubate eggs during this period, and may abandon nests if disturbed.

Feeding. Mast-producing trees and small forest openings are important to feeding hens and poults. Some management precautions are:

- Harvesting stands that contain mast-producing trees to the point that a person is visible >150 ft away will adversely impact feeding habitat. Turkeys need cover near feeding sites.

- Encourage timber harvest practices that leave small openings in timber stands. Turkeys favor the food and cover combinations commonly found near openings created by logging.

- Close and reseed abandoned logging roads when possible, especially those along or in drainages.

Loafing. Turkeys tend to loaf in areas of low visibility near feeding areas. Both topographic and vegetative features can provide habitat structure attractive to loafing birds.

- Leave large downed logs and culls from logging operations, especially where understory tree density or conifer regeneration cover is high. Knowing the location of feeding habitat will enable managers to provide loafing habitat in nearby areas.

- Leave dense clumps of small trees in locations such as canyon rims, ridgetops, and small drainages; these vegetative and topographic features tend to be selected by loafing birds.

Roosting. Large ponderosa pine trees provide the most commonly-used roosts in the Southwest. Leaving old-growth pines in appropriate locations is the best practice for maintaining roosting habitat.

- Permanently mark and protect from timber harvest all known turkey roost sites. Even partial loss of the trees at a roost can be detrimental.

- Timber removal on slopes too steep for conventional logging will adversely affect roosting habitat. Steep areas are favored for roosting, at least partly because most remaining old-growth timber occurs there. The use of cable logging or other techniques to harvest steep slopes can damage roosting habitat.

Grazing Management

As a general principle, grazing should not exceed moderate levels. Rest-rotation grazing systems damage turkey habitat less than year-long grazing. Both elk (*Cervus elaphus*) and cattle can overgraze turkey habitat in the Southwest. Nesting and feeding habitat can be greatly affected by grazing; loafing and roosting habitats suffer few direct impacts.

Nesting. Nesting turkeys select areas with substantial herbaceous cover. Heavy grazing in winter or spring can reduce such cover.

- Cattle grazing in turkey nesting and brood-rearing range should be avoided until after July 1 each year.

- Elk populations should not exceed a conservative estimate of carrying capacity. Elk range commonly overlaps turkey range in spring.

Feeding. Feeding turkeys select areas of greater than average herbaceous cover and height. Heavy grazing can therefore have major effects on feeding habitat.

- Prevent overgrazing in spring and summer in forested openings where turkeys commonly feed.

- Do not graze turkey winter range to the extent that most grass seedheads are removed prior to winter.

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Appendix 1. Merriam's wild turkey expert opinion survey for habitat selection and use study, Arizona, 1988-89.

Objective

Obtain information from individuals knowledgeable about Merriam's turkey in Arizona, and incorporate this information into a preliminary habitat model for Merriam's turkey in Arizona.

Survey Questions

Question 1: You have been hired by Merriam and Silvestris Associates to identify, measure, and describe Merriam's turkey habitat in Arizona. List the *structural, topographic, or spatial* variables that best describe optimum turkey habitat in Arizona for each activity listed. After each variable, specify if it is important at the microsite (within 50 ft) level, stand level, or both.
Winter roost -
Summer roost -
Nesting -
Brood habitat -
Feeding -
Loafing -
Escape cover -

Question 2: What do you think is the primary limiting factor for Merriam's turkey in Arizona?

Question 3: Is it possible to mitigate this factor through habitat management? If so, please elaborate.

Question 4: Below you will find an example of the structural cover profile for black bear bedding habitat. Draw the optimum cover structural profile for Merriam's turkey habitat for each activity listed. Also list any other variables that you feel would better describe this profile (e.g., tree size, location of habitat topographically, etc.).

Question 5: What do you think the maximum road density per section in turkey habitat should be to minimize negative effects of roads?

Question 6: If you could write your "perfect prescription" for Merriam's turkey habitat management in Arizona and have it set into action, what would it be?

Question 7: What do you think is the minimum number of turkeys needed to maintain a local population?

Question 8: What do you think is the minimum area needed to support this population?

Question 9: Are there any other questions (or answers) you would have liked to have included in this exercise?

