# Merriam's Turkey (Meleagris gallapovo merriami)
# Species Assessment

## Prepared for the Grand Mesa, Uncompahgre, and Gunnison National Forests
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Cover Photo: Female Merriam's turkey at Bryce Canyon National Park, Utah, by Matt Vasquez. This hen was in an area previously burned by prescribed fire, consisting of tall grass among mature ponderosa pine with less than 40 percent overstory cover, June 2004.

# TABLE OF CONTENTS



## LIST OF TABLES



## LIST OF FIGURES

## INTRODUCTION

The Merriam's turkey is a focus of this assessment because it has been identified as a Management Indicator Species (MIS) on the Grand Mesa, Uncompahgre, and Gunnison National Forest (Forest). MIS have a dual functionality: 1) to estimate the effects of planning alternatives on fish and wildlife populations (36 CFR 219.19 (a) (1)) and 2) to monitor the effects of management activities on species via changes in population trends (36 CFR 219.19 (a) (6)). The Merriam's turkey is selected as an indicator primarily for mountain shrub (primarily Gambel oak), pinyon-juniper and lower elevation ponderosa pine habitat types, although the species is known to use forest-meadow edges, aspen, and mixed conifer habitats are heavily used during the summer.

The Merriam's turkey has specialized habitat requirements in terms of nesting, brood rearing, and roosting habitat. On the Forest, this species is primarily associated with Gambel oak, pinyon-juniper, ponderosa pine, and forest-meadow edges. Turkeys utilize Gambel oak, especially ponderosa pine and Gambel oak associations, for nesting on the Forest. Both Gambel oak and pinyon-juniper provide foraging habitat for turkeys, particularly during winter. Although Gambel oak may not be reliable as a food source since acorn crops are not produced consistently each year, it is used extensively during years when acorn crops are available.

This report is the first species assessment prepared for the Merriam's turkey on the Forest. The goal of this assessment is to summarize historical and current literature on the Merriam's turkey to provide land managers and the public with an objective overview of this species within the Forest. Peer reviewed scientific literature and summarized data are the primary information sources used in this report. The Forest Wildlife Biologist also incorporated on-the-ground field knowledge of Merriams wild turkey occurrence on the Forest. Local data sources (Colorado Division of Wildlife, Rocky Mountain Bird Observatory, and Forest GIS databases – R2-Veg) were utilized to provide information on distribution, localized abundance, and habitat condition for the Forest. This assessment provides recommendations for the current Forest Plan revision in terms of integrating Merriam's turkey habitat requirements into Forest management planning. This report is a working document that will be updated periodically as new information becomes available from peer-reviewed scientific literature and through monitoring of this species on the Forest.

## SUMMARY OF KEY FINDINGS

On the Forest, the abundance and distribution of the Merriam's turkey (also referred to as "turkey" or "wild turkey") is largely tied to the availability of ponderosa pine, pinyon-juniper with ponderosa pine stringers, Gambel oak, and forest-meadow edges within or adjacent to these vegetation types. Turkeys use a variety of habitats over the course of a year depending on the season. This species benefits from maximum structural diversity within and between stands. Key turkey habitat characteristics include outcrops, logs, or shrubs to provide horizontal cover for nesting; trees greater than 25 cm in DBH with large horizontal branches for roosting (primarily ponderosa pine); and dense conifer stands (ponderosa pine and pinyon-juniper) in winter for thermal cover and pine seed forage (Rumble and Anderson 1993a, Rumble and Hodorff 1993). Overall, Merriam's turkey populations achieve their greatest abundance in the pine-oak-grassland vegetative associations (Korschgen 1967). Acres of primary and secondary habitat on the Forest are summarized for each life history requirement of turkeys in Figure 1.

The majority of primary turkey habitat occurs within the Uncompahgre Plateau Geographic Area. Consequently, the Uncompahgre Plateau likely contains the largest number of turkeys on the Forest. The Gunnison Basin lacks nesting habitat for turkeys; as a result turkey abundance is probably very low within this Geographic Area. Some primary turkey habitat also occurs within the Grand Mesa, North Fork Valley, and San Juan Geographic Areas. Winter habitat in these areas is less extensive.

The wild turkey is considered globally "secure" by the Natural Heritage Program due to its wide distribution across North America. According to the Breeding Bird Survey (BBS), populations appear to be in a significant upward trend in the United States. Based on BBS trend data for the period 1966 to 2004, turkeys have exhibited a significant positive trend of 13.3 percent. Within the state of Colorado and the

Southern Rockies physiographic region, turkey populations have exhibited similar, but insignificant, upward trends. The BBS has detected turkeys on five routes on the Forest, but detection numbers were not sufficient to provide statistically valid results for trend detection. Similarly, the Rocky Mountain Bird Observatory has not detected turkeys in sufficient numbers to determine relative abundance nor provide trend detection information for the Forest. The Colorado Division of Wildlife has conducted turkey reintroductions adjacent to the Forest in the last 16 years that contributed to local turkey populations and expanded turkey distributions.

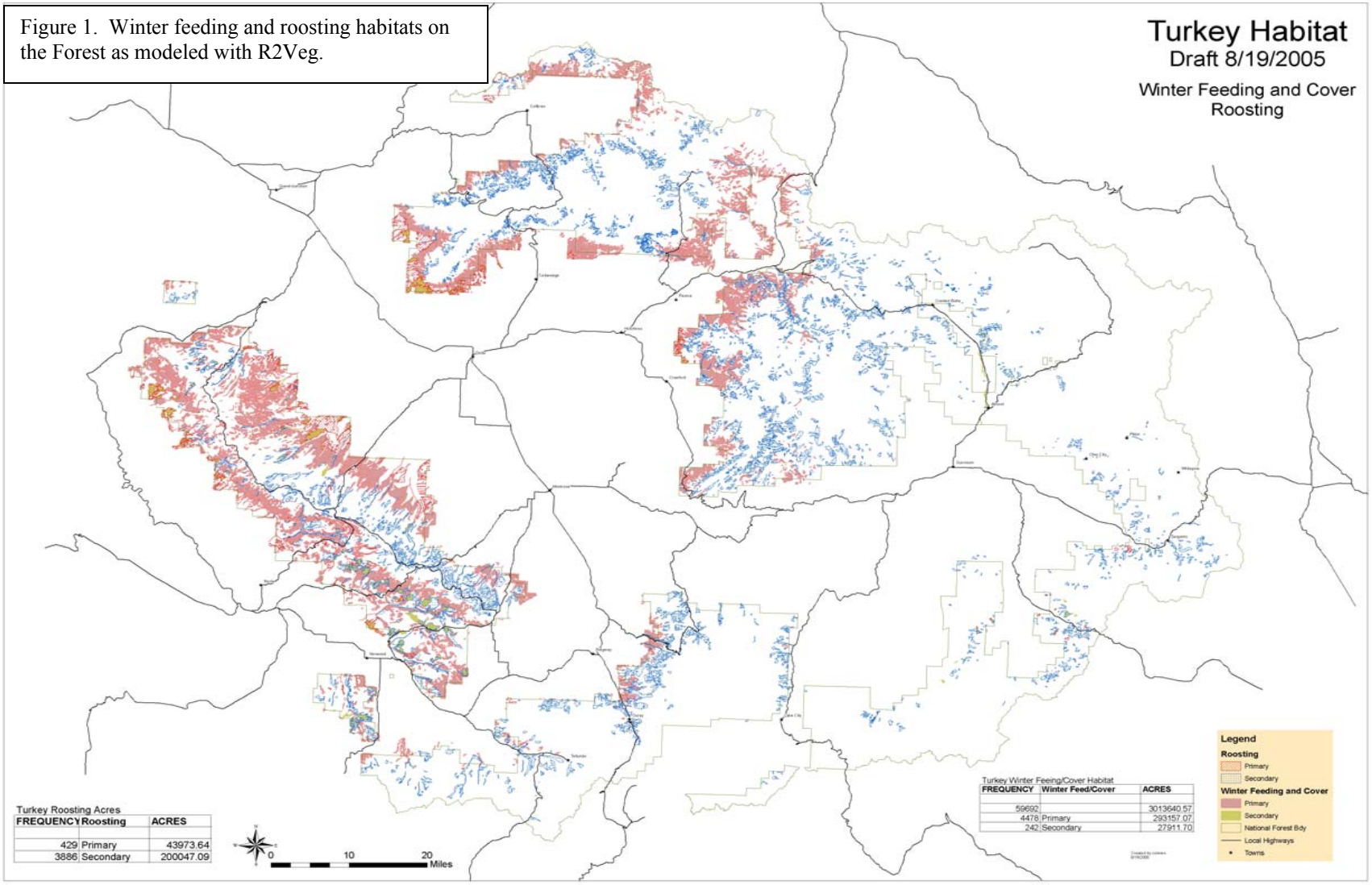
On the Forest, threats to the Merriam's turkey are primarily associated with management activities that cause habitat degradation or result in a loss of habitat. Specifically, management activities such as mechanical treatments, timber harvest, prescribed fire, and grazing are detrimental to turkeys if they degrade brood rearing habitat, isolate roosting sites by causing a reduction in overstory cover, or result in a loss of habitat diversity; yet these activities can also be implemented in a way that benefits turkeys by improving and/or creating habitat, while at the same time meeting multiple use management objectives. Management goals should work towards maximizing within and between stand diversity as recommended by Hoffman et al. (1993).

