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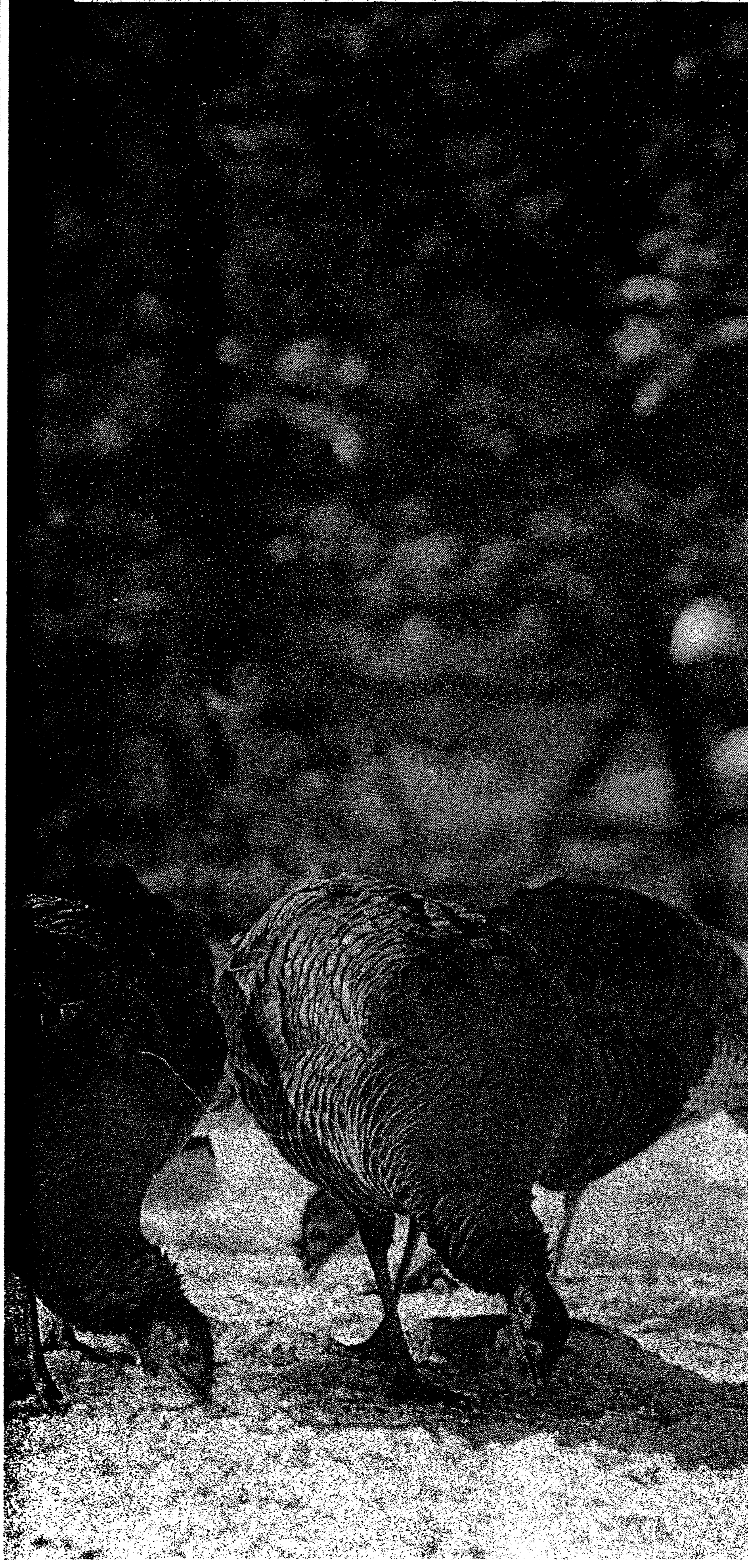

RESEARCH BRANCH
TECHNICAL REPORT #16

WINTER HABITAT RELATIONSHIPS OF MERRIAM'S TURKEYS ALONG THE MOGOLLON RIM, ARIZONA

A Final Report

BRIAN F. WAKELING
TIMOTHY D. ROGERS
June 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 16

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Suggested Citation:

Wakeling, B. F., and T. D. Rogers. 1995. Winter habitat relationships of Merriam's turkeys along the Mogollon Rim, Arizona. Ariz. Game and Fish Dep. Tech. Rep. 16, Phoenix. 41pp.

ISSN 1052-7621
ISBN 0-917563-22-0

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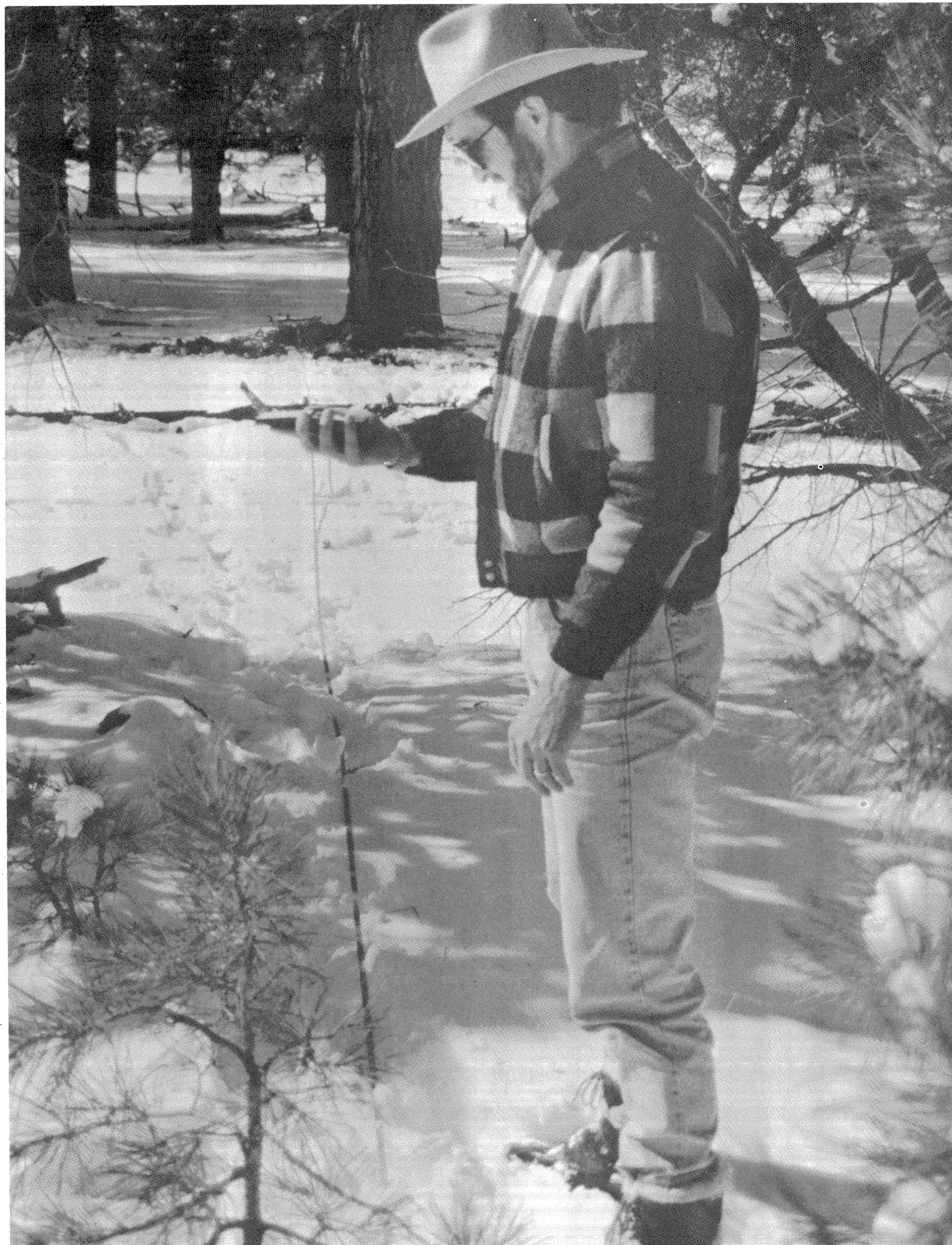


ACKNOWLEDGEMENTS

This project was part of an ongoing study of Merriam's turkeys in Arizona by the Research Branch of the Arizona Game and Fish Department. Its design was reviewed by a steering committee that evaluated the relevancy and scope of our proposed research. We are grateful to Ron Engel-Wilson, Heather Green, Dennis D. Haywood, Larry Holland, Cheryl M. Mollohan, David R. Patton, and Fred Phillips for that review. Harley G. Shaw, although retired from the Arizona Game and Fish Department, continued to lend perspective and critical review to theoretical considerations, experimental design, and pertinent notions. Richard A. Ockenfels and Steven S. Rosenstock provided statistical advice and counsel. Brian S. Cade provided a beta version of the BLOSSOM software that we used to conduct the multiresponse permutation procedure. Vanessa Dickinson provided advice on the selection of blood chemistry parameters. The strengths of our research can be credited to the influences of these people.

Jeffry S. Elliott, Charles H. Lewis, Joe Sacco, Kathy Sergent, and Cara A. Staab assisted with field data collection, laboratory analysis, and capture and telemetry efforts. Scott G. Woods and Jen Wennerlund conducted the GIS analysis. William K. Carrel provided aerial telemetry assistance. Bruce B. Davitt conducted microhistological dietary analysis at the Washington State University Range and Wildlife Habitat Lab. Blood chemistry analyses were conducted by the Animal Diagnostic Laboratory, Inc., in Tucson, Arizona. Carlos Reggiardo conducted additional blood analyses at the University of Arizona Veterinary Diagnostic Laboratory. William H. Miller provided laboratory scales, ovens, and associated equipment for the determination of vegetation biomass at the Arizona State University School of Agribusiness and Environmental Resources. John MacIvor and the staff of the Chevelon Ranger District, Apache-Sitgreaves National Forests, allowed us the use of their ATVs during winters when snow accumulations and road closures impeded data collection. The National Wild Turkey Federation provided rocket nets to capture turkeys. Earlier drafts of this manuscript were reviewed by James C. deVos, Jr., Heather Green, Dennis D. Haywood, Tom Komberec, Mark A. Rumble, Ray Schweinsburg, and Harley G. Shaw. Their review greatly improved the final manuscript; errors that remain are the sole responsibility of the authors. We would also like to thank Vicki L. Webb for typesetting and layout.

This publication is a result of studies undertaken with financial support provided by the Federal Aid in Wildlife Restoration Act Project W-78-R of the Arizona Game and Fish Department. The Act is popularly known as the Pittman-Robertson Act after its Congressional sponsors. The Act provides for a manufacturers' tax on sporting arms, pistols, ammunition, and certain items of archery equipment. The collected tax monies are apportioned to the states and territories on a formula basis by the U. S. Fish and Wildlife Service for the conservation and management of wild birds and mammals. Thus, sport hunters, target shooters, and archers contribute to a program that benefits everyone. First edition publication costs of this report were paid by Pittman-Robertson funds.

Winter Habitat Relationships of Merriam's Turkeys Along the Mogollon Rim, Arizona

Brian F. Wakeling and Timothy D. Rogers

Abstract: Land management practices, such as timber harvesting and fuel-wood cutting, are increasing on winter ranges of Merriam's turkey (*Meleagris gallopavo merriami*), and winter habitat requirements of this subspecies are poorly understood. We studied habitat selection by Merriam's turkeys during the winters of 1990-91 through 1993-94 on the Chevelon study area in northcentral Arizona. Turkeys rarely loafed during winter. Turkeys used roost sites that had overhead canopy present more frequently, larger diameter ponderosa pine (*Pinus ponderosa*) trees, and steeper slopes than random plots. The average roost site had 52.1% canopy completeness, a 9.4 in (23.9 cm) mean diameter of ponderosa pine trees, and a slope of 20.3%. Feeding sites were selected with overhead canopy present more frequently, greater Gambel oak (*Quercus gambelii*) basal area, and fewer pinyon pine (*Pinus edulis*) seedlings than random plots. The average feeding site had 38.9% canopy completeness, 14.3 ft^2/ac (3.2 m^2/ha) Gambel oak basal area, and 11.0 pinyon pine trees/ac (27.2 trees/ha). Feeding sites also had greater biomass proportions of mast than were found on random plots during late winter, whereas composition of food items at feeding sites was similar to random plot food composition during early winter. Turkeys selected Gambel oak acorns and alligator juniper (*Juniperus deppeana*) berries more than other mast items during both early and late winter. Forbs and insects were selected in winter diets as well, whereas grass was selected against. Management strategies that provide $\geq$2 clumps of >30 mature ponderosa pine (clumps should occupy approximately 0.5-1 ac [0.23-0.45 ha]) per mi^2 (2.6 km^2) with basal area >90 ft^2/ac (20.2 m^2/ha) will provide adequate roosting habitat. Known traditional roosts should be protected. Roosts should be <1 mi (1.6 km) from suitable feeding habitat. Management strategies that result in mature Gambel oak and alligator juniper stands with basal area >85 ft^2/ac (19.0 m^2/ha) will provide suitable winter feeding habitat.

Key words: Arizona, blood chemistry, dietary selection, food habits, habitat selection, habitat use, *Meleagris gallopavo merriami*, Merriam's turkey, roost, winter.

INTRODUCTION

Habitat quantity and quality can substantially influence turkey population size and trend. In many states, habitat is considered to be the greatest factor limiting turkey population growth (Natl. Wild Turkey Fed. 1986). Food availability was the habitat component suspected to limit turkey populations in some Arizona winter habitats (Hargrave 1940). Timber removal, fuel-wood harvesting, fire prevention, and grazing have altered Merriam's turkey winter range, and the corresponding effects on turkey populations are poorly understood.

Winter is a critical period for turkey populations. Mortality rates are often greatest during winter (Austin and DeGraff 1975, Wunz and Hayden 1975, Porter et al. 1980, Wakeling 1991). Merriam's turkeys in Arizona may be adversely impacted during winter because of snow accumulations or limited availability of food resources (Hargrave 1940, Reeves and Swank 1955, Wakeling 1991). Unusually severe winters may cause long term population declines (Shaw 1986).

Forest structural characteristics influence turkey habitat suitability (Rumble and Anderson 1992, Wakeling and Shaw 1994, Mollohan et al. 1995, Wakeling and Rogers 1995*a*). Timber harvesting, fuel-wood cutting, and fire prevention have altered forest stand characteristics on turkey winter range by changing species composition, quantity of woody debris, and tree densities. These alterations may have affected the suitability of turkey winter range.