Question 10: How long did you spend on this questionnaire?

Question 11: How many years of experience do you have working with wildlife through research, game management, habitat management, and administration?

Appendix 2. Summary statistics for random plots and use sites, Chevelon study area, Arizona, 1988-1989.

	Random (*n* - 141)		Nest (*n* = 40)		Hen Feed (*n* = 77)		Hen-Poult Feed (*n* = 49)		Hen Loaf (*n* = 46)		Hen-Poult Loaf (*n* = 23)		Roost (*n* = 23)	
Factors	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Turkey visibility	107.5	49.3	44.2	22.1	96.4	39.6	103.2	44.0	73.4	24.5	71.4	30.2	104.0	42.8
Conifers per acre >1 in DBH	207.0	157.0	248.0	219.0	263.0	205.0	232.0	198.0	473.0	280.0	462.0	289.0	247.0	189.0
Conifer regeneration (stems/ac)	335.0	385.0			322.0	487.0	300.0	344.0	512.0	549.0	646.0	794.0		
Slash volume index	12.8	7.4	12.7	7.6	7.9	5.9	10.1	8.4	15.0	10.1	10.7	8.4	9.4	7.2
Slash height (in)	14.8	8.9	15.6	10.6	15.6	7.4	15.1	8.0	16.9	8.3	17.4	8.3	15.2	4.9
Slash size class (in)	8.8	4.3	10.1	5.1	10.5	4.5	11.4	5.8	10.2	4.3	12.9	6.1	13.2	4.4
Basal area (ft^2/ac)	73.0	57.0	85.0	51.0	96.0	67.0	70.0	47.0	142.0	65.0	112.0	68.0	140.0	43.0
Mean conifer DBH (in)	6.8	3.2	7.2	3.3	7.5	3.9	6.9	3.8	7.2	3.3	5.4	3.0	10.0	5.3
Shrubs/ac	1,062.0	2,152.0	7,077.0	10,005.0	1,688.0	4,869.0	967.0	3,042.0	1,322.0	3,064.0	1,523.0	1,523.0	1,294.0	3,220.0
Canopy cover (%)	41.3	22.5			44.0	22.1	46.1	20.6	57.9	17.9	59.6	24.0	52.5	17.6
Height to first canopy (ft)	3.6	4.9	6.8	6.1	3.5	3.1	5.8	6.1	3.7	3.8	4.8	5.2	9.5	7.2
Distance to cover (ft)	31.2	29.5			32.9	26.7	27.8	20.9	20.3	26.4	20.6	17.4	36.0	15.0

Appendix 3. Word model describing optimum habitat for Merriam's turkey.

Nesting Habitat (Fig. 15)

Topography: Nesting habitat is generally slopes >30%, frequently within canyons or drainageways. Nest sites are often located within mesic stands.

Overstory: Species composition of trees within the stand is relatively unimportant, although those trees that have low growing limbs seem to provide better nesting cover. Forest stands with trees of 4-12 in DBH, clumped in distribution, characterize most nest sites. The canopy within nesting habitat is generally multi-storied. Overstory canopy cover is generally >40% and frequently >50%.

Understory: Nesting habitat usually has moderate to dense deciduous or conifer regeneration, clumped in distribution. Canopy cover between 2-6 ft averages 10-40% and is generally composed of shrubs such as *Ribes*, *Quercus*, or *Robinia*, conifer regeneration, and scattered or loosely piled slash.

Herbaceous Vegetation: Grass and forbs provide >30% ground cover at most nest sites. Tall herbaceous vegetation seems to be favored in the selection of nesting sites.

Juxtapositioning of Habitat Components: The stand containing the nest sites is generally comprised of a minimum of 20% horizontal screening cover in 0.1-2 ac patches. Ground cover averages 30-60% within 3 ft of the ground. The composition of this cover includes large (>12 in DBH) downed logs, scattered or loosely piled slash, deciduous and conifer regeneration, and herbaceous vegetation. The height to first canopy at most nest sites is <10 ft. Distance to another standing human at nest sites average <75 ft. Nesting habitat is usually located <0.5 mi from water, and areas <0.5 mi from hen-poult feeding and nesting habitat seem to be favored.

