

[Maps: MSO habitat; NOGO habitat; and 4FRI with forest and district boundaries are not here yet but can be found in the DEIS]

Four-Forest Restoration Initiative Coconino and Kaibab NF Environmental Impact Statement

DRAFT Wildlife Specialist Report

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Contents

Introduction	3
Project Area Location and Description	3
Applicable Laws, Regulatory Requirements, and Best Available Science.....	5
Regulatory Framework.....	5
Methodology.....	8
Wildlife Analysis Questions and Units of Measure for Evaluation.....	8
Methodology Used for Data Collection and Analysis	10
Affected Environment	21
Location and Setting.....	21
Coconino and Kaibab Forest Plan Management Areas, Geographic Areas, and Land Use Zone.....	21
Vegetation Cover Types Within Project Area	30
Federally Listed Threatened, Endangered, Sensitive, and Proposed Species and Critical Habitat	41
Forest Service Sensitive Species	68
Forest Service Management Indicator Species.....	98
Migratory Birds and Important Bird Areas	121
Description of Alternatives	126
Alternative A - No Action.....	127
Alternative B– Proposed Action.....	128
Alternative C	129
Alternative D	130
Design Features, Best Management Practices and Mitigation	131
Assumptions Used to Evaluate No Action and Action Alternatives Common to All Species Analyses	141
Environmental Consequences	142
Climate Change Common to All Alternatives	143
All Alternatives - Cumulative Effects	147
Federally Listed Threatened, Endangered, Sensitive, and Proposed Species and Critical Habitat	157
Forest Service Sensitive Species	261
Forest Service Management Indicator Species.....	339
Migratory Birds and Important Bird Areas	372
Forest Plan Compliance - Hiding and Thermal Cover	383
Literature Cited [Not Complete]	388

Introduction

This report documents existing and desired conditions, and effects analysis for threatened, endangered and proposed species and critical habitat listed under the Endangered Species Act of 1973, as amended, Region 3 Sensitive Species, Management Indicator Species, and Migratory Birds and their habitats within the Four-Forest Restoration Coconino and Kaibab NF project area. Regulatory requirements for effects analysis and determinations have been met using the best available science and professional judgment. Best available science and methodology used for the wildlife analysis is described in this report by species and/or species assemblage.

The objective of this analysis is to reestablish forest structure, pattern, and composition, which will lead to increased forest resiliency and function. Resiliency increases the ability of the ponderosa pine forest to survive natural disturbances such as insect and disease, fire, and climate change (FSM 2020.5). This project is expected to put the project area on a trajectory towards comprehensive, landscape-scale restoration with benefits that include improved vegetation biodiversity, wildlife habitat, soil productivity, and watershed function.

The detailed description of the alternatives as well as the analysis for each proposed restoration action is described in the Silviculture Specialist Report and Fire Ecology Specialist Report. This report incorporates these reports by reference and includes a less detailed description of the alternatives for effects analysis.

Project Area Location and Description

The Forest Service assessed a 988,764 acre project area on the Coconino and Kaibab National Forests. The result of the assessment is a proposal to conduct restoration activities within a treatment area totaling about 587,923 acres on the Coconino NF and Kaibab NF. About 356,115 acres of treatment would occur on the Coconino NF with most of the work focused on the Flagstaff Ranger District and limited treatments included on the Mogollon Rim and Red Rock Ranger Districts. About 231,809 acres of treatment would occur on the Williams and Tusayan Ranger Districts of the Kaibab NF (Figure 1).

Within the 988,764 acre project area, approximately 380,000 acres have been excluded from this proposal. Over 204,957 acres are being analyzed in separate vegetation analyses, over 30,000 acres are located in special areas that include designated wilderness, and over 145,000 acres are non-Forest Service administered lands.

Due to the size of the project area, the landscape was divided into six restoration units (Table 1). A restoration unit (RU) is a contiguous geographic area that ranges from about 46,000 acres to 333,000 acres in size. A need for change (vegetation structure, pattern, spatial arrangement, potential for destructive fire behavior and effects) was identified for each RU.

RU 1 and 2 include portions of the Flagstaff, Mogollon and Red Rock ranger districts (Coconino NF). RU 1 is generally located south of I-40 and east of I-17 and RU 2 is generally located west of I-17 and south of the Mogollon Rim. Note that no treatments are proposed in RU 2. RU 3 includes portions of the Williams district (Kaibab NF), Flagstaff and Red Rock districts (Coconino NF) and is generally located south of I-40 and west of I-17. RU 4 includes portions of the Flagstaff district and the Williams district. It is generally located north of I-40 and west of

Highway 180. Communities in the vicinity of proposed treatments include Flagstaff, Munds Park, Mormon Lake, Tusayan and Williams, Arizona.

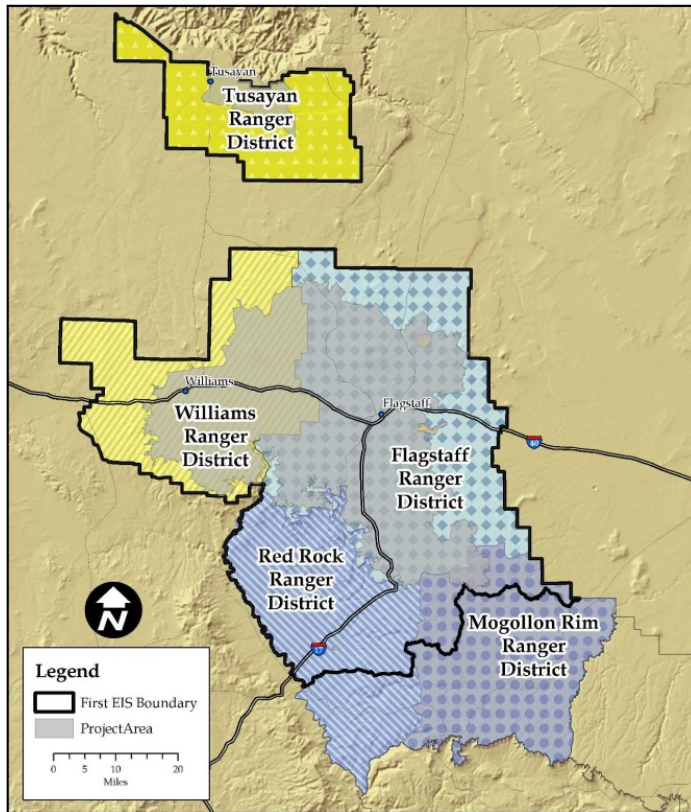


Figure 1. Coconino NF and Kaibab NF ranger districts within the project area

Most of this unit is not ponderosa pine. The team further stratified each RU into several sub-units that range from 4,000 to 109,000 acres in size. Both divisions (RU and sub-units) are based on 6th code watershed boundaries, state and forest transportation systems and the Forest's administrative boundaries (Figure 2).

The 4FRI is primarily focused on ponderosa pine forest. The overall objective is to restore or move the forest on a trajectory leading to restoration (see page 9 of the Draft EIS). Within and adjacent to the treatment area are other vegetation cover types. The 4FRI will take advantage of opportunities to improve wildlife habitat within grassland, savanna, and meadows, Gambel oak associations within the pine, aspen, pinyon-juniper woodlands, and springs and ephemeral channels. The term meadow is used in this report to identify grassy openings within ponderosa pine forest. Meadows are essentially grasslands as identified by soil type (i.e., true mollisols) but function differently from grasslands in terms of wildlife habitat. Meadows can be thought of as openings within the forest whereas grasslands are more extensive openings that may contain widely scattered groups or individual trees. Meadows identified in the 4FRI are typically dominated by ponderosa pine trees. Additional details on vegetation within the project area, the stratification of forested and non-forested land within the project area and analysis area for each species is described on pages 34 to 42. The desired condition is to restore tree density and pattern to the natural range of variability, while meeting forest plan requirements for Mexican spotted

owl (MSO) protected and target/threshold habitat and goshawk nest stands. Canopy gaps and interspaces would provide adequate space for the development of rooting zones for tree groups and an increase in the grass/forb understory. Canopy gaps and interspaces between tree groups or individuals, based on site productivity and soil type, would range from 10 percent on highly productive sites to as high as 90 percent on those soil types that have an open reference condition. Pre-settlement tree evidence would be used to help determine the historic range of variability in tree densities.

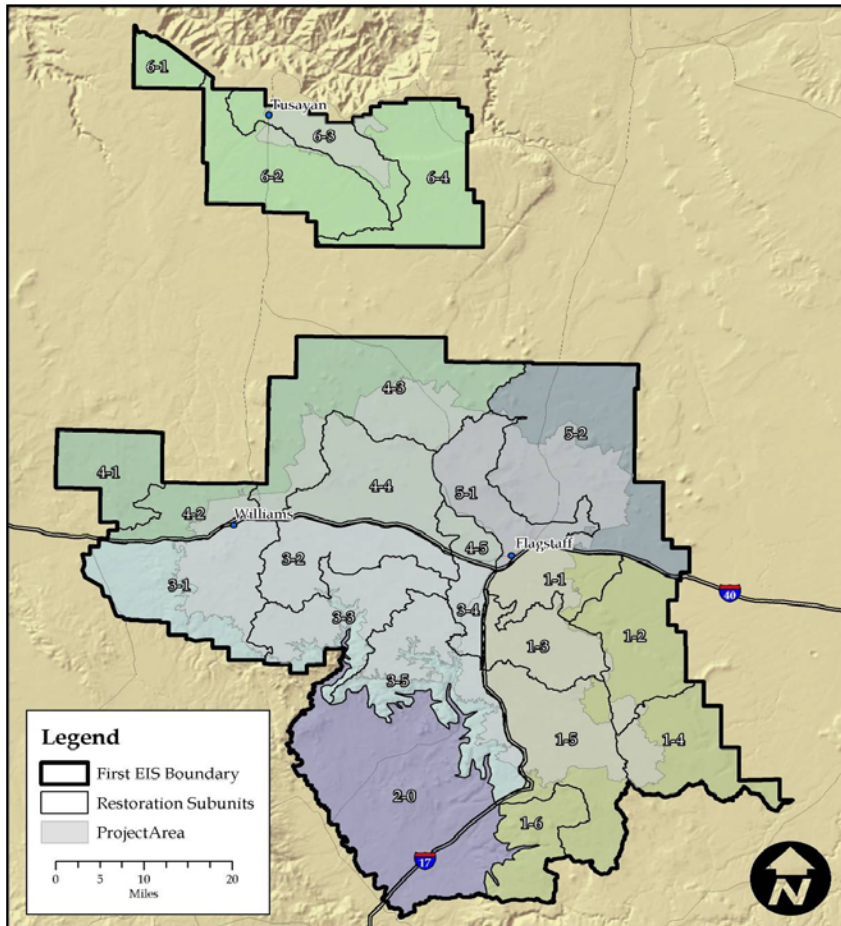


Figure 2. Restoration sub-units within the project area

Applicable Laws, Regulatory Requirements, and Best Available Science

Regulatory Framework

The Forest Service is legally required to comply with a number of federal laws, regulations, and policy, including: the Endangered Species Act of 1973, as amended (ESA), the Bald and Golden Eagle Protection Act of 1940, as amended (Eagle Act), Forest Service Manual (FSM) 2600, the Migratory Bird Treaty Act of 1918 (as amended), Executive Order 13186 (migratory birds), National Environmental Policy Act, 1969, National Forest Management Act, 1976 (as amended), and Coconino National Forest Land and Resource Management Plan, 1987 (as amended).

Endangered Species Act (ESA)

The ESA directs all Federal agencies to use their authorities to carry out programs for the conservation of listed species. It prohibits Federal agencies from carrying out actions likely to jeopardize the continued existence of species listed under the Endangered Species Act. It further requires federal agencies to consult with the Fish and Wildlife Service (FWS) on actions authorized, funded, or carried out by such agencies that may affect listed species and/or their designated Critical Habitat. The ESA mandates consultation with the Secretary of the Interior whenever an action is likely to jeopardize the continued existence of any species proposed for listing as threatened or endangered, or whenever an action might result in destruction or adverse modification of Critical Habitat proposed for listing.

The Endangered Species Act (ESA, PL 93-205), Forest Service Manuals (FSM) 2670.11, 2670.21, and 2670.31, and Forest Plan standards and guidelines all require that National Forest land be managed for both conservation and recovery of endangered, threatened, and proposed (TEP) species. Section 7(a)(2) of the ESA requires that the agency actions are not likely to jeopardize the continued existence of federally listed species. FSM 2670 directs Forests to manage habitats, to assist in the recovery of TEP species, and to avoid actions “which may cause a species to become threatened or endangered”.

Forest Service Manual (FSM) Direction

The biological evaluation (BE) was prepared in accordance with FSM direction 2672.42 and meets legal requirements set forth under Section 7 of the Endangered Species Act of 1973, as amended, and implementing regulations [19 U.S.C. 1536 (c), 50 CFR 402.12 (f) and 402.14 (c)] to ensure that Forest Service actions do not contribute to loss of viability of any native or desired non-native plant or animal species, or contribute to trends toward Federal listing of any species; and, to provide a process and standard by which to ensure that threatened, endangered, proposed, and sensitive species receive full consideration in the decision making process.

The National Forest Management Act of 1976

The National Forest Management Act of 1976, required the Secretary of Agriculture to develop guidelines for land management planning with the individual forest being the planning unit or area. The Act states that “Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area.” (36 C.F.R. § 219.19). A viable population is defined as “[a population] which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area.” (§ 219.19). Therefore, management of viable populations is intended to be accomplished at the individual National Forest level (planning area).

National Environmental Policy Act of 1969 (NEPA)

NEPA established procedures for decision making, disclosure of effects, and public involvement on all major federal actions. Forest Service Manual 1950.2 requires a consideration of the impacts of Forest Service proposed actions on the physical, biological, social, and economic aspects of the human environment (40 CFR § 1508.14).

Forest Service Sensitive Species

Sensitive species are defined as "those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by: a) significant current or predicted downward trends in population numbers or density, or b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution (FSM 2670.5(19)). A primary objective of Forest Service policy is to develop and implement management practices to ensure that species do not become threatened or endangered due to Forest Service actions (FSM 2670.22). Key policies regarding sensitive species are to 1) assist states in achieving their goals for conservation of endemic species, 2) as part of the National Environmental Policy Act process, review programs and activities, through a biological evaluation, to determine their potential effect on sensitive species, 3) avoid or minimize impacts to species whose viability has been identified as a concern, 4) if impacts cannot be avoided, analyze the significance of potential adverse effects on the population or its habitat within the area of concern and on the species as a whole, but the decision must not result in loss of species viability or create significant trends toward federal listing, and 5) establish management objectives in cooperation with the state when projects on National Forest system lands may have a significant effect on sensitive species population numbers or distributions. Establish objectives for federal candidate species, in cooperation with the U.S. Fish and Wildlife Service and Arizona State (FSM 2670.32).

Management Indicator Species (MIS)

Management Indicators are: "Plant and animal species, communities, or special habitats selected for emphasis in planning, and which are monitored during forest plan implementation in order to assess the effects of management activities on their populations and the populations of other species with similar habitat needs which they may represent" (FSM2620.5). Forest-wide assessments summarize current knowledge of population and habitat trends for management indicator species on both the Coconino (USDA Forest Service 2002) and Kaibab (USDA Forest Service 2010) NFs. Additional site specific (Game Management Unit) population information was provided by Arizona Game and Fish Department with their annual survey results.

Migratory Bird Treaty Act (MBTA)

Migratory Bird Treaty Act (as amended 1998) implements Conventions between the United States and four neighboring countries (Canada, Mexico, Japan, and Russia) for the protection of migratory birds and has specific provisions in the statute that includes: Establishment of a Federal prohibition, unless permitted by regulations, to "pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird, included in the terms of this Convention . . . for the protection of migratory birds . . . or any part, nest, or egg of any such bird." (16 U.S.C. 703).

Neotropical Migratory Birds

Executive Order (EO) 13186, signed January 10, 2001, lists several responsibilities of federal agencies to protect migratory birds, among them: (1) support the conservation intent of the migratory bird conventions by integrating bird conservation principles, measures, and practices

into agency activities and by avoiding or minimizing, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions.

Bald and Golden Eagle Protection Act (Eagle Act)

The Eagle Act, originally passed in 1940, prohibits the take, possession, sale, purchase, barter, offer to sell, purchase, or barter, transport, export, or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit (16U.S.C 668(a);50CFR 22). “Take” is defined as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb” a bald or golden eagle. The term “disturb” under the Eagle Act was recently defined via a final rule published in the Federal Register on June 5, 2007 (72 FR 31332). “Disturb” means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.

All golden and bald eagles are protected under the Eagle Act. Project analysis must determine if take is likely to occur with implementation of the action alternatives. The U.S. Fish and Wildlife Service (FWS) issued a report titled Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocols; and Other Recommendations in Support of Golden Eagle Management and Permit Issuance (Pagel et. al 2010) to protect golden eagles.

E.O. 13443 Facilitation of Hunting Heritage and Wildlife Conservation

The purpose of this order is to direct Federal agencies that have programs and activities that have a measurable effect on public land management, outdoor recreation, and wildlife management, including the Department of the Interior and the Department of Agriculture, to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitat.

Forest Plans

Forest Plans (as amended): Forest Plans provide specific goals, objectives, standards, and guidelines for management activities on National Forest lands. The Coconino National Forest Plan (USDA 1987a, as amended 2011) and Kaibab National Forest Land Management Plan (USDA 1987b, as amended 2011) determine standards and guidelines for snags and downed logs, wildlife cover, raptor nest buffers, old growth, turkey nesting and roosting habitat, and bear habitat. They also provide wildlife direction for other programs, including forest management, range management, recreation, etc. Both plans incorporate the Mexican Spotted Owl (MSO) Recovery Plan (USDI 1995) and Management Recommendations for the Northern Goshawk (Reynolds et al. 1992). Because wildlife direction is interwoven throughout both forest plans, the large volume of text can be reviewed in Appendix 1.

Methodology

Wildlife Analysis Questions and Units of Measure for Evaluation

1. What effect would temporary road construction and reconstruction, road decommissioning, road relocation, road use during project implementation and related disturbances have on Threatened, Endangered and Forest Service Sensitive Species,

forest-wide MIS populations and their habitat trends, and migratory birds in the project area?

Unit of measure: miles of road by habitat/vegetation type.

2. What effect would thinning and its related disturbances have on **Threatened, Endangered and Forest Service Sensitive**, forest-wide **MIS** populations and their habitat trends, and **migratory birds** in the project area?

Units of measure: acres treated by habitat/vegetation type; change in numbers per acre of snags, logs, and coarse woody debris (CWD); changes in percent distribution of tree size-classes, changes in canopy, habitat associated with the numbers of springs restored and miles of ephemeral channel restored, future fire behavior, relative change in biomass yield of herbaceous understory species, qualitative changes in tree diversity; and changes in acres of wildlife cover.

3. What effect would prescribed burning and its related disturbances have on **Threatened, Endangered and Forest Service Sensitive**, forest-wide **MIS** populations and their habitat trends, and **migratory birds** in the project area?

Units of measure: acres treated by habitat/vegetation type; change in numbers per acre of snags, logs and CWD; changes in percent distribution of tree size-classes, changes in canopy, habitat associated with the numbers of springs restored and miles of ephemeral channel restored, changes in future fire behavior; relative change in biomass yield of herbaceous understory species, qualitative changes in tree diversity; and changes in acres of wildlife cover

4. How would project activities affect **Threatened, Endangered and Forest Service Sensitive**, forest-wide **MIS** populations and their habitat trends, and **migratory birds** in the project area?

Unit of measure: change in numbers per acre of snags, logs and CWD; changes in percent distribution of tree size-classes, changes in canopy, habitat associated with the numbers of springs restored and miles of ephemeral channel restored, future fire behavior; relative change in biomass yield of herbaceous understory species, qualitative changes in tree diversity; and changes in acres of wildlife cover.

5. How would project activities affect individual animals and populations listed as **Threatened Species, eagles, and goshawks**?

Units of measure: acres treated by habitat/vegetation type; change in numbers per acre of snags, logs and CWD; changes in percent distribution of tree size-classes, changes in canopy, habitat associated with the numbers of springs restored and miles of ephemeral channel restored, future fire behavior; relative change in biomass yield of herbaceous understory species, qualitative changes in tree diversity; and changes in acres of wildlife cover.

6. How would the project affect wildland fire risk in and adjacent to Threatened, Endangered, Sensitive Species, and MIS and their habitats?

Units of measure: changes in Fire Regime Condition Class, change in percent distribution of tree size-classes, relative changes in canopy continuity, and changes in fire behavior.

7. How would the project affect potential impacts of climate change on wildlife?

Units of measure: changes in percent distribution of tree size-classes, changes in tree density, and changes in the relative measure of herbaceous understory biomass yield, changes in Fire Regime Condition Class, and changes in fire behavior.

8. How would project activities in combination with other federal, state, and private projects affect Threatened, Endangered, Forest Service Sensitive Species, and MIS and their habitats?

Units of measure: evaluation of acres of disturbance that overlap in time and space by individual species and/or assemblage of species (e.g. thinning, burning, road miles, etc).

Methodology Used for Data Collection and Analysis

Best Available Science

This analysis is based on best available scientific information. Data sources included research and life history literature (see literature cited section and appendices), forest plan standards and guidelines (“Forest Plans,” page 8 above), participation of researchers and managers from other agencies (as cited in this report), approved survey protocols, professional judgment, and the integration of other specialist reports from this project (silviculture, fire, soils and watershed, and transportation) to determine impacts to wildlife species and their habitats (see project record for additional information). The 4FRI interdisciplinary team developed spatially defined databases for use in a Geographic Information System (GIS) from which the majority of the data and information contained in this report were derived. This database includes variables related to forest structure and forest health, i.e., wildlife habitat such as snags, downed logs, tree density, size-classes, and species, old growth, wildlife habitat classifications, and understory biomass index (see project record for additional information).