## HABITAT CRITERIA USED IN FOREST-WIDE HABITAT EVALUATION

Habitat modeling parameters for Merriam's turkey on the Forest address the sum of all factors affecting the turkey's chance to survive and reproduce on the Forest, specifically in terms of primary habitat and secondary habitat. Patton (1997) describes primary habitat as all the combined habitat areas and environmental factors necessary to support a viable population of the species. Secondary habitat comprises the area in which an organism may spend part of its time, but does not meet all its life requirements (Harris 1984). Secondary habitat may be utilized by a species to avoid intraspecific interactions when all primary habitat is saturated; serve as a travel corridor providing connectivity to more suitable habitat; or it may meet a specific habitat need by a species such as food or cover. While a species may spend part of its time in secondary habitat, secondary habitat alone is not capable of meeting all of a species' life requirements. Thus, a species may utilize a combination of primary and secondary habitat depending on food availability and abundance, time of year, and interspecific or intraspecific interactions.

Merriam's turkeys are distributed throughout 11 western states in North America and they have been confirmed breeding in suitable habitat on the Forest. Merriam's turkeys are permanent residents on the Forest, exhibiting altitudinal migrations. We focused on nesting, brood rearing, roosting, summer cover/feeding, and winter cover/feeding habitat requirements as a basis for habitat modeling in an attempt to predict suitable habitat capable of meeting all the life requirements of the Merriam's turkey. Geographic Information System vegetation data, R2-Veg, was used to create a potential habitat distribution map for the Merriam's turkey on the Forest (Figure 1). The R2-Veg database was produced by aerial photo interpretation in conjunction with some field verification; this is a working database with updates taking place periodically. At the Forest-level, R2-Veg should reliably depict suitable Merriam's turkey habitat on the Forest. R2-Veg attributes used for habitat modeling included vegetation cover type, vegetation species mix, habitat structural stage, shrub size class, structural diversity (multi-storied forests), canopy cover, slope, aspect, and distance from forest-meadow edges. Habitat parameters used to model Merriam's turkey habitat are described in Table 1. Field verification, particularly for project-level analysis, may be required to determine the reliability of habitat modeling at the stand level. Primary and secondary habitat for Merriam's turkeys was determined primarily through literature review in conjunction with habitat characteristics and conditions on the Forest. Verification of accuracy of the habitat modeling was also completed by the Forest Wildife Biologist.

Figure 1. Winter feeding and roosting habitats on the Forest as modeled with R2Veg.




Turkey Roosting Acres

| FREQUENCY | Roosting | ACRES |
|---|---|---|
| 429 | Primary | 43973.64 |
| 3886 | Secondary | 200047.09 |

Turkey Winter Feeing/Cover Habitat

| FREQUENCY | Winter Feed/Cover | ACRES |
|---|---|---|
| 59693 | | 3013640.57 |
| 4478 | Primary | 293157.07 |
| 242 | Secondary | 27911.70 |

Figure 2. Summer feeding, nesting and rearing habitat on the Forest as modeled with R2Veg.