Our objective in this study was to identify habitat components that Merriam's turkeys select on winter range. We posed a hierarchical approach to habitat selection, similar to that of Johnson (1980), who defined selection level by order. First order selection corresponded to the selection of the physical or geographical range of the species of interest. In other words, where this species can be found. Second order selection determined the home range of an individual or social group. Third order selection pertained to the usage made of various habitat components within the home range. Fourth order selection involved the actual procurement of some habitat component at a use site, such as food items from those available at a feeding site.

We first examined selection of habitat characteristics at third order resolution. For our purposes, this comparison included characteristics of sites used by turkeys and random plots. We then evaluated dietary selection at third order resolution (food items at feeding sites vs. random plots), and then at fourth order (diets vs. food items at feeding sites) to identify feeding habitat relationships in Merriam's turkey winter range. We also examined the blood chemistry of Merriam's turkeys we captured to determine if any relevant nutritional deficiencies could be detected. Succinctly, our objectives were to:

- Identify selected habitat characteristics;
- Identify selected foods; and
- Identify baseline blood values for turkeys on the Chevelon study area.

Forested ecosystem data are conventionally recorded in English units. In order to provide commensurate information, all data in our study were recorded and reported in English units. Metric conversions are presented parenthetically within the text.

STUDY AREA

The 335 mi² (860 km²) Chevelon study area (CSA) was located on the Mogollon Rim, approximately 40 mi (65 km) south of Winslow, Arizona, on the Apache-Sitgreaves National Forests (Fig. 1). Elevations ranged from 5,500 ft (1,700 m) in the northern portion to 7,900 ft (2,430 m) in the southern portion. Annual precipitation averaged 18.6 in (47.2 cm), with a bimodal distribution. The first precipitation peak occurred during winter storms in January through March, and the second as summer storms in July through early September (Natl. Oceanic and Atmos. Admin. 1991).

Six vegetative cover types were identified on the CSA based on U.S. Forest Service terrestrial ecosystem surveys (Laing et al. 1989): 1) mixed-conifer; 2) ponderosa pine-Gambel oak; 3) ponderosa pine-pinyon-juniper; 4) pinyon-juniper; 5) aspen (*Populus tremuloides*); and 6) forest-

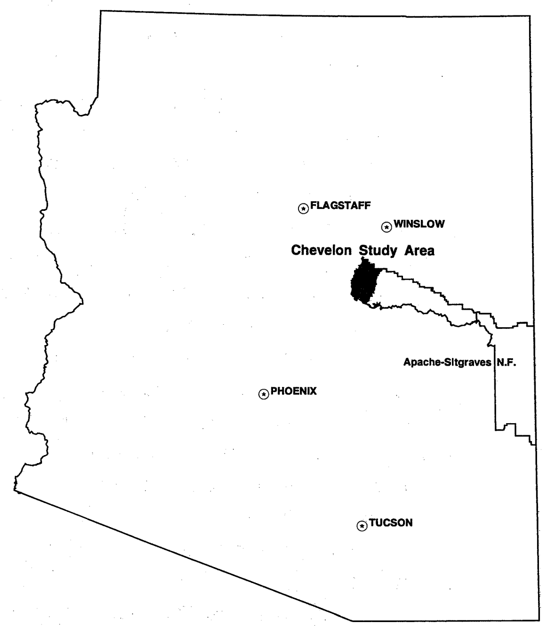


Figure 1. Location of the Chevelon study area in northcentral Arizona.

meadow cover types (Fig. 2). Mixed-conifer cover types were predominant at elevations above 7,600 ft (2,340 m) and extended downward along east-facing slopes and drainages. This habitat included Douglas-fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), limber pine (*Pinus flexilis*), and Rocky Mountain maple (*Acer glabrum*). Ponderosa pine dominated west-facing slopes between 7,600 (2,340) and 6,000 ft (1,850 m). Below 6,000 ft (1,850 m), the pinyon-juniper cover type was dominant, with ponderosa pine stringers within drainages. At elevations below 7,000 ft (2,150 m), pinyon pine and alligator juniper increased. Gambel oak occurred as a widespread co-dominant with ponderosa pine and in pockets with the mixed-conifer and pinyon-juniper cover types. Both aspen and forest meadows were common in more mesic draws at higher elevations.

Logging and livestock grazing were the major commercial land uses on the CSA. Fuel-wood cutting, particularly in the pinyon-juniper cover type, 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

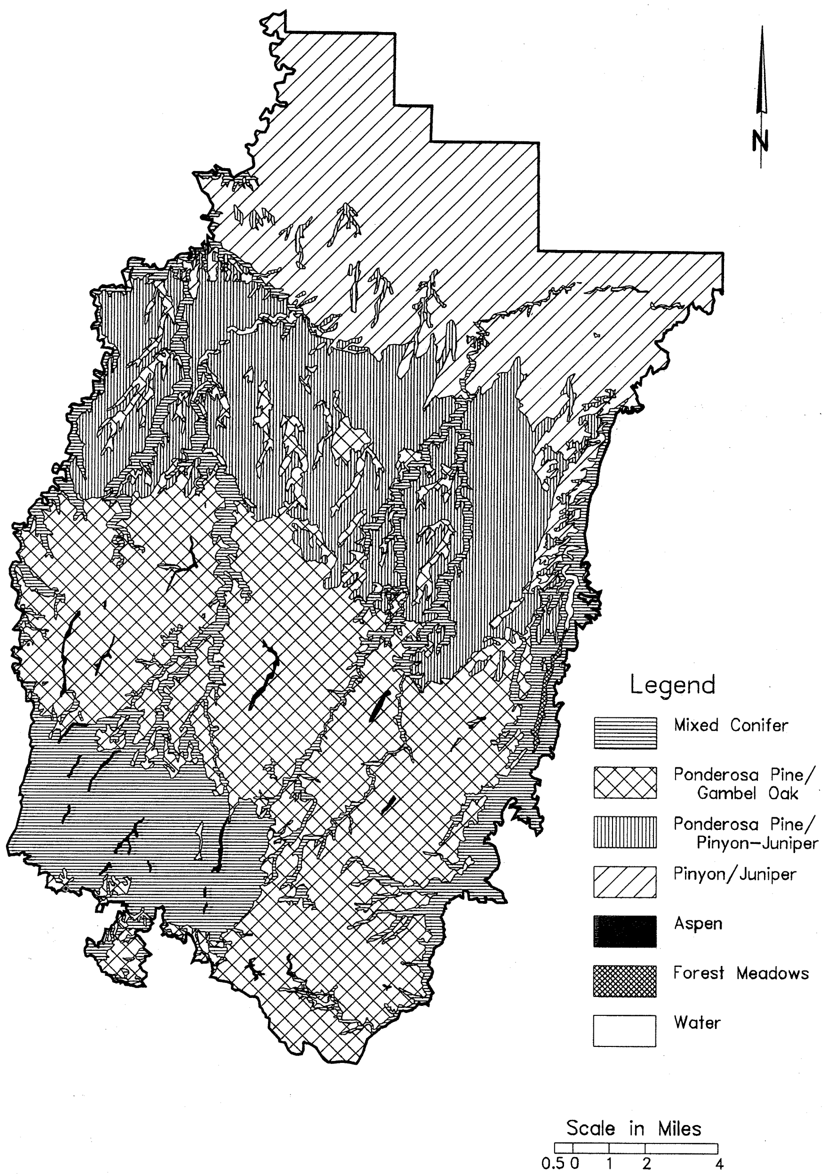


Figure 2. Vegetative cover types on the Chevelon study area, based upon terrestrial ecosystem surveys (Laing et al. 1989).

once. However, little logging has occurred on steeper slopes in larger canyons. Until the 1960s, sheep were the primary livestock on the CSA, but summering cattle have predominated since the 1960s. Livestock numbers declined since the 1960s, while the resident elk herd increased.

Recreation use varied by season. Recreational visits, defined as any visit to the CSA by anyone for any reason (including hunting, fishing, camping, and fuel-wood cutting), averaged 463,000 annual visits during the summer. During this season, activity centered around lakes on the CSA and the major roads leading to those bodies of water. Fall recreational users, mostly hunters, averaged 70,000 annual visits, which were more dispersed than summer visits and proportionally used a greater number of roads. Winter use, primarily fuel-wood cutting and snowmobiling, averaged 13,000 annual visits. The CSA had an average of 11.2 mi (17.9 km) of open road per section (O. C. Martin, U.S. For. Serv., pers. commun.).

METHODS

Capture and Telemetry

We captured turkeys between January 1 and March 31, 1988-92, with drop nets or rocket nets (Glazener et al. 1964, Bailey et al. 1980) located at sites baited with whole oats. Each turkey was fitted with a backpack-mounted radio-telemetry unit weighing 0.2 lbs (100 g; Telonics model LB 400, Mesa, AZ) that was secured with 0.2-in (5-mm) diameter bungee harness.

Because we conducted trapping and capture efforts concurrently with winter habitat data collection, bait placement may have influenced turkey habitat and diet selection. To minimize this bias, we bisected the CSA with a north-south boundary closely corresponding with West Chevelon Canyon. On half of the CSA, we established bait sites, trapped, and instrumented turkeys. On the alternate half, we monitored habitat use and dietary selection of previously marked birds. Activities were alternated each year between sides of the CSA.

Blood Chemistry

During 1992, we collected blood (0.24-0.34 fl oz [7-10 ml]) by jugular venipuncture using a 1-in (2.5-cm) 20 gauge needle (Fig. 3). We determined packed cell volume (PCV) in the field by averaging 2 capillary tube values obtained from this blood sample. The remaining sample was placed in a green top vacutainer that contained the anticoagulant lithium heparin. The vacutainer was mixed for 5 min and then centrifuged for 5 min. We pipetted off the serum and transferred it to cryogenic vials. The serum samples were frozen and transported on dry ice to the laboratory within 24 hrs of sampling. At the laboratory, blood chemistry was determined using a 550 Express Analyzer (Ciba-Corning, Oberlin, OH). Serum was analyzed for 8 blood variables;

Figure 3. Blood being drawn by jugular venipuncture on a captured Merriam's turkey from the Chevelon study area.

glucose, calcium, inorganic phosphorus, total protein, albumin, sodium, potassium, and uric acid. In addition, vitamins A and E were analyzed by high pressure chromatography (Model 110A, Beckman, Fullerton, CA), selenium by gas chromatography (Model 5880, Hewlet Packard, Avondale, PA), and copper by atomic absorption (Model Video 12, Instrumentation Laboratory, Waltham, MD).

Selection of Activity Areas

We obtained 260 locations from radio-instrumented turkeys between November 15 and April 15, 1990-91 through 1993-94. We located turkeys approximately twice daily, although no individual turkey or flock was relocated more than once daily to reduce data autocorrelation.

Each location was mapped on 7.5' U.S. Geological Survey (USGS) topographic maps and Universal Transverse Mercator (UTM) coordinates were recorded. Roost locations from radio-instrumented turkeys were mapped and UTM coordinates recorded. A Geographical Information System (GIS) was used to plot roosts and delineate buffers of 0.5, 1.0, 1.5, and 2.0 mi (0.8, 1.6, 2.4, and 3.2 km) surrounding each roost. GIS was used to calculate the number of locations and the amount of area exclusive to that buffer. In other words, only the area ≤0.5 mi (≤0.8 km) from roosts was classified as buffer 1, only the area >0.5 and ≤1.0 mi (>0.8 and ≤1.6 km) from roosts was classified as buffer 2, only the area >1.0 and ≤1.5 mi (>1.6 and ≤2.4 km) from roosts was classified as buffer 3, and only the area >1.5 and ≤2.0 mi (>2.4 and ≤3.2 km) from roosts was classified as buffer 4. Locations >2.0 mi (>3.2 km) from roosts were excluded from this analysis. We assumed the number of locations within each buffer would represent the proportion of time turkeys spent within that area. We calculated the expected number of turkey locations within each buffer proportionate to the amount of area within each buffer.

Habitat Selection

We collected habitat use data from radio-instrumented turkeys between November 15 and April 15, 1990-91 through 1993-94. The locations we used to evaluate activity areas were used to assess habitat selection. In this assessment, we also used feeding sign (i.e., scratchings and droppings) to identify additional feeding sites. The use site center was defined as the geographic midpoint of the flock when first observed or of feeding sign. As with radio locations, all additional sites were mapped on 7.5' USGS topographic maps, and UTM coordinates were recorded. At all sites, behavior was classified as feeding, loafing, or roosting.

We initially evaluated each site based upon characteristics of the forest stand that contained it. We measured habitat characteristics ≤2 days after radio-located sites were abandoned. All sites located from sign were measured ≤2 days following discovery. We classified vegetative cover types at the sites according to Larson and Moir (1986). We assigned an R03WILD category (Byford et al. 1984) to the stand containing the site based upon the dominant size class of ponderosa pine as follows: 1) grass-forb (no trees); 2) trees <5 in (<12.7 cm); 3) trees 5-11.9 in (12.7-30.2 cm); 4) trees 12-16 in (30.3-40.6 cm); and 5) trees >16 in (>40.6 cm) diameter at breast height (DBH). Landform was classified as minor canyon (<200 ft [62 m] wide), major canyon (≥200 ft [62 m] wide), ridgetop (<300 ft [92 m] wide), or wide ridgetop (≥300 ft [92 m] wide). The understory (vegetation ≤10 ft [3.1 m] tall) and overstory (vegetation >10 ft [3.1 m] tall) was classified as clumped or uniformly distributed. We classified the canopy structure as single storied, 2-storied, multiple storied, or multiple patchy stories.

We used the site center as plot center in the measurement of habitat characteristics. We classified the plot center as having overhead canopy cover present or absent directly overhead, and then estimated the height to first canopy if present. A 0.1-ac (0.04-ha) circular plot was used to estimate conifer and Gambel oak stem densities by counting seedlings (<1 in [2.5 cm] DBH) and trees (≥1 in [≥2.5 cm] DBH). We measured the slope of the 0.1-ac (0.04-ha) plot using a clinometer.