EVALUATION:

1. Stands identified as potential nesting habitat as described above make up what percent of the overall area being considered?

0-5%	6-10%	11-20%	21-30%
unacceptable	minimum	acceptable	optimum

2. What percent of stands identified as potential nesting habitat are <0.5 mi of identified hen-poult feeding and loafing habitat?

0-20%	21-50%	51-90%	91-100%
unacceptable	minimum	acceptable	optimum

Feeding Habitat (Fig. 16)

Topography: Feeding habitat is generally 5-30% slope, mesic stands near a drainageway or canyon. Hen-poult groups seem to be dependent upon openings to provide the quantity and diversity of invertebrates necessary for young turkeys.

Overstory: Stands typically have a clumped tree distribution with a mixture of age classes. Overall stand BAs of 90-120 ft^2/ac are common. Stands average 20-50% canopy cover.

Understory: Stands that have burned and are regenerating with high conifer and deciduous shrub and tree densities and high herbaceous cover may be suitable feeding habitat. Understory ground cover (2-6 ft in height) averages 10-20% and is usually clumped in distribution. Horizontal cover may be provided by moderate to high amounts of slash and downed logs in patches, conifer regeneration, and deciduous and herbaceous vegetation.

Herbaceous Vegetation: Areas with high forb and grass diversity are the most suitable feeding habitat. Herbaceous ground cover >50% and 10-24 in tall seem to be favored.

Juxtapositioning of Habitat Components: Stands used for feeding by hen-poult groups are generally located <0.5 mi from water, and those areas <0.5 miles from potential nesting habitat seem to be favored. Horizontal visibility distance to a standing human in feeding habitat is typically <150 ft. Stands used for feeding generally provide a mosaic of small feeding areas with patches of escape and loafing cover interspersed.

Figure 15a. An example of a nest site on the Chevelon study area.

Figure 15b. An example of nesting habitat on the Chevelon study area.

Figure 16a. An example of mixed conifer feeding habitat on the Chevelon study area.

Figure 16b. An example of ponderosa pine feeding habitat on the Chevelon study area.

Twenty-50% of the stand is generally feeding habitat and 20-50% of the stand is generally escape cover and loafing habitat. Turkeys favor small openings, 0.1-2 ac in size, especially those irregular in shape that maximize edge effects. Turkeys also favor openings that are linear with at least a 2:1 length to width ratio and <150 ft in width. For example, closed, reseeded logging roads or small logged openings with herbaceous cover >50% provide suitable feeding habitat. In mixed-conifer vegetation types, the edges of larger openings (e.g., meadows, power lines) near dense horizontal cover are also used for feeding.

EVALUATION:

3. Stands identified as potential feeding habitat comprise what percent of the area being considered?

0-10%	11-20%	21-30%	31-50%
unacceptable	minimum	acceptable	optimum

4. What percent of stands identified as potential feeding habitat are <0.5 mi from water?

0-20%	21-50%	51-90%	91-100%
unacceptable	minimum	acceptable	optimum

Loafing Habitat (Fig. 17)

Figure 17. An example of loafing habitat on the Chevelon study area.

Topography: Loafing sites are generally located on gentle terrain on the upper edge of a drainageway or canyon. Turkeys use topographic relief to provide cover for escape when disturbed from the loafing site.

Overstory: Loafing sites are generally located within clumps of pole-sized trees, 5-14 in DBH. The predominant tree species in the stand used for loafing is generally ponderosa pine, although any species may be used. BA averages >110 ft^2/ac. Canopy cover at the site averages >50%.

Understory: Loafing sites have little in the understory besides large diameter (>12 in) dead-and-down woody debris. Turkeys frequently loaf in stands containing a fallen snag within the center.

Herbaceous Vegetation: Loafing sites have <20% herbaceous vegetation within the stand.

Juxtapositioning of Habitat Components: Loafing sites are almost universally located adjacent to feeding sites. Loafing sites themselves are stands of about 0.1-0.5 ac in size, interspersed within openings of 0.1-2 ac in size. Horizontal visibility distance to a standing human averages <110 ft. Within an undisturbed flock of turkeys during mid-day, birds may be observed loafing (preening, sleeping, or resting, all while perched upon a log), dusting, or feeding. Several of these activities may be going on simultaneously.