Spatial and Temporal Scales

Effects to species and their habitats were evaluated at multiple scales. Depending on the species and specific analysis, this could include the site (based on stand data), restoration subunit (see figure X), restoration unit (RU; see figure X), and/or individual forest. Data used was generated from modeling identified in the silviculture report (McCusker, unpublished report). Short-term is post treatment (2020), representing conditions after all tree cutting and tree removal occurs followed by prescribed burning in 2015 and in 2019. The temporal timeframe for short term effects associated with aspen treatment is 2020 (when tree cutting is complete) and 2023 (when one prescribed burn would be conducted). Long-term is 30 years post-treatment, 2050.

Details on modeling to evaluate fire risk and departure from historical fire regimes can be found in the fire specialist’s report. Details regarding habitat associated with springs and ephemeral stream channels are in the soils and watershed report. All specialist reports can be located in the project record.

Whenever possible, species-specific habitat and locality data were used. Additionally, data queried by Potential Natural Vegetation Type (PNVT) and forest plan Management Area (Coconino NF) or Geographic Area (Kaibab NF) were used to help with analysis of effects to species’ habitats.

Modeling and Habitat Evaluation

Mexican Spotted Owl Habitat

The Mexican spotted owl Recovery Plan (USDI FWS 1995; “Recovery Plan”) estimated that most Forest Service project planning in the southwestern region occurred at about the 10,000 acre

scale, which they describe as a “limited spatial scale” that precluded a review of MSO habitat at more meaningful ecological scales (USDI 1995). The scale and ecological emphasis of 4FRI created an opportunity to look at landscape scales for designating restricted habitat, including target and threshold habitat. Working closely with the US Fish and Wildlife Service (“FWS”) and wildlife biologists from both National Forests, we reviewed restricted, target, and threshold habitats in the greater 4FRI area (Appendix 2). Previously, the Kaibab NF had developed restricted and target and threshold habitat layers in the mid-1990s for the Williams Ranger District. The Coconino NF designates restricted and target and threshold habitat on a project-by-project basis. Each approach has its advantages. However, in the case of the Kaibab NF, more and newer data is now available. On the Coconino NF, individual projects may not encompass the best available habitat, but ten percent of the restricted habitat within that project-specific boundary was still designated target and or threshold habitat. One of the strengths of landscape-scale planning is the ability to compare habitat across large ecological scales as encouraged in the Recovery Plan. A new target and threshold layer was created within the 4FRI treatment area (see project record for additional information). This large scale approach better meets the goal of providing continuous replacement nesting and roosting habitat over *space* and time.

Meetings were held among wildlife biologists from the USFWS, both National Forests, and members of the 4FRI team on March 4th, 2011. A strategy was developed from these meetings for designating new target and threshold habitat across the 4FRI treatment area. This effort did not include habitat in current or recent projects or within mixed conifer habitat. Those acres are not part of the 4FRI planning effort. Following Recovery Plan guidelines, we identified the best restricted habitat as target and threshold habitat across the 4FRI project area rather than by individual RD or NF. Although the Kaibab and Coconino NFs share a common border across much of the 4FRI project area, the pine-oak forest structure changes on either side of this administrative line. Pine-oak forest on the Coconino NF frequently supports large diameter oak in size-classes suitable for MSO nesting and roosting. Trees large enough for MSO nesting are less common on the Kaibab NF where Gambel oak most frequently occurs in a shrubby form (Chambers 2002). Along with this habitat difference is a clear shift in MSO occupancy. MSO densities are greatest in the center of the range and decrease toward the range periphery (USDI 1995). The Williams RD is at the extreme western edge of the species range across the Mogollon Plateau. No MSOs have been detected in the pine-oak forests on the Williams RD in over 20 years of project surveys other than the last detection of a bird associated with Bill Williams Mountain in 1994. Because of the marked difference between MSO occupancy between the NFs, we focused designation of target and threshold habitat on the Coconino NF where MSOs are much more common.

To be sure to capture the best pine-oak habitat for evaluation as restricted, target, and threshold habitats, data from the Kaibab and Coconino NFs (based on polygons) was merged with pine-oak data from the Lab of Landscape Ecology and Conservation Biology (raster data; Dr. Steve Sesnie and Jill Rundall, Northern Arizona University), were merged into one GIS layer (see project record for additional information). Existing or potential nesting and roosting habitat within this new layer was stratified by the following queries:

- Pine and oak stands with 150 BA
- Stands with at least 10 percent of the trees as oak or 10 BA oak greater than five inches diameter at root crown (drc)
- trees 12 to 18 inches dbh and greater than 18 inches dbh

- ≥ 20 tpa 18 inches dbh or greater
- Northerly (more sustainable) aspects, ranging from 292° to 67° (WNW to ENE)

This subset of stands was then further stratified by describing stands in terms of:

- Trees 18 to 24 inches dbh and trees greater than 24 inches dbh
- Oak 5-12" drc and oak > 12" drc.
- ≥ 20 percent BA of oak greater than five inches drc
- Identifying slopes 0-20 percent, 20-40 percent, and slopes greater than 40 percent (steeper slope was assumed to support moister site conditions more sustainable through time; slopes greater than 40 percent were separated out as protected habitat)

The results of these queries were reviewed on March 11th, 2011 by biologists with on the ground familiarity for both the Coconino and Kaibab National Forests. Blocks of habitat were reviewed to evaluate whether roads and powerlines would fragment selected. Acres were dropped if additional detail was known regarding habitat quality (e.g., juniper was sometimes misidentified as oak in the remote-sensed data from NAU), proximity to designated camping areas (including designated 300 foot camping corridors) under the Travel Management Rule Rule (final as of September, 2011), or if adjacent to likely haul routes for removing logs and forest products during 4FRI project implementation.

Evaluations compared forest structure, long-term sustainability of selected stands, and the practicality of future occupancy by MSOs, e.g., stands were selected to provide strategically located blocks of habitat that could potentially function as future MSO PACs and provide landscape connectivity for MSOs (versus creating relatively small, scattered islands of isolated habitat). Fire threat was also included in the spatial configuration of future MSO habitat in that we sought to augment protected habitat by identifying neighboring stands as restricted habitat, assuming that known or suspected owl use indicated higher quality habitat. However, predominant winds come from the southwest on this landscape so we rarely identified additional MSO habitat southwest of existing PACs unless they had northerly aspects. Conversely, areas southwest of PACs were evaluated for treatments that would reduce future risk of high-severity fires from entering PACs. Finally, field reviews evaluating a subset of stands was performed in autumn, 2011.

Over 12 percent of the new restricted habitat layer was designated as target and threshold habitat. Subsequent data reviews, field visits and familiarity of ground conditions by district personnel led to a drop in total restricted habitat, lowering the ratio of target and threshold habitat to about 11 percent. More importantly, this process has identified habitat in areas that support MSOs and are capable of developing habitat that can sustain MSOs in the future.

A similar process was initiated to consider the potential for specialized treatments in MSO PACs. Working closely with the FWS and wildlife biologists from both National Forests, we reviewed each individual PAC in the 4FRI planning area. At this point project boundaries had not yet been specified, so this review effort looked at PACs that could potentially be within the 4FRI treatment area. The habitat status of 117 PACs out of 195 total PACs on both Forests was individually appraised to ascertain whether mechanical treatments within the PAC could better move the habitat towards desired conditions versus, avoiding mechanical treatments inside all PACs. Evaluations included dominant forest type (e.g., pine-oak or mixed conifer), habitat structure, available demographic data (i.e., owl occupancy and productivity), topographic attributes (e.g., aspect and slope), human access, designated wilderness boundaries, recent and ongoing projects

affecting PAC habitat, fire history, status of current habitat, and whether mechanical treatments would move the habitat towards the desired conditions described in the Recovery Plan. Potential improvements to MSO habitat were defined as follows:

1. Decrease in the amount of time required for increasing tree height and diameter;
2. Decrease in overall tree density in selected stands within PACs while maintaining density of large trees; and
3. Increase in canopy height to improve flight zone (i.e., improve owl foraging ability) and reduce canopy fire threat.

It was agreed no mechanical treatments would occur in core areas. Prescribed burning was recommended for all PACs that were evaluated, including core areas. Mechanical treatments were deemed unnecessary for 99 of the 117 PACs assessed (Figure 3). PACs were not considered for treatment if they were previously treated by other projects ($n = 32$), habitat had been recently altered by fire ($n = 10$), PACs occurred in habitats outside the scope of 4FRI (e.g., mixed conifer, designated wilderness, or canyon habitat; $n = 20$), habitat conditions inside the PAC boundary were such that active management was not necessary ($n = 11$), treatments outside the PAC were such that active management was not necessary inside the PAC ($n = 24$), or there simply was not enough information to prompt a proposal for treatments ($n = 2$). A total of 18 of the 117 PACs were recommended for mechanical treatments to improve habitat quality within the PAC boundary.

Data evaluations were followed by field visits to a subset of PACs potentially being proposed for treatment (see Appendix 3). Vegetation simulation modeling was completed on all stands within the 18 PACs. Modeling indicated 10,800 total acres within the 18 PACs could be improved with mechanical treatments (see Silviculture report).

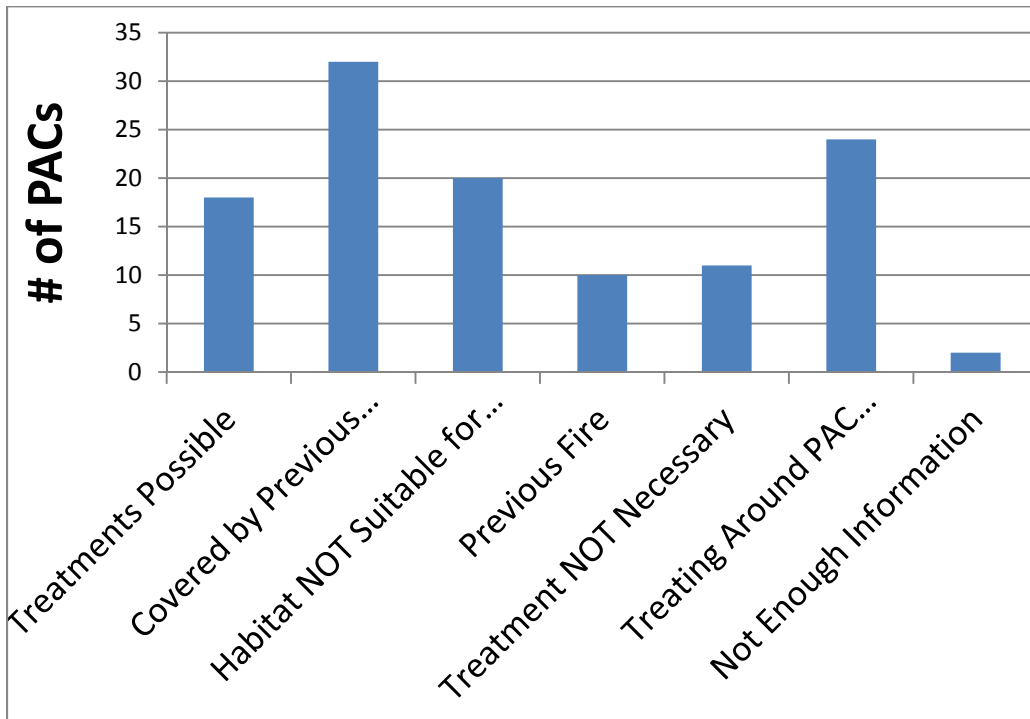


Figure 3. 4FRI MSO PAC Evaluation by Number of PACs and Category (2011-2012)

Goshawk Habitat

Coconino NF and Kaibab NF forest plan direction states “Use site quality to identify and manage dispersal PFA and nest habitat at 2 - 2.5 mile spacing across the landscape” for identifying potential goshawk post-fledgling family areas. Dispersal post-fledgling family areas (dPFAs) are intended to retain potential habitat for adult goshawk pairs in areas that appear suitable but where surveys were never completed. The process of identifying dPFAs started with a meeting among wildlife biologists from both National Forests and the 4FRI team (February 2, 2011). A follow-up meeting occurred on February 14, 2011. See appendix 2 of this report for data and documentation related to evaluating goshawk habitat for this analysis. The following criteria were identified for designating dPFAs in areas of high quality habitat potentially capable of supporting a breeding pair of goshawks:

- Only include areas within ponderosa pine or pine/oak cover types consisting of uneven aged forest
- Buffer existing PFA’s 1.25 miles
- Blocks of habitat occurring with ≤ 50 percent overlap with the above PFA buffers qualified for evaluation as dPFA habitat; by default, if areas occurring between known PFAs overlapped the PFA buffers by more than 50 percent, they were not carried forward as potential dPFA habitat
- Exclude areas within: existing projects with completed NEPA; designated wilderness areas; private and State lands ; and mollisol soils (indicating historic grasslands)

- Use forest stand data (and FFE stand data) to select for: Vegetation Structural Stages 4s, 5s, and 6s; TPA 18 inches dbh and larger; numbers of large (≥ 18 inches dbh) snags; and Crown Base Height to identify potential goshawk habitat
- Compare data query results with orthoquad photos and topographic maps

Once areas were identified that met the above criteria, the delineation of dPFA boundaries incorporated the use of a new goshawk-habitat relationships model developed in an independent process. A spatially explicit landscape-scale predictive model of the relationships between northern goshawks and their habitat was being developed at the Lab of Landscape Ecology and Conservation Biology, Northern Arizona University (Dr. Brett Dickson). This model is under review and will be submitted for publication in a scientific journal. The model was used to assess habitat blocks resulting from the queries listed above and allowed an unbiased evaluation of habitat that could be applied at landscape scales using the best science available. Dispersal PFAs were carried forward as if they were occupied and silvicultural treatments assigned to them the same as known occupied PFAs.

A description of the development of the silviculture database can be found in the silviculture specialist's report. Model outputs from silvicultural and prescribed burning treatments were incorporated into this analysis. Details on the models can be found in the respective specialist's reports. The exercise resulted in the designation of 19 dPFAs totaling 11,279 acres.

Habitat Connectivity

Arizona Game and Fish Department (AGFD) provided GIS files of habitat linkages developed as part of the Coconino County Wildlife Connectivity Assessment: Report on Stakeholder Input (AGFD 2011). Working with AGFD, proposed 4FRI treatments were evaluated within priority linkage areas in terms of wildlife connectivity concerns (i.e. closed canopy/interior habitat, open habitat). Maps of AGFD proposed linkages were overlaid with multiple layers of GIS data to inform discussions of stand treatments. "Open" corridors typically fit within or amongst mollisol and mollic intergrade soils or included stands that connected patches of the historic grassland and savanna habitats. "Closed/interior" corridors were evaluated across the entire project area one area at a time to identify the best and most sustainable closed forest habitat. Treatments were modified to balance the intent of the linkage areas with site conditions. Typically, treatment intensity was adjusted to meet the intent of the linkage corridor. Lower intensity treatments were assigned to leave more trees and smaller openings within closed canopy/interior corridors and higher intensity treatments were used to leave fewer trees and larger openings within open habitat corridors. For example, changes in interior corridors frequently changed treatments intended to provide 40 to 55 percent openings post-treatment to either 10 to 25 percent or 25 to 40 percent openings. In open linkages, treatments designed to provide 40 to 55 percent openings were typically increased to a savanna treatment where stands overlapped mollic-intergrade soils. Savanna treatments are designed to restore an open reference condition within ponderosa pine forest using occurrence of mollic-intergrade soils as a guide. On occasion, the corridor itself was adjusted so that target conditions did not go against the ecology of the site. For example, if a true mollisol soil occurred within an intended "closed corridor," the corridor was shifted to other soil types. Additionally, alternative C was changed from burn-only treatments to mechanically cutting invading pines and pine plantations within open linkages in grasslands (i.e., on true mollisol soils). In this way, ecologically-based, site-specific decisions were used to create connectivity at landscape scales. All data and documentation related to the evaluation of habitat connectivity is located in Appendix 4.

Forest Attributes and Wildlife Needs (FAAWN)

Forest Attributes and Wildlife Needs is a national-scale model with a supporting relational database that was published in the book *Forest Wildlife Ecology and Habitat Management* by Dr David Patton (2011). FAAWN is a model that uses wildlife biology and habitat relationships data. It includes data from R3HARE, a model originally developed for southwestern national forests in Region 3 of the USFS by School of Forestry Faculty at Northern Arizona University, Flagstaff (Patton and Chambers 2002). Dr. Patton has served as Dean of the School of Forestry at Northern Arizona University on three separate occasions, has worked in wildlife and ecological planning around the world, and early in his career worked for the research branch of the USFS. He formatted and enhanced FAAWN specifically for use by 4FRI.

Habitat Capability

NFMA directs National Forest managers to maintain enough habitat adequately distributed across each forest to maintain populations of designated MIS. Wildlife theories such as carrying capacity and habitat effectiveness were adopted in the respective forest plans to assist forest managers in meeting this direction. Habitat capability models were originally developed to inform managers on the amounts, distributions, and kinds of habitat needed to maintain populations of MIS (Hurley et al. 1982). The output from habitat capability models is an index ranging from zero to one. A habitat capability index (HCI) of zero means an area does not support the resources necessary to maintain a given species and a value of one equals optimal habitat for that species. The word “optimum” is important because the intent of the modeling was to estimate the optimum density or carrying capacity of a species in a given area without deteriorating its environment (USDA 1987). Carrying capacity is a theoretical value influenced by a variety of factors, including weather, human activities, other wildlife populations, and stochasticity. Since the forest plans were published in the late 1980s, the concepts of habitat capability indices and defining the carrying capacity of an area has largely fallen out of favor.

HCI models are based on a limited number of variables that influence the habitat needed to maintain a reproductive pair of a given species (Hurley et al. 1982). HCI models provide a simple form for understanding major environmental factors thought to be the most influential on the occurrence and abundance of a wildlife species. Each habitat variable is defined as a range of values. While many of the habitat variables are not difficult to identify, defining a numeric range of values for each habitat component can be highly subjective. Each range of values is then broken down into expected ranges of low, medium, or high value to each particular species. Frequently a species’ habitat requirements are represented by two broad habitat categories: forage (any habitat where a species may obtain food, including vegetation for herbivores and prey for predators) and cover (including thermal, nesting, denning, hiding, etc.) (Hurley et al. 1982). It is assumed that the HCI represents the final response of a wildlife species to the combination of environmental variables included in the model (Morrison et al. 2006). However, HCI models do not provide information on population size, trend, or behavioral response of animals to shifting conditions (Morrison et al. 2006). Reviews of this model construct have shown they tend to perform poorly and should be viewed as only presenting a hypothesis on species – habitat relationships and not casual functions (Morrison et al. 2006). They provide purely deterministic predictions with no statements of uncertainty leading to results that are not particularly interpretable and which should be viewed with caution (Morrison et al. 2006).

Both the Coconino and Kaibab forest plans adopted the HCI approach in the 1980s when these approaches were new to managers. The intent was to estimate the carrying capacity of each MIS and assign an HCI target for maintaining appropriate habitats on the landscape (USDA 1987 and 1988). HCI modeling was not used in the 4FRI wildlife analyses because the HCI approach does not meet direction for use of the best available science. Instead, ecosystem management can be viewed in terms of the evolutionary environment or range of natural variability under which habitats and their associated species evolved (Fule et al. 2002, Abella 2008).

The desired conditions for the 4FRI project are intended to move forest structure towards the historical range of variation and therefore represent the evolutionary environment of ponderosa pine forest in northern Arizona. Meeting or moving forest conditions towards desired conditions is expected to result in more resilient wildlife communities and more sustainable wildlife habitat by moving them towards the evolutionary environment. This follows the recommendations by Abella (2008) for managing wildlife communities within an ecosystem context which therefore promotes more vigorous plant communities, healthy soil processes, and overstory tree structures reasonably consistent with the evolutionary environment under which the communities evolved. This approach has been incorporated into the MIS analyses contained in this report by comparing habitat elements such as early seral-habitat, late-seral habitat, or large snags, to the desired conditions specifically developed to represent the historical range of variation.

The comparison of habitat elements is done among alternatives and through time. The landscape was grown into future years using the Forest Vegetation Simulator (FVS). FVS is a model used for predicting forest stand dynamics throughout the United States and is the standard model used by various government agencies including the USDA Forest Service, USDI Bureau of Land Management, and USDI Bureau of Indian Affairs (Dixon 2008). The FVS is an individual tree, distance independent growth and yield model with linkable modules called extensions, which simulate various insect and pathogen impacts, fire effects, fuel loading, snag dynamics, and development of understory tree vegetation. FVS can simulate a wide variety of forest types and stand structures has been used extensively to summarize current stand conditions, predict future stand conditions under various management alternatives (Dixon 2002). FVS is continually updated to correct known deficiencies, take advantage of technological advances, incorporate additional data into model relationships, and improve default values and surrogate species assignments (Dixon 2002).

This process allows comparisons of alternatives, including the no action alternative (alternative A). While still a modeling-based approach to changes in wildlife habitat, this approach provides much more rigor than comparing an estimated habitat capability index to a theoretical carrying capacity with no evaluation criteria to assess how well the model functions. This approach better meets the intent of the forest plans. Although the HCI model was not specifically used (forest-specific models are no longer available on either the Coconino or Kaibab NF), the approach used in this analysis is consistent with the intent of the forest plans in terms of maintaining appropriate habitats on the landscape. All data related to assessing a surrogate for HCI is located in MIS effects analysis (pages 334 to 367).