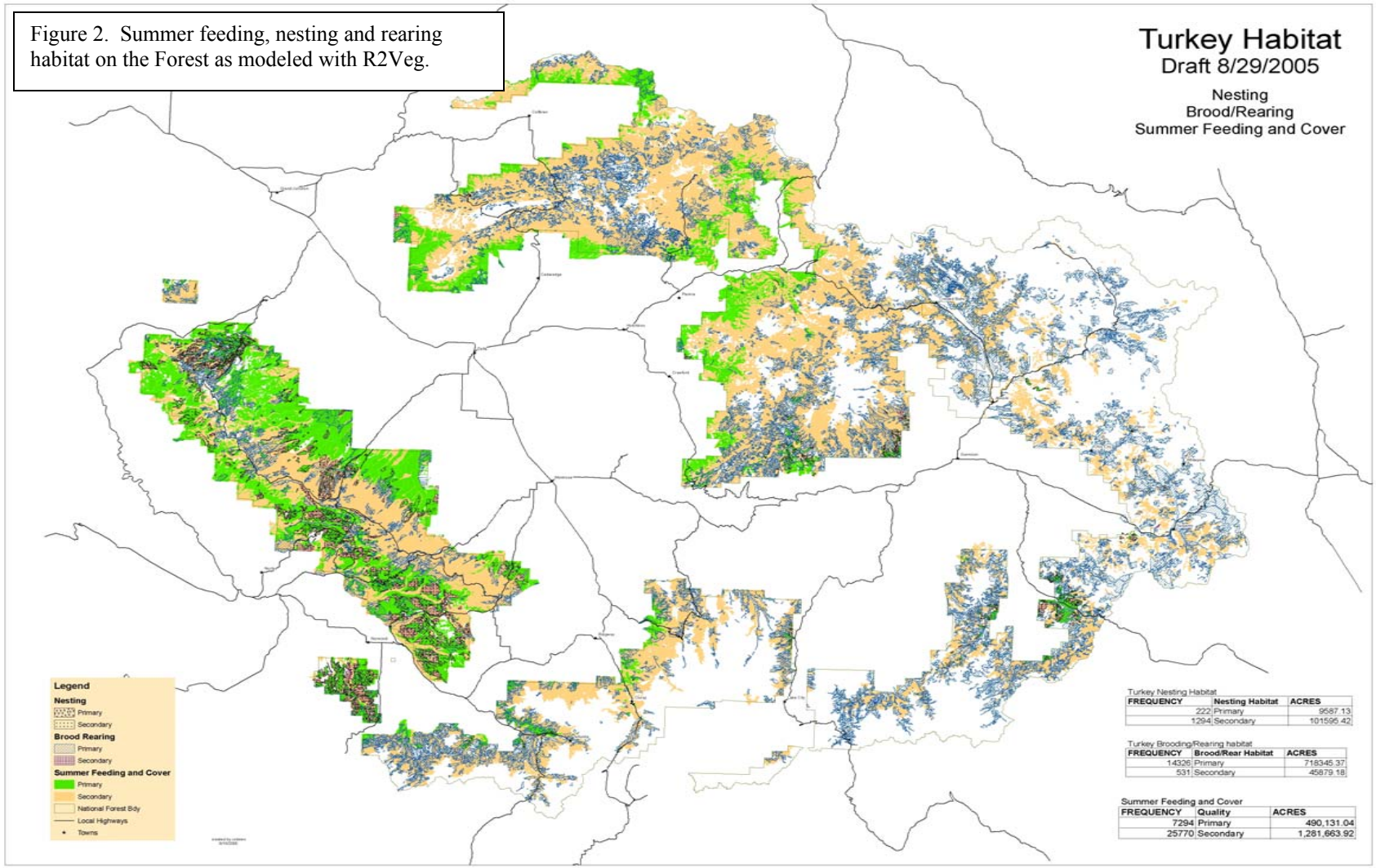


**Table 1.** Habitat parameters for modeling Merriam's turkey habitat on the Forest.

| Habitat Parameter | Primary Habitat | Secondary Habitat |
|---|---|---|
| SUMMER FEEDING AND COVER | • 3a, 4a ponderosa pine<br>• 4a, 4b, 4c pinyon-juniper<br>• Gambel Oak<br>• Grassland/forbland areas within or adjacent to ponderosa pine, pinyon-juniper, Gambel oak or mixed forests with a ponderosa pine or aspen component (include only the portion of meadows that falls w/in 10 m of the forest-meadow edge)<br>• Stage 1 wet meadow (include only the portion of meadows that falls w/in 10 m of the forest-meadow edge)[1]<br>• Stages 1 & 2 riparian habitat | • All structural stages of: Aspen, cottonwood, Douglas-fir, mountain shrub<br>• Mixed conifer comprising spruce-fir, aspen, ponderosa pine, pinyon-juniper, and/or Gambel oak for the Uncompahgre Plateau only<br>• ponderosa pine (excluding 3a and 4a)<br>• 1-3c pinyon-juniper<br>• Stages 3a, 3b, 4a, 4b riparian habitat |
| NESTING | • 3b, 3c ponderosa pine that contains a Gambel oak understory and/or rock outcrops/slides and/or logs/slash to provide horizontal cover for nests<br>• Gambel oak and snowberry cover types with medium and large size classes<br>• Slope: 10-40%<br>• ≤ 0.8 km from brood rearing habitat[2] | • 4b, 4c ponderosa pine that contains a Gambel oak understory and/or rock outcrops/slides and/or logs/slash to provide horizontal cover for nests<br>• Slope: 0-40%; include all vegetation and structural stage types that fall under primary nesting habitat if they contain a slope of 0-20%.<br>• All primary nesting habitat if it falls > 0.8 to 3.5 km from brood rearing habitat (0 - 3.5 km for secondary habitat; exclude secondary and primary nesting habitat that falls > 3.5 km from brood rearing habitat)[3] |
| BROOD REARING | • Grassland/forbland areas within or adjacent to ponderosa pine, pinyon-juniper, Gambel oak or mixed forests with a ponderosa pine, pinyon-juniper or aspen component (include only the portion of meadows that falls w/in 10 m of the forest-meadow edge)<br>• > 40% canopy cover at the forest-meadow edge<br>• Ponderosa pine and pinyon-juniper ≤40% canopy cover (used by poults < 7 weeks old)<br>• Aspen ≤70% canopy cover<br>• Stages 1, 2, 3a, and 4a riparian areas<br>• Indicate primary brood rearing ≤ 0.8 km from nesting habitat (important criteria for poults only a few days old)[2]<br>• Indicate primary brood rearing > 0.8 km from nesting habitat (older poults are capable of moving greater distances compared to a few days after hatching)[3] | • 1t areas (openings created by some type of disturbance, such as timber harvest, especially clear-cuts; include only the portion of meadows that falls w/in 10 m of the forest-meadow edge[1])<br>• > 40% canopy cover at the forest-meadow edge<br>• Ponderosa pine >40% canopy cover (used by poults > 7 weeks old; listed as secondary because high quality brood rearing habitat is most important to poults < 7 weeks old) |
| ROOSTING HABITAT | • 4b, 4c ponderosa pine ≥40 cm dbh; multiple layering<br>• 4b, 4c pinyon-juniper; multiple layering<br>• Slope: 20-30%<br>• Slope position: ridges and top of slopes<br>• < 10,000 ft. | • 4b and 4c: cottonwood, Douglas-fir; multiple layering<br>• 4b, 4c ponderosa pine 25 cm to <40 cm dbh; multiple layering<br>• Slope ≥ 5%<br>• 4b, 4c ponderosa pine, multiple layering, that falls on north, south, or west aspects; and that falls on slopes other than ridges and top of slopes.<br>• < 10,000 ft. |
| WINTER FEEDING AND COVER | • 4c ponderosa pine and pinyon-juniper<br>• Large oak (ht. shrub > 6.4 ft. tall)<br>• Aspect: south, southwest, southeast | • 4b, ponderosa pine and pinyon-juniper<br>• Gambel oak, medium and large size class<br>• Cottonwood riparian (used for roosting if snow cover pushes turkeys below the conifer zone)<br>• Aspect: south, southwest, southeast |

[1] Hens with poults in meadows were seldom observed more than 10 m from the forest-meadow edge (Rumble and Anderson 1993).

[2] Rumble and Hodorff (1993) reported that potential brood rearing habitats occurred within 0.8 km of all nests in their study.

[3] Day et al. (1991a) and Rumble and Anderson (1993) observed that hens often moved broods up to, but not exceeding, 3.5 km to brood rearing areas within a few days after hatching. This criteria only applies to nesting habitat distance to brood rearing habitat for broods only a few days old; once hens with broods reach brood rearing habitat following hatching, hens have been documented moving broods 24 days old as far as 5.6 km in less than four days to large meadows; and the longest movement by a hen with poults was more than 23.4 km over a 6-week period (Rumble and Anderson

1993).

Total acres of summer feeding and cover, nesting, brood rearing, roosting, and winter feeding and cover habitat based on habitat quality are provided in Table 2.

**Table 2.** Acres of turkey habitat on the Forest based on habitat parameters and habitat quality.

| Habitat Parameter[1] | Habitat Quality | | Total Acres[1] |
|---|---|---|---|
| | Primary | Secondary | |
| Summer feeding/cover | 490,131 | 1,281,664 | 1,771,795 |
| Nesting | 9,587 | 101,595 | 111,182 |
| Brood/rearing | 718,345 | 45,879 | 764,224 |
| Roosting | 43,974 | 200,047 | 244,021 |
| Winter feeding/cover | 293,157 | 27,912 | 321,069 |

[1] Some overlap occurs between the different habitat types, thus acres should be analyzed separately for each habitat parameter, rather than combined. Combining acres for different habitat parameters will result in an overestimate of turkey habitat on the Forest.

The above habitat modeling criteria reflect second-level analysis because we are relying predominantly on the dominant species of vegetation and overstory canopy cover to predict suitable Merriam's turkey habitat, although slope and aspect criteria for nesting, brood rearing, and winter habitat further refines those habitat types. Rumble and Anderson (1992) determined that habitat selection patterns of Merriam's turkeys were best described when habitats were stratified by dominant species of vegetation and overstory canopy cover. Rumble and Anderson (1992) concluded that implications for forest management activities on turkeys at this level of habitat stratification could be made. However, the above modeling criteria still reflect habitat mapping for Merriam's turkey at the macro-habitat level of resolution. Rumble and Anderson (1996a) stated that understanding habitats of Merriam's turkeys at the macro-habitat level of resolution is insufficient to predict changes in ecosystems that do not alter the dominant vegetation type or affect the forest structure. Consequently, the habitat modeling criteria described above should not be used to determine Merriam's turkey responses to management activities that cause subtle changes in vegetative conditions. Discussions of macro-habitat and micro-habitat characteristics are presented further in this document under Species-Habitat Relationships, which might provide an understanding of how Merriam's turkeys may respond to subtle changes in vegetative conditions as influenced by management activities.

## MANAGEMENT STATUS AND NATURAL HISTORY

### Management Status

- **USFS Rocky Mountain Region:** the Merriam's turkey has been identified as a MIS on the Forest within Region 2 as part of the 2005 Forest Plan MIS Amendment, although there is no regional status.

- **Natural Heritage Program (NHP) Conservation Status:** global rank of G5; it is demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

- **State of Colorado Natural Heritage Program Conservation Status:** species is ranked S5; secure across the state (www.natureserve.org).

- **Colorado Division of Wildlife:** managed under the Division's Wild Turkey Hunting Regulations.

### Existing Regulatory Mechanisms, Management Plans, and Conservation Strategies

Turkeys are considered a game species in Colorado and are protected against "take", except as prescribed by Colorado's Wild Turkey Hunting Regulations. The spring hunting season generally occurs in April and May and the fall season occurs in September and October. The annual bag and possession limit is one bearded turkey in the spring and one turkey of either sex in the fall. Legal hunting methods include shotguns, hand-held bows, crossbows, and rifles and handguns (illegal in spring season, allowed only in fall). It is illegal to use bait while turkey hunting.