EVALUATION:

5. Stands identified as potential loafing habitat comprise what percent of the area being considered?

0-5%	6-10%	11-20%	21-50%
unacceptable	minimum	acceptable	optimum

6. What percent of stands identified as potential feeding habitat are <0.5 mi from water?

0-20%	21-50%	51-90%	91-100%
unacceptable	minimum	acceptable	optimum

Roosting Habitat (Fig. 18)

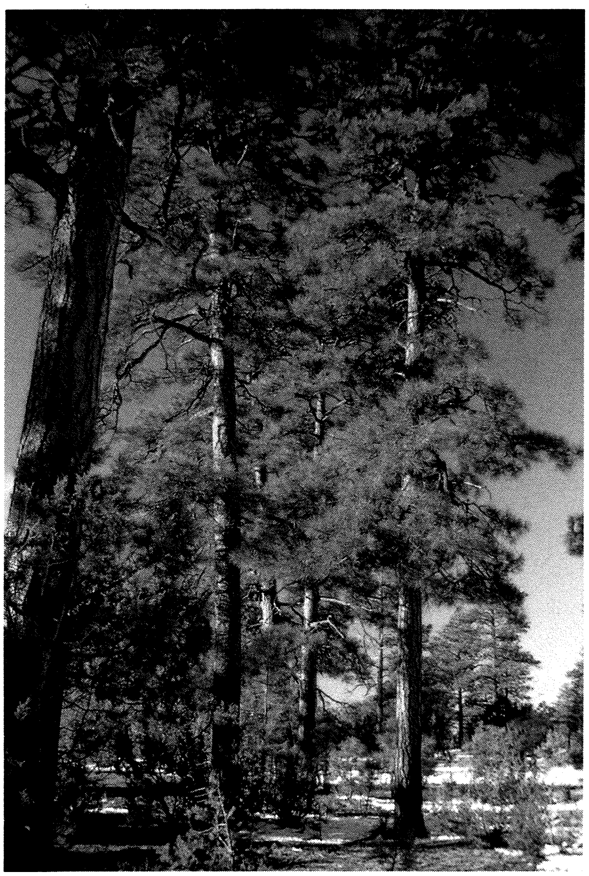

Figure 18a. An example of a summer roost on the Chevelon study area.

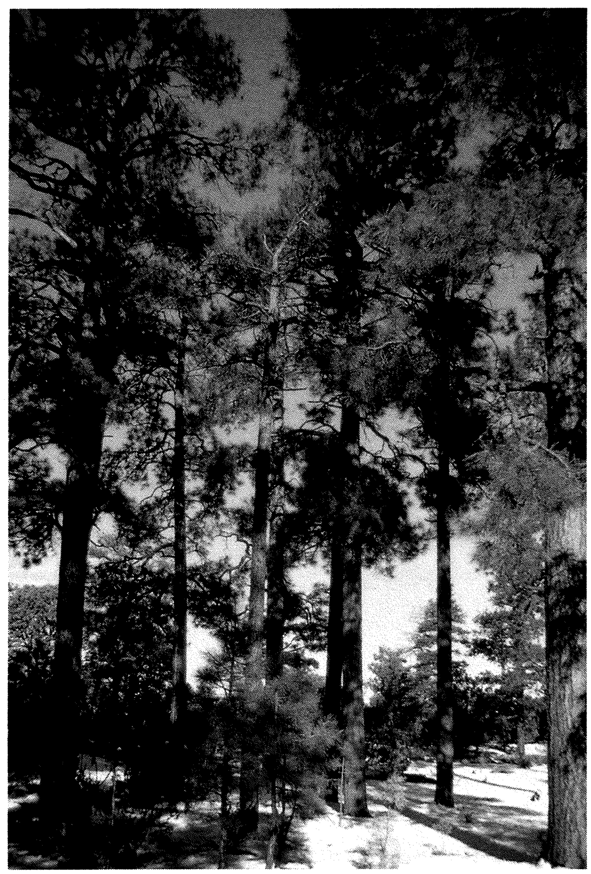

Figure 18b. An example of a year-long roost on the Chevelon study area.