We measured the DBH of all ponderosa pine and Gambel oak trees on the 0.1-ac (0.04-ha) plot with a diameter tape. The diameter at root crown (DRC) was measured with a diameter tape on all juniper and pinyon pine trees. Mean DBH, DRC, and density data on each plot were used to calculate basal area (BA) by tree species according to the formula:

$$BA = \Sigma((DBH/2)^2 \times 3.14) \times 10.$$

Canopy coverage of forbs, grasses, shrubs, deciduous trees, conifer trees, rocks, and snow was estimated along 4 25-ft (7.7-m) line-intercept transects (Canfield 1941) for all sites except roosts. The first transect was oriented randomly, radiating from site center. The 3 remaining transects were each oriented 90° from the preceding transect. We estimated canopy coverage in 3 height categories: 1) 0-17.9 (0-45.9); 2) 18-35.9 (46-91.9); and 3) 36-72 in (92-184 cm). We estimated overhead crown completeness (Vales and Bunnel 1988) with a spherical densiometer (Strickler 1959) at 4 points, 37.2 ft (11.4 m) from the plot center, along the same bearing as the line-intercept transects. We averaged these 4 values to calculate a mean crown completeness for each site.

We evaluated horizontal sight distances (HSD) using 3 measures of visibility. First, we used a commercial turkey silhouette placed at site center to determine a turkey HSD value. The distance from the plot center, in 4 directions, each parallel to the line-intercept transects, to the point where the silhouette was entirely obscured was paced. Second, we obtained a person HSD value along these same bearings by pacing to the point where a standing person was obscured from a kneeling observer at plot center. An average HSD value was calculated for both measures at each site. Finally, we ocularly estimated the distance to the nearest cover that would completely obscure a turkey.

We ocularly estimated the distance to the nearest canopy opening from each site center. We defined canopy opening as any horizontal gap in the overstory canopy that was greater than 100 ft^2 (9 m^2). We also ocularly estimated the dimensions and calculated the area of the canopy opening.

At roost sites, we counted the number of trees in the roost clump. We also enumerated those ≥16 in (40.6 cm) DBH. Species of tree used for roosting was recorded. We measured DBH of all roost trees used at the site.

We recorded measurements on the same habitat parameters, except those specific to roosts, at 103 random plots. Random plots were located based upon computer-generated UTM coordinates plotted on 7.5' USGS maps, within the elevational range of habitats known to be occupied by turkeys during winter. We located each of these points on the ground and then paced a random distance (<300 ft [92 m]) on a random bearing to facilitate random plot center placement. This procedure was used to minimize biases associated with initial random point location in the field. Random plots were measured throughout winter.

Dietary Selection

During the winters of 1990-91 through 1992-93, we measured food availability and female turkey diet. Male turkey diet analysis was included during the winters of 1991-92 through 1992-93. We collected all potential food items within 3 3.8-ft^2 (0.35-m^2) circular plots; the first located at site center, and the remaining plots were located 20 ft (6.2 m) from site center directly opposite each other along the initial line-intercept transect. Samples were placed in paper bags and dried at 122 F (50 C) for 48 hrs in a forced-air oven. Food items were then identified and weighed on laboratory scales. Percent composition of food items at feeding sites was determined by dividing the biomass of an individual item by the sum of the biomasses of all items included in the analysis. Samples were also collected at random plots and processed similarly.

Fecal samples were collected at feeding sites and partitioned by gender into early (November 15 through January 31) or late winter (February 1 through April 15) categories. Gender was determined by flock composition and confirmed by physical characteristics of fecal material. Early and late winter were separated because snowfall records on the CSA during our study demonstrated that snow accumulations were frequently >5 in (12.7 cm) at 7,000 ft (2,150 m) elevation, which was the effective upper limit of turkey winter range on the CSA, prior to February 1. Snow depth and prevalence diminished after that date.

Plant reference material and fecal samples were processed according to Davitt and Nelson (1980). Several important modifications were employed in their procedure when compared with other chemical epidermal preparations (Sparks and Malechek 1968, Hansen et al. 1971, Holechek 1982, Holechek et al. 1982). The fecal material was gently agitated with water at low speed in a blender for several minutes, rather than grinding in a Wiley mill through a 1-mm mesh screen, because the latter technique might affect the discernibility of some fragments (Vavra and Holechek 1980, Samuel and Howard 1983). The fecal material was washed in cool water over a 200-mesh screen (75-micron openings), and stored in 95% ethanol for ≥24 hrs to remove pigments. Ethanol was decanted, and the residue bleached for 5 to 10 min. The residue was then rewashed using the 200-mesh screen and placed in a lactophenol blue staining solution for $\geq$24 hrs. Excess stain was washed off using cool water, and the epidermal and cuticle fragments were transferred to a slide, covered with glycerin gel, and sealed with a cover slip.

Botanical composition of the diets was determined using a modification of existing relative frequency-density conversion sampling procedures (Sparks and Malechek 1968, Holechek and Vavra 1981, Johnson 1982) and frequency addition sampling procedures (Holechek and Gross 1982). A minimum of 25 randomly-located fields on each of 8 slides (200 total views) with identifiable epidermal cell fragments were sampled; each slide was evaluated as a replicate. A 10 $\times$ 10 square grid (100 total, each 100 micron $\times$ 100 micron in size) mounted in the ocular of the microscope was used to measure the area covered by each positively identified fragment (100 $\times$ magnification). Each discernible fragment was recorded by species, but unidentifiable fragments were recorded by forage class.

Percent diet composition was calculated by dividing the percent cover of each plant species by the total cover of all species comprising >1% of the diet. Because mast comprised >70% of the overall diet, we did not correct for differential digestibility (Rumble and Anderson 1993*a*).

Statistical Analyses

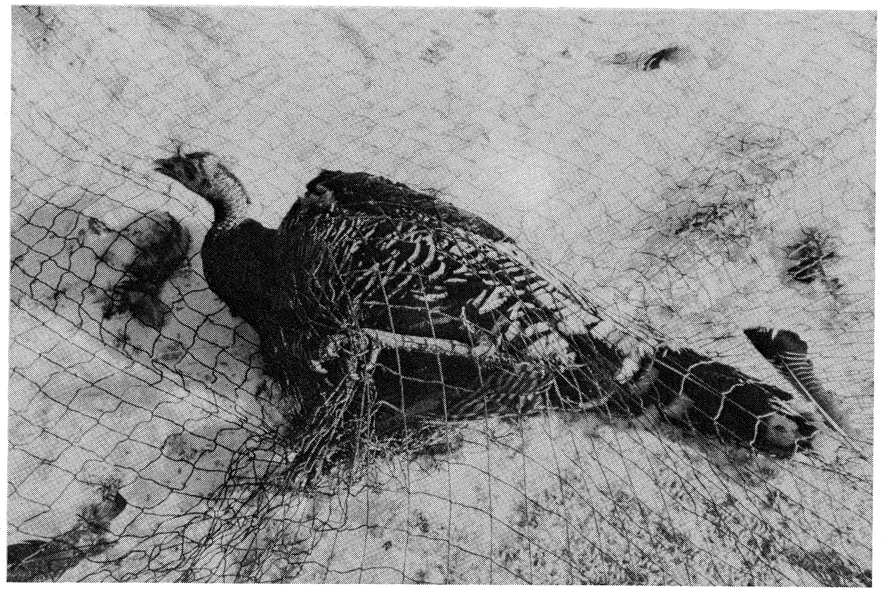
We tested 3 hypotheses concerning the use of habitats by Merriam's turkeys on the CSA. The first hypothesis was that all habitats received equal use regardless of the distance from identified roost sites. Second, characteristics of use sites, including biomass composition of food, did not differ between sites selected by turkeys (third order selection) and random plots. Finally, turkey diet composition (fourth order selection) did not differ from the biomass composition of food at feeding sites.

Specific to our first hypothesis, selection of activity areas was analyzed using the Chi-square goodness-of-fit test (Zar 1984) to determine if the expected frequency of locations differed from the observed. Individual buffer differences were determined using Bonferroni confidence intervals (Neu et al. 1974, Byers et al. 1984) and Jacobs' *D* selectivity index (Jacobs 1974).

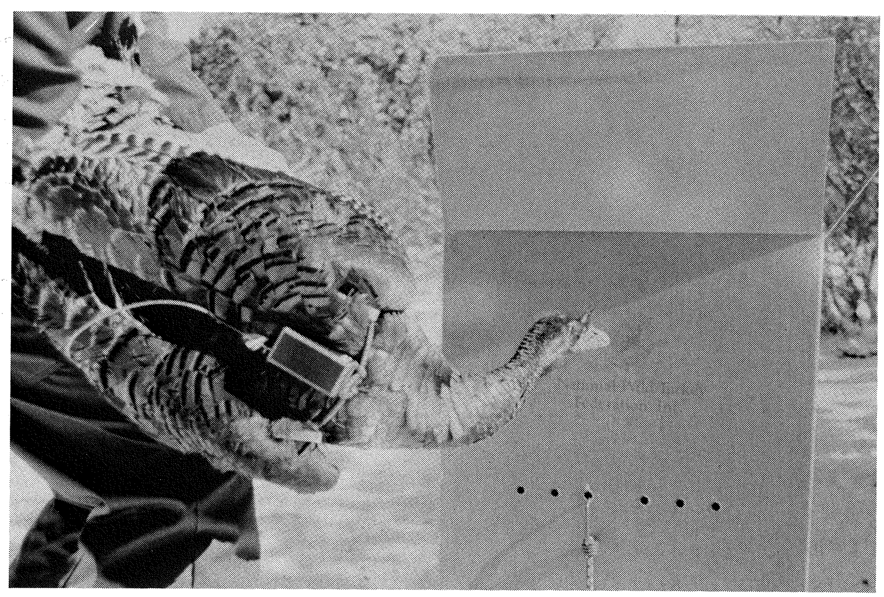
The evaluation of our second hypothesis was more complex. Habitat use data were compared with random plots. We evaluated habitat selection using a distribution-free multiresponse permutation procedure (MRPP) (Mielke 1984) for continuous data. Non-continuous data were tested using Chi-square contingency table analysis (Zar 1984) because availability was estimated from random plots and goodness-of-fit tests were inappropriate (Thomas and Taylor 1990). Categorical differences were determined using Bonferroni confidence intervals and Jacobs' *D* selectivity index. We then used forward stepwise logistic regression to evaluate which parameters best predicted habitat use (Harrell 1980) by behavior. In this multivariate analysis, we included only variables that differed from random for each behavior in the univariate analyses previously described. Variables were excluded from the logistic equation if correlated with other variables in the equation ($r \geq 0.4$); the variable that explained the least variation was excluded. The logistic cutpoint, the probability value above which a site is predicted as used, was selected as 0.5.

Dietary analyses addressed both our second and third hypotheses. We pooled dietary samples across all years because small sample sizes precluded analysis of annual relationships. We evaluated only those items that comprised >1% of the diet. We chose 1% because rare species tend to be highly variable and may yield spurious results (Uresk 1990). Differences in composition of food items between feeding sites and random plots were deemed to correspond with third order habitat selection. Differences between dietary composition and feeding site composition were then considered representative of fourth order habitat selection.

Dietary selection was evaluated using the Kruskal-Wallis nonparametric analysis of variance (Zar 1984) to determine if differences existed among diet, feeding site, and random plot composition. A median separation procedure (Miller 1966:166) was used to detect individual class differences. Jacobs' *D* selectivity index was applied to median compositional values to determine degree of selection and avoidance of individual dietary items in both third and fourth order comparisons.



Merriam's turkey hen captured with rocket net.



Merriam's turkey hen with radio-telemetry unit attached just prior to release.

RESULTS

Capture and Telemetry

Seventy Merriam's turkeys were captured and radio instrumented (Table 1). We located 7 loafing sites, 20 roosts, and 234 feeding sites. We used 103 random plots for comparison. Because only 7 loafing sites were obtained from radio-instrumented turkeys, we were unable to statistically analyze selection for these sites. Because only 20 roosts were located, we used a random subset of 40 random plots for comparison with availability. Preliminary analyses indicated insufficient data had been collected to evaluate annual variation. Consequently, all data were pooled across years.

Most radio locations were obtained during mid-day due to our differential sampling effort (Table 2). We located 28.0% of our habitat use sites by locating sign or observing non-instrumented turkeys (Table 3). We located 8 turkeys >15 times, providing 54.2% of our use sites. The remainder of our locations were obtained from a variety of single and multiple relocations on turkeys (Table 3).

Table 1. Age and sex of Merriam's turkeys monitored during the winters of 1990-94 on the Chevelon study area by year of capture.

	Male		Female		
Year	Sub-adult	Adult	Sub-adult	Adult	Total
1988	2	0	4	3	9
1989	0	0	0	1	1
1990	0	1	4	18	23
1991	1	9	3	14	27
1992	6	2	0	2	10
Total	9	12	11	38	70

Table 2. Time classes in which turkeys were visually located on the Chevelon study area, 1990-1994.

Time Class	Percent of Observations
≤1000 hrs	19.9
1001-1400 hrs	42.6
>1400 hrs	37.5

Blood Chemistry

We collected blood from 10 turkeys (6 subadult males, 4 adult females). Little difference was apparent between age-gender classes of turkeys (Table 4). Serum levels of copper were deficient (Table 5). Turkeys sampled on the CSA would require a 5-fold increase in serum copper concentrations in order to meet the range of values recommended for domestic turkeys. By the same comparison, selenium levels were marginal (Table 5). If serum selenium levels in turkeys sampled on the CSA were doubled, their values would be within the range found in domestic birds. Serum levels of calcium, inorganic phosphorous, and potassium were also marginal when compared with domestic turkeys.

Selection of Activity Areas

Turkeys selected habitats <0.5 mi (0.8 km) (X^2 = 386.769, 3 df, P < 0.001) from roosts for most daily activities (Table 6). Areas between 0.5 and 1.0 mi (0.8 and 1.6 km) from roosts were used consistent with availability. Habitats >1.0 mi (1.6 km) from roosts were used less than available for daily activities (Table 6). The density of roosts within the selected buffer <0.5 mi (0.8 km) from roosts was 1.7 roosts per mi^2 (0.8 per km^2). The density of roosts within the buffers selected and used as available (i.e., all areas <1.0 mi [1.6 km] from roosts) was 0.6 roosts per mi^2 (0.3 per km^2). Concentric buffers around roosts encompassed 11.5, 34.9, 59.0, and 84.2 mi^2 (29.4, 89.1, 150.8, and 215.2 km^2), respectively (Fig. 4).