Under the National Forest Management Act (NFMA) the Forest Service is required to sustain habitats that support healthy populations of native and desired non-native plant and animal species on national forests and grasslands, particularly for Management Indicator Species. For the 2005 Forest Plan MIS Amendment, the Merriam's turkey was selected due to its specialized habitat requirements in ponderosa pine, pinyon-juniper, Gambel oak, and forest-meadow edge habitats, specifically in terms of nesting, brood rearing, and roosting habitat. Additionally, wild turkeys are considered economically important. The current 1991 Amended Land and Resource Management Plan provides direction and includes standards and guidelines for management of habitat for MIS (Table 4).

**Table 4.** 1991 Amended Land and Resource Management Plan general standards and guidelines for MIS.

| Management Activities | General Direction | Standards and Guidelines |
|---|---|---|
| Aquatic and Terrestrial Habitat Management | Manage for habitat needs of indicator species (FP III-24). | |
| | Manage habitat for viable populations of all existing vertebrate wildlife species (FP-III-26). | Maintain habitat capability at a level at least 40% of potential capability[1] |

[1] This standard and guideline varies with specific Management Area direction.

The 2005 Forest Plan MIS Amendment provides general direction for MIS with new language that states: "manage for habitat needs of selected wildlife species for a given area" (USDA 2005). The Monitoring and Evaluation Program, which is the management control system for the Forest Plan, will provide language regarding monitoring and evaluation for MIS that states:

> *"Use the best available science, data and analysis to estimate the effects of habitat changes and other management activities on MIS. Incorporate species population data from various sources, if available. In accordance with the 2004 Planning Rule, 36 CFR 219.14(f), obligations relating to management indicator species [may be met] by considering data and analysis relating to habitat; and site-specific monitoring or surveying of a proposed project or activity area is not required, but may be conducted at the discretion of the Responsible Official for specific projects."*

## Distribution and Abundance

The Merriam's turkey has the widest distribution and is the most common subspecies of the wild turkey in North America. The Forest is well within the distribution range of the Merriam's turkey. They occupy many forested mountainous areas throughout western Colorado, especially those with ponderosa pine, pinyon-juniper, oakbrush, and cottonwoods. On the Forest, turkeys are primarily associated with ponderosa pine, pinyon-juniper, Gambel oak, and forest-meadow edges, aspen and mixed conifer forests. Figure 2 shows the relative breeding season abundances for the wild turkey and reflects the percent change per year, based on Breeding Bird Survey data (Sauer 2005).

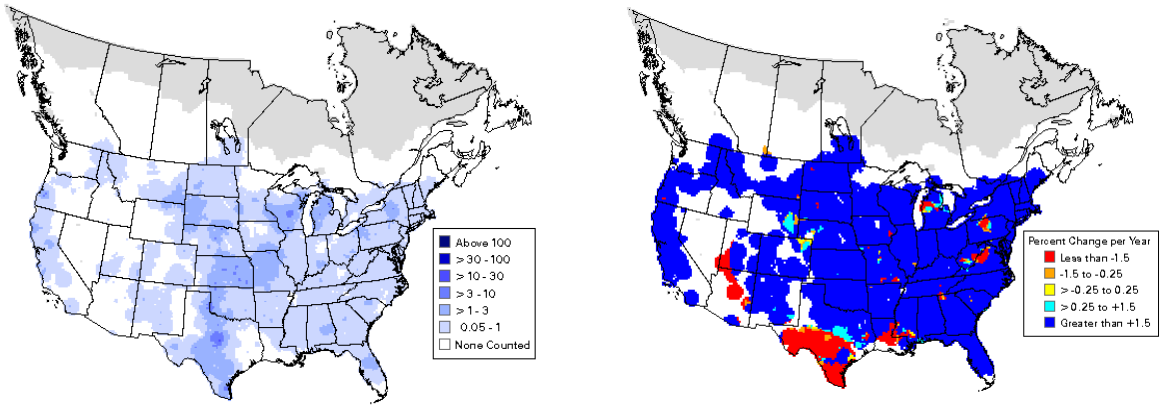



**Figure 2.** LEFT: Relative breeding season abundance of the wild turkey based on average number of birds per route, obtained from Breeding Bird Survey data (Sauer et al. 2005). RIGHT: Percent change per year in turkey abundance during the breeding season, obtained from Breeding Bird Survey data (Sauer et al. 2005).

According to the Breeding Bird Survey, where routes occur on the Forest, turkeys average from 0.06 to 0.86 individuals per route each year.

## Population Status

*North American Breeding Bird Survey (reference period 1966 to 2004)*

The Breeding Bird Survey (BBS) monitors bird populations over large geographic areas and tracks the status and trends of North American bird populations. This program was initiated in 1966 and is coordinated by the USGS Patuxent Wildlife Research Center, and the Canadian Wildlife Service and National Wildlife Research Center. The BBS is capable of informing researchers and wildlife managers of significant changes in bird populations. Roadside survey routes are conducted during the avian breeding season each year. Each route is 24.5 miles long with stops at 0.5-mi intervals, totaling 50 point-count stations per route. A three-minute point count is conducted at each station, whereby every bird heard or seen within a 0.25-mi radius is recorded.

Turkeys have been detected on 3 routes throughout the Southern Rocky Mountain ecosystem, and detections have occurred on 11 routes throughout Colorado. According to the BBS, turkey populations in North America have been in an upward trend from 1966 to 2004. Within the Southern Rockies ecosystem and the state of Colorado, turkeys have exhibited similar long-term increases. Table 5 displays BBS trend data for the turkey at nation-wide and region-wide geographic scales.

**Table 5.** Breeding Bird Survey trend data for the wild turkey from 1966 to 2004 (From Sauer et al. 2005).

| | 1966-2004 | | | 1966-1979 | | | 1980-2004 | | |
|---|---|---|---|---|---|---|---|---|---|
| **Location** | **Trend** | **P value** | **N routes** | **Trend** | **P value** | **N routes** | **Trend** | **P value** | **N routes** |
| United States | 13.3 | 0.00 | 1002 | 4.7 | 0.20 | 65 | 12.8 | 0.00 | 983 |
| Western Region | 23.1 | 0.00 | 89 | -1.0 | 0.37 | 4 | 22.8 | 0.00 | 88 |
| Colorado | 31.7 | 0.06 | 11 | a | a | a | 43.5 | 0.11 | 11 |
| Southern Rockies | 145.1 | 0.41 | 3 | a | a | a | 174.6 | 0.38 | 3 |

N routes = number of routes this bird was detected on.

a = no data

The Breeding Bird Survey has detected turkeys on five BBS routes on the Forest; however detection numbers were not sufficient to provide statistically valid trend detection information for the Forest. Turkeys are considered a low relative abundance species, and are rarely encountered during roadside surveys conducted by the BBS on the Forest. Similarly, birders from the Rocky Mountain Bird Observatory have not detected turkeys in sufficient numbers to determine relative abundance nor provide statistically valid trend detection information for the Forest.

*Colorado Division of Wildlife*

Colorado's population of wild turkeys has expanded as a result of transplanting efforts by the Colorado Division of Wildlife (CDOW 2001 Annual Report). CDOW has conducted turkey reintroductions adjacent to the Forest in the last 16 years that may have contributed to local turkey populations and expanded turkey distributions (Table 6). State-wide, there are an estimated 21,000 Merriam's turkeys (CDOW 2001 Annual Report).

**Table 6.** Merriam's turkey transplants that have taken place adjacent to the Forest from 1989 to 2003.

| Date | Release Site | Nearest Town | Number of turkeys released |
|---|---|---|---|
| 2-16-1989 | Red Canyon | Crawford | 13 |
| 2-21-1989 | Red Canyon | Crawford | 15 |
| 1-31-1991 | Fruitland Mesa | Crawford | 15 |
| 2-1-1991 | Fruitland Mesa | Crawford | 15 |
| 2-7-1991 | Fruitland Mesa | Crawford | 7 |
| 12-21-1991 | Muddy Creek | Maher | 22 |
| 2-5-1993 | Muddy Creek | Maher | 19 |
| 2001 | West of Grand Junction | Grand Junction | 23 |
| 1-27-2002 | Minnesota Creek | Paonia | 27 |
| 2-28-2002 | Muddy Creek | Maher | 21 |
| 2-10-2003 | FS rd 265, Little Henderson Creek | Paonia | 20 |
| Unknown date | FS rd 712 (Smith Fork) | Crawford | 8 |

Turkey populations on and adjacent to the Forest are apparently self sustaining and healthy enough to support both a spring and fall hunting season. Hunter success surveys can be used as a general indicator of the relative abundance of wild turkeys in an area. More reliable quantitative methods to estimate density or total population abundance are currently not available, nor has a single method emerged as a standard for surveying populations (Carson National Forest 2003). Spring gobbling surveys can be used to confirm presence and success in new transplant areas, but is unsuitable for estimating population numbers (Hoffman et al. 1993). Summer brood counts and winter track counts, if conducted consistently on a yearly basis, can be used to determine population trends. If resource managers incorporate turkey habitat management guidelines into management objectives, forest activities will contribute to maintaining turkey populations.