Hiding and Thermal Cover

Providing for hiding and thermal cover is required by both forest plans. Hiding cover is intended to conceal animals from observation and this mitigate potential human disturbance. It is defined as enough vegetative cover to hide 90 percent of a standing elk from a viewer at a distance of 200

feet or less. Thermal cover intended to ameliorate weather effects and consist of coniferous trees with a high degree of crown closure. Both plans direct for at least 10 percent hiding cover and 10 percent thermal cover in assessment areas. An additional 10 (Coconino NF) to 20 percent (Kaibab NF) of cover can be either unless the needs of species listed as threatened or endangered under the ESA conflicts with this direction (USDA 1985, 1987). Wildlife cover on the Coconino NF should be assessed in 10,000 acre blocks while the Kaibab describes cover assessments in terms of project areas. Both are intended to ensure that cover is provided across the area under consideration and not concentrated in some regions and absent from others. However, neither scale meets the intent of the forest plans when applied to the 4FRI treatment area. Ten thousand acre blocks are small relative to 4FRI and the project area is too large. Therefore, wildlife cover will be evaluated at the subunit scale, allowing for an assessment of unit areas fully distributed across the treatment area.

Both plans were written before the 1996 amendment that moved management from relatively even-aged stand-based objectives to an interspersed of various-aged groups and clumps of trees. Sizes of tree groups and canopy cover developed for the 4FRI are from the scientific literature and site conditions assigned by the Terrestrial Ecosystem Survey. The resulting forest structure is designed to meet or move towards forest plan direction (e.g., even-aged stands cannot attain uneven-aged conditions in a single entry). This approach does incorporate the best science available to better meet the intent of the forest plans. In the context of the 4FRI cover assessment, stands that meet the following conditions were defined as hiding cover:

1. Ponderosa pine stands that average VSS 2-4 B or C (B = canopy cover of 40 to 60 percent and C = canopy cover greater than 60 percent) the denser canopy cover values indicate denser forest structure
2. All MSO protected habitat outside PACs – by definition these are slopes greater than 40 percent and have not been harvested in the last 20 years (PACs are too variable to generalize as meeting hiding cover)
3. All MSO restricted habitat (because of the oak component)
4. Pine-oak with 500 tpa or greater of oak less than five inches dbh (note: this is outside restricted habitat but can include elements of PAC habitat)
5. All pine-sage habitat
6. Ponderosa pine with pinyon pine and/or alligator, one-seed, and/or Utah junipers 500 tpa or greater and less than five inches dbh
7. Ten BA or 10 percent BA of pinyon pine and/or alligator, one-seed, and/or Utah junipers greater than five inches dbh and
8. Any stands meeting VSS 2BC, 3BC, or 4BC.

However, if the above conditions are met in UEA, (uneven-aged) , IT (intermediate thin), or SI (stand improvement) 40-55 treatments, only half the acres would count due to the higher intensity of the treatments and increased open space. The stands would still be dominated by dense trees or support a woody understory, but the amount of openings would prevent the whole stand from functioning as hiding cover.

The rationale for numbers 1 through 7 above is that, regardless of the VSS class, the understory is developed enough to provide hiding cover. The canopy conditions are such that, in number eight, even without woody understory species, the forest would be dense enough in these smaller diameter classes that sight distances would still be broken-up by the number of tree boles.

Thermal Cover was simply defined as VSS 4BC, 5BC, and 6BC, except for the treatments resulting in 40-55 percent openings. If UEA, IT, and SI 40-55 treatments meet the above conditions, only half the acres would count due to the higher intensity of the treatments and increased open space. The stands would still be dominated by dense large trees, but the amount of openings would prevent the whole stand from functioning as thermal cover.

Hiding and Thermal Cover Assumptions

One of the design criteria with the 4FRI project is that no oak, pinyon, or juniper will be cut. However, trees would be lost due to mechanical damage and fire. The FVS modeling accounts for some loss of trees through the burning prescriptions. If the modeled stands meet the above criteria, they will be counted as providing cover.

Whenever a modeled stand drops from canopy categories B or C to A, it will be assumed that there will not be adequate tree densities to provide cover. Similarly, if the VSS class for a stand drops from 3 or more to a 1 (seedlings), it will not count as cover. Treatments designed to meet wildlife-urban interface, open-habitat corridors, or savanna objectives will count towards cover. Slope by itself does not contribute to thermal cover.

The following assumptions were made for treatment intensities:

- Stands designed to have 10 to 25 percent openings are comparatively closed forests
- Stands designed to have 25 to 40 percent openings are relatively open forests in the short-term (see definition of short term provided earlier in this report) due to the combination of VSS 1s & 2s along with the intended openings but they are only moderately open forests in long-term
- Stands designed to have 40 to 55 percent openings are comparatively open forests

Final assessments for cover categories included a combination of treatment intensity, VSS category, canopy cover, and woody plant species other than pine. All data and documentation related to hiding and thermal cover is located in Appendix 5.

Surveys

Wildlife surveys have been conducted on the two Forests since the late 1980s. Surveys specific to the 4FRI analysis began in 2010 and are continuing. Surveys for particular species or species group follow approved protocol or follow the recommendations of the U.S. Fish and Wildlife Service and/or the Arizona Game and Fish Department:

- Mexican spotted owl surveys utilized the survey protocol developed by the U.S. Fish and Wildlife Service. The Mexican spotted owl survey protocol was first developed in 1988 by the Southwest Region of the U.S. Forest Service and has been revised several times, most recently by the U.S. Fish and Wildlife Service
- Surveys for northern goshawks use the Southwestern Region Protocol
- Northern leopard frog surveys follow the recommendations of the U.S. Fish and Wildlife Service and the Arizona Game and Fish Department
- Personnel from the Kaibab South Zone and Flagstaff Ranger Districts carry out surveys along established routes for wintering bald eagles each year in January and these efforts are coordinated with the Arizona Game and Fish Department

- Game surveys are conducted by the Arizona Game and Fish Department
- Forestwide landbird surveys, including many MIS and migratory bird species, were initiated on the Kaibab NF in 2005 and on the Coconino NF in 2006. Rocky Mountain Bird Observatory took the lead for this effort in 2007. This effort became part of the “Integrated Monitoring in Bird Conservation Regions” (IMBCR) project which uses a spatially balanced sampling design to allow inferences to avian species occurrence and population sizes from local scales to entire Bird Conservation Regions (<http://www.rmbo.org/public/monitoring/>). Data will continue to be collected in 2012
- Tassel-eared squirrel surveys were incorporated into the landbird surveys starting in 2005. Statistical problems were discovered in the study design when data analysis was initiated in 2010. The survey methodology was adjusted and implemented with the 2011 surveys. Preliminary results from the 2010 analysis are presented in this report.

Additional survey information can be found in the individual species sections and in appendix 6.

Field Reviews

Field reviews specific to 4FRI were conducted to verify conditions in MSO habitat and cave resources within the 4FRI treatment area. Seven separate trips were made to select PACs to evaluate the potential for mechanical treatments to improve nesting and roosting habitat. Trips were made by the wildlife biologists, silviculturalist, fire ecologist, and team lead from the 4FRI planning team. Trips also included district personnel from the Coconino and Kaibab NFs, including people from the wildlife and fire programs. Also participating in joint and in separate PAC field reviews were personnel from the Flagstaff Field Office of the USFWS. See Appendix 3 for details from these efforts.

Field visits were done to evaluate the designation of target and threshold habitat. The wildlife field crew from the Flagstaff district checked stands selected for different reasons, including areas where remote imagery might have misidentified cover (juniper classified as oak was noted in the GIS exercises, particularly on the Kaibab NF) or where conditions might lead to marginal habitat. Field checks on MSO habitat were conducted in September and October of 2011 after the crew had spent the season surveying for goshawks and MSO. Field teams were able to review 84 individual stands designated as target or threshold habitat, including 23 on the Coconino NF and 61 on the Kaibab NF. Data was recorded in each stand visited, including total BA, average dbh, slope, aspect, and the percent of overstory by species. The stands were ranked from “bad” to “very good” along with comments on the general habitat viewed. A series of photos were taken in just over half of the stands. Overall, 91 percent of the stands ranked as “Okay” (n = 15) or “Good” (n = 61). Seven stands were considered “Bad” and one stand was “Very Good.”

A total of 34 caves occur in the treatment area or within 300 feet of treatment boundaries. The subterranean program director from Bat Conservation International has been visiting caves in cooperation with the 4FRI planning team. Since January of 2010 through April of 2012 he has surveyed a total of 42 natural caves on the Kaibab and Coconino National Forests. The purpose of the visits is to establish baseline data and significance of these features. Four field trips were conducted to evaluate potential relationships between forest restoration and cave management (Appendix 2). Visits to basalt and limestone features revealed direct and unintended impacts were possible. Cave resource reviews by Bat Conservation International are continuing to determine use by roosting bats. The result of these findings is that a no-management buffer will be designated around each cave to prevent siltation, exposure of cave entrances to direct sunlight and

subsequent alteration of the cave twilight zone, and to avoid heavy machinery from unknowingly operating over shallow subterranean passages.

Scientific Literature

Scientific literature citations for references used in the development of this analysis are listed at the end of the document. Understory Response to Changes in Overstory Cover (Appendix 8) summarizes literature pertinent to soils resources, plant community structure and composition, water and nutrient cycles, forage production, biodiversity, wildlife habitat, and fire effects across the Four Forest Restoration Initiative landscape. This document is the basis for comparing vegetative response to proposed treatments and corresponding wildlife response to those changes. A review of MSO biology, ecology, and habitat components is presented in Appendix 7.

Affected Environment

A diverse assemblage of wildlife (species identified under the ESA, Forest Service sensitive, MIS, migratory birds) are known to occur or have habitat within or adjacent to the treatment area. Each species that occurs or have potential to occur within the project area are analyzed within their respective sections. In some cases, surveys for these species have confirmed their presence in or near the project area. In cases where a species has not been detected, the presence of suitable habitat indicates they could be present and therefore their presence was assumed under this analysis. Aquatic TES and MIS are addressed in the Fisheries Specialist Report. Sensitive plant species are addressed in the Botany Specialist Report. The effects to Mexican spotted owl are also analyzed in a separate Biological Assessment (BA) for the purpose of section 7 consultation with the U.S. Fish and Wildlife Service.

Location and Setting

See the DEIS for descriptions of the project's location and acres that have been excluded from the project area.

Coconino and Kaibab Forest Plan Management Areas, Geographic Areas, and Land Use Zone

The project area includes 23 management areas (MA) as described in the Coconino NF forest plan (pp. 46 to 206-113). Because the FLEA MA incorporates 10 MAs, the location-specific direction in the various MAs has been utilized (per forest plan direction). The MAs located within the project area, forest plan MA emphasis specific to wildlife, and the relationship between MA total acreage to the project are displayed in Table 1.

On the Kaibab NF, the project area includes five geographic areas (GAs) and one land use zone (LUZ). Approximately 183, 729 acres of GA 2 (Williams forestland) and 41,012 acres of GA 10, (Tusayan forestland) is proposed for treatment in the project area. About 8,353 acres of treatment are proposed within GA 1 (Western Williams Woodland), 3 (North Williams Woodland), and GA 8 (Tusayan Woodland). Treatments are proposed within about 1,049 acres of LUZ 21, existing developed recreation sites.

For additional information, see chapter 4 of the forest plans (Coconino NF Forest Plan, pp. 21 to 206-118), Kaibab NF Forest Plan (pp. 16 to 114) where detailed descriptions of forest-wide

resource direction specific to the management or geographic areas can be found. A summary of management emphasis specific to wildlife is presented in the table.

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Table 1. Project Area Management Area, Geographic Area, and Land Use Zone Emphasis and Acres

Forest Plan Management Areas (MA) and Geographic Areas (GA) within the project area*	Description	Forest Plan emphasis relevant to wildlife	Forest-wide MA and GA acres	MA and GA acres within project area	Acres/Percent (%) of forest-wide MA/GA proposed for treatment
MA 3	Ponderosa pine and mixed conifer on less than 40% slope	Manage habitat for the following indicator species through ISM: Turkey, Goshawk, Pygmy nuthatch, Elk, Abert squirrel, Red squirrel, Hairy woodpecker, Spotted owl	511,015	236,245	190,763/37
MA 35	Lake Mary Watershed	Re-introduce fire's natural role as much as possible, and ponderosa pine lands progress towards desired forest structure, including northern goshawk and Mexican spotted owl habitats.	62,536	59,301	37,801/60
MA 38	West	Within the Urban/Rural Influence Zone, and along the Highway 89A corridor, reduce the risk of catastrophic wildfire, emphasize daytime recreation activities, both motorized and non-motorized, balance recreation demands with protection of the soils, water, wildlife and vegetation, and maintain public access to public lands. Maintain wildlife travelways.	36,298	36,134	19,538/54
MA 33	Doney	Restore natural grasslands, and promote healthy pinyon/juniper woodland. Ponderosa pine lands progress towards desired forest structure (goshawk habitat).	40,530	25,779	14,023/35

Forest Plan Management Areas (MA) and Geographic Areas (GA) within the project area*	Description	Forest Plan emphasis relevant to wildlife	Forest-wide MA and GA acres	MA and GA acres within project area	Acres/Percent (%) of forest-wide MA/GA proposed for treatment
MA 36	Schultz	Reduce the risk of catastrophic wildfire, especially within the Urban/Rural Influence Zone. Reintroduce fire's natural role as much as possible. Balance recreation demands with protection of the soils, water, vegetation, and sensitive species. Ponderosa pine lands progress towards desired forest structure (goshawk habitat).	21,289	21,130	7,069/33
MA 37	Walnut Canyon	Reduce fire risk in urban/rural interface zone, progress towards desired forest structure including MSO and goshawk habitats	20,566	18,030	6,420/31
MA 13	Cinder Hills	Management Indicator Species for this MA are mule deer, pygmy nuthatch, and hairy woodpecker	13,711	13,732	13,670/99
MA 6	Unproductive timber lands	Emphasize a combination of wildlife habitat, watershed condition, and livestock grazing. Other resources are managed in harmony with the emphasized resources. Manage for the following indicator species: Elk, Abert's squirrel, Mule Deer, Hairy woodpecker	67,146	12,115	11,628/17
MA 4	Ponderosa pine and MC above 40%	Emphasize wildlife habitat, watershed condition, and dispersed recreation. Management intensity is low. Manage for the following indicator species: Turkey, Goshawk, Pygmy nuthatch, Elk, Abert squirrel, Red squirrel, Hairy woodpecker, Spotted owl	46,382	11,793	8,107/18

Forest Plan Management Areas (MA) and Geographic Areas (GA) within the project area*	Description	Forest Plan emphasis relevant to wildlife	Forest-wide MA and GA acres	MA and GA acres within project area	Acres/Percent (%) of forest-wide MA/GA proposed for treatment
MA 32	Deadman Wash	Restore and maintain grasslands and grassland adapted wildlife species, especially antelope. Provide large tracts of un-roaded landscape for disturbance sensitive species and remote recreation experiences.	58,133	11,659	11,380/20
MA 31	Craters	Restore natural grasslands, re-establish or maintain fire in pinyon-juniper woodland	29,940	8,969	8,969/15
MA 10	Transition Grassland/Sparse PJ above Mogollon Rim	Emphasize range management, watershed condition, and wildlife habitat. Other resources are managed to improve outputs and quality. Emphasis is on prescribed burning to achieve management objectives. Manage for antelope, indicator species.	160,494	8,544	8,012/5
MA 9	Mountain Grasslands	Emphasize livestock grazing, visual quality, and wildlife habitat. Smaller mountain meadows in remote areas are managed mostly for wildlife habitat, especially for elk summer range. Manage for the following indicator species: antelope, elk	9,049	7,102	5,385/60
MA 20	Highway 180 Corridor	Scenic attraction, access to year-round recreation and Grand Canyon NP. Manage local and temporary roads intersecting with Hwy 180 as needed to enhance wildlife habitat, dispersed recreation and safety .	7,608	6,213	4,237/56

Forest Plan Management Areas (MA) and Geographic Areas (GA) within the project area*	Description	Forest Plan emphasis relevant to wildlife	Forest-wide MA and GA acres	MA and GA acres within project area	Acres/Percent (%) of forest-wide MA/GA proposed for treatment
MA 7	PJ Woodlands < 40%	Emphasize firewood production, watershed condition, wildlife habitat, and livestock grazing. Wildlife habitat management emphasizes forage production on 0 to 15 percent slopes, in conjunction with firewood harvest using Integrated Stand Management (ISM). Manage for the following indicator species: plain titmouse, mule deer, elk	273,815	3,206	3,203/1
MA 5	Aspen	Emphasize a combination of wildlife habitat, visual quality, firewood production, watershed condition, and dispersed recreation with other resources and uses managed to be compatible. Manage for the following indicator species: yellow bellied sapsucker and mule deer.	3,450	2,761	695/20
MA 28	Schnebly Rim	Schnebly Hill Road serves as a seasonal gateway for visitors entering the redrock landscape from Interstate 17. Conserve wildlife habitat, especially winter range for deer, elk and turkey.	5,090	2,455	2,455/48
MA 34	Flagstaff	Reduce the risk of catastrophic wildfire, emphasize daytime non-motorized recreation opportunities and balance recreation demands with protection of the soils, water, wildlife and vegetation, and maintain public access to public lands.	1,781	1,675	1,460/82

Forest Plan Management Areas (MA) and Geographic Areas (GA) within the project area*	Description	Forest Plan emphasis relevant to wildlife	Forest-wide MA and GA acres	MA and GA acres within project area	Acres/Percent (%) of forest-wide MA/GA proposed for treatment
MA 18	Elden Environmental Study Area	Lessen risk of catastrophic wildfire and maintain shrubs, such as Arizona cliffrose, that provide winter food source for deer.	1,577	1,611	337/21
MA 12	Riparian and Open Water	Emphasize wildlife habitat, visual quality, fish habitat, and watershed condition on the wetlands, riparian forest, and riparian scrub. Manage for the following indicator species: cinnamon teal, Lincoln's sparrow, yellow breasted chat, Lucy's warbler, macroinvertebrates. Defer logging activities from April 15 to June 30 in known bear maternity areas.	20,490	653	609/3
MA 8	PJ Woodlands greater than 40 %	Wildlife habitat management emphasizes forage production on 0 to 15 percent slopes, in conjunction with firewood harvest using Integrated Stand Management (ISM).	19,077	248	248/<1
MA 15	Developed Recreation Sites	developed recreation emphasis – no relevant wildlife direction	874	805	48/6
MA 14	Oak Creek Canyon	Wildlife habitat, healthy stream conditions and clean air and water are protected.	5,388	7	7/<1

Forest Plan Management Areas (MA) and Geographic Areas (GA) within the project area*	Description	Forest Plan emphasis relevant to wildlife	Forest-wide MA and GA acres	MA and GA acres within project area	Acres/Percent (%) of forest-wide MA/GA proposed for treatment
Kaibab National Forest					
GA 2	Williams Forestland	Emphasis areas include suitable timberland, recreation, grazing, and wildlife habitat. Improve habitat components and diversity through vegetative manipulations and the coordinated interaction of other planned resource practices.	308,394	299,842	181,371/59
GA 10	Tusayan Forestland	Emphasis areas include suitable timberland, recreation, grazing, and wildlife habitat. Principal elk calving, deer and pronghorn antelope fawning, and turkey nesting habitat in the Tusayan District are located here. Improve habitat components and diversity through vegetative manipulations and the coordinated interaction of other planned resource practices.	86,250	43,559	41,012/48
GA 1	Western Williams Woodland	Emphasis includes wildlife habitat (including quality winter and summer habitat for elk and deer), sandstone products, scenic routes and features, grazing, and wild burro territory. Improve habitat components and diversity through vegetative manipulations and the coordinated interaction of other planned resource practices.	169,041	4,807	3,360/2

Forest Plan Management Areas (MA) and Geographic Areas (GA) within the project area*	Description	Forest Plan emphasis relevant to wildlife	Forest-wide MA and GA acres	MA and GA acres within project area	Acres/Percent (%) of forest-wide MA/GA proposed for treatment
GA 3	Northern Williams Woodland	Emphasis includes winter wildlife habitat for mule deer, elk, pronghorn, and turkey, scenic routes and features, and grazing. Improve habitat components and diversity through vegetative manipulations and the coordinated interaction of other planned resource practices.	65,533	3,485	3,475/5
GA 8	Southern Tusayan Woodland	Emphasis includes wildlife habitat, scenic routes and features, grasslands, and grazing. Improve habitat components and diversity through vegetative manipulations and the coordinated interaction of other planned resource practices.	195,118	1,518	1,518/1
LUZ 21	Existing Developed Recreation Sites	Emphasis includes existing public and private sector developed recreation sites and other smaller sites (trailheads, interpretive sites, etc.) There is no specific emphasis for wildlife.	1,556	1,049	1,049/67

Vegetation Cover Types Within Project Area

The dominant forest on the Coconino and Kaibab NFs is ponderosa pine. Similarly, the majority of the treatment area is ponderosa pine (86 percent), but other habitat types include pine/oak (eight percent), water (less than one percent), aspen (less than one percent) and grasslands, savannas, and meadows (eight percent) (Table 2). A map of the dominant cover types can be found in the silviculture report. Cover types are summarized by RU across the analysis area (593,211 acres).

Table 2. Vegetation Cover Type Acres by Restoration Unit (RU)

Cover Type	Cover Type Acres by RU					
	RU 1	RU 3	RU 4	RU 5	RU 6	Total
Non-Vegetated						
Barren	120	134	129	1,301	48	1,732
Non-Forest Communities						
Grassland	8,230	12,799	22,665	4,987	93	48,774
Forest Communities						
Pinyon Juniper Woodland	1,427	5,884	7,283	8,845	2,219	25,658
Oak Woodland	287	1,633	926	523	30	3,399
Ponderosa Pine	145,793	129,225	134,301	61,671	41,188	512,178
Aspen	368	201	499	403	0	1,471
Total Forested Acres:	147,875	136,943	143,009	71,441	43,437	542,705
Total Analysis Area Acres:	156,225	149,876	165,803	77,730	43,578	593,211

Ponderosa Pine Forest

The ponderosa pine forest vegetation community is dominated by ponderosa pine but includes other species such as oak, junipers, and pinyon. Species such as aspen, Douglas-fir, white fir, and blue spruce may also be present, but occur infrequently as small groups or individual trees. This forest vegetation community typically occurs with an understory of grasses and forbs and sometimes includes shrubs. There are 512,178 acres of ponderosa pine forest in the project area.