Habitat Selection

Feeding Sites. Turkeys selected (X^2 = 10.645, 1 df, P = 0.001) clumped understories for feeding (Table 7). They also selected (X^2 = 13.212, 3 df, P = 0.004) sites on east-facing slopes, while avoiding those facing north (Table 8). No selection by feeding turkeys could be detected for overstory distribution (X^2 = 0.060, 1 df, P = 0.801) or canopy structure (X^2 = 0.736, 3 df, P = 0.865). Turkeys did not select any individual landform for feeding activities (X^2 = 0.312, 3 df, P =

Table 3. Frequency of individual turkey relocation on the Chevelon study area, 1990-1994.

Number of Relocations	Number of Turkeys in Category[a]	Percent of Locations	Number of Locations
1-2	14	3.6	13
3-5	5	5.5	20
5-10	4	8.6	31
11-15	3	11.6	42
16-20	7	35.7	129
21-25	1	6.9	25
Relocation Frequency Unknown[b]	-	28.0	101

[a] Remaining 36 turkeys were either radio-located with other turkeys or died before they could be radio-located.
[b] Visual location of non-instrumented turkeys or location determined by sign.

Table 4. Summary of blood chemistry values for subadult males and adult females captured on the Chevelon study area, 1992.

	Subadult Males			Adult Females		
Blood Chemistry Values	$\bar{x}$	SE	*n*	$\bar{x}$	SE	*n*
PCV (%)	31.6	6.9	6	35.2	3.8	4
Glucose (mg/dl)	380.3	16.3	6	409.0	40.2	4
Calcium (mg/dl)	9.4	0.2	6	9.8	0.6	4
Inorganic Phosphorus (mg/dl)	2.9	0.3	6	2.7	0.3	4
Total Protein (g/dl)	3.2	0.2	6	3.6	0.3	4
Albumin (g/dl)	1.8	0.1	6	1.9	0.1	4
Sodium (mEq/l)	142.8	2.4	6	144.3	2.8	4
Potassium (mEq/l)	3.5	0.2	6	3.8	0.3	4
Uric Acid (mg/dl)	7.0	1.0	6	5.9	0.7	4
Vitamin A (ug/ml)	0.91	0.13	2	0.88	0.13	2
Vitamin E (ug/ml)	5.7	0.5	2	3.9	0.2	2
Copper (ppm)	0.04	0.03	2	0.04	0.03	2
Selenium (ppm)	0.06	0.01	2	0.06	--	1

Table 5. Mean blood chemistry values for free-ranging Merriam's turkeys sampled on the Chevelon study area and acceptable ranges from domestic turkey (Puls 1988).

Blood Chemistry Value	Merriam's Turkey $\bar{x}$	Domestic Turkey Range
PCV (%)	33.0	27-36
Glucose (mg/dl)	391.8	40-180
Calcium (mg/dl)	9.6	10-15
Inorganic Phosphorous (mg/dl)	2.8	4.1-10
Albumin (g/dl)	1.8	1.4-2.0
Sodium (mEq/l)	143.4	131-142
Potassium (mEq/l)	3.6	5-6.5
Copper (ppm)	0.04	0.18-0.28
Selenium (ppm)	0.06	0.085-0.15

Table 6. Selection of concentric 0.5, 1.0, 1.5, and 2.0 mi buffers surrounding roosts during winter by Merriam's turkey on the Chevelon study area, 1990-1994.

Buffer	Area (mi^2)	Locations	Observed Proportion	Expected Proportion	Bonferroni Confidence Interval[a]	Selection[b]	Jacobs' *D*
0.5	11.5	118	0.469	0.131	0.387-0.551	+	0.708
1.0	26.9	86	0.343	0.307	0.265-0.421	=	0.082
1.5	24.1	32	0.126	0.275	0.071-0.181	-	-0.449
2.0	25.2	15	0.062	0.287	0.022-0.102	-	-0.718

[a] Overall X^2 = 386.769, 3 df, $P < 0.001$.
[b] + denotes selection, - denotes avoidance, and = denotes use consistent with availability.

0.958). Turkeys did not select any vegetation structural stage within the R03WILD habitat capability model when feeding (X^2 = 1.533, 4 df, P = 0.821).

Site composition of ponderosa pine and Gambel oak was greater within feeding sites, whereas pinyon pine comprised greater composition in random plots (Appendix 1). Feeding sites had greater densities of Gambel oak trees ($P < 0.001$) than random plots. The mean DBH of both Gambel oak ($P < 0.001$) and ponderosa pine ($P = 0.027$) was also greater in feeding sites, as were their respective BAs ($P < 0.001$, $P = 0.007$). Pinyon pine were lower in density ($P = 0.009$), mean DRC ($P < 0.001$), and BA ($P = 0.008$) in feeding sites than random plots; total BA was greater ($P < 0.001$) in feeding sites (Appendix 1).

Feeding sites differed from random plots in composition of canopy cover. Feeding sites were lower in forb ($P < 0.001$) and grass ($P < 0.001$) cover than random plots (Appendix 2). Feeding sites also contained less downed woody debris between 18-35.9 in (46-91.9 cm) tall than random plots. Shrub cover <18 in (45.9 cm) tall (P = 0.003) and shrub (P = 0.004) and rock cover (P = 0.033) between 36-72 in (92-184 cm) was less on feeding sites than random plots. Feeding sites had less snow ($P < 0.001$) than random plots. Deciduous trees <18 in (45.9 cm) tall ($P < 0.001$) and between 36-72 in (92-184 cm) tall ($P < 0.001$) comprised greater cover in feeding sites than random plots. Conifer trees between 36-72 in (92-184 cm) tall also provided greater ($P = 0.010$) cover on feeding sites. Feeding sites had lower ($P < 0.001$) total cover <18 in (45.9 cm) tall and

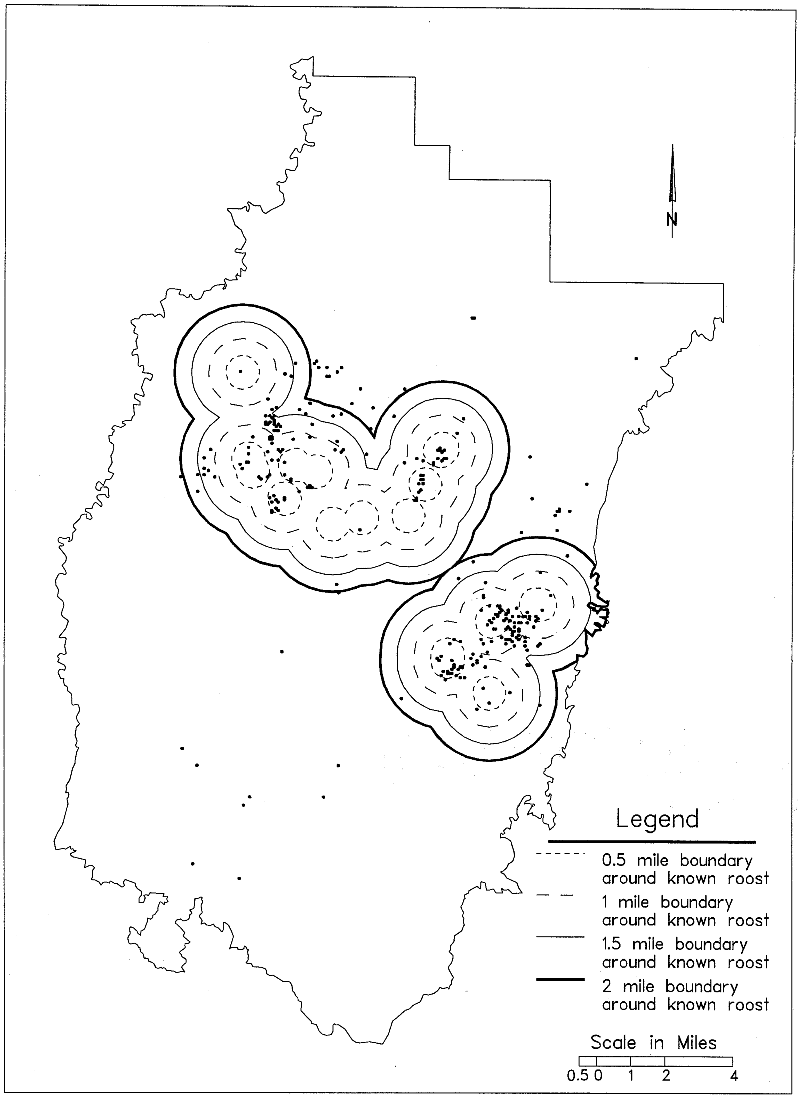


Figure 4. Concentric buffers of 0.5, 1.0, 1.5, and 2.0 miles around known winter roosts with all turkey radio-locations on the Chevelon study area during winter, 1990-1994.

Table 7. Selection of understory characteristics at feeding sites during winter by Merriam's turkeys on the Chevelon study area, 1990-1994.

Understory Distribution	Use *n*	Observed Proportion	Available Proportion	Available *n*	Bonferroni Confidence Interval[a]	Selection[b]	Jacobs' *D*
Even	31	0.128	0.272	28	0.080-0.176	-	-0.436
Clumped	212	0.872	0.728	75	0.824-0.920	+	0.436

[a] Overall X^2 = 10.645, df = 1, P = 0.001.

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

Table 8. Selection of aspect at feeding sites during winter by Merriam's turkeys on the Chevelon study area, 1990-1994.

Characteristic	Use *n*	Observed Proportion	Available Proportion	Available *n*	Bonferroni Confidence Interval[a]	Selection[b]	Jacobs' *D*
North	48	0.205	0.381	39	0.139-0.271	-	-0.410
South	30	0.128	0.144	15	0.073-0.183	=	
East	99	0.423	0.268	28	0.342-0.504	+	0.334
West	57	0.244	0.206	20	0.174-0.314	=	

[a] Overall $X^2 = 13.212$, 3 df, $P = 0.004$.
[b] + denotes selection, - denotes avoidance, and = denotes use consistent with

greater ($P = 0.002$) cover between 36-72 in (92-184 cm) (Appendix 2).

Height to first canopy in feeding sites was lower ($P < 0.001$) than in random plots (Appendix 3). Distance to the nearest opening was greater ($P < 0.001$) at feeding sites than at random plots (Appendix 3).

We found a logistic relationship describing feeding site habitat selection that had an overall classification rate of 85.6% (Table 9). Canopy presence, greater Gambel oak BA, and fewer pinyon pine seedlings were factors influencing feeding site selection. Random plots were classified correctly 67.0% and feeding sites 94.3%.

Roost Sites. All trees used for roosting were ponderosa pine, although 3 were ponderosa pine snags. The mean number of trees in a winter roost site was 36.6 (SE = 22.9). Most of these trees ($\bar{x} = 32.7$, SE = 21.9) were >16 in (40.6 cm) DBH. The mean DBH of trees in which turkeys perched was 24.9 in (63.2 cm). Roost sites were typically clumps of large, mature or overmature trees amongst other age classes of trees.

Roost sites were selected ($X^2 = 6.00$, 1 df, $P = 0.014$) in stands with clumped overstories (Table 10). Turkeys selected ($X^2 = 6.126$, 2 df, $P = 0.047$) patchy multiple canopied stands, while avoiding single storied canopies (Table 11). Turkeys also selected ($X^2 = 20.199$, 1 df, $P < 0.001$) canyons for winter roosts, while avoiding ridgetops (Table 12). Roost sites were selected ($X^2 = 30.305$, 1 df, $P < 0.001$) within the vegetation structural stage representing largest diameter trees within the R03WILD habitat capability model, while all others were avoided (Table 13). Turkeys selected roost sites without regard to understory distribution ($X^2 = 2.406$, 1 df, $P = 0.121$) or aspect ($X^2 = 0.684$, 3 df, $P = 0.877$).

Table 9. Logistic regression models describing Merriam's turkey winter habitat selection on the Chevelon study area, 1990-94.

Model	*n*		X^2	*P*	Logistic Regression Models	Predictions (% correct)	
	Use	Random				Use	Random
Roost	20	40	42.02	<0.001	$\hat{Y} = 21.290 + 9.803$CNPY[a] + 0.742XPPDBH[b] + 0.386SLOPE[c]	93.8	96.3
Feeding	234	78	170.99	<0.001	$\hat{Y} = -0.279 + 1.438$CNPY + 0.117GOBA[d] - 0.035PYS[e]	95.2	66.0

[a] Presence of canopy; absent = 0, present = 1.
[b] Mean ponderosa pine DBH on 0.1-ac plot.
[c] Mean slope (%).
[d] Gambel oak basal area.
[e] Pinyon pine seedling density.

Table 10. Selection of overstory characteristics at roost sites during winter by Merriam's turkeys on the Chevelon study area, 1990-1994.

Overstory Characteristic	Use *n*	Observed Proportion	Available Proportion	Available *n*	Bonferroni Confidence Interval[a]	Selection[b]	Jacobs' *D*
Even	0	0.000	0.250	26	0.000-0.000	-	-1.000
Clumped	20	1.000	0.750	77	1.000-1.000	+	1.000

a Overall X^2 = 6.000, 1 df, P = 0.014.
b + denotes selection, - denotes avoidance, and = denotes use consistent with availability.

Table 11. Selection of canopy structure at roost sites during winter by Merriam's turkeys on the Chevelon study area, 1990-1994.

Canopy Structure	Use *n*	Observed Proportion	Available Proportion	Available *n*	Bonferroni Confidence Interval[a]	Selection[b]	Jacobs' *D*
Single Storied	0	0.000	0.239	27	0.000-0.000	-	-1.000
Two Story	9	0.450	0.469	53	0.172-0.728	=	
Multi-Storied	3	0.150	0.221	25	-0.050-0.350	=	
Multi-Patchy	8	0.400	0.071	8	0.126-0.674	+	0.783

a Overall X^2 = 6.126, 2 df, P = 0.047.
b + denotes selection, - denotes avoidance, and = denotes use consistent with availability.

Table 12. Selection of landform at roost sites during winter by Merriam's turkeys on the Chevelon study area, 1990-1994.

Landform	Use *n*	Observed Proportion	Available Proportion	Available *n*	Bonferroni Confidence Interval[a]	Selection[b]	Jacobs' *D*
All Canyons	18	0.900	0.282	29	0.750-1.050	+	0.916
All Ridgetops	2	0.100	0.718	74	-0.050-0.250	-	-0.916

a Overall X^2 = 20.199, 1 df, $P < 0.001$.
b + denotes selection, - denotes avoidance, and = denotes use consistent with availability.

Table 13. Selection of R03WILD categories at roost sites during winter by Merriam's turkeys on the Chevelon study area, 1990-1994.