## Species-Habitat Relationships

General Habitat Use

Merriam's turkeys historically occurred in ponderosa pine and Gambel oak forests in the southwestern U.S. (Rumble et al. 2003). Turkeys on the Forest are altitudinal migrants, moving to lower elevations comprised of ponderosa pine, pinyon-juniper, Gambel oak, and cottonwood riparian to escape snow cover in winter, then following the snow line to higher elevations as it recedes during the spring (B. Diamond and L. Spicer pers. comm. 2005). During spring, turkeys utilize ponderosa pine and Gambel oak associations, grassland and shrubland meadows, riparian areas, aspen forests, and higher elevation coniferous forests. Turkeys use a variety of habitats over the course of a year depending on the season. This species benefits from maximum structural diversity within and between stands. Key turkey habitat characteristics include rocks, outcrops, logs, or shrubs to provide horizontal cover for nesting; trees greater than 25 cm in DBH with large horizontal branches for roosting; and dense conifer stands in winter for thermal cover and pine seed forage (Rumble and Anderson 1993a, Rumble and Hodorff 1993). Importantly, habitats that contain herbaceous vegetation provide foraging habitat for hens with poults. Poults have narrow dietary protein requirements (McClean et al. 1998) that may be met by meadow habitats (especially Forest-meadow edges), ponderosa pine with ≤40 percent overstory canopy cover, and aspen with ≤70 percent overstory canopy cover (Rumble and Anderson 1996b). Meadows and open forested areas usually contain herbaceous vegetation, providing habitat for insects that are a critical food source for poults during their first four to seven weeks after hatching (Rumble and Anderson 1993b). Overall, Merriam's turkey populations achieve their greatest abundance in the pine-oak-grassland vegetative associations (Korschgen 1967). Mixed conifer and aspen stands are also used during the summer and fall on the Forest (Holland, pers. comm..).

Nesting

A review of the literature revealed that nest site characteristics are fairly consistent across the range of Merriam's turkeys. Studies have shown that Merriam's turkeys have an affinity for steep slopes (Petersen and Richardson 1975, Schemnitz et al. 1985, Rumble and Hodorff 1993, Hoffman et al. 1993), ranging between 20 to 40 percent (Rumble and Hodorff 1993) but usually greater than 30 percent (Hoffman et al. 1993). Aspect appears to influence the location of nests (Petersen and Richardson 1975, Lockwood and Sutcliffe 1985, Rumble and Hodorff 1993) with nest sites commonly found on east, south, or west aspects (Rumble and Hodorff 1993). Rumble and Hodorff (1993) found that a greater proportion of successful nests were located on westerly aspects, but they failed to find any preference relative to aspect for nest sites overall. Hoffman et al. (1993) stated that aspect is not important if suitable cover is present. Overstory canopy cover within four feet above the nest usually exceeds 80 percent, consisting of vegetation, rock outcrops/ledges, or slash (Hoffman et al. 1993). Nest sites within Forested habitats are typically found in stands with greater than 60 percent overstory canopy cover (Hoffman et al. 1993). Horizontal cover is usually dense within a five to seven foot radius of the nest (Hoffman et al. 1993), consisting of logs, rock, shrub clumps, tall (> 38 cm.) herbaceous cover, or thickets of young trees.

Turkey hens may have up to a total of three nest attempts if earlier nests fail. Hens usually begin nesting in late April before herbaceous vegetation reaches peak standing crop, and deciduous shrubs are usually not leafed out during initiation of first nests (Rumble and Hodorff 1993). Consequently, their first nest attempt may take place in habitats with a forested overstory. By their third nest attempt, herbaceous vegetation has increased substantially and deciduous shrubs are capable of providing good concealment for nests. Hoffman et al. (1993) stated that later in the nesting season, hens might renest in tall (> 38 cm.) herbaceous cover, if available. Rumble and Hodorff (1993) reported that third nest attempts were more successful than earlier nest attempts, and that higher western snowberry cover at successful nests also occurred at third nest attempts. In a study conducted in central South Dakota (Day et al. 1991b), hens selected woodland sites for early nest attempts, but selected grassland sites for later nest attempts because of increased cover. Successful nests usually take place during later nest attempts (May-June), which is likely attributed to greater nest concealment from herbaceous vegetation and deciduous shrubs that may not be available during first nest attempts in April.

Brood Rearing

Turkey broods frequent areas such as natural or created openings, riparian areas, springs and seeps, burns, aspen stands, and flood plains (Hoffman et al. 1993). On the Forest, poults likely utilize forest-meadow edges, riparian areas, and ponderosa pine and aspen stands that contain abundant herbaceous vegetation. Porter (1992) described the selection of habitats with abundant herbaceous vegetation by hens with poults as the most consistent of any habitat relation for turkeys (McClean et al. 1998). The most productive habitat for broods includes natural openings with abundant herbaceous vegetation adjacent to forested cover (Hoffman et al. 1993).

Turkey poults have very narrow dietary requirements during their first four to seven weeks after hatching (Robbins 1983, Hurst 1992, McClean et al. 1998). For successful growth and development, young turkey poults require animal protein that they obtain from eating substantial quantities of invertebrates (Johnson and Boyce 1990). Thus, turkey poults forage along edges of meadows where invertebrates are abundant (Rumble and Anderson 1993b), and abundance of invertebrates is directly related to herbaceous productivity in these meadows (Healy 1985, Rumble 1990, Hoffman et al. 1993).

The size and amount of an opening used is related to the height of the vegetation within the opening and juxtaposition of other habitat types that serve as escape cover (Hoffman et al. 1993). In a study conducted by Rumble and Anderson (1993b), hens with poults in meadows were seldom observed more than 10 m from the Forest-meadow edge. Forested overhead cover or shrub thickets are essential within 10 m of openings to provide small poults protection from raptors (Hoffman et al. 1993). Hoffman et al. (1993) state that turkeys can use more of large openings further than 10 m from the forest-meadow edge if shrub thickets or small patches of trees are interspersed through the open area or if herbaceous vegetation exceeds 38 cm in height. Scott and Boeker (1977) found that turkeys in Arizona seldom ranged farther than 45 m from escape cover. Without adequate vegetative cover interspersed throughout meadows, turkey use will likely be restricted to the forest-meadow edge.

Turkey poults require loafing and roosting sites in close proximity to brood rearing habitat. Loafing sites usually occur in the adjacent forest within 15-18 m of openings (Hoffman et al. 1993). Loafing sites are characterized by a dense overstory, an open understory with good visibility, and contain abundant coarse woody debris consisting of fallen snags, logs, large diameter slash, and/or low rock outcrops that are used as perches (Hoffman et al. 1993). In drier areas of the Forest where ground cover is limited, particularly ponderosa pine and pinyon-juniper habitats, management that provides slash and downed logs for loafing is encouraged.

Connectivity between brood rearing habitat and nesting habitat is important because hens do not nest adjacent to brood rearing areas (McClean et al. 1998). Day et al. (1991a) reported direct movements of up to 3.5 km from nests to centers of habitat for turkey broods, and Rumble and Hodorff (1993) reported that potential brood rearing habitats occurred within 0.8 km of all nests in their study area. In the Black Hills of South Dakota, hens with poults sometimes used aspen as travel lanes to meadows (Rumble and Anderson 1993).