The ponderosa pine forest includes two major associations or sub-types: Ponderosa pine-bunchgrass and ponderosa pine-Gambel oak. Associations are named for the most shade tolerant understory species successfully regenerating and which are most diagnostic for these sites.

Ponderosa pine commonly grows in pure stands and currently is found in even-aged and uneven-aged structural conditions across the area (see the silviculture report for details). The open park-like stands characteristic of the reference conditions for ponderosa pine forests promoted greater faunal diversity and fire resilience than the dense stands of today. Ponderosa pine forests within the project are generally denser and more continuous than in reference conditions and accumulations of forest litter and woody debris are much higher than would have occurred under the historic disturbance regime. Lack of fire disturbance has led to increased tree density and fuel loads that increase the risk of uncharacteristically intense wildfire and drought-related mortality. There is a moderate risk of insect and/or disease outbreak, which is also a function of increased tree density.

Ponderosa Pine – Understory Vegetation

Understory vegetation beneath ponderosa pine represents nearly all the vegetation species richness and diversity in southwest ponderosa pine forests. Herbaceous vegetation affects soil, supports the arthropod community which in turn provides other ecosystem services (e.g., pollination, pest control, soil health services, etc), and provides food and cover for most of the vertebrate wildlife (see Appendix 8 for details). Research conducted within the current 4FRI treatment boundaries has shown substantial declines in herbaceous vegetation diversity and biomass over the past century due to increased tree density, increased canopy cover, and increased litter depth. This trend indicates a shift away from a more diverse balance across a broad variety of understory plants to productivity dominated by pine trees. The ponderosa pine analysis area is dominated by high stand densities and closed tree canopies, locking up many nutrients that historically were available to herbaceous plants. The relative density of young to mid-aged trees is uncharacteristically high (see silviculture report, USDI 1995, and Appendix 8), creating closed canopy conditions that suppress understory growth. Current understory conditions represent a fraction of the herbaceous biomass that used to occur within the proposed 4FRI project area and declines are expected to continue with time (Appendix 8).

Ponderosa Pine – Gambel Oak

The ponderosa pine-Gambel oak association is a major sub-type of the ponderosa pine forests of northern Arizona. Gambel oak is a common understory species with ponderosa pine, but the forest plan and MSO Recovery Plan (Recovery Plan) provide definitions of the ponderosa pine-Gambel oak association based on basal area and/or percent of total trees. Gambel oak is frequently the only deciduous tree in the relatively pure southwestern ponderosa pine forests. Its presence adds diversity to forest structure and habitat, understory vegetation, and soil microflora (see Appendix 8 for details). Similar to pure ponderosa pine forests, pine-Gambel oak forests have been altered since Euro-American settlement in the late 1800s. These changes have resulted in an overall increase in small- and medium-sized Gambel oak stems and a more simplified forest structure (Abella 2008). Oak management strategies within this project includes conservation of all existing large, old oaks, maintaining a variety of growth forms and managing for densities similar to the historical range of variability for oak. Gambel oaks provide important elements of wildlife habitat. Small, brushy growth forms provide hiding cover; intermediate sizes have the highest mast production, and larger diameter trees (greater than 10 inches dbh) provide a range of

nesting substrates, including cavities and branching for cup and stick nesters. Pine encroachment will eventually lead to a reduction of Gambel oak in general and a loss of large diameter oak specifically. These changes in forest structure are expected to negatively affect wildlife in northern Arizona, including Management Indicator Species and migratory birds. Species likely affected include: elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), black bear (*Ursus americanus*), wild turkeys (*Meleagris gallopavo*), Abert's squirrels (*Sciurus aberti*), acorn woodpeckers (*Melanerpes formicivorus*), band-tailed pigeons (*Columba fasciata*), and many songbirds that derive part of their diet from Gambel oak. Some bat species occur more frequently in ponderosa pine-Gambel oak forests than ponderosa pine forests, including southwestern myotis (*Myotis auriculus*), Allen's lappet-browed bat (*Idionycteris phyllotis*), and red bats (*Lasirurs blossevillii*); and Gambel oak is an important component of MSO habitat (reviewed in Chambers 2002). Ponderosa pine – Gambel oak habitat is managed as Restricted Habitat under the MSO Recovery Plan (USDI 1995).

Summary

The above information describes several key habitat features outside the historical range of variation. Ponderosa pine forests within the 4FRI treatment area have less structural diversity due to more acres occurring as even-aged forest compared to historical conditions. Structure is also limited by the abundance of young and mid-aged stands and the decrease in mature and old-growth stands. These conditions do not meet forest plan direction for the ratio of age-classes interspersed across the landscape. The abundance of younger, continuous forest reduces canopy gaps. The loss of solar radiation reaching the forest floor, along with infilling of meadows, savannas, and grasslands, reduces understory vegetation. Habitat structural within the project area can determine the present or absence of wildlife species. Many wildlife species select habitat provided by large and old trees, including bark gleaners (e.g., pygmy nuthatches and hairy woodpeckers which are both MIS), cavity nesters (e.g., MSO which is a Threatened Species), communal roosting species (e.g., Allen's lappet-browed bats, a Sensitive Species), and larger/heavier nesting species (e.g., northern goshawks, a MIS and Sensitive Species). Simplifying structure and declines of habitat features like aspen, Gambel oak, and the herbaceous community reduce habitat for an array for wildlife species from multiple trophic levels, including invertebrate communities and larger carnivores.

Quaking Aspen

Within the project area, quaking aspen is limited to small patches within a larger forest matrix dominated by ponderosa pine or mixed conifer vegetation. Aspen is an early seral component of the ponderosa pine ecosystem and a species that provides for habitat diversity. Similar to Gambel oak, aspen provides diversity within the relatively homogeneous forest conditions of southwestern ponderosa pine. The leaf litter changes soil chemistry and micro-flora. Aspen snags provide nesting and foraging sites, creating habitat that sustains a diversity of avian species.

Aspen reproduces asexually through root suckers that are a clone of the original parent tree. Fire, insect, disease, wind and human disturbances regenerate this shade-intolerant species by opening up the canopy and removing conifers from the understory. Without disturbance, conifers gradually overtop aspen, close the canopy, and eventually kill the mature trees and reduce regeneration. Aspen is highly susceptible to browsing and disease or death due to bark injuries. Elk are particularly damaging to aspen, browsing on aspen suckers, rubbing antlers on mid-sized

trees and eating bark from larger trees. Aspen patches are regenerating successfully where ungulates are excluded by fencing.

There are approximately 7,700 acres of aspen in the project area. Most aspen within the project area show signs of decline. Aspen is dying or rapidly declining on both forests due to the combined effects of conifer encroachment, browsing, insect, disease, severe weather events, and lack of fire disturbance (USDA 2008, 2009). The desired condition is to maintain and/or regenerate aspen. Where possible, there is a need to stimulate growth and increase individual recruitment of aspen. Ungulate browsing has nearly eliminated aspen regeneration and insects, disease, and overtopping by pine is causing mortality and crown dieback in older trees. A study by Fairweather et al. (2008) on the Coconino NF indicates that aspen on low-elevation dry sites (<7500 ft) has sustained 95 percent mortality since 2000. Mortality on these sites is expected to continue as many live trees currently have only 10 to 30 percent of their original crown. There are unique habitat features associated with islands of aspen within a sea of ponderosa pine that are being lost and the loss is expected to continue under current conditions.

Pinyon – Juniper Woodlands

The pinyon-juniper cover type is collectively composed of the pinyon-juniper grassland, pinyon-juniper sagebrush, pinyon-juniper evergreen shrub and pinyon-juniper persistent woodland communities. Two-needle pinyon pine is common; as well as one-seed, Utah, Rocky Mountain, and alligator juniper. Species composition and stand structure vary by location primarily due to precipitation, elevation, temperature, and soil type. There are 25,658 acres of pinyon-juniper habitat within the analysis area.

Most of the pinyon-juniper vegetation communities are currently younger and denser than they were historically, because of changes in wildfire occurrence and past grazing. Greater tree density has increased competition for water and nutrients. This, in turn, has caused a reduction in understory plant cover and diversity, a loss of ground cover, and subsequent increases in soil erosion. Pinyon-juniper woodland supports a wider array of birds and mammals than ponderosa pine forest. Several species of birds are directly associated with pinyon-juniper habitats, including pinyon jays and juniper titmice, and woodlands provide key winter habitat for a range of species including ungulates and raptors. The pinyon-juniper communities support high densities of small mammals, making them important foraging areas for carnivorous mammals, birds, and snakes. Many species of wildlife select for large trees for foraging and large snags for nesting. Current conditions slow growth rates of trees, prolonging the time required to develop old and large trees. The delay in replacing this component of woodland habitat also delays future large diameter snag recruitment.

Grasslands, Savannas, and Meadows

Grasslands within the project area typically categorized as the productive Montane/Subalpine and the more arid Colorado Plateau/Great Basin and total 48,774 acres. Grasslands vary in size from just a few acres (“meadows”) to well over 1,000 acres and support a wide variety of species of grasses, forbs, shrubs and/or trees that vary by soil type, soil moisture, and temperature. Historically, grasslands typically had less than 10 percent tree cover. Savannas generally supported 10 to 30 percent tree cover and could appear as grasslands with scattered groups and individual trees. Technically, savannas are open forest but from the wildlife perspective they can function more like grasslands in terms of the habitat and its associated wildlife species. Meadows

permeated the open grown ponderosa pine forests of northern Arizona and are associated with mollic-intergrade soils (Appendix 8). The use of the term meadow in this report references dry meadows that are proposed for restoration treatments. Historically, tree regeneration was limited by the fire return interval. The vegetation within the 4FRI landscape has been described as a zonal pattern of grasslands within woodland and forest cover types (USDI 1995). Combined with the effects of diverse topography, there was an interspersed of grasslands, savannas, and meadows creating abundant and widespread forest-meadow interfaces (USDI 1995). Grasslands, savannas, and meadows provide valuable habitat for many wildlife species including pronghorn antelope (MIS), Bendire's thrasher and grasshopper sparrows (migratory birds), raptors such as burrowing owls, Swainson's hawks, and ferruginous hawks (Sensitive Species) and an abundance of small mammals including Navajo Mogollon voles and Merriam's and dwarf shrews (Sensitive Species). Changes in wildlife populations within grasslands, savannas, and meadows since Euro-American settlement in northern Arizona include: one species has been extirpated as a direct result of human activities (black-footed ferret [*Mustela nigripes*]); seven species, including birds and mammals, have decreased in abundance; and two species have increased in abundance (Brown and Davis 1998).

Impacts from grazing, logging, and fire suppression practices that started in the late 1800s are still discernible on the landscape today. These practices reduced or eliminated the vegetation necessary to carry low-intensity surface fires across the landscape, thereby altering the natural fire regimes and allowing uncharacteristic forest succession to take place. Ponderosa pine and other woody vegetation encroached upon or invaded the once open grasslands, savannas, and meadows due to disruption of the historic fire regimes and historic grazing patterns. Many of the pre-settlement trees that grew along the edges of these grasslands were removed historically. These edges as well as much of the interior of the grasslands have become stocked by sapling and young to mid-aged trees. These trees are growing rapidly due to the developed soils, open growing conditions and a lack of competition. As tree canopy increases, understory productivity decreases. These conditions have been further exacerbated by recent increases in invasive, nonnative plants, soil erosion, and low-density rural home development.

Over half of the total grassland acres across the Coconino NF and Kaibab NF have become encroached with trees and converted to forest. This represents a direct reduction in habitat for many grassland species. An assessment completed in 2008 found that within ponderosa pine on the Coconino NF, grasslands have decreased from approximately 8 to 3 percent since historic conditions (generally pre-1900). On the Kaibab NF, grasslands have decreased from approximately 15 percent to 7 percent. In addition to loss of habitat, pine encroachment decreases habitat effectiveness of remaining habitat. Tree encroachment changes the pH balance of soils and increases total lignin component, slowing decomposition rates. Increased shading reduces solar radiation reaching the ground and the trees compete for water and nutrient. The sum of these effects reduces biomass and decreases species richness in the herbaceous layer (see Appendix 8). The declining trend in the plant community can decrease hiding cover, forage, including arthropod biomass, affecting a broad range of vertebrate species. Many of the species affected by loss of meadows include important prey species for MSO and northern goshawks.

The vegetation database does not include "meadows" as a separate cover-type from grasslands. Meadows are smaller scaled open areas within forest habitat while, due to their inherent size, grasslands are a separate vegetation type. Some species are common in meadows but may avoid extensive grasslands (e.g., long-tailed voles) while others are common in grasslands but seldom select for meadows (e.g., pronghorn). Some of the wildlife discussions below focus on meadow

habitat and meadow restoration. Acreage summaries of these habitats are based on and dominated by actual grasslands. Sometimes acres of meadow can be identified because true grassland is limited or does not occur as in MSO protected habitat. Here all or nearly all “grassland” values in MSO protected habitat can be assumed to be meadows. Other times actual meadow acreage is unknown as in MSO restricted habitat where grasslands can be intermixed with MSO habitat and cannot be accurately identified as a stand-alone habitat component. Because grassland habitat is classified differently from forest habitats, a query of grassland acres within restricted habitat could not be accomplished. Therefore, acres of grassland and meadow treatments in restricted habitat were estimated by calculating those acres occurring within Critical Habitat boundaries. While this is known to likely be negatively biased, it is expected to provide a reasonable estimate to evaluate effects to restricted habitat.

The 4FRI treatment area includes nearly 48,500 acres of grassland that would benefit from prescribed burning and mechanical treatments, nearly 45,500 acres of encroached savanna (defined by mollic-intergrade soils), and small meadows scattered across nearly 311,000 acres of ponderosa pine forest.

Tree Density

Euro-American settlement in northern Arizona has altered wildlife populations indirectly through uncharacteristic changes in forest structure. Ponderosa pine forests within the project area are generally denser and more continuous than in reference conditions. The density of the forests and the continuous nature of the canopy simplifies forest structure from the perspective of wildlife habitat. Forest gaps or interspaces between tree groups are largely grown in with trees, limiting understory development (Silviculture report; Appendix 8). The abundance of trees and lack of fire has allowed an uncharacteristic build-up of forest litter and other fuels that suppresses understory development and sets up high severity fire and the risk of active crown fire. The combination of these characteristics reduces habitat both directly (effects vary by species) and indirectly (limiting forage for most species, including herbivores, insectivores, carnivores, and omnivores; Appendix 8) while maintaining a higher risk from high severity fire.

Stand density is relevant to wildlife because it affects both forest structure and forest health. In terms of wildlife habitat, this relates to habitat quality and resiliency. Common measures of stand density are basal area (BA), TPA, and stand density index (SDI). BA is the cross-sectional area of all trees, measured in square feet per acre. TPA is simply a count of the total number of trees on an acre. These summary statistics do not give an indication of tree sizes and therefore can be biased when used alone to determine site conditions. For example, using BA alone does not differentiate between a stand with many small trees or a stand with few big trees. These very different forms of wildlife habitat could have the same BA value. TPA alone does not reveal much information either. TPA by size-class is more informative, but without a reference to site potential, it does not address issues related to the health of the stand. However, Stand Density Index (SDI) is a relative measure of tree density based on the number of TPA and the mean diameter of the trees (Reineke 1933). SDI expresses tree size and density relative to the theoretical maximum density possible for trees of that diameter and species. SDI is a good indicator of how site resources are being used by the trees and so provides insight into habitat conditions such as open or closed growing conditions and susceptibility to stochastic events.

Long (1985) divided SDI percentages into four zones which consider the percent of an area occupied by trees relative to a maximum density possible for a given tree species at a particular

diameter (Table 3). Each zone describes the relationship between tree growth, competition, and potential mortality, which all relate to habitat resiliency. Based upon established forest density/vigor relationships, density-related mortality begins to occur once the forest reaches 45-50 percent of maximum stand density (zone 3), and mortality is likely at density levels of 60%+ of maximum stand density (zone 4).

Table 3. Relationships of Forest Density to Forest Stand Development and Tree Characteristics

% Maximum SDI*	Zone	Forest Stand Development and Tree Characteristics
0 – 24% Low Density	1	Less than full site occupancy, maximum understory forage production. No competition between trees, little crown differentiation. Maximum individual tree diameter and volume growth. Minimum whole stand volume growth.
25 – 34% Moderate Density	2	Less than full site occupancy, intermediate forage production. Onset of competition among trees, onset of crown differentiation. Intermediate individual tree diameter and volume growth. Intermediate whole stand volume growth.
35 – 55% High Density	3	Full site occupancy, minimum forage production. Active competition among trees, active crown differentiation. Declining individual tree diameter and volume growth. Maximum whole stand volume growth. Upper range of zone marks the threshold for the onset of density-related mortality.
56+% Extremely High Density	4	Full site occupancy, minimum forage production. Severe competition among trees, active competition-induced mortality. Minimum individual tree diameter and volume growth, stagnation. Declining whole stand volume growth due to mortality

*Ponderosa pine SDImax basis (450)

When existing conditions are summarized by BA, tpa, and percent of maximum SDI, most of the landscape is either approaching the onset of density-related mortality or currently in the range of active competition-induced mortality (Table 4). The average relative density is highest in RUs 1 and 3, which are well above the zone 4 threshold. Although there is site-specific variability in terms of habitat quality, both of these are key RUs for MSO. The average relative density in RUs 4 and 6 are on the high end of zone 3, while RU 5 is in the middle of zone 3. The high percent of maximum SDI indicates severe competition among trees so that, despite the site-specific

variation, the habitat is at risk from high-severity fire, insects, and disease. Conversely, forest health and resiliency is low on this landscape.

Table 4. Existing Forest Density by Restoration Unit

Restoration Unit	Acres	Basal Area		Trees Per Acre		% of Maximum Stand Density Index		
		Range	Avg.	Range	Avg.	Range	Avg.	Zone
1	145,793	31 to 270	136	73 to 8,850	789	20 to 100	66	4
3	129,225	14 to 227	132	86 to 2,050	711	8 to 100	63	4
4	134,301	13 to 197	115	59 to 1,620	450	6 to 89	51	3
5	61,671	35 to 197	98	107 to 1,442	472	20 to 92	45	3
6	41,188	53 to 144	98	297 to 1,462	823	31 to 76	51	3
Total	512,178	13 to 270	123	59 to 8,850	646	6 to 100	58	4

Based on these forest density relationships, a variety of stand and tree characteristics would develop by varying the timing, scale, and intensity management. For example:

- Grassy stands of open canopy, large-diameter trees with long, heavy-limbed crowns will develop by maintaining densities in zones 1 and 2.
- Stands of moderately dense canopy, intermediate-sized trees with thrifty, well-pruned crowns will develop by maintaining densities in the upper half of zone 2 and the lower half of zone 3.
- Clumpy, irregular stands containing groups of varying ages will develop by periodically making openings (regeneration group openings) where growing space is made available for seedling establishment. Growing space areas would fall into zone 1.
- Longevity of existing old-growth trees would be enhanced by thinning adjacent smaller trees to create zone 2 or 3 growing conditions.
- Maintaining dense stands while avoiding density-related mortality and maintaining forest vigor can be achieved by maintaining densities at or less than the lower half of zone 3.

The risk of insect and/or disease outbreak is also a function of increased tree density. Dense conditions (e.g., Zones 3 and 4) facilitate the outbreak of insects and disease, moving the forest further from the historical range of variation. Insects, disease, fires, and competition-induced mortality tend to disproportionately kill older trees. Large (greater than 18 inches dbh), old trees are already deficit on the landscape and take longer to replace (USDI 1995), moving the forest further from desired conditions. Overall, forest resiliency has decreased with the changes in forest structure over the last century.

Euro-American settlement in northern Arizona has also directly altered wildlife populations. These changes include: three mammal species extirpated as a direct result of human activities (grizzly bear (*Ursus arctos*), gray wolf (*Canis lupus*), and Merriam's elk (*Cervus elaphus*)); six species of birds and mammals have decreased in abundance; and nine species of birds and mammals have increased in abundance, including Abert's tree squirrels (Brown and Davis 1998). Gray wolves have since been reintroduced near the Arizona-New Mexico border and Rocky Mountain elk were introduced to Arizona in 1912.

The review of the existing conditions above illustrates the need to move vegetation structure and diversity towards desired conditions by creating a mosaic of interspaces and tree groups of varying sizes and shapes. The existing condition lacks diversity in forest structure, with key components such as large trees, open meadows, and pockets of aspen decreasing across the landscape. Moving towards a desired condition where forest structure consists of sustainable ratios all age and size classes would improve northern goshawk and Mexican spotted owl habitat, as identified in the 1996 forest plan amendment.

The above changes, along with maintaining areas of dense forest and connected forest canopy, would provide a range of wildlife habitats. Species associated with forest openings or deciduous woody species in association with pine currently have only a portion of their historic habitat available. Species that prefer dense pine forests have, in general, reduced forage availability whether they are herbivores, carnivores, insectivores, or omnivores.

Vegetation Structure in Goshawk and MSO Habitat

The northern goshawk standards and guidelines apply to the forest and woodlands that are outside of MSO Protected and Restricted areas. Within MSO Protected and Restricted habitat, the MSO standards and guidelines take precedence over the northern goshawk standards and guidelines, leading to dichotomy in desired conditions in the ponderosa pine forest. One or the other set of standards or guidelines apply to all forest and woodland communities, but the MSO standards always take precedence in areas of overlap. This dichotomy in management direction applies to the 4FRI analysis area and determines treatment types within the ponderosa pine forest (Figure 4). Acres of MSO and northern goshawk habitat within the project area are displayed in Table 5.