Category	Use *n*	Observed Proportion	Available Proportion	Available *n*	Bonferroni Confidence Interval[a]	Selection[b]	Jacobs' *D*
1-4 (≤16 in)	1	0.050	0.824	85	-0.059-0.159	-	-0.978
5 (>16 in)	19	0.950	0.176	18	0.841-1.059	+	0.978

[a] Overall X^2 = 30.305, 1 df, $P < 0.001$.
[b] + denotes selection, - denotes avoidance, and = denotes use consistent with availability.

Roost sites were dominated by ponderosa pine. Roost sites had lower densities of juniper (P = 0.018) and pinyon pine trees (P = 0.022) than random plots on the winter range (Appendix 1). Mean DBH (P = 0.012) and BA (P = 0.001) of ponderosa pine was greater at roost sites than random plots, whereas mean DRC (P = 0.024) and BA (P = 0.028) of pinyon pine was greater on random plots. Roost sites had a lower (P = 0.036) density of conifer seedlings than random plots. Total BA at roost sites was greater (P = 0.014) than at random plots (Appendix 1).

Physical characteristics of roost sites differed from random plots. Roosts were located on steeper ($P < 0.001$) slopes than random plots occurred on (Appendix 3). Roosts also had greater (P = 0.002) canopy completeness than random plots. The height to first canopy was greater (P = 0.003) at roost sites, as was the distance ($P < 0.001$) to the nearest opening (Appendix 3).

The logistic relationship we found to describe roost habitat yielded an overall classification rate of 95.4% (Table 9). Factors that identified winter roost sites in the equation were the presence of overhead canopy, larger diameter ponderosa pine, and greater slope. Using these factors, 96.3% of all randoms and 93.8% of all roosts were correctly classified.

Dietary Selection

We analyzed 24 and 19 female, and 13 and 21 male, composite fecal samples from early and late winter time period feeding sites, respectively (Appendix 4). Because female and male feeding sites were selected based upon similar characteristics (Wakeling and Rogers 1995*b*), feeding sites were pooled across sexes for our comparison with dietary composition. Diets were compared with 40 early winter feeding sites, 86 late winter feeding sites, 23 early winter random plots, and 54 late winter random plots.

Third Order Selection. The location of female feeding sites became more specific as winter progressed. Female turkeys selected against grass (Jacobs' D = -0.454) in the location of feeding sites during early winter (Table 14) despite its predominance at feeding sites and random plots. Predominance of grass at all sites decreased during late winter (Table 15). Female turkeys still selected against (Jacobs' D = -0.500) grass in late winter; however, other factors became influential in the selection for these sites. Late winter feeding sites were selected with greater proportions of acorns (Jacobs' D = 0.999), juniper berries (Jacobs' D = 0.999), ponderosa pine staminate cones (Jacobs' D = 0.631), and ponderosa pine seeds (Jacobs' D = 0.540).

Male turkeys also became more selective of feeding sites as winter progressed. During early winter, male turkeys avoided (Jacobs' D = -0.454) grass in feeding site selection (Table 16). During late winter, male turkeys selected feeding sites that provided greater percent composition of acorns (Jacobs' D = 0.999) and ponderosa pine staminate cones (Jacobs' D = 0.542), as well as insects (Jacobs' D = 0.778) (Table 17). Forbs (Jacobs' D = -0.999) and grasses (Jacobs' D = -0.499) were selected against in feeding site location during late winter.

Table 14. Composition, probabilities of differences, and degree of selection between female diets and measured availability during early winter (Nov 15 - Jan 31) across all years on the Chevelon study area.

Diet Item	K-W P^d	Percent Dietary Composition	Selection[e] Index	Percent Feeding Site Composition	Selection[f] Index	Percent Random Plot Composition
Pinyon Seeds	0.334	1.70[a]		0.00[a]		0.00[a]
Ponderosa Pine Seeds	0.028	1.27[a]	-0.538	4.11[b]		2.27[ab]
Ponderosa Pine Staminate Cones	0.002	0.00[a]	-0.999	13.75[b]		5.50[b]
Acorns	<0.001	6.04[a]	0.999	0.00[b]		0.00[b]
Juniper Berries	<0.001	58.55[a]	0.989	0.79[b]		0.00[b]
Grass	<0.001	8.19[a]	-0.788	42.98[b]	-0.454	66.72[c]
Forbs	<0.001	12.10[a]	0.984	0.04[b]		1.23[b]
Insects	0.456	0.40[a]		0.06[a]		0.03[a]

[abc] Diets with the same letter are not different based upon a median separation procedure (Miller 1966:166).
[d] Kruskal-Wallis ANOVA *P* value.
[e] Jacobs' *D* selection index (Jacobs 1974) between dietary items and feeding sites.
[f] Jacobs' *D* selection index (Jacobs 1974) between feeding sites and random plots.

Table 15. Composition, probabilities of differences, and degree of selection between female diets and measured availability during late winter (Feb 1 - Apr 15) across all years on the Chevelon study area.

Diet Item	K-W P^d	Percent Dietary Composition	Selection[e] Index	Percent Feeding Site Composition	Selection[f] Index	Percent Random Plot Composition
Pinyon Seeds	0.470	0.00[a]		0.00[a]		0.00[a]
Ponderosa Pine Seeds	<0.001	0.30[a]	-0.903	5.56[b]	0.540	1.73[c]
Ponderosa Pine Staminate Cones	<0.001	0.00[a]	-0.999	30.27[b]	0.631	8.93[c]
Acorns	<0.001	6.95[a]	0.385	3.21[b]	0.999	0.00[c]
Juniper Berries	<0.001	18.42[a]	0.989	0.13[b]	0.999	0.00[c]
Grass	<0.001	35.52[a]		39.16[a]	-0.500	65.86[b]
Forbs	<0.001	10.92[a]	0.999	0.00[b]	-0.999	1.10[c]
Insects	<0.001	2.46[a]	0.953	0.06[b]	0.500	0.02[c]

[abc] Diets with the same letter are not different based upon a median separation procedure (Miller 1966:166).
[d] Kruskal-Wallis ANOVA *P* value.
[e] Jacobs' *D* selection index (Jacobs 1974) between dietary items and feeding sites.
[f] Jacobs' *D* selection index (Jacobs 1974) between feeding sites and random plots.

Table 16. Composition, probabilities of differences, and degree of selection between male diets and measured availability during early winter (Nov 15 - Jan 31) across all years on the Chevelon study area.

Diet Item	K-W P[d]	Percent Dietary Composition	Selection[e] Index	Percent Feeding Site Composition	Selection[f] Index	Percent Random Plot Composition
Pinyon Seeds	0.119	41.95[a]		0.00[a]		0.00[a]
Ponderosa Pine Seeds	0.077	2.10[a]	-0.333	4.11[b]		2.27[ab]
Ponderosa Pine Staminate Cones	0.010	1.43[a]	-0.833	13.75[b]		5.50[b]
Acorns	0.074	1.43[a]		0.00[ab]		0.00[b]
Juniper Berries	0.062	27.40[a]	0.959	0.79[b]		0.00[b]
Grass	<0.001	5.80[a]	-0.849	42.98[b]	-0.454	66.72[c]
Forbs	0.372	0.81[a]		0.04[a]		1.22[a]
Insects	<0.001	0.00[a]	-0.999	0.06[b]		0.03[b]

[abc] Diets with the same letter are not different based upon a median separation procedure (Miller 1966:166).
[d] Kruskal-Wallis ANOVA P value.
[e] Jacobs' D selection index (Jacobs 1974) between dietary items and feeding sites.
[f] Jacobs' D selection index (Jacobs 1974) between feeding sites and random plots.

Table 17. Composition, probabilities of differences, and degree of selection between male diets and measured availability during late winter (Feb 1 - Apr 15) across all years on the Chevelon study area.

Diet Item	K-W P[d]	Percent Dietary Composition	Selection[e] Index	Percent Feeding Site Composition	Selection[f] Index	Percent Random Plot Composition
Pinyon Seeds	0.014	3.25[a]	0.999	0.00[b]		0.00[b]
Ponderosa Pine Seeds	0.039	4.63[a]	-0.229	7.18[b]		2.95[b]
Ponderosa Pine Staminate Cones	<0.001	0.00[a]	-0.999	33.21[b]	0.542	12.86[c]
Acorns	<0.001	8.21[a]	0.689	1.62[b]	0.999	0.00[c]
Juniper Berries	<0.001	33.87[a]	0.992	0.20[b]		0.00[b]
Grass	<0.001	24.26[a]	-0.327	38.69[b]	-0.499	65.36[c]
Forbs	<0.001	2.16[a]	0.999	0.00[b]	-0.999	1.07[a]
Insects	<0.001	9.32[a]	0.985	0.08[b]	0.778	0.01[c]

[abc] Diets with the same letter are not different based upon a median separation procedure (Miller 1966:166).
[d] Kruskal-Wallis ANOVA P value.
[e] Jacobs' D selection index (Jacobs 1974) between dietary items and feeding sites.
[f] Jacobs' D selection index (Jacobs 1974) between feeding sites and random plots.

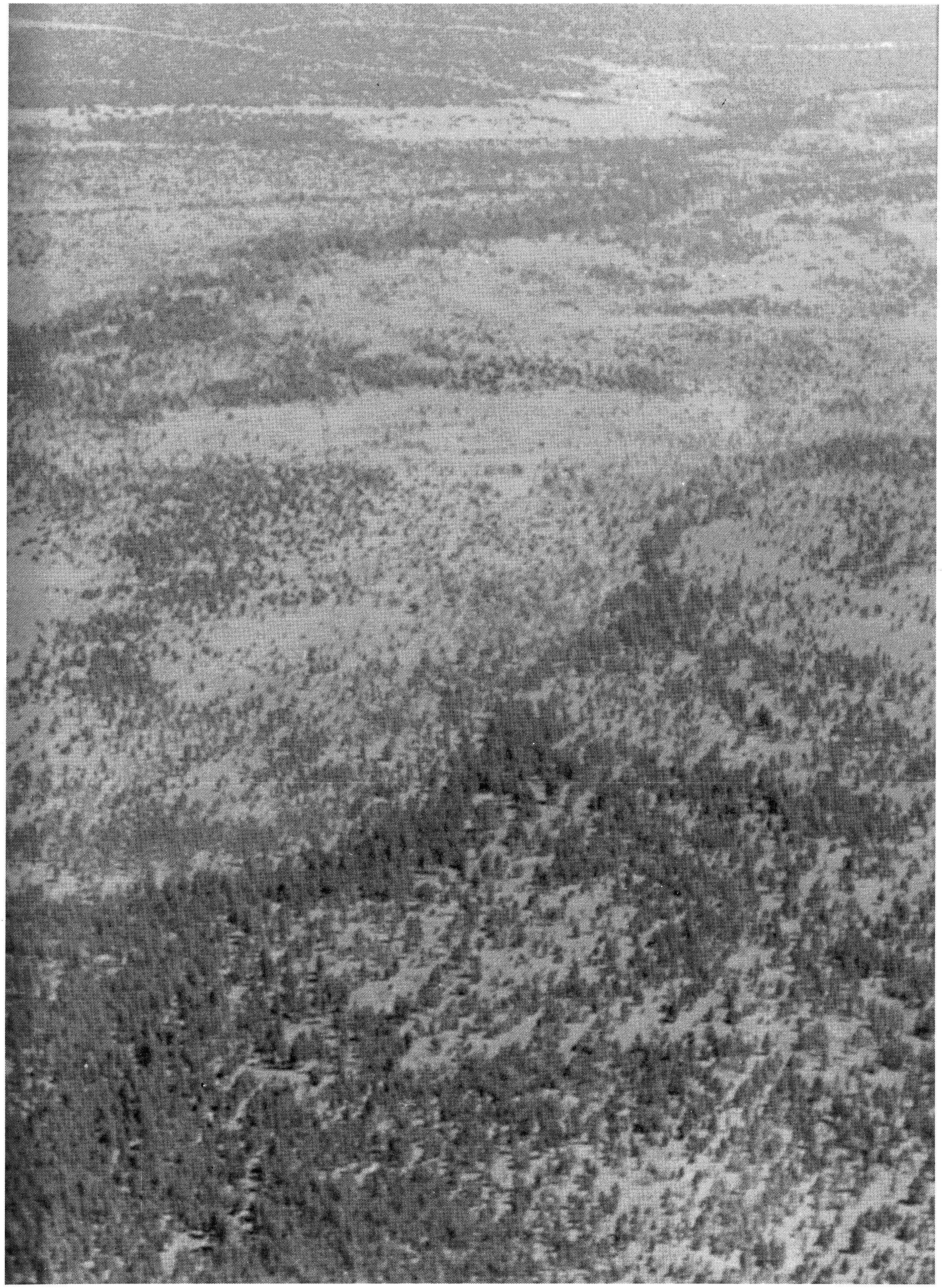
During both early and late winter, both gender class feeding sites had greater abundance of pinyon seed, ponderosa pine seed, Gambel oak acorn, and alligator juniper berry mast items than random plots (Table 18). Random plots had greater abundance of herbaceous material than feeding sites. Biomass data indicated that turkeys selected mast items and avoided herbaceous vegetation in the selection of feeding sites (Table 18).

Fourth Order Selection. In contrast to third order selection, fourth order selection remained relatively constant throughout winter in female turkey diets. Female turkeys actively selected for acorns (Jacobs' D = 0.999), juniper berries (Jacobs' D = 0.989), and forbs (Jacobs' D = 0.984) and selected against ponderosa pine staminate cones (Jacobs' D = -0.999), grass (Jacobs' D = -0.788), and ponderosa pine seeds (Jacobs' D = -0.538) (Table 14). During late winter, female turkeys consumed grass in similar proportion to its availability (Table 15). Forbs (Jacobs' D = 0.999), juniper berries (Jacobs' D = 0.989), insects (Jacobs' D = 0.953), and acorns (Jacobs' D = 0.385) were favored, while ponderosa pine staminate cones (Jacobs' D = -0.999) and seeds (Jacobs' D = -0.903) were selected against in the diet.