Roosting

Winter roost sites are used traditionally and often communally by several flocks, with concentrations of 100 or more birds of both sexes jointly using the same winter roosting site (Hoffman et al. 1993). Smaller flocks comprised of hens with poults, broodless hens, or males use summer roost sites, which have fewer trees and encompass a smaller area than winter roost sites (Hoffman et al. 1993). The same flock may use summer roosts for several days in succession or different flocks may repeatedly use the same site, but traditional use of summer roost sites is rare unless suitable roost sites are limited (Hoffman et al. 1993).

Turkeys most commonly use ponderosa pine trees for roosting (Rumble 1992, Hoffman et al. 1993). On the Forest, turkeys may also roost in Douglas-fir, limber pine, large Gambel oaks, pinyon-juniper, and cottonwoods. Roost sites are typically on ridges or near the top of slopes and include an average of five to

13 roost trees per site (Hoffman et al. 1993). Rumble (1992) observed several evident patterns at roost sites that include higher basal areas, lower tree densities, and greater than average dbh. Hoffman (1968) did not find roosts in second growth timber in Colorado. Rumble (1992) reported that Merriam's turkeys avoided roosting in even-aged or single story stands, and he documented a statistical preference for multistory stands for roost sites in his study. Turkeys prefer multistoried stands containing trees with layered horizontal branches spaced at least 60.96 cm (24 in.) apart (Hoffman et al. 1993). Trees that contain layered horizontal branches with adequate spacing allow easy access by turkeys (Rumble 1992) and are characteristic of roost trees observed by other researchers (Jonas 1966, Hoffman 1968, Boeker and Scott 1969).

Mature trees are typically selected for roosting but the range of acceptable tree sizes (dbh) varies geographically and may be a function of growth rates. Hoffman (1968) reported that roost trees in Colorado averaged 160 years old. In areas where precipitation patterns are conducive to faster growth rates, such as South Dakota, faster growing trees presumably have adequate limb spacing at a younger age (Hoffman et al. 1993). Turkeys in South Dakota roosted in trees as small as 22.86 cm (9 inches; mean = 14 in.) in dbh during winter and summer (Hoffman et al. 1993). In areas with dryer conditions and slower growth rates, such as Arizona, trees must go through natural pruning processes before the proper limb configurations suitable for roosting become available. Winter and summer roost trees in Arizona averaged 63.5 cm (25 in) and 40.64 cm (16 in.) in dbh, respectively; 85 percent of winter roost trees were greater than 50.8 cm (20 inches; Hoffman et al. 1993).

Several studies report that Merriam's turkeys usually select roost sites on moderately steep (20-30%) slopes (Jonas 1966, Lutz and Crawford 1987, Rumble 1992), but occasionally use relatively gentle slopes (5%; Scott and Boeker 1975, Rumble 1992). Studies conducted in Colorado (Hoffman 1968) and Oregon (Lutz and Crawford) reported that slopes at summer roosts were gentler than winter roosts. In the Black Hills of South Dakota, Rumble (1992) found that most turkeys in his study roosted near the top of slopes or on ridges, which was consistent with studies conducted by Lutz and Crawford (1987) and Schemnitz et al. (1985). Some researchers report that many roost sites occur on slopes with easterly aspects (Rumble 1992, Boeker and Scott 1969). Selection of sites on east aspects may be a function of the location of preferred roosting habitat. Ponderosa pine, the most common tree selected for roosting by Merriam's turkeys (Rumble 1992, Hoffman et al. 1993), is associated with sites deficient in rainfall (Fowells 1965) which is typical of eastern slopes on mountain ranges in the western United States (Rumble 1992).

Winter

Winter food availability varies both within and between years, which influences habitat use patterns. Consequently, turkeys must have a diversity of habitat types across several stocking densities from which to search for food (Hoffman et al. 1993). During years of abundant seed or acorn production (mast), turkeys use dense stands of ponderosa pine and Gambel oak that occur on southerly aspects. Several researchers reported that ponderosa pine seeds were the preferred winter food of turkeys in South Dakota (Rumble and Anderson 1996c), Montana (Jonas 1966), and in Arizona (Scott and Boeker 1973). Ponderosa pine and Gambel oak do not produce seeds and acorns consistently each year, thus they may not be available as a food source every winter although ponderosa pine is likely more reliable as a winter food source than Gambel oak. During years of poor mast production, turkey use shifts to openings or forested stands with open canopies (Hoffman et al. 1993) where they may search for kinnikinnick seeds (Rumble and Anderson 1996c). Rumble and Anderson (1996c) reported that the turkeys they studied consumed more ponderosa pine seeds in years of higher availability, switching to kinnikinnick fruits during late winter and in years when pine seeds were unavailable. Pinyon-juniper stands bordering or mixed with ponderosa pine provide a consistent source of grasses, seeds, and berries, and are used by turkeys in the Southwest during most winters (Hoffman et al. 1993). On the Forest, pinyon-juniper habitats below the ponderosa pine zone likely become increasingly important to turkeys during years of deep, persistent snow cover. The location of roosting habitat probably influences turkey use of pinyon-juniper habitats on the Forest. The presence of ponderosa pine stringers suitable for roosting within pinyon-juniper habitats is likely used by turkeys during winter. Deep snow or lack of diversity on winter ranges may force turkeys into agricultural fields or riparian habitats, such as cottonwood riparian areas and river corridors, below the

coniferous zone where they frequently become dependent on humans for food. Pinyon nuts are an important source of food during fall, winter and spring on the Forest (Holland, pers. comm..).

## CONSERVATION

### Threats

Threats to the Merriam's turkey on the Forest are primarily associated with management activities that cause habitat degradation or result in a loss of habitat. Specifically, management activities such as mechanical treatments, timber harvest, prescribed fire, and grazing are detrimental to turkeys if they degrade brood rearing habitat, isolate roosting sites by causing a reduction in overstory cover, or result in a loss of habitat diversity. These same activities can also be implemented in such a way that they benefit turkeys by improving and/or creating habitat. Maintaining a mosaic of habitat types that is structurally diverse is necessary to provide habitat that is capable of meeting all the life requirements of turkeys. On the Forest, turkeys likely utilize ponderosa pine, Gambel oak, pinyon-juniper, forest-meadow edges, aspen and mixed conifer, and riparian habitats to the greatest extent; thus, when implementing management activities within these habitat types, resource managers should consider impacts in terms of both changes that may take place at the landscape scale (changes in forest structure and/or dominant vegetation) affecting macro-habitat, and subtle changes that affect microhabitat for Merriam's turkeys. Management recommendations are provided below based on literature review, with emphasis on roosting habitat. Without suitable roosting habitat or connectivity to roost sites, virtually all habitats otherwise suitable for turkey will likely not be utilized.

### Habitat Management

Forested Stands

Where turkeys occur on the Forest, management activities such as logging, thinning, and prescribed fire should be restricted during the nesting season (1 Apr to 1 Jul; Hoffman et al. 1993). Known or modeled roost and nest habitats should be managed to maintain an overstory canopy cover of at least 60 percent. In addition, for areas identified as potential turkey habitat, the Forest should limit timber harvest to no more than ten percent of these areas at any one time. Re-entry into treated stands should not occur until remaining trees average 30.48 cm (12 in.) dbh and a basal area (BA) of 23 $m^2$ per hectare or a 100 $ft^2$ per ac (Hoffman et al. 1993). Logging slash, if left in adequate amounts and of adequate sizes, may provide nesting sites for turkeys. Hoffman et al. (1993) recommends leaving 12 to 15 tons per hectare (five to six tons per ac) of logging slash in patchy distributions. Of those 12 to 15 tons, five to seven should contain a diameter greater than 7.6 cm (3 in.) and there should be occasional patches three to seven meters (10 to 12 ft) in diameter approaching 24.7 tons per hectare (10 tons per ac). Large culls (greater than 30 cm) should be left in place, particularly those with branches intact, to provide possible nesting sites for turkeys (Hoffman et al. 1993).