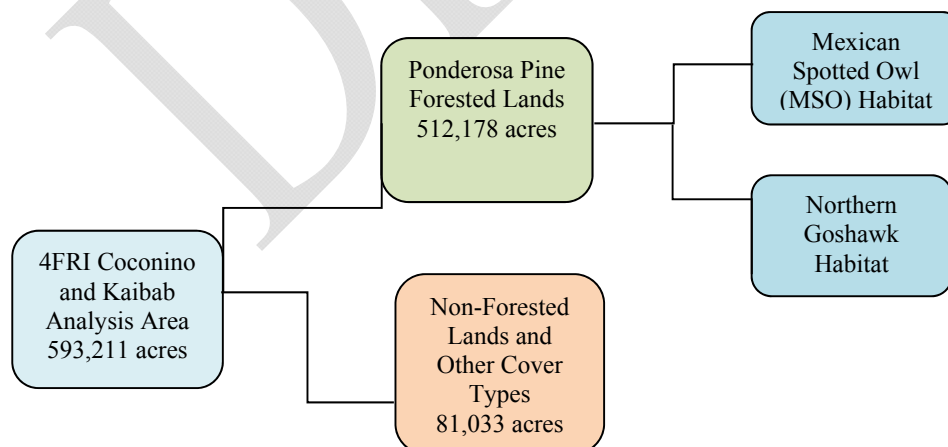


Figure 4. Stratification of ponderosa pine forested lands, other cover types and non-forested land within the project area

Table 5. Goshawk and MSO habitat within project area¹

Habitat Type	Acres
Goshawk Protected Fledgling Family Area (PFA), dispersal PFA and nest stands	30,600
Goshawk non-PFA	369,033
Goshawk habitat total acres	399,633
MSO Protected Activity Area (PAC)	35,566
Protected >40 % slope	889
MSO Restricted	67,378
MSO Target/Threshold	8,713
MSO habitat total	112,546
Total Acres of goshawk and MSO habitat	512,178

¹ See the Mexican spotted owl and northern goshawk affected environment for additional details on habitat within the project area

Ponderosa pine typically grows in pure or nearly pure stands in northern Arizona. Historical descriptions refer to open forests dominated by older and larger trees and trees typically grew in groups (see silviculture report and Appendix 8. Openings defined the groups and supported denser understories. Currently ponderosa pine is found in even-aged and uneven-aged structural conditions across the project area (Table 6). The former is largely a result of past timber management (see silviculture report for additional baseline information) and the latter frequently lacks the interspersed openings. Over 50 percent of the project area lacks age and size class diversity and is in an even-aged structure (silviculture report). The forest is no longer dominated by older trees, instead, 57 percent is mid-aged to mature and 36 percent is young forest, leaving a deficit in seedlings and saplings as well as mature and old forest (silviculture report).

Table 6. Distribution of even-aged stands in goshawk habitat outside of Post-family Fledgling Areas Within the 4FRI Project Area

Vegetation Structural Stage (VSS)	Tree Diameter (dbh)	Even-Aged Existing % of Area	Forest Plan Desired % Distribution*
1 – Grass/Forb/Shrubs	0.0 – 0.9”	8	uneven-aged in all VSS classes
2 – Seedling/Sapling	1.0 – 4.9”	0	
3 – Young Forest	5.0 – 12”	36	
4 – Mid-age Forest	12.0 – 17.9”	47	
5 – Mature Forest	18.0 – 23.9”	8	
6 – Old Forest	24”+	1	

*The Coconino NF and Kaibab NF forest plan standards and guidelines do not describe desired

even-aged stand conditions for goshawk non-PFA area habitat. The desired condition is to convert all even-aged stands outside of post-family fledgling areas to the uneven-aged structural conditions shown in table 4 and convert all goshawk PFA/nest stands to the desired uneven-aged structural conditions shown in table 5.

Approximately 56 percent of northern goshawk (*Accipiter gentilis*) foraging habitat is in an even-aged stand condition. Current uneven-aged stands are dominated by young and mid-aged stands, lacking mature and old-aged trees and lacking regeneration for future recruitment into older age-classes. About 76 percent of all goshawk habitat outside of post-family fledgling areas is currently comprised of young to mid-aged forest (Table 7). The open park-like stands characteristic of the reference conditions for ponderosa pine forests promoted greater diversity of flora and faunal and greater resilience to wildfire than the dense stands of today.

Table 7. Forest structure in goshawk PFA/nest stands in the project area

Vegetation Structural Stage (VSS)	Tree Diameter (dbh)	Existing % of Area	Forest Plan Desired % Distribution
1 – Grass/Forb/Shrubs	0.0 – 0.9”	2	10
2 – Seedling/Sapling	1.0 – 4.9”	1	10
3 – Young Forest	5.0 – 12”	34	20
4 – Mid-age Forest	12.0 – 17.9”	46	20
5 – Mature Forest	18.0 – 23.9”	11	20
6 – Old Forest	24”+	6	20

Forest structure for MSO pine-oak habitat has changed through time similar to ponderosa pine forest in general. MSO habitat includes protected and restricted habitat and, within restricted, target/threshold habitat. MSO habitat can be evaluated by comparing the percent stand density index (SDI) by size class to the desired percent of SDI by size class and TPA greater than 18 inches dbh. SDI is a metric used to rate the potential for density related tree mortality. The MSO Recovery Plan puts emphasis on retaining and developing large trees to maintain MSO habitat. The ponderosa pine forested landscape is dominated by single story young to mid-aged trees (see Silviculture Specialist’s Report). MSO habitat has an excess of five to 18 inch dbh trees and is deficit in trees 18 inches dbh and larger, particularly trees greater than 24 inches dbh (Table 8). The deficit in large trees limits the distribution of potential nesting and roosting habitat. The preponderance of single-storied young and mid-aged trees limits recruitment of suitable future nesting habitat. The dominance of closed forest conditions in young to mid-aged trees limits food and cover development for potential prey habitat by shading out understory growth (Appendix 8).

Table 8. Percent of the total existing stand density index (SDI) and trees per acre in MSO habitat

Stand Density Index (SDI) by dbh and Trees per Acre $\geq 18''$ dbh class	Existing Percent (%) SDI in MSO restricted habitat		Desired Percent (%) SDI and Trees Per Acre $\geq 18''$ dbh class
	Target/Threshold	Restricted (non-target/threshold)	
SDI – 12'' to 18''	30	32	15
SDI – 18'' to 24''	16	13	15
SDI – 24''+	6	6	15
TPA $\geq 18''$	17.9	11.8	20

Additional detail on habitat components such as large snags, downed logs, old growth, riparian and ephemeral channels, and the influence of forest structure, fire and the transportation system are addressed by individual species or species assemblages.

Federally Listed Threatened, Endangered, Sensitive, and Proposed Species and Critical Habitat

The following list of federally Threatened, Endangered and Proposed species is adopted from the USFWS web-page (<http://www.fws.gov/southwest/es/arizona>), accessed on March 22, 2012). This list includes all federally Threatened, Endangered and Proposed species in Coconino County. For the purpose of this analysis, only those Federally listed threatened, endangered, candidate species and their critical habitat, along with Forest Service sensitive species, that are known or have potential to occur within the 4FRI project area are analyzed below. Species that are not present or do not have potential habitat in the project area are dismissed from further analysis as the project would have no affect to these species.

There are 48 species of special status addressed by this analysis. Several species are analyzed more than once if more than one status applies. For example, red-naped sapsuckers are addressed as both MIS and migratory birds. In total, there are 3 Threatened and Endangered species, Critical Habitat for one species, 20 Forest Service Sensitive Species, 10 MIS, 19 neotropical migratory birds, one Important Bird Area, and golden eagles (protected under the Bald and Golden Eagle Protection Act) occurring in the treatment area. One terrestrial threatened species with critical habitat, the MSO, has the potential to occur in the treatment area. This report excludes fish, aquatic invertebrates, mussels, snails, and plants, as these are addressed in the fisheries and botany specialists' reports for this project. Table 9 lists species that are known to occur or have potential to occur within the project area and are addressed by this analysis. Species in Bold Font Apply to Both the Coconino and Kaibab Forests, Others Only Apply to the Coconino National Forest.

Table 9. Threatened, Endangered, Candidate, Sensitive, Migratory Bird and Management Indicator Species Evaluated in this Analysis

Scientific Name	Common Name	Status
Amphibians (1)		
<i>Lithobates pipiens</i>	Northern Leopard Frog	S
Birds (28)		
<i>Gymnogyps californianus</i>	California Condor	E
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	T
<i>Haliaeetus leucocephalus</i>	Bald Eagle	S
<i>Accipiter gentilis</i>	Northern Goshawk	S/MIS/Mig Bird ¹
<i>Falco peregrinus anatum</i>	American Peregrine Falcon	S
<i>Aechmophorus clarkii</i>	Clark's Grebe	S
<i>Athene cunicularia hypugaea</i>	Burrowing Owl (western)	S/Mig Bird
<i>Buteo regalis</i>	Ferruginous Hawk	S/Mig Bird
<i>Sitia pygmaea</i>	Pygmy nuthatch	MIS
<i>Meleagris gallopavo</i>	Turkey	MIS
<i>Picoides villosus</i>	Hairy woodpecker	MIS
<i>Sphyrapicus varius</i>	Red-naped sapsucker	MIS
<i>Baeolophus ridgwayi</i>	Juniper titmouse	MIS
<i>Otus flammeolus</i>	Flammulated Owl	Mig Bird
<i>Contopus cooperi</i>	Olive-sided Flycatcher	Mig Bird
<i>Empidonax occidentalis</i>	Cordilleran Flycatcher	Mig Bird
<i>Setophaga graciae</i>	Grace's Warbler	Mig Bird
<i>Melanerpes lewis</i>	Lewis's Woodpecker	Mig Bird
<i>Progne subis</i>	Purple Martin	Mig Bird
<i>Carpodacus cassinii</i>	Cassin's Finch	Mig Bird
<i>Syphirapicus nuchalis</i>	Red-naped sapsucker	Mig Bird
<i>Vireo vicinior</i>	Gray Vireo	Mig Bird
<i>Gymnorhinus cyanocephalus</i>	Pinyon Jay	Mig Bird
<i>Baeolophus griseus</i>	Juniper Titmouse	Mig Bird
<i>Setophaga nigrescens</i>	Black-throated Gray Warble	Mig Bird
<i>Empidonax wrightii</i>	Gray Flycatcher	Mig Bird

Scientific Name	Common Name	Status
<i>Buteo swainsoni</i>	Swainson's Hawk	Mig Bird
<i>Ammodramus savannarum</i>	Grasshopper Sparrow	Mig Bird
<i>Toxostoma bendirei</i>	Bendire's Thrasher	Mig Bird
Insects (3)		
<i>Piruna polingii</i>	Four-spotted Skipperling	S
<i>Speyeria nokomis nitocris</i>	Nitocris Fritillary	S
<i>Speyeria nokomis nokomis</i>	Nokomis Fritillary	S
Mammals (14)		
<i>Mustela nigripes</i>	Black-footed Ferret	E
<i>Microtus mexicanus Navaho</i>	Navajo Mexican Vole	S
<i>Microtus longicaudus</i>	Long-tailed Vole	S
<i>Sorex merriami leucogengys</i>	Merriam's shrew	S
<i>Sorex nanus</i>	Dwarf Shrew	S
<i>Lasiurus blossevillii</i>	Western Red Bat	S
<i>Euderma maculatum</i>	Spotted Bat	S
<i>Idionycteris phyllotis</i>	Allen's Lappet-browed Bat	S
<i>Corynorhinus townsendii pallescens</i>	Pale Townsend's Big-Eared Bat	S
<i>Eumops perotis californicus</i>	Greater Western Mastiff Bat	S
<i>Sciurus aberti</i>	Abert's squirrel	MIS
<i>Cervus elaphus</i>	Rocky Mountain elk	MIS
<i>Odocoileus hemionus</i>	Mule deer	MIS
<i>Antilocapra americana</i>	Pronghorn	MIS
Reptiles (1)		
<i>Thamnophis rufipunctatus</i>	Narrow-headed Garter Snake	S

Status: E = Federally Endangered; T = Federally Threatened; C = Federal Candidate; S = Forest Service Sensitive; MIS = Management Indicator Species; Mig Bird = Migratory Birds

¹ Analyses for Management Indicator Species and Migratory Birds can be found below

²Note that MSO are analyzed as a Threatened Species under the ESA

Table 10 lists species that are not present or do not have potential habitat in the project area and therefore were dismissed from further analysis as the project will have no effect on these species.

Table 10. Threatened, Endangered, Candidate, Sensitive, Migratory Bird and Management Indicator Species not Addressed in This Analysis

Scientific Name	Common Name	Rationale for Dropping	Status
Amphibians (3)			
<i>Lithobates chiracahuensis</i>	Chiricahua Leopard Frog	Neither the species nor its habitat occurs in the project area	T
<i>Bufo microscaphus microscaphus</i>	Southwestern (Arizona) Toad	Neither the species nor its habitat occurs in the project area	S
<i>Lithobates yavapaiensis</i>	Lowland Leopard Frog	Neither the species nor its habitat occurs in the project area	S
Birds (5)			
<i>Empidonax traillii extimus</i>	Southwestern Willow Flycatcher	Neither the species nor its habitat occurs in the project area	E
<i>Gymnogyps californianus</i>	California Condor	Not Known to occur in project area (random occurrence may happen)	E/Exp-NonE
<i>Rallus longirostris yumanensis</i>	Yuma Clapper Rail	Neither the species nor its habitat occurs in the project area	E
<i>Icteria virens</i>	Yellow-breasted chat	Indicator habitat does not occur in project area	MIS
<i>Vermivora luciae</i>	Lucy's warbler	Indicator habitat does not occur in project area	MIS
<i>Melospia lincolnii</i>	Lincon's sparrow	Indicator habitat does not occur in project area	MIS
<i>Anas cyanoptera</i>	Cinamon teal	Indicator habitat does not occur in project area	MIS
<i>Coccyzus americanus occidentalis</i>	Western Yellow-billed Cuckoo	Neither the species nor its habitat occurs in the project area	C
<i>Buteogallus anthracinus</i>	Common Black Hawk	Neither the species nor its habitat occurs in the project area	S
<i>Pipila aberti</i>	Abert's Towhee	Neither the species nor its habitat occurs in the project area	S
<i>Strix occidentalis lucida</i>	Mexican spotted owl	Indicator habitat does not occur in project area2	MIS
Mammals (3)			
<i>Lutra canadensis sonora</i>	Southwestern River Otter	Neither the species nor its habitat occurs in the project area	S

Scientific Name	Common Name	Rationale for Dropping	Status
<i>Perognathus amplus cineris</i>	Wupatki Arizona Pocket Mouse	Neither the species nor its habitat occurs in the project area	S
<i>Reithrodontomys montanus</i>	Plains Harvest Mouse	Neither the species nor its habitat occurs in the project area	S
<i>Tamiasciurus hudsonicus</i>	Red squirrel	Indicator habitat does not occur in project area	MIS
Reptiles (2)			
<i>Thamnophis eques megalops</i>	Northern Mexican Garter Snake	Neither the species nor its habitat occurs in the project area	C
<i>Heloderma suspectum suspectum</i>	Reticulate Gila Monster	Neither the species nor its habitat occurs in the project area	S
Insects (3)			
<i>Various Species</i>	Aquatic Insetcs ¹	Not Addressed in the Terrestrial Wildlife Species Report	MIS

STATUS: E = Federally Endangered; T = Federally Threatened; Exp-NonE = Experimental/Non-essential; C = Federal Candidate; S = Forest Service Sensitive; MIS= Management Indicator Species; Mig Bird = Migratory Birds

¹Analyzed in the Fisheries Report

² Analyzed as a Threatened Species

Mexican Spotted Owl Habitat

The proposed 4FRI project occupies the western portion of the Upper Gila Mountain Recovery Unit (UGM). A summary of MSO biology, and ecology, and habitat use can be found in Appendix 7 and is incorporated into this report. The MSO Recovery Plan recommends recovery actions concentrate on: Recovery Units with the highest owl populations and where significant threats exist; management within these Recovery Units should emphasize alleviating the greatest threats; and that management actions should be tailored to the needs of the area under analysis (USDI FWS 1995). The UGM supports over half the known population of MSOs (Ganey et al. 2011) and is at significant risk of high-severity wildfire (USDI FWS 1995). Lands managed by the USDA Forest Service account for 42 percent of the UGM and include portions of the Coconino, Kaibab, Apache-Sitgreaves and Gila National Forests. MSOs appear to be more continuously distributed in the UGM, relative to other Recovery Units, and show high levels of movement and gene flow. The central location of the UGM within the overall range of the MSO also facilitates gene flow across their range (Figure 5). The 4FRI analysis area occupies the extreme western end of the UGM along the Mogollon Rim. More information on the status of the UGM can be found in Appendix 7.

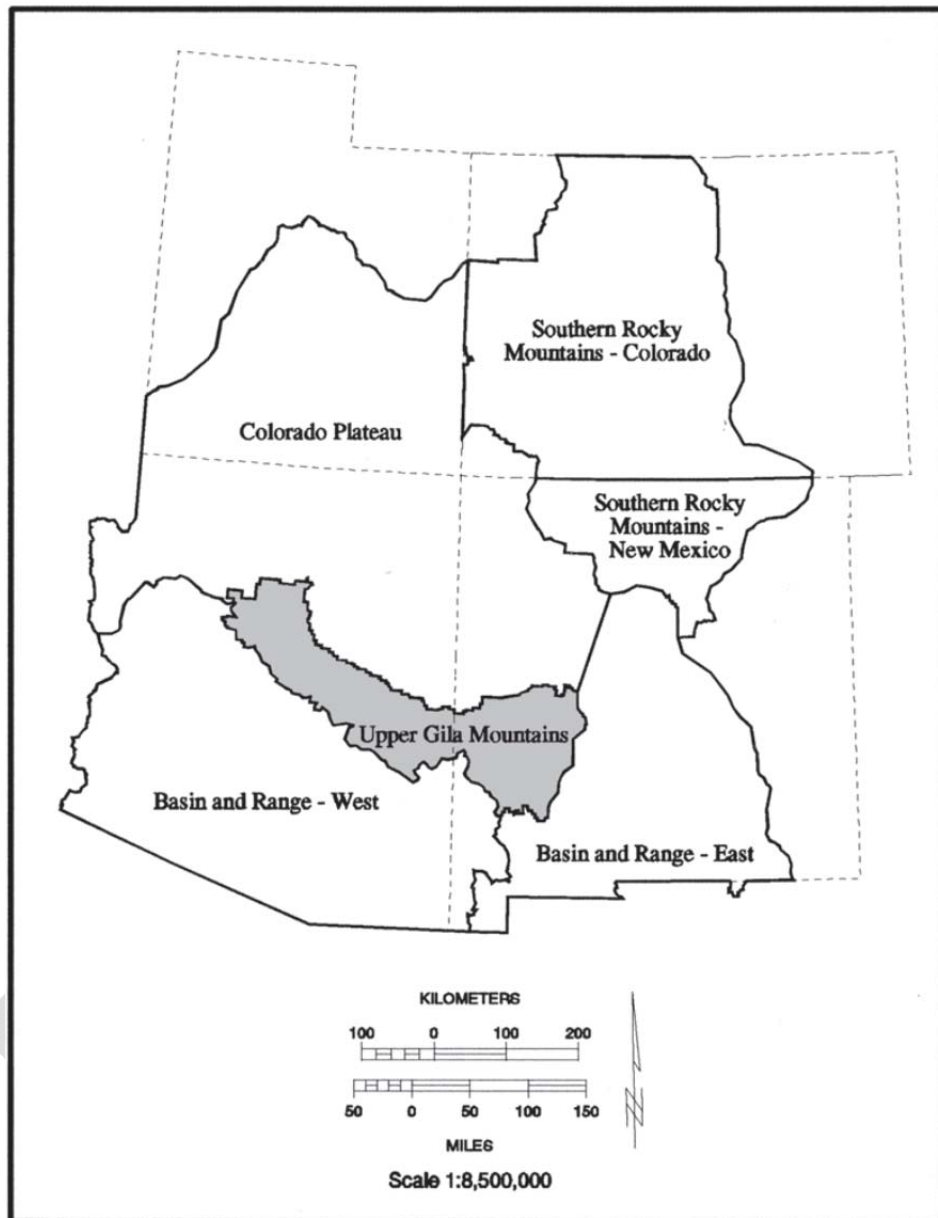


Figure 5. Recovery Units Designated in the Mexican spotted owl Recovery Plan (USDI 1995).

About 19 percent (112,546 acres) of the analysis area (593,211 acres) is designated as MSO habitat. Some areas are centers of concentrated use by MSOs (e.g., Mormon Mountain, Bar M Canyon), use is widely scattered in other areas (Williams RD), and some areas have never had documented use (Tusayan RD). Because of the scale of this analysis, MSO habitat is frequently summarized by Restoration Unit in this report (Table 11). Further details can be found in Appendices 7 and 14. There is no designated MSO habitat in Restoration Unit 6, the Tusayan Ranger District.

Table 11. Acres of Mexican Spotted Owl Habitat within the Analysis Area

MSO Habitat	Cover Type Acres by Restoration Unit					
	RU 1	RU 3	RU 4	RU 5	RU 6	Total
Protected Habitat						
Protected Activity Center	29,349	4,268	556	1,393	0	35,566
Pine Oak >40% Slope	648	239	3	0	0	889
Total MSO Protected Acres:	29,996	4,507	558	1,393	0	36,455
Restricted Habitat – Pine Oak						
Threshold	873	1,032	0	0	0	1,977
Target	3,941	2,867	0	0	0	6,736
Restricted Other	26,421	38,748	1,575	634	0	67,378
Total MSO Restricted Acres:	31,234	42,648	1,575	634	0	76,091
Total MSO Habitat Acres	61,231	47,155	2,134	2,026	0	112,546

The Recovery Plan directs the establishment of Protected Activity Centers (PACs) at all MSO activity sites known since 1989. PACs are a category within MSO protected habitat and should include core areas that contain habitat commonly used during the breeding season. There are 168 MSO PACs occurring entirely on the Coconino NF. In addition, 6 PACs on the Coconino NF overlap with the Apache-Sitgreaves NF, 4 PACs overlap with Walnut Canyon National Monument, 4 PACs overlap with State lands, 3 PACs overlap with the Kaibab NF, 1 PAC overlaps with the Navajo Army Depot, 1 PAC overlaps with the Naval Observatory and State land, 1 PAC overlaps with private property, and 2 PACs overlap with both private property and the Apache-Sitgreaves NF. The Kaibab NF has 3 PACs, not including those that overlap with the Coconino NF. In total, the Kaibab NF administers 6 PACs. Overall, there are 195 PACs occurring completely or partially on the two NFs.