Male turkeys, like females, demonstrated little difference in dietary selection throughout winter. During early winter, male turkey diets contained a high, although statistically insignificant, proportion of pinyon pine seeds (Table 16). Male turkeys selected juniper berries (Jacobs' D = 0.959) while selecting against insects (Jacobs' D = -0.999), grass (Jacobs' D = -0.849), ponderosa pine staminate cones (Jacobs' D = -0.833), and ponderosa pine seeds (Jacobs' D = -0.333) in their diet (Table 16). Even though grass composition of feeding sites decreased and proportion in the diet increased during late winter, grass was still selected against (Jacobs' D = -0.327) by male turkeys (Table 17). Pinyon seeds (Jacobs' D = 0.999), forbs (Jacobs' D = 0.999), insects (Jacobs' D = 0.985), juniper berries (Jacobs' D = 0.992), and acorns (Jacobs' D = 0.689) were selected in the diet. Ponderosa pine staminate cones (Jacobs' D = -0.999), and ponderosa pine seeds (Jacobs' D = -0.229) were selected against (Table 17).

Table 18. Mean and SE of food biomass (lbs/ac) found on early winter (Nov 15 - Jan 31) and late winter (Feb 1 - Apr 15) feeding sites and random plots across all years on the Chevelon study area.

	Early Feeding Sites n = 86		Late Feeding Sites n = 40		Random Plots n = 77	
Item	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Pinyon Pine Seed	3.7	14.2	16.1	49.2	2.8	14.0
Ponderosa Pine Seed	29.3	29.8	36.9	49.1	11.3	12.8
Ponderosa Pine Catkin	331.4	540.8	217.1	271.0	120.4	280.1
Gambel Oak Acorn	295.8	624.2	106.3	290.8	8.4	33.4
Alligator Juniper Berry	76.5	292.8	200.1	472.1	51.4	280.3
Grasses	961.1	1460.8	957.7	1093.2	1702.3	1935.1
Forbs	16.0	48.5	28.3	59.8	190.5	1197.7
Insects	1.3	2.0	1.8	3.5	1.0	2.5



Ponderosa pine stringers can increase the effective winter turkey range, especially during severe winters.

DISCUSSION

Blood Chemistry

Published information concerning the blood chemistry of wild turkeys is scarce. Consequently, we found it difficult to contrast our results with those of other studies. In addition, we could not consider our data to be representative of any larger group of turkeys because our sample size was insufficient.

Furthermore, comparisons with standards developed for domestic turkeys may be irrelevant, because research on domestic poultry generally focuses on the levels required for maximum production, rather than minimal levels of nutrients required for survival. In addition, marginal or deficient levels for some factors in our study may be artifacts of the sampling or processing procedures, despite following recommended protocols (C. A. Reggiardo, University of Arizona Veterinary Diagnostic Laboratory, pers. commun.).

Both copper and selenium are considered trace elements, essential, but in small quantities. Copper is necessary for hemoglobin and melanin formation. Copper is also a major component in several blood proteins and enzyme systems (Robbins 1983). Deficiency is signified by a host of maladies, including diarrhea, nervous disorders, loss of feather color, reduced feather growth, bone deformities, and impaired reproduction (Robbins 1983). Selenium interacts with vitamin E to maintain tissue integrity. Selenium deficiency can cause muscle degeneration, liver necrosis, diarrhea, and reduced fertility (Robbins 1983). However, free-ranging animals with deficiencies in these nutrients may display no visible symptoms (Robbins 1983).

Calcium and phosphorus are macroelements largely associated with skeletal formation. Calcium is also associated with blood clotting, nerve and muscle excitation, egg shell formation, and muscle contraction. Phosphorus is involved in almost all animal metabolism (Robbins 1983). Deficiencies in either element may result in bone deformities, egg shell thinning, appetite problems, musculature or skeletal problems, and death (Robbins 1983).

Potassium functions within the cells in nerve and muscle excitability, carbohydrate metabolism, enzyme activation, tissue pH, and osmotic regulation. Deficiencies include muscle weakness, intestinal distension, cardiac and respiratory failure, retarded growth, and tubular kidney degeneration. The high potassium content of growing plants reduces the chances of potassium deficiencies prevailing in free-ranging wildlife (Robbins 1983).

Other than a lack of yearling nesting attempts (Wakeling 1991), no potentially diet-related problems have been detected with the turkey population on the CSA. We conducted no blood tests on subadult females, and we are unable to predict what blood chemistry values they would share with those age and gender classes we did sample. Vitamins A and E are linked to reproduction, as are calcium, phosphorous, and albumin. Deficiencies of any of these items in subadult females could lead to a lack of yearling nesting attempts. Yearling Merriam's hens in the Black Hills of South Dakota nest at rates similar to adults (Rumble and Hodorff 1993). Subadult hens that have greater mid-winter weights tend to nest as yearlings; artificial food sources may contribute to this greater mid-winter weight (R. W. Hoffman, Colo. Div. Wildl., pers. commun.). We are unable to speculate whether greater caloric content or some other nutritional factor influenced yearling nesting attempts by Merriam's turkey.

Selection of Activity Areas

Turkeys on the CSA concentrated daily activities around roost sites. Major changes to habitat surrounding roost sites may cause abandonment of the roost and surrounding habitat (Scott and Boeker 1977). Our research suggests that eliminating roosts from a habitat, if other suitable roost sites are not available, may greatly reduce the suitability of that habitat for turkeys because of their tendency to forage adjacent to roosting habitat. The importance of the relationship between roost sites and useable habitat has been demonstrated in Rio Grande turkeys (*M. g. intermedia*). In 1 instance, their range was expanded with the addition of suitable artificial roost structures (Kothmann and Litton 1975).

Habitat recommendations frequently use minimum densities of 2 roosts per mi^2 (0.9 per km^2) (Phillips 1982, Mollohan and Patton 1991, Hoffman et al. 1993). The density of roosts within the zone selected by turkeys on the CSA was very close to this minimum number. Because turkeys move less and are more dependent on fewer roost sites during winter than summer (Shaw and Mollohan 1992, Hoffman et al. 1993), 2 roost clumps per mi^2 (0.9 per km^2) may be a critical threshold during winter.

Habitat Selection

Loafing Sites. The lack of loafing site use by turkeys probably reflected little time spent in this activity during winter. Because loafing sites are used frequently during summer (Rumble 1990, Mollohan and Patton 1991), there are at least 4 explanations for infrequent winter loafing: 1) winter energetic demands are greater than summer, and more time must be spent feeding to meet energy demands; 2) food is more difficult to find during winter, and more time must be spent searching for food; 3) days are shorter during winter, and less time is available to feed; and 4) turkeys use loafing cover to avoid thermal loading during mid-day during summer, and this heat gain is not problematic during winter. In at least 1 Arizona population with access to winter barnyard food sources, turkeys have been observed loafing during mid-day in winter (J. Hinkle, Ariz. Game and Fish Dep., pers. commun.). Despite the indication that loafing may be related to caloric intake, the role of loafing within winter seasonal habitat is not well understood.

Feeding Sites. The lack of selection for any particular R03WILD vegetational structural stage during winter foraging was similar to the lack of selection during summer foraging (Mollohan et al. 1995). The vegetational structural stages have been modified since the onset of our studies by further subdividing the largest vegetational structural stage (Reynolds et al. 1992). These vegetational structural stages were assigned coefficients, based upon expert opinion, to reflect the importance of each stage to individual wildlife species. This method is used to evaluate impacts that habitat changes will likely have on wildlife species. Because Merriam's turkeys in the southwest have not been shown to select characteristics measured by these models, we recommend that they not be used to evaluate turkey feeding, loafing, or nesting habitat during any season. We have found no evidence to suggest these models can discriminate between suitable and non-suitable turkey habitat in the southwest for these behaviors.

Aspect selection on the CSA by feeding turkeys would allow the birds to take advantage of early morning through mid-day radiant heat. East-facing slopes receive the first sunlight of the day and warm first. The CSA is predominately north-facing by nature, and these slopes tend to remain snow covered longer than other aspects. Additionally, snow cover was avoided at feeding sites (Appendix 2). Because turkey winter diets are composed mostly of mast items, which must be obtained by scratching in forest duff, snow cover can obscure these items. The forest canopy also reduced snow accumulation and prevalence because of the shielding effect during gentle snowfalls. Feeding sites were generally located beneath forest canopies where mast items accumulated and less snow cover occurred.

The clumped distribution of the understory selected for winter feeding sites by turkeys is consistent with their habitat selection during other times of the year (Mollohan et al. 1995). Habitat selection on small-scale microhabitat patches seemed characteristic of the manner in which turkeys select summer feeding, loafing (Mollohan et al. 1995), and nesting habitat (Rumble and Hodorff 1993, Wakeling and Shaw 1994). Clumped understories seemed important in the juxtaposition and interspersion of suitable turkey habitat.

Tree species characteristics and composition at feeding sites were related to winter food habits. Greater cover provided by tall deciduous and conifer trees indicated the presence of mature mast producers. Although turkeys selected no forest stand characteristics indicating the importance of alligator juniper, this species was available throughout the CSA winter range. The selection for other mast producers was evident. Gambel oak and ponderosa pine trees produced mast consumed by Merriam's turkeys during winter on the CSA. Turkeys did not select ponderosa pine seeds in our study, but they have used this food item extensively in other studies (Reeves and Swank 1955, Rumble 1990). Ponderosa pine seeds may be important during years when large-seeded mast is unavailable.

Pinyon mast can be an important winter food source (Reeves 1953, Reeves and Swank 1955). However, pinyon-juniper habitats generally receive greatest use during winters with deep snow accumulations or poor food availability in adjacent habitats (Ligon 1946, Reeves 1954). Because winters during our study were relatively mild, pinyon-juniper habitats received limited use (Wakeling and Rogers 1995*a*). Consequently, pinyon pine tree mean DRC, density, and BA were lower on feeding sites than on random plots in our study.

Ground cover characteristics of winter feeding sites also reflected dietary selection. Less herbaceous vegetation was present in feeding sites than in random plots; dietary analysis identified a third order avoidance of these items. Deciduous trees (Gambel oak) provided greater cover, as did conifer trees, on feeding sites. Dietary analysis demonstrated a third order selection for acorns and conifer mast items. Because turkeys tended to feed beneath the canopy of mast producing species, the mean height to first canopy was less in feeding sites than random plots. Similarly, because mast items were available beneath trees, less time was spent within openings and mean distance to opening was greater for feeding sites than random plots. Canopy completeness was similar between feeding sites on CSA winter and summer range (Mollohan et al. 1995). Winter feeding habitat in South Dakota had greater canopy closure than corresponding summer range (Rumble and Anderson 1993*b*). This South Dakota habitat provided superior mast availability than did other habitats (Rumble 1990).

Factors identified in the logistic regression model as best predicting winter feeding habitat included 2 factors whose biological importance was readily apparent. Overhead canopy cover and greater Gambel oak basal area were affiliated with favored mast-producing species. The avoidance of pinyon pine seedlings was probably a reflection of a habitat type avoidance. Pinyon pine habitats may be used during more severe winters then those experienced during our study.

When evaluated by gender, selection of feeding habitat by female and male turkeys was similar, but not identical (Wakeling and Rogers 1995*b*). Canopy presence, greater Gambel oak BA, and lower pinyon pine seedling densities were identified as important variables in logistic regression models of feeding habitat use by gender. In addition, the coefficients for each of those characteristics, as well as the constant, were similar. Both models also included an avoidance of tall cover (rocks for females, shrubs for males). Further, visual evaluation of mapped locations of female and male feeding sites did not demonstrate distributional differences in habitat use. The use of winter feeding habitat between sexes differed little.

Turkeys probably selected Gambel oak with greater BA because of its mast producing properties. Although mean Gambel oak DBH in feeding sites on the CSA appeared immature (5.6 in [14.2 cm]), these stands frequently contained 1 or more mature trees, as well as multiple smaller stems that reduced the average DBH. Because acorns fall beneath tree canopies, the area beneath mature Gambel oak tree canopies would be a high probability search area for mast. Feeding beneath canopies may have provided cover from predators as well.

Roost Sites. Roosting turkeys on the CSA consistently selected stands classified in the R03WILD habitat capability model category with the largest trees. Similar results were found with roosts used by turkeys on summer range (Mollohan et al. 1995). If this model is applied to forest stands (i.e., ecological boundaries), it appears to discriminate between unsuitable and potentially suitable roost habitat. Because roosts are generally small clumps (0.1-2.0 ac [0.04-0.9 ha]) (Hoffman et al. 1993, Mollohan et al. 1995), classification of stands for evaluation must be on the same scale. Larger scale applications from stand exam data may be diluted by the presence of greater numbers of small trees, thus making potential roost stands impossible to detect and identify.

Characteristics of winter roost sites selected in our study differed little from those identified in previous southwestern research. Although winter roosts in New Mexico were selected on east-facing aspects (Schemnitz et al. 1985), we found no aspect selection by roosting turkeys on the CSA. Because roost sites were typically clumps of large, mature or overmature trees amongst other age classes, overstories and canopies were clumped and uneven-aged. The height to first canopy was greater at roost sites than at random plots because of the mature nature of the trees within the roost clump.

Stand characteristics of roost sites were dominated by ponderosa pine; pinyon and juniper trees rarely occurred in roost sites. Turkeys roosted mostly within live ponderosa pine trees during our study, but occasionally used a ponderosa pine snag. Ponderosa pine has been the most frequently selected roost tree throughout much of Merriam's turkey range (Hoffman 1968, Phillips 1980, Mollohan and Patton 1991, Rumble 1992), although Douglas-fir and white fir have been selected in some areas (Mackey 1982, Schemnitz et al. 1985). White fir and Douglas-fir, although common on the CSA, were rare on the winter range. No other suitable roost tree species occurred on the winter range.

Steep slopes are also common to roost site selection throughout much of Merriam's turkey range (Hoffman 1968, Phillips 1982, Mackey 1984, Mollohan and Patton 1991, Rumble 1992). Roosts in our study were also selected on slopes steeper than slopes on random plots. Slope steepness and the association with roost placement in canyons may facilitate flight paths for turkeys in and out of roost trees. Although strong fliers for short distances, slopes probably help birds attain perches in roost trees with less effort.

Roosts in our study were best predicted by the presence of overhead canopy, steep slopes, and larger diameter ponderosa pine trees. These characteristics were typical of the dominant stands of mature ponderosa pine used for winter roosting on the CSA.

Dietary Selection

Turkeys did not select all food items consistently across orders of resolution. Pine staminate cones, for example, were selected when feeding sites were compared with random plots, yet were avoided when the diet was compared with feeding sites. This can be explained because staminate cones were abundant at sites where acorns, juniper berries, or ponderosa pine seed were also abundant. Staminate cones, however, were not favored food and were ingested rarely, possibly accidentally, by feeding turkeys. Conversely, forbs were more abundant at random plots than feeding sites, but were selected in diets. We believe that, although forbs appear to be favored in winter diets, turkeys did not select feeding sites based upon forb abundance. Mast is the food of primary importance to turkeys during winter.