Overall, management directed toward maintaining habitats of all overstory categories within each of the different vegetative types would ensure that habitat needs for turkeys, as well as many other wildlife species, are met (Hoover and Wills 1984). Management goals should work towards maximizing within and between stand diversity. For turkeys, Hoffman et al. (1993) suggest maintaining an equal distribution of habitats that includes openings to forested stands with greater than 29.64 $m^2$/ha (130 $ft^2$/ac) of BA. Forested stands should range from sapling to mature stands. To ensure habitat diversity, adjacent stands should differ by at least 6.9 $m^2$/ha (30 $ft^2$/ac) and/or 10.16 cm (4 in.) in dbh. Turkeys benefit from uneven-aged management. Hoffman et al. (1993) recommends that for stands under even-aged management, the maximum stand size should be less than 8.1 ha (20 ac). All deciduous tree regeneration and shrub thickets that occur in forest understories should be protected, as well as some coniferous tree regeneration. Hoffman et al. (1993) suggests retaining seven to ten patches of coniferous tree regeneration per square mi, with patches not exceeding 0.04 ha (0.1 ac).

*Ponderosa Pine*

Hoffman et al. (1993) provides recommendations and goals for specific vegetation types, including ponderosa pine and oak habitats. For ponderosa pine, Hoffman et al. (1993) suggests maintaining 20 percent of the area in openings, 25 percent in stands greater than 23 $m^2$ per hectare (100 $ft^2$ per ac) BA of which 15 percent should be greater than 321 $m^2$ per hectare (130 $ft^2$ per ac), 20 percent at 18 to 23 $m^2$ per hectare (80 to 100 $ft^2$ per ac) BA, and 35 percent at 11.5 to 18 $m^2$ (50 to 80 $ft^2$ per ac) BA. For forested stands within 91.44 m (300 ft) of openings, management should work towards ensuring that these stands contain a BA of at least 23 $m^2$ per hectare (100 $ft^2$ per ac) and a canopy cover of at least 40 percent to provide escape cover for turkeys, especially hens with poults. Environmental conditions may preclude high basal areas in some locations, thus the habitat should not be discounted for turkeys if the above goals are not attainable (Hoffman et al. 1993) for some areas of the Forest.

*Gambel Oak*

For oak habitats, Hoffman et al. (1993) recommends that for oaks growing in the arborescent form, maintain a patchy distribution at greater than 8 $m^2$ per hectare (35 $ft^2$ per ac) BA. Work towards a BA of greater than 18 $m^2$ per hectare (80 $ft^2$ ac) for conifer stands that are adjacent to oak stands. All mature oaks should be protected because of their potential to produce acorns, and oak thickets growing in the shrub form beneath the forest canopy and adjacent to openings should be protected because of their value as nesting habitat, escape cover, and as potential sources of mast (Hoffman et al. 1993). Hoffman et al. (1993) suggests applying penalties for damage to oak trees during timber harvest activities.

*Pinyon-Juniper*

Merriam's turkeys likely inhabit much of the pinyon-juniper vegetative type on the Forest where mature ponderosa pine trees are available for roost sites. Pinyon-juniper habitats suitable for turkey on the Forest comprise 136,879 acres. Approximately 52 percent of the pinyon-juniper cover type is potentially primary habitat for turkeys, consisting of roosting habitat, brood rearing habitat, summer feeding and cover, and winter feeding and cover. Table 7 summarizes acreage of potential pinyon-juniper habitat based on habitat parameters and habitat quality.

**Table 7.** Acres pinyon-juniper habitat potentially suitable for turkeys based on habitat parameter and habitat quality for the Forest.

| Habitat Parameter[1] | Habitat Quality | | Total Acres[1] |
|---|---|---|---|
| | Primary | Secondary | |
| Summer feeding/cover | 70,592.20 | 66,287.15 | 136,879.35 |
| Winter feeding/cover | 771.11 | 12,925.55 | 13,696.66 |
| Brood rearing | 22,007.19 | 2,773.07 | 24,780.26 |
| Roosting | 40,617.51 | 0 | 40,617.51 |

[1] Some overlap occurs between the different habitat parameters in terms of habitat structural stage; thus acres should be analyzed separately for each habitat parameter, rather than combined. Combining acres for different habitat parameters will result in an overestimate of pinyon-juniper turkey habitat on the Forest.

In the Forest Comprehensive Assessment (In Draft; GMUG 2005) an analysis of terrestrial resources was conducted for all Geographic Areas on the Forest, which included an analysis of pinyon-juniper woodlands. The majority of pinyon-juniper occurs within the Uncompahgre Plateau Geographic Area, comprising 77 percent (106,000 ac) of all the pinyon-juniper on the Forest. From 1955 to 2003, 11 percent of the pinyon-juniper was affected by mechanical treatments and two percent was treated with fire. The Grand Mesa Geographic Area contains 19 percent (25,400 ac) of the total pinyon-juniper on the Forest, with three percent of this type affected by mechanical treatments, and two percent prescribed burned to improve habitat for big game. The North Fork Geographic Area contains two percent (3,200 ac) of the overall pinyon-juniper on the Forest; three percent of this type was mechanically treated to improve habitat for big game. The San Juan Geographic Area has the least amount of pinyon-juniper, comprising less than one percent (900 ac) of all pinyon-juniper on the Forest; no past activities were documented from 1955 to 2003.

There are no pinyon-juniper dominated areas on National Forest System Lands within the Gunnison Basin Geographic Area.

Mechanical treatments and prescribed burning are the primary management activities implemented in pinyon-juniper habitat types on the Forest. Mechanical treatments typically involve chaining or rollerchopping methods to restore earlier seral conditions, remove older shrub stands and enhance habitat for wildlife. Chaining took place primarily during the 1960s to improve forage for both livestock and wildlife. Currently, the vast majority of the pinyon-juniper on the Uncompahgre Plateau and the Grand Mesa is in late seral conditions of continuous dense even-age stands. Factors contributing to current conditions include heavy livestock grazing that persisted until the mid-1950s and past fire suppression that prevented fires from periodically burning in this habitat type. Pinyon-juniper has expanded into areas formerly dominated by shrubland and grasslands only in localized areas (Manier et al. 2003), but the overall density of pinyon-juniper stands on the Forest has increased as a result of past heavy livestock grazing and fire suppression. Consequently, this has affected habitat conditions for wildlife that utilize pinyon-juniper habitats, including turkeys.

In a study conducted in Arizona to determine the responses of Merriam's turkey to pinyon-juniper control (Scott and Boeker 1977), turkeys used the pinyon-juniper community year-round and contributed the highest brood counts recorded on the study area. Within pinyon-juniper communities, turkeys prefer pinyon pine seeds as a food source but pine seeds are not dependable as an annual food source. Juniper is one of the more consistent mast producers. Scott and Boeker (1973, 1977) found that turkeys fed on juniper seeds extensively during drought periods or in years when seed production by pines and oaks was low. Additionally, they observed turkeys feeding at meadow edges near escape cover of pinyon-juniper, especially during summer. When using meadow edges, turkeys seldom ranged farther than 45 m from escape cover, and they consistently chose roosting sites in mature or overmature ponderosa pines that were within 45 m of open meadows 0.2 ha or larger (Scott and Boeker 1977).

Management activities in pinyon-juniper appear to have the greatest impact on turkeys when treatments isolate roosting sites because of reductions in pinyon-juniper cover habitat (travel corridors between roost sites) or when suitable roosting trees are eliminated. Scott and Boeker (1977) reported a 64 percent reduction in turkey populations following a pinyon-juniper control program within the southern portion of their study area that isolated roost sites 300 m or more from cover. Two year-round roost sites consisting of small ponderosa pine stands within the treatment area were isolated from travel corridors by at least 300 m as a result of treatment activities; consequently turkeys did not use these roost sites again. The most drastic reductions occurred during summers, but post-treatment reductions were also significant during spring and fall (Scott and Boeker 1977). Scott and Boeker (1977) noted that if the pinyon-juniper trees on steep rocky slopes had not been removed, travel lanes to roost sites would have been available and the treatment would undoubtedly have had a less detrimental effect on the turkey population.

In contrast, partial harvesting of ponderosa pine trees within the northern portion of their study area (Scott and Boeker 1977) caused only a temporary reduction in turkey populations using the area. After timber harvest activities ceased, turkeys returned in numbers similar to relatively undisturbed portions of the study area. However, turkeys partially or completely abandoned some former roosting sites after these were heavily cut (Scott and Boeker 1977). Table 8 shows a comparison of the distribution of turkeys before and after treatments (ponderosa pine timber harvest vs. pinyon-juniper manipulation; Scott and Boeker 1977).