There are 99 PACs within the 4FRI project area boundary (988,764 acres), including all state, private, and all Federal lands (Table 12). PACs within a ¼ mile of the project area boundary (110 total) are included for the cumulative effects analysis. The 4FRI treatment area is approximately 512,178 acres and represents those lands managed by the FS and proposed for mechanical and/or prescribed burning activities within the project area boundary. Areas outside the treatment area but within the project area include designated wilderness, current and recent projects on the individual ranger districts, mixed conifer vegetation, etc. There are 72 PACs in the 4FRI treatment area (table 12).

Table 12. Mexican spotted owl Protected Activity Centers within and/or in close proximity to the 4FRI project and treatment area

Location	Number of MSO PACs
Within the 4FRI Treatment Area (512,178 ac)	72
Within ¼ mile of 4FRI Treatments	91
Within the 4FRI Project Area Boundary* (988,764 ac)	99
Within ¼ mile of the Project Area Boundary	110

*Total of only those lands managed by the Forest Service within the Project Area is 593,211 acres

Protected habitat also includes all areas in mixed-conifer and pine-oak habitat types with slopes greater than 40 percent where timber harvest has not occurred in the past 20 years (USDI USFWS1995). The project area contains approximately 36,455 acres of MSO protected habitat, of which 35,566 acres are within designated PAC's that are considered occupied. The remaining protected habitat (889 acres) occurs on steep slopes where timber harvest has not occurred in the previous 20 years. The intent of this habitat designation is to protect occupied MSO habitat and existing high quality nesting habitat, and to develop future nesting structure elsewhere (see Appendix 7). See pages 23-24 and Appendix 3 for process used to identify PACs, the existing condition, and need for habitat improvement.

map of MSO habitats

Restricted habitat is defined as unoccupied mixed-conifer forests, pine-oak forests, and riparian areas on slopes less than 40% (USDI USFWS 1995). Current forest plan direction and the Recovery Plan require that 10 percent of MSO restricted habitat be designated as target and threshold habitat. Target habitat is to be managed towards achieving nesting and roosting forest structure conditions as described in Table III.B.1 of the Recovery Plan (Table 11). Threshold habitat represents forest structure currently meeting nesting/roosting criteria and management activities should not bring any of these habitat values below the minimum described in Table III.B.1. The intent of target and threshold habitat is to provide future nesting/roosting habitat to facilitate the delisting of the MSO. Approximately 76,091 acres of MSO restricted habitat exists within the project area, including 1,977 Threshold acres and 6,736 Target acres. The Recovery Plan recommends management activities provide continuous and well distributed MSO habitat over space and time while retaining management flexibility to abate high fire risk (USDI 1995). The latter is particularly important in the UGM.

Table 11. Minimum values for Target and Threshold Habitat as Defined in the Mexican Spotted Owl Recovery Plan

Upper Gila Mountain Recovery Unit	Percent of Restricted Habitat	Percent stand density of trees 12-18" dbh	Percent stand density of trees 18-24" dbh	Percent stand density of trees >24" dbh	Stand Basal area	Trees per acre >18" dbh	Basal area of oak > 5" drc
Pine-oak forest	10	15	15	15	150	20	20

MSO critical habitat was designated by the U.S. Fish and Wildlife Service in 2004 (USDI 2004). Critical habitat is defined as protected and restricted habitats within designated areas which contain the primary constituent elements necessary for conservation of the species (USDI 2004). Areas within designated critical habitat must be managed to maintain or enhance primary constituent habitat elements. Primary constituent elements in pine-oak forest provide for MSO habitat needs including, but are not limited to, nesting, roosting, foraging, dispersing, and elements of prey habitat (USDI 2004).

Six Critical Habitat Units (CHUs) occur partially or completely within the 4FRI analysis area (Table 12). They encompass 488,974 acres of Forest Service land, including mixed-conifer forest, but do not include State, private, Naval Observatory, or certain WUI areas. A total of 93,739 acres of CH occur within the 4FRI treatment area (Table 12).

Table 12. Critical Habitat Units (CHUs) occurring in the 4FRI treatment area

Critical Habitat Unit	Total CHU Acres	Acres of Proposed Treatments	National Forest(s)	Approximate Location Description
UGM 11	144,790	53,018	Coconino	South-southeast of Mountaineer, encompassing: Howard, Mormon, and Hutch Mountains; Interstate 17 to Happy Jack; excluding Mormon Lake and Stoneman Lake
UGM 12	17,359	1,150	Coconino	East of Flagstaff
UGM 13	238,092	37,544	Coconino, Kaibab, and Prescott	Between Flagstaff and Williams, from Camp Navajo to the Mogollon Rim, including Bill Williams Mountain, Sycamore Canyon Wilderness, and Volunteer Canyon
UGM 14	55,533	1,457	Coconino	Due north of Flagstaff, encompassing the San Francisco Peaks, Hochderffer Hills, O'Leary Peak, the Dry Lake Hills, and Elden Mountain
UGM 15	22,286	570	Kaibab	Northwest of Flagstaff, west of Hwy 180, encompasses Kendrick Peak northwest to Wild Horse Canyon
UGM 17	10,914	0	Kaibab	North of Parks, including Sitgreaves Mountain, RS Hill, and Government Hill

Surveys and Monitoring

Annual MSO monitoring on the Coconino and Kaibab NFs is highly variable. Some PACs are rarely monitored while others are monitored nearly every year. Well over 50 percent of known territories have been monitored annually to assess occupancy and reproductive status on the Coconino NF. However, the data collected was not designed to estimate population trend. There have been dramatic fluctuations in PAC occupancy and reproduction between 1987 and 2011 with average annual reproduction varying from 0 to 2.6 young per adult pair on the Coconino NF. There is less information available on reproductive success MSOs on the Kaibab NF. Reproductive effort appears to be strongly influenced by precipitation (Ganey et al. 2011).

Wildfire has altered forest structure and so presumably affected reproductive success as well. Forest management has not likely directly affected MSOs since the 1990s given how little work was typically done in MSO habitat.

MSO surveys started on the Kaibab NF in 1978. Although surveys were not all to protocol, repeat visits were initiated in 1994 and have been used each year since then. Results indicate that 1 to 5 PACs out of the 6 managed by the Kaibab NF are typically occupied in a given year (USDA 2010). Owls have not been detected in the Bill Williams PAC since 1994.

Most of the pine-oak forest has been surveyed for MSO within the 4FRI treatment area according to Southwestern Regional protocols. However, some surveys are years old. Most unsurveyed habitat occurs in remote wilderness or in marginal potential habitat. Monitoring summaries for each forest are presented in Tables 13 and 14. The highest concentrations of PACs in the treatment area occur in RU 1, specifically in sub-units 1-3 (Bar-M watershed) and 1-5 (Mormon Mountain, Hutch Mountain, and near the southern boundary of the treatment area). Smaller groups of PACs occur around the edges of Oak Creek Canyon (subunit 3-3) and the larger cinder cones in RU 4 (including Kendrick Mountain).

Table 13. Coconino NF Summary of PACs Monitored 1987 to 2011.

Year	Number of PACs Monitored	Percent (%) Occupied	PACs w/ Adult Pairs	Pairs w/ Young	Total Young	Young per Reproductive Pair (Average)
1987	10	100	7	3	5	1.7
1988	27	100	15	2	4	2
1989	49	98	30	19	32	1.7
1990	92	96	59	21	27	1.3
1991	105	82	66	42	73	1.7
1992	121	79	82	40	69	1.7
1993	121	87	91	44	88	1.8
1994	127	83	75	8	15	1.9
1995	91	64	35	11	16	1.5
1996	97	60	32	7	11	1.6
1997	114	46	40	11	17	1.6
1998	94	52	33	21	30	2
1999	109	47	43	21	54	2.6
2000	97	61	47	8	13	1.6
2001	108	56	41	1	2	2
2002	51	86	32	20	34	1.7
2003	41	68	14	5	6	1.2

Year	Number of PACs Monitored	Percent (%) Occupied	PACs w/ Adult Pairs	Pairs w/ Young	Total Young	Young per Reproductive Pair (Average)
2004	33	73	16	5	7	1.4
2005	28	71	13	9	16	1.8
2006	29	79	15	6	10	1.7
2007	18	72	10	3	5	1.7
2008	39	51	15	0	0	0
2009	26	46	9	4	5	1.25
2010	20	65	4	0	0	0
2011	27	41	6	2	4	2

Table 14. Kaibab NF Summary of PACs Monitored 1978 to 2011

Year	PACs Surveyed	PACs with MSO	Known Percent Occupied	Detections	
				Adult(s)	# of Young
1978	1	1	100	1	Unknown
1979	1	1	100	1	Unknown
1983	1	1	100	1	Unknown
1984	1	1	100	1	1
1990*	3	3	100	2 Pairs + 1 Male	2
1991	4	4	100	3 Pairs + 1 Female	3
1992	2	2	100	2 Pairs	1
1993	4	4	100	3 Pairs + 1 Single	1 Sub-adult & 2 young
1994	6	6	100	4 Pairs + 1 Male + 1 Single	3
1995	6	3	50	2 Pairs + 1 Male	Unknown
1996	6	5	83	3 Pairs + 2 Males	Unknown
1997	6	3	50	2 Pairs + 1 Female	Unknown

Year	PACs Surveyed	PACs with MSO	Known Percent Occupied	Detections	
				Adult(s)	# of Young
1998	6	5	83	4 Pairs + 1 Single	Unknown
1999	2	1	50	Unknown	Unknown
2000	6	2	33	1 Pair + 1 Male	2
2001	6	4	66	3 Pairs + 1 Single	3
2002	6	1	17	Pair	Unknown
2003	4	2	50	2 Pairs	Unknown
2004	3	2	66	1 Pair & 1 Single	Unknown
2005	3	1	33	1 Single	Unknown
2006	3	2	66	2 Singles	Unknown
2007	6	5	83	3 Pairs + 1 Male + 1 Single	Unknown
2008	6	4	66	2 Pairs + 1 Single	Subadult
2009	6	5	83	2 Pairs + 1 Male + 1 Female + 1 Single	Unknown
2010	6	1	17	Male	Unknown
2011	3	2	66	1 Pair + 1 Male	Unknown

*Previous to 1990 surveys were not organized by the Forest and available results are intermittent

Forest Structure in MSO Habitat

Existing habitat components in MSO protected habitat meet Recovery Plan guidelines for trees 12 to 23.9 inches dbh, but average values fall short of the desired conditions for trees greater than or equal to 24 inches dbh, the number of TPA 18 inches dbh or greater, and the density of Gambel oak for trees greater than 5 inches drc (Table 15).

Table 15. Existing Ponderosa Pine-Gambel Oak Forest Structure by Recovery Unit (RU) in Mexican Spotted Owl (MSO) Protected Habitat

MSO Habitat	RU	Avg. Percent of Total Pine SDI by DBH Size Class			Avg. TPA 18"+	Avg. Gambel Oak BA (% of Total BA)
		12.0 – 17.9"	18.0 – 23.9"	24.0" +		
Forest Plan/Recovery Plan Desired Conditions	All	15	15	15	≥20	≥20
Restoration Unit (RU) Existing Conditions	RU 1	31	14	8	14.6	13
	RU 3	31	15	9	17.9	12
	RU 4	30	10	6	9.2	9
	RU5	29	15	7	14.4	12
	Averaged Total	31	14	8	14.9	13

The relative distribution of tree size-classes can be described more than one way. Table 15 above displays the dominant size-class as assessed by SDI. Forest structure can also be described by averaging individual trees in a given area by diameter class. A comparison of existing conditions and desired conditions for a restored landscape based on trees per acre is presented below (see silviculture report). Desired conditions for MSO habitat would be, on average, denser than the desired conditions identified below (Table 16). Even so, existing forests in the project area are well below target values in key size classes. In addition, the low value for trees less than 5 inches dbh suggests future recruitment into larger sizes classes could be limited. This separate analysis again shows that numbers of mature and old growth trees are currently low and an abundance of mid-aged trees exists.

Table 16. Desired and Existing Conditions of Trees per Acre by Size Class in the Analysis Area

Condition	Average Percent (%) Trees Per Acre by Size Class (dbh)				
	0-4.9"	5-11.9"	12-17.9"	18-23.9"	24"+
Desired	45% (40 to 50)	30% (25 to 35)	12% (10 to 14)	8% (7 to 9)	5% (4 to 6)
Existing	38% -	39% +	17% +	4% -	1% -

Forest Density within MSO Protected Habitat

Forest density is a combination of BA and TPA values. BA within MSO protected habitat is variable across RU, but average values are consistently high (Table 17). Existing conditions in Tables 15 and 16 above indicate that much of the BA is within young to mid-aged tree size-classes. Table 3 (page 47) displays the effects of varying categories of maximum SDI. Based on Table 4 (page 48), these values indicate that, on average, three of the four RUs supporting protected habitat are in zone 4 where trees are at full site occupancy, thereby minimizing understory production and creating severe competition among trees (Long 1985). The remaining RU with protected habitat (RU 4) averages 55 percent of maximum SDI, where zone 3 merges into zone 4, marking the onset of density-related mortality. On average, protected habitat is undergoing active competition-induced mortality in stands where the goal is to retain and enhance dense forest conditions. Current forest densities will minimize individual tree diameter and volume growth, leading to stagnation or declines in whole stand volume growth due to individual tree mortality. Because young trees grow more vigorously than older trees, ongoing mortality can be expected to be disproportionately concentrated in the larger diameter size-classes (Ganey and Vojta 2011). These conditions can lead to an unraveling of MSO habitat and loss of stand resiliency. Combined, protected habitat will be at increasing risk of loss from stochastic events such as fire, insects, and disease.

Table 17. Existing Forest Density by Restoration Unit in MSO Protected Habitat

Restoration Unit	Acres	Basal Area		TPA		SDI % of Maximum	
		Range	Avg.	Range	Avg.	Range (%)	Avg (%)
1	29,996	31 to 270	154	73 to 8,850	1,064	20 to 100	78
3	4,507	14 to 216	167	135 to 1,385	987	10 to 97	82
4	558	13 to 177	114	59 to 1,385	680	6 to 88	55
5	1,393	93 to 195	140	534 to 1,385	967	46 to 92	70
Total	36,455	13 to 270	155	59 to 8,850	1,041	6 to 100	78

Canopy Cover

Canopy cover is an important feature of nesting and roosting habitat. All overstory trees contribute to canopy cover, but about 90 percent of the overstory is commonly comprised of ponderosa pine trees within the 4FRI project area (Appendix 8). Although deciduous species are a small component of the overstory, they affect understory vegetation and soil characteristics differently than pure conifer canopies and are an important component of other ecosystem processes. Canopy cover of 40 percent or greater generally provides closed canopy conditions. Canopy cover in habitat selected by MSOs is higher than average forest values and can range from 50 percent to greater than 80 percent (USDI 1995). On average, canopy cover is currently high across the 4FRI landscape (see Silviculture report). Local variety occurs as a result of meadows, savannas, and patches of open grown forest. The information presented above regarding BA and TPA indicates forests are dominated by trees 5 to 18 inches dbh. Key components of MSO habitat are the TPA 18 inches and larger dbh. High canopy closure in smaller diameter trees creates dense conditions with low crown base height. The dense canopy restricts development of the herbaceous biomass, limiting prey habitat, and low branching limits flight ability for foraging owls. In the review of PACs proposed for treatment (appendix 7), closed canopy conditions created by dense, mid-aged trees were contributing to loss of large pine and large oak trees. Other habitat features like small meadows, springs, and aspen patches were also being compromised by encroaching young to mid-aged trees. In addition, surface fuels were building and there was little understory development. While canopy cover is a key attribute of MSO habitat, it must be balanced with other MSO habitat components.

MSO Prey Habitat

Understory Development

Canopy cover has a direct influence on understory development. Once a threshold level in canopy cover is reached, herbaceous cover declines rapidly. The following summary is from Appendix 8, which is incorporated by reference into this wildlife analysis:

“Dense groups of young pine trees limit sunlight, compete for water, and act as strong nitrogen sinks, creating unfavorable growing conditions for many understory species. More nutrients are translocated into forest canopies while slower nitrogen mineralization and nitrification rates occur beneath the forest floor. Combined with slower decomposition rates and allelopathic qualities associated with ponderosa pine litter, current forest floor conditions are creating selection pressure for a different suite of herbaceous species than what occurred here presettlement, causing changes to the understory community. Declines in total cover and species richness resulting from current forest conditions have been documented throughout the 20th century. The decrease in total cover and species richness resulting from current forest conditions includes selection pressures that limit total foliar production, flower production, and seed production. The net effects to wildlife are changes in vegetative cover and food quantity and quality, including reduced arthropod availability. Negative impacts reflected in the arthropod community can directly influence wildlife by reducing food availability for insectivores and omnivores. In the long-term, reduced arthropod populations can exert secondary limits or selection pressures on the plant community by decreasing the pollinator assemblage. This can further limit the potential understory community with potential impacts moving up through community trophic levels (page 8)”.

An index of relative understory biomass was developed to compare understory response among the proposed alternatives. Details on how the index was developed and the science behind the relationships between overstory and understory vegetation and between understory vegetation and arthropod response can be found in Appendix 8. Biomass indices comparing current trajectories and those of each action alternative were graphed by individual subunit and can be found in Appendix 8, pages 48 to 58.

Conditions in dense stands of trees designated for nesting and roosting habitat precludes much understory development. However, small, scattered canopy gaps can create patches of food and cover for MSO prey species. Aspen and meadows within MSO habitat and patches of Gambel oak can also provide prey habitat while still managing pine-oak forest on a trajectory for nesting and roosting habitat.

Snags, Down Logs, and Coarse Woody Debris

Another identifiable feature of nesting and roosting habitat is the presence of down logs and large snags. MSOs and key prey species are associated with stands containing numerous logs and large snags (Ganey et al. 2011). The Coconino and Kaibab forest plans call for an average of two large snags per acre in ponderosa pine forests, with large snags defined as 18 inches or larger dbh and 30 feet tall or higher. However, these forest plan specifications may be unrealistic. Ganey (1999) found only 30 percent of ponderosa pine plots in un-logged sites met or exceeded USFS snag guidelines and Waskiewicz (2003) found pine snag densities well below FS guidelines in relatively undisturbed forests in northern Arizona.

Fire promotes recruitment of large snags, but in a study conducted locally, 40 percent of snags resulting from high-severity fire fell within seven years (Chambers and Mast 2005). Over 80 percent of ponderosa pine snags created by high severity fire fell within 10 years post-fire (Chambers *pers. comm.*, Mast *pers. comm.*). Similar fall rates appear to occur for beetle-killed ponderosa pine trees (Chambers *pers. comm.*, Mast *pers. comm.*). Chambers and Mast (2005) found greater densities of large diameter snags in unburned plots vs. burned plots on the Coconino and Kaibab NFs. Similarly, Holden et al. (2006) found significantly lower snag

densities in the Gila NF (New Mexico) where fire had occurred 2-3 times since 1946 compared to areas that had only burned once. Bagne et al. (2008) found that in forests experiencing fire suppression for long periods of time, the greatest loss of snags occurred during initial burns, but the long-term rate of loss decreased and eventually leveled off during subsequent burns.

Ganey and Vojta (2005) documented an increase in snag recruitment, but the greatest increase was among smaller-sized trees. This pattern is reflected in Forest Inventory Analysis (FIA) data collected between 1995 and 2007 showing an overall increase in ponderosa pine snag density on the Kaibab NF, similar to results reported by Ganey and Vojta (2005; Table 18). In 2011, Ganey and Vojta reported a 74 percent increase in ponderosa pine mortality from 2002 to 2007 compared to mortality between 1997 and 2002. While more trees were dying in the smaller size-classes, proportions of dying trees were greatest in the largest size classes. Large snags cannot be created without large trees and both large trees and large snags are important to the MSO (USDI 1995). Mortality of aspen and Gambel oak in pine-oak forests were also proportionally greater than expected, relative to species composition of live tree forests (Ganey and Vojta 2011).

Table 18. Average ponderosa pine snag density on the Kaibab NF portion of the 4FRI (FIA unpublished data, 1995 to 2007)

Kaibab NF Ranger District	Dead Trees Per Acre (No.) by Tree Size Class (dbh)		
	5"-10.9"	11"-14.9"	>=15"
1995			
Tusayan	0.39	0.00	0.11
Williams	0.99	0.00	0.24
Total	2.49	0.00	0.49
2007			
Tusayan	0.33	0.16	0.33
Williams	2.18	0.60	0.79
Total	5.00	1.50	1.20

The present density of snags 18 inches dbh or greater is well below forest plan guidelines of two snags per acre in ponderosa pine forest (Table 19). In MSO Critical Habitat, snags important to owls and their prey species are defined as 12 inches dbh or greater. The combination of snag size classes above 12 inches dbh exceeds two per acre. This should provide habitat for MSO prey species, but still does not meet forest plan direction. The Recovery Plan used the combination of BA, large (greater than 18 inches dbh) tree density, and tree size-class distribution as surrogates for availability of snags and downed logs. The assumption was that if these live tree attributes are at adequate levels across the landscape, than adequate amounts of snags and downed logs should also be present (USDI 1995). In terms of snags greater than 12 inches dbh as well as general forest dynamics, MSO habitat criteria are currently being met. The deficit in snags is primarily a forest plan issue. More information on snag recruitment and retention can be found in Appendix 7.