Third order selection for dietary items changed as winter progressed. During early winter, turkeys exhibited little third order habitat selection between feeding site and random plot composition of food items, with the exception of the avoidance of grass. During this season, food may have been abundant, and site selection may have been less critical. However, during late winter, distinct selection for feeding sites was apparent. Sites that yielded more mast and less herbaceous vegetation were actively selected. We speculate that as winter progressed, mast became less abundant throughout the CSA, and turkeys became more selective for sites that provided more mast. During late winter, sites were selected that provided more acorns, juniper berries, ponderosa and pinyon pine seed, and ponderosa pine staminate cones. Herbaceous vegetation was still avoided at this level of resolution.

On the CSA, winter feeding sites typically occurred in areas where ponderosa pine, Gambel oak, alligator juniper, pinyon pine, and Utah juniper (*Juniperus osteosperma*) could be found in proximity. Generally, lower elevations and drier climes on southern slopes were dominated by pinyon pine, Utah juniper, and some ponderosa pine. Higher elevations contained stands of ponderosa pine, Gambel oak, and alligator juniper. Intergrades also existed and were largely a function of aspect, substrate, and moisture regimes. With minimal snow cover (<2-3 in [5-6 cm]) and duration, turkeys favored areas with an abundance of Gambel oak, alligator juniper, and ponderosa pine. Increased snow depth and duration sometimes forced birds to move to lower elevations where pinyon pine and Utah juniper dominated. Even then, habitats occupied by turkeys generally contained ponderosa pine, Gambel oak, and alligator juniper as well, suggesting a reliance on these species.

Fourth order selection for food items by both genders remained similar across winter time periods. Mast items and forbs were consistently selected by turkeys in their diet regardless of gender or time period. Insects were selected during late winter by both genders. Grass and ponderosa pine staminate cones were consistently avoided.

Juniper berries and Gambel oak acorns were staples in turkey winter diets. Both acorns and juniper berries were found to have relatively high crude fat and metabolizable energy (Decker et al. 1991). As winter snow depth, cold temperatures, inclement weather, and winter duration increased, energetic demands upon turkeys increased as well. Snow cover may limit turkey mobility, increasing the value of mast-producing alligator juniper and Gambel oak stands. These stands may have to sustain turkeys for prolonged periods during severe winters.

Older alligator juniper trees provided dense crowns that may shield mast beneath the crown from deep snow accumulations. In addition, juniper was the most dependable mast producer on the CSA. For these reasons, and because more mature trees tend to produce more mast, older-age-class alligator junipers may be extremely important in southwestern Merriam's turkey winter range.

Although ponderosa pine seeds have been found to be an important turkey winter food (Reeves and Swank 1955) with greater caloric content per unit weight than acorns (Rumble 1990), our study found turkeys ate more alligator juniper berries and Gambel oak acorns. This discrepancy between studies may be the result of differing dietary analyses, habitat differences between study areas, or turkey preference (as opposed to selection) which may differ among varying food availabilities.

In addition, we did not feed captive turkeys simulated diets to test our assumption that turkey diets, comprised mostly of mast (including Gambel oak acorns, juniper berries, ponderosa pine seed, and pinyon pine seed), did not require correction for differential digestibility. Because juniper berries differ from other mast items in that they have identifiable internal fragments, they may be over-represented in uncorrected diets (M. A. Rumble, Rocky Mountain For. and Range Exp. Sta., pers. commun.). Consequently, other mast items would be under-represented, increasing the importance of acorns and pine seed in the turkey diet. If juniper berries were over-represented in our study, the magnitude of the difference was likely small (B. B. Davitt, Wash. State Univ., pers. commun.).

Turkey dietary selection may be explained by facets of optimal foraging theory (Schoener 1971), although our conclusions are speculative. Acquisition of acorns and juniper berries was probably facilitated because those mast items were larger than ponderosa and pinyon pine seeds and occurred at greater densities in some areas. Selection of abundant, large mast items requires less handling time than smaller mast. The selection of forbs over grasses may also be optimal foraging, where forbs may have superior digestibility when compared with lignified grasses.

Food supplies on the CSA appear to have a greater influence on winter habitat selection than did habitat structure. During late winter, the magnitude of that selection was demonstrated in third order food item differences between feeding sites and random plots. Even the measured characteristics at feeding sites identified by logistic models, such as Gambel oak BA and canopy presence, are indicative of feeding activities beneath mast-producing trees. We believe that dietary selection was the dominant factor in the selection of winter feeding habitat on the CSA.

Over-winter mortality rates may be greatest during winter because of greater food and energy requirements. Winter energetic demands were undoubtedly greater than those in summer. If food availability markedly reduces nutritional uptake, physiological condition of turkeys should decline. This decline may force turkeys to forage in less suitable habitat or further from roosts. Turkeys may simply be less wary, agile and able to elude predators. Winter food deficiencies may be the greatest detriment to over-winter survival.

MANAGEMENT IMPLICATIONS

Following are a list of management options that may be employed to improve habitat conditions for Merriam's turkey populations. Each option must be evaluated by natural resource managers familiar with conditions within a given area to decide if that option is applicable. In some instances, we present minimum BAs and tree densities based upon availabilities on the CSA. In these instances, we are unable to speculate upon the maximum desirable quantities, for example, BAs on feeding habitat. If turkeys are using habitats above minimum recommended quantities, we do not wish to imply that reducing the BA or tree density will improve that habitat.

Foods and Feeding Habitat

Winter diets of Merriam's turkeys were comprised mostly of mast. In the southwest, acorns and juniper berries appear to be favored food items. Ponderosa and pinyon pine seed may be important diet items during years when they produce plentiful mast or during years when other mast items are scarce. The selection for mast may become more critical as winter progresses and food becomes less abundant. Although grass was selected against by feeding turkeys, it often comprised 20% of the diet and may be a necessary food item.

Stands selected for feeding during winter contained Gambel oak, alligator juniper, and ponderosa pine. Stands containing Gambel oak acorns (Fig. 5) or alligator juniper berries (Fig. 6) were favored by feeding turkeys. Alligator juniper may be critical to overwinter survival because it is the most dependable mast producer in many areas. Winter food diversity and availability appears to directly influence turkey population density and stability.

Management activities in winter feeding habitat should retain mature, mast-producing species. Those habitats <1 mi (1.6 km) from known winter roost sites should be favored in management activities because turkeys concentrate their activities in these areas. Stands managed for winter turkey feeding habitat should have minimum total BAs of 85 ft^2/ac (19.0 m^2/ha). Openings should not exceed 0.15 ac (0.07 ha) nor occur at densities of >1/ac (2/ha). Manipulations of pinyon-juniper feeding habitat should not create openings >0.06 ac (0.03 ha) and should not occur at densities >2/ac (4/ha). All pinyon-juniper habitats within 1 mi (1.6 km) of roosting habitat or ponderosa pine stringers should be considered potential winter turkey range.

Roost Habitat

Roost sites are critical components of turkey winter range. Roost sites were activity centers that were repeatedly used between and within winters. Turkeys selected habitats near roost sites for feeding and may use roosts only when food is available nearby. Roosts may not be used every year, perhaps only those years when food resources are abundant nearby.

Winter roost sites were clumps of >30 mature or overmature ponderosa pine trees (Fig. 7). Mean diameters on trees used for roosting were 24.9 in (63.2 cm). Any smaller diameter trees and regeneration within roost sites should be maintained because they may replace older trees and increase the longevity of the roost site. Mean site BAs were 90 ft^2/ac (20.2 m^2/ha). Because winter roosts are traditional, known roosts should be marked and protected from timber harvest. Roost sites should be protected at a minimum of 2 per mi^2 (0.9 per km^2). Potential roost sites should be protected at 6 per mi^2 (2.4 per km^2) because not all sites classified as potential will be used by turkeys.

Food sources may dictate where turkeys spend the winter, but turkeys still require roosts to make winter habitat acceptable. Many marginal turkey ranges tend to have stable populations, or even high density populations, but during severe winters experience dramatic declines in numbers. In many of these ranges, turkeys may be forced to forage in habitats far from suitable roost sites, thus making them susceptible to greater predation and physiological stress. Ponderosa pine stringers should be protected wherever they extend into lower elevation habitats that may be used for feeding.

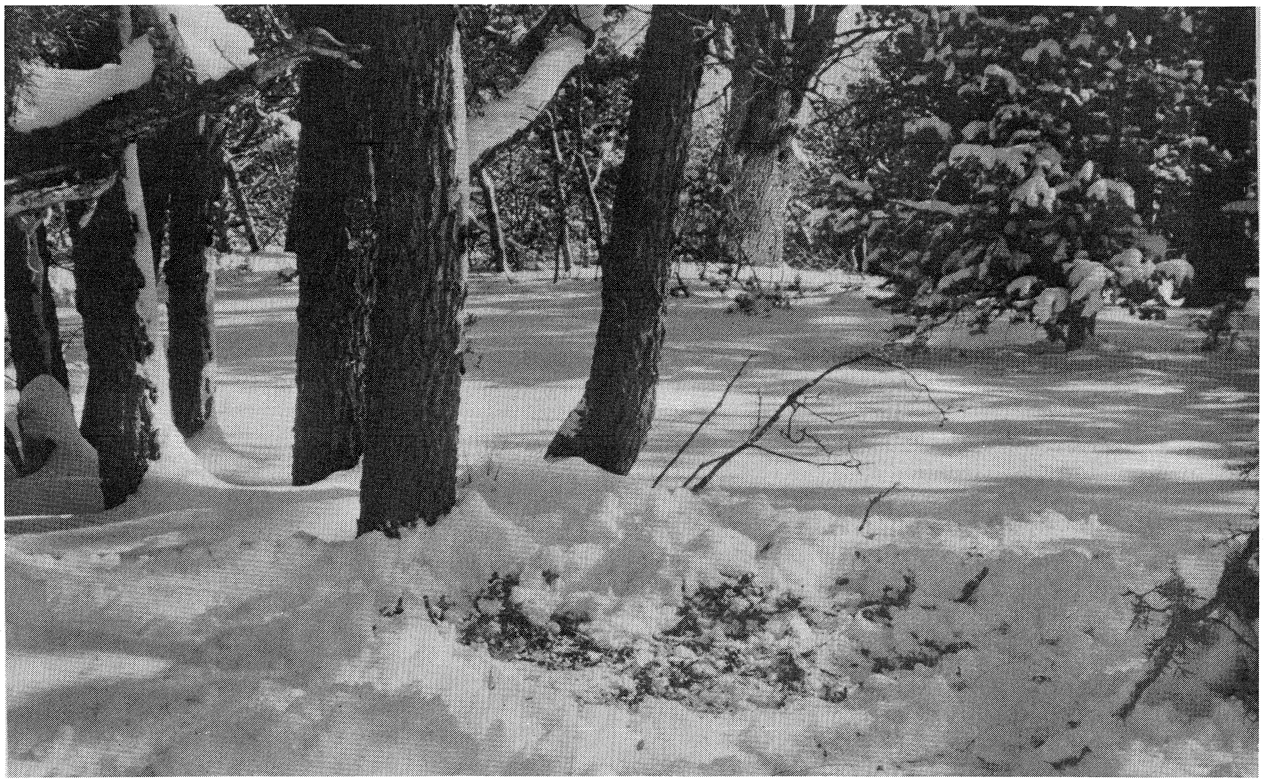


Figure 5. Gambel oak feeding site on the Chevelon study area.

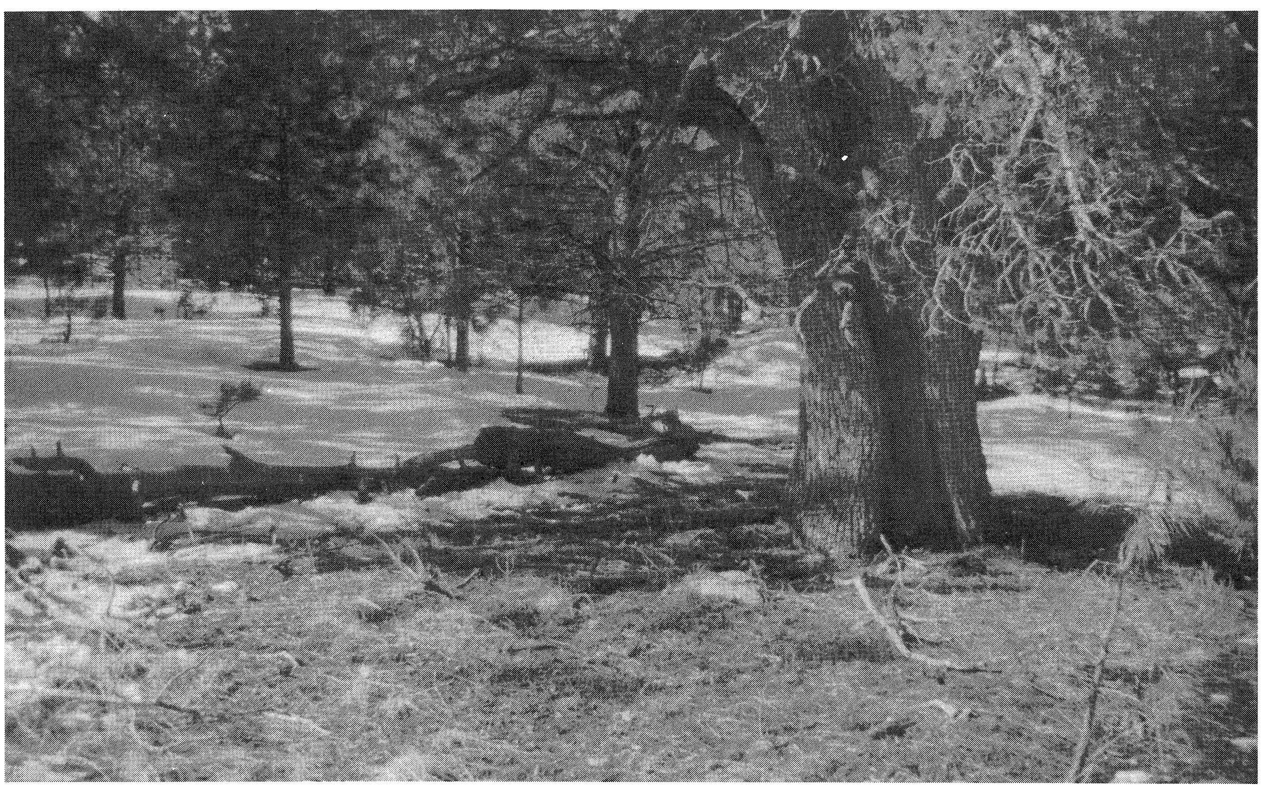


Figure 6. Alligator juniper feeding site on the Chevelon study area.