**Table 8.** Distribution of turkeys before and after treatments conducted in Arizona, consisting of ponderosa pine timber harvest and pinyon-juniper manipulation; from Scott and Boeker (1977).

| | | | Percent of total seen | | | |
|---|---|---|---|---|---|---|
| | Total turkeys seen | | Ponderosa pine timber harvest area | | Pinyon-juniper treatment area | |
| Season | Before | After | Before | After | Before | After |
| Spring | 1410 | 1185 | 27 | 43 | 29 | 20 |
| Summer | 790 | 467 | 22 | 27 | 32 | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Fall | 1728 | 739 | 37 | 36 | 31 | 10 |
| Total | 3928 | 2391 | 31 | 38 | 30 | 13 |

The portion of the study area where ponderosa pine timber harvest took place consisted of approximately 1,800 hectares, of which 65 percent of the mature ponderosa pine, plus suppressed trees, were harvested (Scott and Boeker 1977). The portion of the study area subjected to a pinyon-juniper control program consisted of about 1,100 hectares; approximately 27 percent (300 ha) were treated. All shrubs and trees, except for small groups of ponderosa pines, were removed by chaining and burning (Scott and Boeker 1977). The entire study area comprised approximately 5,000 ha and included treated and untreated areas. As mentioned previously, a 64 percent reduction in turkey numbers was observed within the pinyon-juniper control area, and most turkey observations were in an untreated portion of the area. Scott and Boeker (1977) provided management recommendations based on the results of their study, which might also be applicable to pinyon-juniper habitats utilized by turkeys on the Forest. They suggest that since turkeys seldom feed in open areas farther than 45 m from cover, cleared strips no wider that 90 m would be adequate for turkey management. To maintain availability of roosting sites for turkeys, resource managers should implement pinyon-juniper treatments in a way that retains cover strips as travel corridors to stands of mature ponderosa pines, especially those where turkeys knowingly roost.

*Roosting Habitat*

Ponderosa pine is the most common tree species used for roosting (Hoffman et al. 1993). On the Forest, turkeys may also roost in Douglas-fir, limber pine, cottonwoods, and pinyon pine. Turkeys have been observed roosting in large pinyon-pines, but consistent use of pinyon-juniper habitat is dependent upon the proximity of taller trees, particularly ponderosa pine (Hoffman et al. 1993). Roosting habitat is important to turkeys year-round. A lack of roost sites or travel corridors to roost sites will likely make otherwise suitable habitats useless. Hoffman et al. (1993) and Rumble (1990, 1992) provide management recommendations for maintenance of roosting habitat.

1) Manage for roost sites, rather than individual roost trees. Ideal roosting sites typically occur on easterly aspects located on the upper third of slopes, encompass at least 0.1 ha (0.25 ac), contain a BA exceeding 18.4 $m^2$/ha (80 $ft^2$/ac), and include at least five mature trees with a minimum dbh of 50.8 cm (20 inches; Hoffman et al. 1993). Roosting habitats should be dispersed throughout forested areas, including those that comprise winter habitat (Rumble 1990, 1992). Rumble (1992) asserted that in terms of Forest Service management criteria, ponderosa pine stands in the 4c habitat structural stage are capable of meeting turkey roosting habitat requirements.

2) Within roost sites, individual roost trees should contain layered horizontal branches, spaced at 0.6 to 0.9 m (2-3 ft) intervals in the upper half of the tree (Rumble 1992). Trees with these structural characteristics facilitate easy access for turkeys into the tree, and ideal roost trees contain an unobstructed flight path into and out of the tree from the uphill side (Hoffman et al. 1993). Timbered stands managed to provide roosting habitat that retain trees on the upper third of slopes with the above structural characteristics will benefit turkeys (Rumble 1992).

3) Known roost sites should be protected from timber harvest by a buffer zone of 40 m (132 ft) surrounding the outermost trees (Hoffman et al. 1993). Importantly, travel corridors must be maintained to roost sites; corridors should be no less than 91 m (300 ft) wide and contain a BA of 18.4 m2/ha (Hoffman et al. 1993).

4) Management should stress protection of known or potential roost sites. Two to six potential roost sites per mi2 should be established (Hoffman et al. 1993). If known roost sites occur, potential roost sites (2-6 per mi2) should be established within 0.4 to .08 km (0.25 to 0.5 mi) of the existing roosts. Hoffman et al. (1993) assert that all trees within roost sites should be protected regardless of size, which stresses the importance of high canopy cover needed by turkeys at roost sites.

5) Although turkeys show a preference for roosting on slopes greater than 30 percent, turkeys will also roost on gentle slopes less than 30 percent, so these areas should also be considered when implementing management activities (Hoffman et al. 1993).

Grazing Management

Moderate grazing may stimulate new herbaceous growth, but continuous, intensive grazing depletes invertebrate abundance and reduces the cover component necessary for poult growth and development (Hoffman et al. 1993, Rumble and Anderson 1993b). Livestock are usually attracted to openings and riparian areas, which are also important turkey habitats. Livestock utilization of herbaceous vegetation should not exceed 50 percent (Hoffman et al. 1993).

Openings

Openings are an important habitat component in that they provide a source of invertebrates, which are critical to poult development. Growth and development of turkey poults is linked to invertebrate abundance, which in turn is linked to the abundance of herbaceous vegetation in meadows (Rumble et al. 2003). Adult turkeys also use openings year-round for feeding, and for breeding during spring. The amount of herbaceous biomass within openings influences turkey use of these areas, and the value of openings to turkeys becomes increasingly important if adequate forage does not exist under the forest canopy or if there is poor mast production (Hoffman et al. 1993). Turkey poult survival is generally low (Rumble et al. 2003). Consequently, forest management activities that maintain high quality meadows with an abundant herbaceous vegetation and invertebrate component might increase poult survival (Rumble et al. 2003). Hoffman et al. (1993) provides habitat management guidelines regarding openings for turkeys. The following management guidelines apply only to those portions of the Forest that comprise turkey habitat, primarily those areas consisting of ponderosa pine, pinyon-juniper, and gambel oak habitat types.

1. In forested areas comprising turkey habitat, management should work towards maintaining ten to 25 percent of the area in natural or created openings. Several small openings ranging in size from 0.8 to 2 hectares (2-5 ac) scattered within the forest provides more usable habitat than one large opening, however all openings should be considered important turkey habitat regardless of size or origin.

2. If management activities result in the creation of openings within areas designated as turkey habitat, direct management to establish openings in mesic or alluvial sites because these sites are more productive to turkeys, especially hens with poults. Hoffman et al. (1993) recommends creating long, narrow openings with an irregular edge and not exceeding 73 m (240 ft) in width. Scott and Boeker (1977) provide slightly more flexibility regarding meadow width, suggesting that cleared strips no wider that 90 m (295 ft) would be adequate for turkey management. If the above meadow configurations cannot be achieved for meadows larger than 4 hectares (10 ac), than shrub thickets or tree clumps should be maintained within these areas. Trees encroaching into small openings or natural meadows should be removed, and slash should be removed from created openings to promote growth of herbaceous vegetation. If applying seed mixtures to created openings, they should consist of native grasses (50%) and forbs with emphasis toward large seeded grasses and legumes. Hoffman et al. (1993) suggests that disturbance-tillage can be used in portions (20%) of openings to promote annual forbs.

3. Herbaceous vegetative cover within openings should exceed 70 percent. Management that works towards providing at least 897 kilograms/hectare (800 pounds/acre) of standing herbaceous biomass and vegetation heights of at least 25.4 cm (10 in.) will provide suitable cover and food for poults. Management should work towards maximizing herbaceous vegetation heights in openings, with a goal of reaching 38.1 cm (15 in.). If the herbaceous biomass goal is not attainable in some openings due to poor site conditions, then the height goal should take priority.

4. Adequate escape cover should adjoin openings, consisting of shrub thickets and tree stands exceeding 23 $m^2$ (100 $ft^2$/acre) BA for at least 91 m (300 ft) from the forest-meadow edge. Course woody debris beneath the forest canopy within 15 to 18 m (50-60 ft) of openings should be retained for potential loafing sites.

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