The range in snag values indicate that the distribution of snags is patchy and while guidelines may be met at different scales, snags could be lacking within a given stand (Table 19). The distribution of snags relates to how they are formed. Individual snags may be a result of natural causes, but tree mortality resulting from beetles, fire, mistletoe, etc., tend to result in patches or small groups of snags. This emphasizes that, even where snag numbers may exceed forest plan guidelines in a given area, snag retention may still be important on a stand by stand basis.

Table 19. Existing Snags and Coarse Wood > 12 inches diameter in MSO Protected Habitat by Restoration Unit (RU)

Habitat	RU	Acres	Snags 12 to 18" Per Acre		Snags ≥18" Per Acre		Coarse Wood (tons per acre)		Log Equivalent (ft)
			Range	Avg	Range	Avg	Range	Avg	Avg
MSO Protected	1	29,996	0 to 11.4	2.8	0 to 5.3	0.6	0.2 to 20.5	5.5	16.6
	3	4,507	0 to 8.2	2.9	0 to 2.5	0.7	0.9 to 16.1	6.5	19.6
	4	558	.3 to 4.5	1.8	0.1 to 1.0	0.5	2.4 to 6.6	5.6	16.9
	5	1,393	.9 to 4.5	2.4	0.1 to 2.4	0.6	2.1 to 10.9	5.5	16.6
	All	36,455	0 to 11.4	2.8	0 to 5.3	0.6	0.2 to 20.5	5.6	16.9
MSO – Restricted Target/ Threshold	1	4,814	.6 to 6.1	2.4	.2 to 1.4	0.5	5.6 to 9.0	6.3	19
	3	3,899	.6 to 6.1	2.6	.1 to 1.4	0.6	2.1 to 9.0	4.9	14.8
	All	8,713	.6 to 6.1	2.5	.1 to 1.4	0.6	2.1 to 9.0	5.4	16.3
MSO – Restricted Other	1	26,421	.4 to 3.9	1.8	.2 to .8	0.4	2.1 to 7.4	4.5	13.6
	3	38,748	.4 to 3.9	1.8	.2 to 1.1	0.4	1.4 to 7.4	3.8	11.4
	4	1,575	.5 to 3.7	1.6	.2 to 1.1	0.5	1.4 to 5.9	3.1	9.3
	5	634	.6 to 2.9	1.2	.2 to .8	0.4	2.1 to 5.4	3.3	9.9
	All	67,378	.4 to 3.9	1.8	.2 to 1.1	0.4	1.4 to 7.4	4.0	12.0

Forest plan direction for woody debris is to leave three large downed logs per acre and five to seven tons of coarse woody debris (CWD) per acre. Downed logs are defined as 12 inches in diameter and at least 8 feet long and CWD is 3 inches or larger on the forest floor. Ganey and Vojta (2012) documented increased fall rates of trees in plots across the Coconino and Kaibab

NFs since 2004. Plots with logs present increased by over eight percent between 2004 and 2009 and log length, density, volume, and area covered all increased significantly ($p < 0.001$) during that same period. These changes represent initial results from a drought-mediated pulse in tree mortality (Ganey and Vojta 2011).

Data on logs and CWD for the 4FRI does not include length of the logs. Traditional stand data does not measure this attribute, but Brown et al. (2001) developed a conversion factor for this kind of data. The bole weight of a dead 12 inch ponderosa pine tree averages about .332 tons. Knowing the diameter of CWD then allows an estimate of how many logs are included in the tonnage value. The equivalent levels of logs based on CWD greater than 12 inches diameter exceeds forest plan direction (Table 19).

Forest Structure Summary for MSO Habitat

The 4FRI database (see silviculture report) and PAC reviews indicated a number of consistent issues relative to MSO habitat in the 4FRI project area, including:

- An imbalance in tree size-classes leading to a lack of diversity in tree ages and structural diversity;
- Threats to existing big and old trees because of competition from smaller trees;
- Decreased quality in prey habitat due to numbers of trees in smaller size classes;
- Overall decline in forest resiliency due to competition among trees and, indirectly, from threats from high severity crown fire, insects, and disease resulting from the uncharacteristic competition;
- Snags greater than 18 inches dbh are deficit across the landscape relative to forest plan direction; combined with snags 12 to 18 inches dbh MSO habitat needs may be met, but snags numbers vary considerably;
- CWD and logs tend to be abundant and meet forest plan direction, although stand-by-stand variation exists;
- Fire risk to dense forest conditions within the ponderosa pine forest type remains high and outside desired conditions, threatening the ability to maintain MSO habitat components through time

Habitat loss from high severity wildland fire was identified as a primary risk in the Recovery Plan in 1995, yet the three most active fire seasons in Arizona history have occurred since 2008, with nearly a million acres burned in 2011 alone (Paxon 2011). Because of the nature of closed canopy, dense forest structure, fire risk is higher in MSO habitat. Minimum requirements for BA in protected habitat, as outlined in the forest plans and Recovery Plan, do not allow the same flexibility in management as in ponderosa pine forest outside MSO habitat.

Key features of MSO habitat described in the Recovery Plan include:

- a range of tree sizes and ages with a preponderance of trees greater than 12 inches dbh,
- BA and density of pine and Gambel oak
- canopy cover and structure
- tree sizes suggestive of uneven-aged management, and
- large dead trees (snags) with a diameter of 12 inches or greater

MSO populations are influenced by prey availability. Key features of prey habitat include:

- high volume of fallen trees (mid-point diameter of 12 inches or greater) and other woody debris
- plant species richness, including woody species
- residual plant cover to maintain fruits, seeds, and regeneration to provide needs of MSO prey species, and
- other improvements to prey habitat

These forest structure elements are reflected in the evaluation criteria and are used to describe the existing condition of the habitat and the effects of the proposed activities.

Fire

Abundant research exists with consistent conclusions regarding existing fuel levels and fire behavior relative to the historical range of variation for ponderosa pine forests in general and in northern Arizona specifically (see Fire Specialists report). Ponderosa pine and ponderosa pine-Gambel oak forests are highly departed from the historical fire regime (Table 20). MSO habitat is dominated (90 percent or greater) by conditions “highly departed from the historical fire regime” and has a higher percent of acres in Fire Severity Departure Class 3 than ponderosa pine forests in general (Table 20).

Table 20. Fire Severity Departure Classes within Treatment Area, MSO Habitat

Vegetation/Habitat Type	Total Acres	Fire Severity Departure (%)		
		Class 1	Class 2	Class 3
Ponderosa Pine	512,481	6	7	87
MSO Protected	36,757	2	8	90
MSO Target/Threshold	8,713	1	8	91%
MSO Restricted Other	67,378	2	7	91

Current conditions in the pine-oak component of the project area are outside of the historical range of variability (Abella 2008). Frequent fire was part of the historic environment, with fire return intervals often averaging less than 10 years (Abella and Fule 2008). The small tree form of Gambel oak dominates the oak growth form along the Mogollon Rim which is different from the shrubby type that is found further east. In the absence of high severity fire, Gambel oak stands reach maturity in 60 to 80 years. The tree form rarely produces crown fire. Fire exclusion has contributed to a shift in oak densities, with increases in oak density and BA since the late 1800’s (Abella 2008, Fule et al. 1997). The majority of this increase is from small and medium-sized stems. Prescribed fire will reduce densities of small-diameter oak while treating surface fuels, but Gambel oak resprouts vigorously the 1st growing season following fire (Ffolliott and Gottfried 1991, Kunzler and Harper 1980). Managed fire may reestablish oak within the range of historical variability (Abella 2008). Fire response in mature stands is similar to that in young poles: A severe fire will recycle the stand; low-severity fires create openings for resprouts.

Pine-oak is a subset of within the general ponderosa pine forest. Nearly 200,000 acres of overall ponderosa pine forest is at risk of crown fire across the project area (Table 21). Some of the

surface fire included in the ponderosa pine fire behavior represents savanna habitat where fire would be expected to burn differently from the typical forest structure in this landscape. While technically forest habitat, savanna is, by definition, very open habitat. Although the acres of savanna habitat could not be modeled separately from the rest of the ponderosa pine, it does bias the results by implying more fire would burn as surface versus crown fire. Desired conditions are for no more than 10 percent of the ponderosa pine in the analysis area to be prone to crown fire and with less than 30 acres of contiguous areas susceptible to high severity fire (Swetnam and Baison, 1996; Roccaforte et al., 2008). Pine- oak forest structure corresponds to the overall conditions of general ponderosa pine forest (see Fire Ecology Specialist's Report).

Table 21. Current fire behavior under moderate conditions (equal to the Schultz Fire) across ponderosa pine forest in the project area

Restoration Unit	1	3	4	5	6	Totals
Total acres	146,037	129,225	134,301	61,730	41,188	512,076
Surface fire	81,276	72,734	83,435	42,304	33,675	313,423
Passive crown fire	15,967	12,629	10,614	7,104	2,219	53,540
Active crown fire	48,300	43,227	39,806	8,532	5,247	145,113
Surface fire %	56%	56%	62%	70%	82%	61%
Passive crown fire %	11%	10%	8%	12%	5%	9%
Active crown fire %	33%	33%	30%	14%	5%	28%

Crown fire can be active, where it advances from crown to crown in the tops of trees, conditional where it is initiated in adjacent areas and spreads through canopy fuels alone, or passive where ladder fuels carry a fire into the canopy, igniting individual trees or groups of trees without spreading into neighboring trees or stands of trees. According to fire modeling, about half of the total MSO habitat in the treatment area would support some form of crown fire with nearly a third of MSO habitat (33,549 acres) at risk of active crown fire (Table 22).

Table 22. Predicted Fire Behavior in Existing Mexican Spotted Owl Habitat

MSO Habitat	Acres	Surface Fire (Ac)	Passive Crown Fire (Ac)	Active Crown Fire (Ac)	Conditional (Ac)	Surface Fire (%)	Passive Crown Fire (%)	Active Crown Fire (%)	Conditional (%)
Protected	36,757	18,610	3,141	9,930	4,917	51	9	27	13
Target/ Threshold	8,713	4,292	926	2,854	625	49	11	33	7
Restricted	67,378	35,465	6,608	20,764	4,423	53	10	31	7

The risk of crown fire means potential loss of the tree-sized component of Gambel oak. The larger sized tree boles often have heart rot and provide substrate for MSOs and a host of other

cavity nesting birds. While oak would remain on the landscape, high-severity fire could lead to losses in the larger diameter tree form of oak while maintaining the shrubby oak form in MSO habitat.

Before Euro-settlement, Southwestern ponderosa pine forests supported frequent, low severity surface fire for at least the last 1,400 years (Roos and Swetnam 2012). The historic fire regime both shaped and maintained the largely open-grown, groupy nature of the forest. The lack of fire has allowed surface fuels to accumulate for over a century instead of burning under a frequent fire return interval. The amount of fuel feeding a surface fire affects burn severity and the risk of fire burning into the canopy. Rather than fire predominantly consuming fuels such as litter, duff, woody debris, and dried herbaceous materials, fires are now uncharacteristically prone to crown fire (Roos and Swetnam 2012).

The existing condition for surface fuels is directly related to forest density: general ponderosa pine forests in the treatment area support less total tonnage of surface fuels than restricted habitat and restricted habitat has less than protected habitat (Table 23). In addition to denser forests and canopies, MSO habitat also has higher fuel build-up at ground level. Litter primarily consists of pine needles and accumulations of coniferous litter and duff can alter soil chemistry. These changes can affect MSO prey habitat by eventually altering the composition of the understory community (Appendix 8). Additionally, high litter levels present a risk to logs and coarse woody debris from higher severity surface fire presenting another threat to maintaining habitat for MSO prey species. High severity ground fire can change post-fire understory response and alter micro-flora communities (Appendix 8). Although the desired condition is returning fire behavior to predominantly surface fire, current fuel loading presents threats to MSO prey habitat from both the risk of crown fire and uncharacteristic surface fire.

Table 23. Surface Fuel Loading Under Tree Size-Classes (dbh) Within Forested Habitats

Habitat by DBH Size Classes		Fuels (tons/acre)	
	1000-Hr	Duff	Litter
Ponderosa Pine			
12 to 18 "	4.0	3.5	3.5
18 to 24"	3.7	3.1	2.6
>= 24"	2.8	2.4	2.1
Restricted			
12 to 18 "	4.2	3.4	4.3
18 to 24"	4.0	3.0	2.8
>= 24"	2.6	2.5	2.3
PACs			
12 to 18 "	4.8	3.8	4.6
18 to 24"	4.1	7.6	2.8
>= 24"	3.9	2.8	3.1

Forested stands adjacent to and southwest of MSO PACs were reviewed on a PAC-by-PAC basis across the treatment area by the core team silviculturist, GIS specialist/data manager, and wildlife biologists. Treatments in these stands were reviewed and increasing the intensity of treatments was evaluated to reduce fire threat to neighboring stands inside PACs. Treatment intensity was frequently increased 1 level in these areas, e.g., a UEA 10 to 25 would be changed to a UEA 25 to 40. This was done after the initial treatment types was assigned with the goal of better safeguarding the dense stand conditions within PAC habitat.

Road Systems

A total of 905 miles of road within the 4FRI treatment area were recommended for decommissioning under the Travel Management Rule (see the transportation report for more detail) and will be addressed in this analysis. About 164 miles of road is proposed for decommissioning within MSO habitat (17% of the 961 total open roads in MSO habitat). Roads proposed for decommissioning by MSO habitat type and total miles of proposed road decommissioning are the same in each alternative (Table 24). About 15 percent of the 793 miles of road within MSO Critical Habitat is being proposed for decommissioning.

Table 24. Total Road Miles and Proposed Miles for Decommissioning in MSO Habitat Within the 4FRI Treatment area.

MSO Habitat	Miles of Roads Proposed for Decommissioning	Total Road Miles	Percent of Roads Proposed For Decommissioning
Protected	49	235	20
Core Area	5	20	20
Target/Threshold	17	82	21
Restricted Other	98	624	16
Total	164	957	17

Open road systems in MSO habitat increase the probability of human-caused disturbance during the nesting season. Access allows firewood cutters to cut snags and logs. While limits exist on what snags can be legally removed from the forest, a direct correlation has been identified between snag availability and road access. Snags were nearly three times more abundant in stands away from roads as they were in stands with roads and snags were less abundant in stands closer to towns and in flatter topography (Wisdom and Bate 2008). The same relationship between human access and decreased snag and log availability has been recognized in northern Arizona ponderosa pine stands and in pine-oak habitat within the treatment area (Chambers 2002, Ganey, *pers comm.*). Road decommissioning within MSO habitat should improve habitat conditions for MSOs and their prey. Road maintenance, temporary road construction, and road relocation will also occur in MSO habitat (Table 25).

Table 25. Road Maintenance, Construction, and Relocation in Mexican spotted owl Habitats Within the 4FRI

MSO Habitat	Road Maintenance	Temporary Road Construction	Road Relocation	Total Miles of Road Work
Protected Total	97.6	7.2	0.1	104.9
Target/Threshold Total	40.9	5.3	0.1	46.3
Restricted	319.1	63.5	1.0	383.5
Total	457.6	76.0	1.2	534.7

An identified road system for hauling harvested materials out of the forest was identified to implement restoration activities. Haul routes were evaluated across the entire project area relative to MSO PAC habitat. The objective was to assess road systems for hauling materials with the goal of avoiding or minimizing impacts to MSOs. This required assessing blocks of commercial treatment areas ranging from 100s to 1000s of acres, and connecting the sites to major transportation corridors. This broad scale effort was evaluated in a site specific manner as roads around each individual PAC were examined in terms of functional haul routes and avoiding disturbance to MSOs. This four day review involved the 4FRI assistant team lead, 4FRI biologists, and 4FRI GIS specialist.

Springs, Ephemeral Channels, Meadows, and Aspen

Springs and ephemeral channels typically represent areas of concentrated use by wildlife, from invertebrates to large mammals. Increased moisture availability after tree removal at these sites can potentially support more diverse vegetation, more robust plants, and more total biomass compared to sites growing in the dry forests northern Arizona. The desired condition for springs is to have the necessary soil, water, and vegetation attributes to be healthy and functioning at or near potential. Spring restoration would move water flow patterns, recharge rates, and geochemistry towards historical levels that persist over time. Water quality and quantity would maintain native aquatic and riparian habitat and water for wildlife and designated beneficial uses, consistent with water rights and site capability. The desired condition for vegetation near springs is for plant distribution and species composition resilient to natural disturbances. Microsite vegetation is important to wildlife, including MSO prey species. Spring restoration treatments proposed under 4FRI are the same in all alternatives. Spring restoration is proposed in 74 different sites across the 4FRI treatment area. Twenty three springs (29 percent) are in MSO habitat, including protected and restricted habitats.

Ephemeral streams are important for hydrological function of watersheds and provide important seasonal habitat for a variety of wildlife, including MSO prey species. Some ephemeral stream channels are heavily eroded with excessive bare ground, denuded vegetation, and head cuts, including riparian and non-riparian streams. Forty three miles of ephemeral stream channel restoration is proposed across the 4FRI treatment area. Over four miles of ephemeral stream channel restoration is proposed within MSO habitat (Table 26). Ephemeral stream channels

proposed for restoration treatments under 4FRI are the same in all alternatives and would occur in all MSO habitat classifications.

Restoration of springs and ephemeral channels would be evidence-based and designed to improve species composition of the associated vegetation. Pre-settlement trees would remain where present and the largest trees available would be left where there is evidence of other pre-settlement trees. Areas without evidence of pre-settlement trees could be treated to provide forest interspace. The objectives in applying treatments are:

- Conserve or recover native biological diversity
- Remove post-settlement trees within soil types indicating regularly moist conditions around springs or ephemeral channels to avoid shading and uncharacteristic translocation of water and nutrients from affected soils.

Restoration activities proposed for springs and ephemeral channels would include initial and maintenance prescribed burning. Design features associated with spring and ephemeral channel restoration include:

- Using soil and water best management practices to minimize the impacts of management activities within riparian areas
- Retain large snags and logs on site
- Apply northern leopard frog mitigation where breeding habitat occurs

Spring and channel restoration would occur in four of the six CHUs occurring within the treatment area.

Table 26. Number of Springs and Miles of Ephemeral Stream Channel Restoration Proposed under the 4 Forest Restoration Initiative

Feature	UGM-11	UGM-12	UGM-13	UGM-14
Spring (Coc NF)	8	0	9	0
Ephemeral Stream	2.26	0.48	0.68	0.67

Within the silviculture database, MSO habitat is defined as ponderosa pine with greater than 20 BA of Gambel oak. By stand definitions, meadows and aspen are not MSO habitat. Meadows and aspen within pine-oak habitat tend to occur as small inclusions and, because of the prey base they tend to support, may be regularly used by foraging MSOs even if owls would not nest or seldom roost within these stands. Interspersed patches of higher quality prey habitat could support source populations for surrounding habitats degraded by uncharacteristic densities of young and mid-aged pine. Therefore, acres of meadows and aspen were summarized by PAC and CHU where individual stands could be tallied within discrete polygons of MSO habitat. Direct tallies of meadow and aspen habitat could not be made within restricted habitat. This latter category is defined on a stand by stand basis, even when stands of restricted habitat are typically clustered. Unlike PACs and Critical Habitat where “non-MSO” stands could be queried within the respective **polygons**, the database could not be queried for habitat elements within or between **stands** of MSO habitat. Therefore, results from queries of Critical Habitat will be used for approximating acres of meadow and aspen within restricted habitat, recognizing Critical Habitat includes protected habitat and restricted habitat occurs outside Critical Habitat boundaries.

Over 4,000 acres of meadow treatments are proposed in MSO habitat within the 4FRI treatment area. Up to 135 acres of meadow treatments are proposed in 12 different PACs, depending on the alternative. Meadow treatments average 11 acres per PAC, ranging from one acre (Howard Mountain) to 28 acres (Meadow Tank). Treatment types vary by alternative and all PACs with proposed meadow treatments are located on the Coconino NF. Meadow treatments would occur in five CHUs (UGM-11, UGM-12, UGM-13, UGM-14, and UGM-15) and total 3,870 acres. Treatments would occur on both the Coconino (2,411 acres) and Kaibab (1,460) NFs. Meadow treatments range from small inclusions within pine-oak forest to larger grassland treatments near or adjacent to MSO habitat. Treatment objectives vary from operational burns to prescribed fire. Operational burns are not intended to change habitat structure, but instead would simply allow fire to carry across an area to facilitate attaining prescription objectives in neighboring stands while minimizing creation of firebreaks in non-ponderosa pine habitats. Firebreaks could be as simple as scrapping a hand-line in litter and duff or require pushing material with a dozer blade. Objectives related to prescribed fire could be removal/reduction in litter, raising a stand's crown base height, or deliberate tree mortality intended to restore the function of the habitat.

Approximately 1,471 acres of aspen occur in the treatment area. Aspen treatments vary by alternative. Up to 209 acres of aspen are proposed for treatment in PAC habitat and up to 959 acres are proposed for treatment within Critical Habitat (UGM-11, UGM-13, UGM-14, UGM-15, and UGM-17). Treatment objectives vary from operational burns to tree removal and prescribed burning intended to restore the function of the habitat. Treatments designed to achieve aspen restoration would occur within restricted habitat. Actual aspen restoration, intended for restricted habitat, would be comprised of the removal of all post-settlement conifers inside aspen clones and within 100 feet surrounding treated clones. Some removal of aspen within the clone as well as ground disturbing activity or burning may occur to stimulate suckering. Each clone would be evaluated as to the need for fencing or creation of other barriers to reduce ungulate browsing of regenerating aspen. Aspen restoration would improve overall habitat diversity for MSOs.

California Condor (Endangered/Experimental Population)

The California condor is a long-lived species with low reproductive rates, with breeding pairs laying one egg every other year. Condors nest in various types of rock formations including crevices, overhung ledges, potholes, caves. Near the Pacific coast they also nest in tree cavities. In Arizona, condors nest and roost in steep terrain with cliffs, ledges, and caves (AGFD website: http://www.AGFD.gov/w_c/california_condor.shtml). Cliffs, tall conifers, and snags are generally used as roost sites, which also provide strong updrafts required for lift into flight. Condors are opportunistic foragers, feeding only on carcasses found by sight. Most condors forage in open terrain, and can travel 100 miles or more per day.