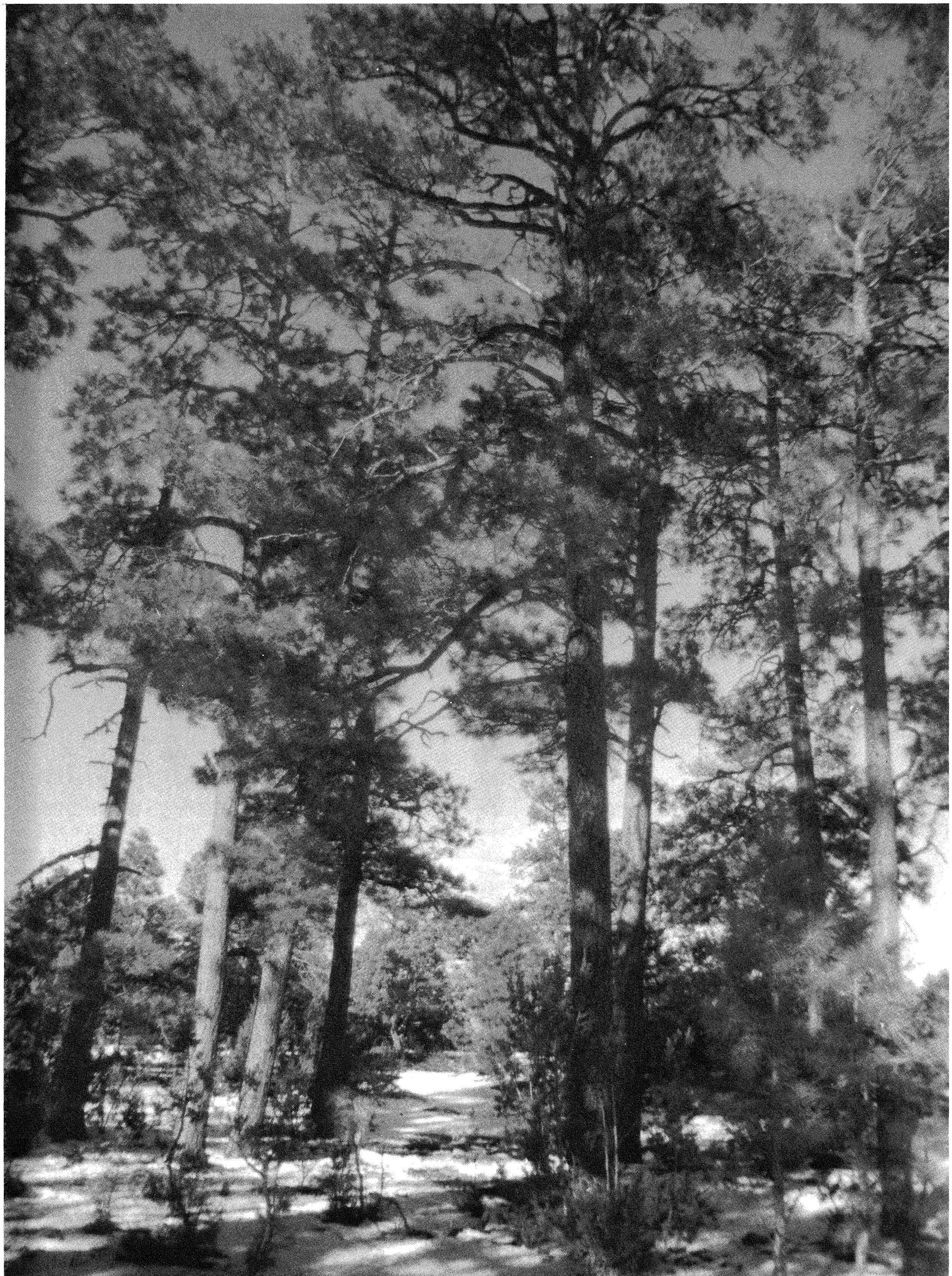


Figure 7. Winter roost site on the Chevelon study area.

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Appendix 1. Mean and SE of tree variables measured at random plots and feeding, roosting, and loafing sites and MRPP probabilities that feeding and roosting sites differ from random plots on the Chevelon study area during winter, 1990-1994. Means that differ from random are shown in bold.

Parameter	Random Plots		Feeding Sites			Roost Sites			Loafing Site	
	$\bar{x}$	SE	$\bar{x}$	SE	*P*	$\bar{x}$	SE	*P*	$\bar{x}$	SE
Mean Ponderosa Pine DBH (in)	6.4	0.5	**7.6**	0.3	0.027	**9.4**	1.1	0.012	5.4	2.0
Ponderosa Pine BA (ft^2/ac)	35.4	3.2	**47.0**	2.4	0.007	**78.9**	11.3	0.001	57.5	12.5
Ponderosa Pine Density (tpa)[a]	152.9	19.2	200.8	15.9	0.085	266.3	84.9	0.685	496.7	291.7
Mean Gambel Oak DBH (in)	2.3	0.4	**5.6**	0.3	<0.001	3.0	0.9	0.411	2.3	1.5
Gambel Oak BA (ft^2/ac)	3.0	0.6	**14.3**	1.1	<0.001	6.5	2.1	0.234	63	5.2
Gambel Oak Density (tpa)	25.0	6.4	**76.4**	7.5	<0.001	53.7	22.6	0.248	16.7	13.1
Mean Juniper DRC (in)	7.9	0.7	8.2	0.4	0.707	6.0	2.3	0.425	5.8	1.7
Juniper BA (ft^2/ac)	27.5	3.6	25.3	1.9	0.485	9.8	6.2	0.871	16.8	8.3
Juniper Density (tpa)	56.7	7.7	57.0	3.9	0.296	**14.7**	5.0	0.018	45.0	17.3
Mean Pinyon DRC (in)	1.8	0.3	**0.8**	0.1	<0.001	**0.4**	0.4	0.024	1.2	1.2
Pinyon BA (ft^2/ac)	4.7	1.1	**2.2**	0.5	0.008	**0.2**	0.2	0.028	8.4	8.4
Pinyon Density (tpa)	25.5	5.8	**11.0**	2.3	0.009	**0.5**	0.5	0.022	23.3	23.3
Total Site BA (ft^2/ac)	70.5	4.4	**88.9**	2.8	<0.001	**95.4**	10.8	0.014	89.0	14.0
Conifer Seedlings (tpa)	308.6	25.0	338.8	16.5	0.290	**203.7**	33.3	0.036	273.3	156.5
Gambel Oak Seedlings (tpa)	133.7	38.5	**235.2**	26.1	<0.001	106.3	42.4	0.248	25.0	25.0
Shrubs (tpa)	104.4	55.1	**200.4**	65.3	0.007	150.0	73.3	0.946	71.4	71.4

[a]Trees per ac.

Appendix 2. Mean and SE of percent canopy cover from line-intercept transects at random plots, feeding sites, and loafing sites and MRPP probabilities that feeding sites differ from random plots on the Chevelon study area during winter, 1990-1994. Means that differ from random are shown in bold.

Parameter[a]	Random Plots		Feeding Sites			Loafing Sites	
	$\bar{x}$	SE	$\bar{x}$	SE	P	$\bar{x}$	SE
Class 1 Forb	0.4	0.1	**0.2**	<0.1	<0.001	<0.1	<0.1
Class 1 Grass	6.8	0.8	**3.1**	0.2	<0.001	0.7	0.4
Class 1 Downed Wood	3.8	0.4	3.6	0.2	0.057	4.2	1.3
Class 2 Downed Wood	0.4	0.1	**0.1**	<0.1	0.004	1.7	0.7
Class 1 Conifer Tree	2.0	0.3	2.1	0.2	0.247	3.5	1.4
Class 2 Conifer Tree	3.5	0.6	2.9	0.2	0.211	4.6	3.3
Class 3 Conifer Tree	5.9	0.7	**8.2**	0.6	0.010	15.0	6.2
Class 1 Deciduous Tree	0.1	0.1	**0.4**	0.1	<0.001	0.0	0.0
Class 2 Deciduous Tree	0.3	0.1	0.3	0.2	0.218	0.0	0.0
Class 3 Deciduous Tree	0.1	0.1	**1.3**	0.2	<0.001	0.0	0.0
Class 1 Shrub	0.5	0.1	**0.2**	<0.01	0.003	0.1	0.1
Class 2 Shrub	0.3	0.1	0.2	0.1	0.200	0.0	0.0
Class 3 Shrub	0.3	0.1	**<0.1**	<0.1	0.004	0.0	0.0
Class 1 Rock	4.1	0.8	3.0	0.3	0.333	1.9	1.4
Class 2 Rock	0.1	<0.1	0.1	<0.1	0.690	0.0	0.0
Class 3 Rock	<0.1	<0.1	**.0**	0.0	0.033	0.0	0.0
Class 1 Snow	26.4	3.6	**12.8**	1.9	<0.001	40.0	24.5
Class 1 Total Cover	44.0	3.1	**25.3**	1.8	<0.001	50.4	23.2
Mean Height of Class 1 Cover (in)	4.6	0.3	4.1	0.2	0.052	6.5	0.6
Class 2 Total Cover	4.6	0.6	3.6	0.2	0.096	6.3	2.9
Class 3 Total Cover	6.6	0.7	**9.6**	0.6	0.002	16.8	16.1

[a] Class 1 is cover between 0-17.9 in of ground surface, Class 2 is cover between 18.0-35.9 in of ground surface, and Class 3 is cover between 36-72 in of ground surface.

Appendix 3. Mean and SE of site variables measured at random plots and feeding, roosting, and loafing sites and MRPP probabilities that feeding and roosting sites differ from random plots on the Chevelon study area during winter, 1990-1994. Means that differ from random are shown in bold.

Parameter	Random Plots		Feeding Sites			Roost Sites			Loafing Sites	
	$\bar{x}$	SE	$\bar{x}$	SE	*P*	$\bar{x}$	SE	*P*	$\bar{x}$	SE
Slope (%)	9.0	1.1	8.6	0.6	0.999	**20.3**	2.7	<0.001	10.3	2.5
Turkey HSD (ft)	116.7	10.1	105.4	2.7	0.089	106.1	5.6	0.241	85.7	16.5
Person HSD (ft)	161.8	7.0	163.4	4.2	0.431	160.9	10.3	0.540	152.4	37.8
Canopy Completeness (%)	36.8	2.3	38.9	1.3	0.574	**52.1**	4.8	0.002	48.2	9.1
Height to First Canopy (ft)	13.7	2.0	**8.6**	0.5	<0.001	**27.6**	3.9	0.003	9.0	2.9
Distance to Opening (ft)	5.2	1.2	**10.5**	0.7	<0.001	**14.6**	2.9	0.001	14.0	6.3
Size of Opening (ft^2)	6196.4	805.6	6214.5	653.8	0.881	3035.3	440.5	0.203	2600.0	880.2
Distance to Cover (ft)	89.3	5.9	83.7	3.4	0.145	**77.4**	4.7	0.023	87.1	29.0

Appendix 4. Mean percent diet composition of female and male Merriam's turkeys during early and late winter on the Chevelon study area, 1990-1994.

Dietary Item	Female Early Winter	Female Late Winter	Male Early Winter	Male Late Winter
Agropyron smithii	1.9	9.5	1.1	4.4
Aristida spp.	0.0	0.0	0.0	0.3
Bouteloua gracilis	0.2	1.7	0.0	0.3
Bromus ciliatus	0.9	7.1	0.1	4.9
Bromus japonicus	0.4	4.5	0.2	1.8
Dactylis glomerata	0.7	2.7	0.1	1.1
Festuca arizonica	0.6	2.8	0.8	6.5
Koelaria cristata	0.5	0.7	0.0	1.8
Muhlenbergia spp.	0.3	0.5	0.0	0.0
Phleum pratense	0.6	1.9	0.0	0.8
Poa spp.	0.7	4.1	1.1	1.3
Schizacrym scoparium	0.0	1.0	0.0	0.2
Sitanion hystrix	0.0	0.1	0.0	0.2
Stipa comata	0.4	1.0	0.0	2.0
Other grasses	0.7	1.3	1.5	1.1
Total grasses	7.9	38.9	4.9	27.3
Forb 1[a]	11.0	5.1	0.1	0.2
Forb 2[b]	0.2	1.7	0.0	0.2
Forb 3[c]	0.0	1.5	0.1	0.9
Lepidium perfoliatum	0.0	0.0	0.0	1.1
Lupinus spp.	0.4	0.0	0.0	0.0
Trifolium spp.	0.0	0.4	0.0	0.0
Other forbs	1.7	3.9	1.2	2.8
Total forbs	13.3	12.6	1.4	5.2
Rosa arizonica	0.0	0.1	0.0	0.3
Other shrubs	0.1	0.1	0.0	0.1
Total shrubs	0.1	0.2	0.0	0.4

Appendix 4 (continued). Mean diet percent composition of female and male Merriam's turkeys during early and late winter on the Chevelon study area, 1990-1994.

Dietary Item	Female Early Winter	Female Late Winter	Male Early Winter	Male Late Winter
Juniperus spp. berry	57.7	18.6	34.4	32.8
Pinus edulis seed	4.3	5.8	45.6	10.1
Pinus ponderosa needle	0.3	0.2	0.0	0.1
Pinus ponderosa catkin	2.0	1.2	2.2	0.2
Pinus ponderosa seed	3.7	0.8	5.7	6.1
Quercus gambelii acorn	7.0	16.5	5.0	8.9
Total trees	75.0	43.1	92.9	58.2
Insects	3.7	5.2	0.8	8.9

[a] Possible species include *Agoseris*, *Erysimum*, or *Lithospermum*.
[b] Possible species include *Arabis* or *Cardamine*.
[c] Possible species include *Lithophragma* or *Saxifraga*.

NOTES

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Key words: Arizona, blood chemistry, dietary selection, food habits, habitat selection, habitat use, *Meleagris gallopavo merriami*, Merriam's turkey, roost, winter.

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