Topography: Turkeys frequently select roost sites on slopes >30%, as long as those stands meet other overstory and juxtaposition needs. However, in the absence of suitable stands on steep slopes, suitable stands on level ground may be used for roosting. Eastern or northeastern slopes are favored in some habitats. Similarly, in the absence of suitable stands on easterly aspects, suitable stands on any aspect may be used. Roost sites are typically located on the upper third of slopes, canyonwalls, draws, or open ridges. The clump of trees used for roosting generally extends onto the ridgetop.

Overstory: Roost sites are mature or overmature stands of predominantly ponderosa pine, encompassing 0.1-0.6 ac in summer and 0.25-5 ac in winter. Summer roost sites number 3-23 useable trees within a site, while winter roost sites may number as many as 80 trees. The minimum DBH on trees used for roosting is 16 in and averages >20 in. BA on roost sites averages 90 ft^2/ac and generally exceeds 110 ft /ac. Roost sites average >50% canopy cover. Large mature or overmature ponderosa pines with relatively open crowns and horizontal branches are favored as roost trees. Occasionally limber pine, white fir, or Douglas-fir trees are also used for perching. The lowest branches in most roost trees are >12 ft above ground and most are twice that high.

Understory: Limited conifer regeneration is common in roosting site understory. The understory below and above the immediate roost clump is characteristically sparse, a feature that may facilitate turkey flight into and out of roosting sites.

Herbaceous Vegetation: Roosting sites have little herbaceous vegetation within the stand. As with loafing sites, high BA and canopy cover decrease the quantity of herbaceous vegetation within the stand.

Juxtapositioning of Habitat Components: Roost site location is important to its suitability. Roost site densities of 2/mi^2 have been recommended and seems consistent with observed turkey habitat use. A good flight path, comprised of either an opening or sparse understory, is common above and below most roosting sites. Horizontal visibility distance to a standing human averaged <150 ft at roost sites. Roost sites are generally <0.75 mi from water. During winter, turkeys concentrate daily activities <1 mi from roost sites. During this time period, winter food sources (e.g., juniper, oak) may influence roost site selection; roost sites are rarely >1 mi from food sources.

EVALUATION:

Known roost sites should be identified and protected during management activities. However, if roost sites must be identified without knowledge of turkey habitat use within the area, potential roost sites should be protected that meet the above description. Stands of intermediate size classes (12-16 in DBH) can be managed as potential roost sites at a density of ≥2/mi^2.

7. What is the density of known or potential roost sites within the habitat you are evaluating?

Not acceptable	Minimum	Adequate	Optimum
<2	2	3	4+

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Abstract: Vegetative and topographic components of habitat believed to be important to Merriam's turkey (*Meleagris gallopavo merriami*) were identified through a literature review and expert opinion survey. Between 1986 and 1989, these components were measured in a habitat selection study on the Chevelon study area in northcentral Arizona. Measurements of habitat components were made at use sites and at random plots; measurement differences were used to infer selection for or against specific habitat conditions. Turkey behavior at each use site was categorized as nesting, feeding, loafing, or roosting. Nesting turkeys selected steep slopes, typically in canyons, that had more shrubs and greater overhead and horizontal cover than random plots. Feeding turkeys sought out forest openings averaging 0.25 ac in size created mainly by logging; feeding hens with poults selected sites with higher herbaceous cover and species richness than were found in random plots. Feeding sites were typically surrounded by structurally diverse areas that provided adequate escape cover. For loafing, turkeys selected dense pole stands that contained higher volumes of large downed timber than did random plots. Turkeys roosted in high-basal-area stands of large ponderosa pine (*Pinus ponderosa*) trees, often in association with a drainage. Results were used to develop a preliminary model for identifying Merriam's turkey habitat suitability. Management implications of this research are discussed.

Key Words: Arizona, brood, habitat selection, habitat use, loaf, *Meleagris gallopavo merriami*, Merriam's turkey, nest, roost.

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