Reintroduction of captive-bred condors in Arizona began in 1996 at the Vermilion Cliffs National Monument Release Site. Condors were reintroduced under Section 10(j) of the Endangered Species Act (USDI FWS 1996). Section 10(j) allows for the designation of a nonessential experimental population. Under this designation the protections for an endangered species are relaxed, providing greater flexibility for management of a reintroduction program. An experimental population area was designated to accommodate future movements and expansions of reintroduced condors (USDI FWS 1996). The designated nonessential experimental population area is located in Arizona, Utah, and Nevada. The nonessential experimental population status applies to condors only when they are within the geographic bounds of the designated 10(j) area of the Southwest, which is defined by: Interstate Highway 40 on the south, U.S. Highway 191 on

the east (parallel to the New Mexico and Colorado state borders), Interstate Highway 70 on the north, and Interstate Highway 15 to U.S. Highway 93 near Las Vegas, Nevada on the west. When condors leave this area they receive full protection of the ESA, which may have regulatory implications. Portions of the Coconino and Kaibab NFs north of I-40 are within the designated experimental population area.

The condors have been known to fly widely, but generally remain within the Grand Canyon Ecoregion/Colorado River corridor. Early in the program, condors left the nonessential experimental area on several occasions, flying as far as Flaming Gorge, Wyoming (310 miles from the release site), and Grand Junction, Colorado (approximately 250 miles from the release site). All of the far-wandering condors returned to the release area.

Between 2002 and 2006 The Peregrine Fund obtained more than 50,000 relocation fixes from an average of 17 GPS-equipped condors (Austin et al. 2007). Condor use is focused on the North and South rims and river corridor of the Grand Canyon, the Kaibab Plateau, and the Kolob region area of southern Utah (approximately 70 miles north of the release site on the Paria Plateau). Condors do not spend much time south of the Grand Canyon. When they have travelled into the southern extent of the designated recovery zone they head back north relatively rapidly. There are few reports of condors on Coconino National Forest or the Williams or Tusayan Ranger Districts of the Kaibab National Forest (Parrish, *pers. comm.*). The Arizona condor population was at 74 as of March, 2011 (AGFD website accessed April 25, 2012). Four FRI would not affect nesting or roosting habitat and, because condors rarely occur within the project area, would not affect foraging habitat. Therefore, this project would not affect condors and no further analysis will be conducted.

Black-footed Ferret (Endangered)

There are presently no known naturally occurring populations of black-footed ferret. There are no known records of black-footed ferrets on the Coconino or Kaibab National Forests. If reintroduction efforts were to take place in northern Arizona, they would likely occur on areas occupied by Gunnison's prairie-dogs, as black-footed ferrets are dependent upon prairie dogs for food and burrows, and Gunnison's prairie-dogs are the only prairie-dog species that occurs in northern Arizona. Within the project area, prairie dogs occur in grasslands. Open linkages have been mapped within the project and are identified for prairie dogs (Appendix 4).

Characteristics used to determine the suitability of prairie-dog colonies for black-footed ferrets include size of colonies, distance from other colonies, density of each colony, and disease dynamics. Essentially, larger colonies in close proximity of other colonies that have a high density of occupancy are more suitable for supporting black-footed ferrets. Prairie-dog colonies that are less than 7 km (4.3 mi) apart are considered a complex. Habitat for black-footed ferrets in Arizona has been described as an active prairie dog complex greater than 80 ha (200 acres) in size with a burrow density of > 20 burrows per ha (>8 burrows/ac) (Mikesic and Nysted 2001). Three Gunnison's prairie dog complexes have been mapped within the project area. Of these, two complexes are within the treatment area. Table 27 displays the acres of each complex by subunit. Because these complexes exceed the 200 acre threshold identified in (Mikesic and Nysted 2001), habitat suitable for supporting a population of black-footed ferrets could be present in the treatment area, depending on prairie-dog activity and burrow density. Plague outbreaks, eradication efforts and drought have contributed to the lack of Gunnison's prairie-dog activity on these colonies. Prairie dog surveys will be completed prior to treatments within these complexes

and if colonies are active and burrow densities adequate black-footed ferret surveys will be completed prior to implementation in these areas.

Table 27. Prairie Dogs Complexes/Colonies within the Treatment Area by Subunit

Complex	Subunit	Acres	Number of Colonies
Complex 1	1-1	175	2
	1-3	7	1
	1-5	20	1
	3-2	503	7
	4-2	17	1
	4-3	376	5
	4-4	727	22
	4-5	128	2
	5-1	60	5
Total		2,187	46
Complex 2	1-2	181	2
Total		181	2

In addition to these complexes there are 48,774 acres of grassland within the treatment area that could provide additional habitat for Gunnison's prairie-dogs and black-footed ferrets. Conifer encroachment is occurring around the edges of and within grasslands in the project area, reducing quality and availability of habitat for prairie-dogs and potential for occupancy by black-footed ferrets. Corridors identified for prairie dogs are fragmented from pine encroachment, private development and past tree plantings within meadows reducing the ability of prairie dogs to colonize new areas.

Forest Service Sensitive Species

Sensitive species are defined as “those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by: (a) significant current or predicted downward trends in population numbers or density, or (b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution (FSM 2670.5(19)).” It is the policy of the Forest Service regarding sensitive species to: (1) assist states in achieving their goals for conservation of endemic species; (2) as part of the National Environmental Policy Act process, review programs and activities, through a biological evaluation, to determine their potential effect on sensitive species; (3) avoid or minimize impacts to species whose viability has been identified as a concern; (4) if impacts cannot be avoided, analyze the significance of potential adverse effects on the population or its habitat within the area of concern and on the species as a whole (the line officer, with project approval authority, makes the decision to allow or disallow impacts, but the decision must not result in loss of species viability or create significant trends toward Federal listing); and (5) establish management

objectives in cooperation with the state when projects on National Forest System lands may have a significant effect on sensitive species population numbers or distributions. Establish objectives for Federal candidate species, in cooperation with the U.S. Fish and Wildlife Service and state of Arizona (FSM 2670.32). The presence of species carried forward for analysis were determined by consulting forest records, results of surveys conducted on the forest, and use of the FAAWN database (Patton 2011).

Northern Goshawk

This analysis addresses policy requirements and responds to key issues raised by the public including Issue #2, Conservation of Large Trees and Issue #3, Canopy Cover and post-treatment landscape open-ness in the context of impacts to goshawk and post-treatment viability. Metrics used to evaluate impacts are described in Environmental Consequences. This report utilizes and incorporates by reference the vegetation cover type and vegetation existing condition information provided in the silviculture report and the respective forest-wide MIS reports.

Forest Plan Compliance and Analysis Framework

Elements that relate to northern goshawk forest habitat apply to the forest and woodland communities. See Appendix 1 for details.

Project Area Affected Environment

Ponderosa Pine - The majority of the project area is the ponderosa pine plant association. The ponderosa pine associations include two major sub-types: Ponderosa pine-bunchgrass and ponderosa pine-Gambel oak. The ponderosa pine project area is dominated by high stand densities and closed tree canopies. Data in the silvicultural report shows that the average relative density throughout the project area is considered extremely high and 57 percent has closed canopy conditions (see silviculture report).

Approximately 44 percent of the landscape outside of goshawk nesting habitat is in an even-aged condition characterized by stands of trees dominated by a single age class. The current average stand density across the landscape is 58 percent, which is considered to be extremely high. The existing stand density in goshawk habitat outside of post-family fledging areas is 53 percent. The desired future condition for stand density in goshawk habitat outside of post-family fledging areas is 20.4 percent, which is considered to be low density. For a full discussion of this topic refer to the silvicultural report for this project.

Gambel Oak Within Ponderosa Pine Forest – Gambel oak is frequently the only deciduous tree in otherwise pure southwestern ponderosa pine forests, adding diversity to these forests. Similar to pure ponderosa pine forests, pine-Gambel oak forests have become altered since Euro-American settlement in the late 1800s resulting in an overall increase in small- and medium sized Gambel oak stems and a more simplified forest structure. Goshawk population dynamics have been shown to be strongly tied to prey abundance and the availability of alternate prey species during years when focal prey species populations are low (Salafsky 2004). The presence of Gambel oak means additional food availability for goshawk prey species in terms of mast (acorns) and increased species richness in terms of invertebrate prey species (Appendix 8).

Understory Vegetation Within Ponderosa Pine Forest - Grasses and forbs make up the herbaceous understory within the ponderosa pine plant associations throughout the project area.

Research across the 4FRI project area has shown substantial declines in herbaceous vegetation diversity and growth over the past century due to increased tree density, canopy covers, and forest floor depth (Appendix 8). This trend indicates a shift away from abundant food and cover for goshawk prey species as site occupancy and resource use became dominated by pine trees. See the goshawk MIS report and the silviculture report for additional information on habitat characteristics within the project area.

Coconino NF goshawk habitat characteristics (Forest Service 2002, draft 2012)

Most of the ponderosa pine, ponderosa pine/Gambel oak and mixed-conifer habitats on the Coconino Forest have been surveyed according to USFS Regional protocol for the northern goshawk. The earliest record for a goshawk on the forest was in 1972. Opportunistic sightings and limited surveys were conducted in the 1980s and in 1990. Since 1991 annual surveys were initiated and have continued since then. Some surveys may have been conducted during nonbreeding or low breeding years thereby reducing survey success rates. Additionally, much of the habitat not associated with projects (i.e. wilderness) has not been surveyed. Therefore, the number of goshawk territories is likely underestimated on the Coconino NF. As of 2008, there were 70 known territories on the Coconino NF (Table 28). Goshawk territories have been established based on the results of surveys. Some goshawk nesting areas were known prior to 1991, but survey efforts increased in the early 1990's. In 1987, 11 territories were known on the Forest. Some level of monitoring has occurred since 1991 and is summarized in the MIS section for goshawk. The history of goshawk occupancy on the Coconino NF is summarized in Table 28.

Table 28. Goshawk occupancy and reproduction from 1991 through 2008 on the Coconino National Forest

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
# Known Territories	41	52	56	57	57	60	60	62	64	66	66	66	66	66	68	69	69	70
Territories Monitored	41	51	50	36	36	40	41	43	45	38	48	25	26	26	18	22	27	26
Total Occupied	36	36	35	19	22	13	12	17	21	19	12	18	16	16	6	8	10	6
% Occupied	88	71	70	53	61	33	29	40	47	50	25	72	62	62	33	36	37	23
Nesting Attempts	28	24	26	13	17	8	7	16	19	16	5	9	8	7	4	5	4	3
Mean # of young	1.2	1.7	1.3	0.5	1.4	1.0	0.7	1.5	1.8	1.2	0.8	1.0	0.5	1.7	1.25	1.4	1.5	1.0
# Successful (fledged young)	22	21	20	5	16	6	5	14	18	11	3	9	4	12	5	7	6	3
% Nest Success	79	88	77	39	94	75	71	88	95	69	60	100	50	100	100	100	100	100

On the Coconino National Forest, some northern goshawk territories have been monitored every year since 1989, with an average of 43 territories monitored from 1991 to 2001. The occupancy rate of territories has declined over these last eleven years; however, this does not signify a corresponding trend in population numbers. This decrease in PFA occupancy could be an artifact of finding more nesting sites and establishing more PFAs, and then monitoring most if not all PFAs when the goshawks may be moving around and breeding in different areas in some years. It is likely that nonbreeding goshawks would not be observed. During the later years of this time period, precipitation amounts have been below average. Climate may very well play an important role in whether or not northern goshawks breed in a given year, and would also influence nesting success of northern goshawks. Data collected on the Forest are not designed to detect changes in population trend. The goals of monitoring are to gain some information of territory occupancy and reproduction.

The age class distribution of ponderosa pine is dominated by mid-seral stage stands. Some loss of old-growth and older trees continues to occur, primarily from fire, insects, and disease (see the silviculture report). Figures 7 through 10 display forest age-class distributions in goshawk habitat. This decrease in older trees may have affected nesting habitat for goshawks. Some early seral-stage habitat has been created, mostly by wildfire (see fire ecology report). Because this species is dependent on the Forest's ability to provide a continuous flow of habitat structural types over time to provide nesting and foraging habitat, the habitat trend for goshawks should improve as vegetation management projects are implemented with the newer standards and guidelines and moved towards historic conditions. Goshawk surveys were conducted in 2011 and will continue in 2012 in association with 4FRI planning efforts. Previously unsurveyed areas meeting criteria for habitat and distance from occupied post-family fledgling areas (PFAs) were designated as dispersal PFAs (dPFAs; see Modeling and Habitat methodology above).

Kaibab NF goshawk habitat characteristics (Forest Service 2010)

Forests and woodlands used for breeding by goshawks show great variation in horizontal and vertical vegetation structure. Despite the wide diversity of habitats occupied by goshawks, within a habitat type, goshawk nest areas are consistently comprised of mature and older forests. Typically, nest areas are composed of large, dense trees, closed canopies created by a variety of tree sizes, and open understories, but exact structure depends on forest type, elevation, and growth site potential. In the southwest, goshawks use ponderosa pine extensively. Goshawks construct stick nests in the lower third of the largest tree available. Nest height significantly correlated with nest-tree height, thus tree size and structure may be more important than tree species.

Overall, goshawks are closely tied to prey resources and less so to forest habitat type. If there is ample prey available in or adjacent to areas with preferred nesting structure, goshawks will nest regardless if the habitat type is forests, woodlands, or shrub lands. Goshawks like to forage in habitat with relatively open understories so they can easily see and pursue their prey, or use open forest habitats because they can hunt from perch trees for rabbits or ground squirrels in openings between trees. The variety of foraging habitat lends to the variety of prey items taken. In general, goshawks primarily eat medium-sized birds (e.g., woodpeckers and jays) and small mammals (e.g., squirrels and rabbits). Salafsky et al. (2005) suggest that inter-annual fluctuations in precipitation and conifer seed production are correlated with, and may be responsible for, variation in prey abundance which in turn is strongly associated with goshawk reproduction.

Together this suggests that goshawk demography is a complex interaction between vegetation composition and structure and natural variation in goshawk food resources, all of which may be confounded by ongoing drought conditions.

Although most of the NKRD appears to be at carrying capacity, goshawk reproduction on the Kaibab Plateau has been highly variable over 15 years and overall showed a significant decline from 1991 to 2005, including the portions of the Plateau within the Grand Canyon National Park . Data for the rest of the Forest show a similar decline in occupied territories (Figure 6). While a decline in territories does not translate directly into reproductive effort, it does indicate that the number of adults that could be breeding on the Forest is decreasing and that this decrease would result in less offspring recruited into the population. Data should be interpreted cautiously as the number of nests with unknown occupancy does vary by year. Goshawk surveys were conducted in 2011 and will continue in 2012 in association with 4FRI planning efforts. Previously unsurveyed areas meeting habitat and distance from occupied PFAs criteria were designated as dispersal PFAs (see Modeling and Habitat methodology above). There are currently 68 goshawk territories on the southern portion of the Kaibab NF, including 36 goshawk PFAs on the Kaibab NF portion of the project area.

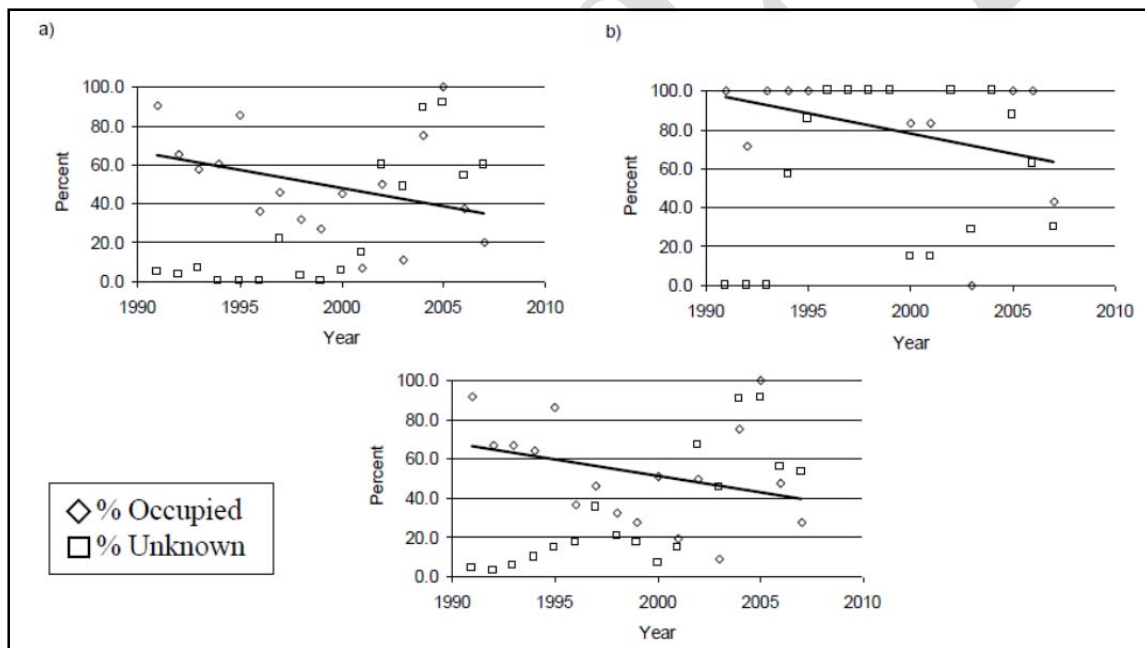


Figure 6. Percent of surveyed and occupied goshawk territories present on the Kaibab National Forest (1990 to 2010) : a) Williams Ranger District, b) Tusayan Ranger District, and, c) South Zone (Williams and Tusayan Ranger Districts combined)

Considering the information above, northern goshawks are assumed to be declining on the Kaibab National Forest. However, if future weather patterns produce good precipitation, the population could stabilize. Only precipitation can fuel forest productivity in terms of abundant seed crops which result in prey population increases that occur at greater frequencies. Continued reduction of forest stem density and basal area should ameliorate the stochastic nature of weather by reducing the threat of large-scale, high-severity crown fire, thereby helping stabilize the population.

Habitat Strata and Scales of Analysis

An analysis at three spatial scales is required by the Forest Plan for northern goshawk habitat. Evaluations of PFA habitat (used for nesting, breeding and primary foraging during the nesting season) and lands outside of the PFA (LOPFA; used primarily for foraging) will be done at the project, subunit, and restoration unit (RU) levels. An additional fourth scale of analysis will be done at the landscape scale and will include all of the ponderosa pine within the project area.

Large trees are defined as being 18" or greater in diameter and the size class for VSS 5 starts at 18" dbh. Considering that both the MSO and the northern goshawk are associated with larger, older forested habitats, overlap in their habitats is to be expected. Management direction for those areas of overlap would follow prescriptions for the MSO because of its threatened status under the ESA. Those acres being managed for the MSO and under MSO prescriptions are not included in the total acre calculations for northern goshawk LOPFA habitat assessments. In general, the prescriptions for MSO habitat would result in dense forest structure with canopy gaps, versus the mosaic of tree groups and associated openings desired for goshawk habitat. MSO habitat treatments are designed to move the habitat towards denser, older stand conditions. For an analysis of the effects to MSO protected, restricted, and threshold habitats, see the MSO habitat analysis section of this report.

For perspective, the following graphs depict the relative percentages of the various northern goshawk habitat strata that would be under MSO prescriptions. Nest stands are the smallest unit of northern goshawk habitat and potentially the most limiting. Figure 7 displays just over one-quarter of the nest stands fall within either protected or restricted MSO habitat. The PFA area immediately surrounding the nest stands provides the closest foraging opportunities as well as alternate nesting sites. Similar to the nest stands, Figure 8 shows about the same portion of the PFA, slightly less than one quarter, is considered MSO habitat.

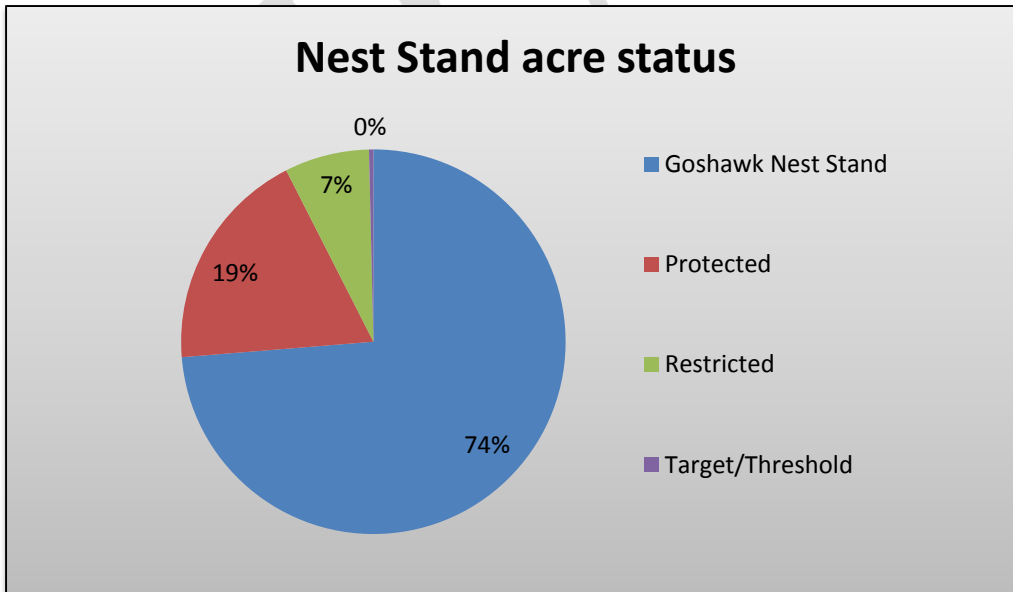


Figure 7. Goshawk nest stand status by habitat type and percent of acres

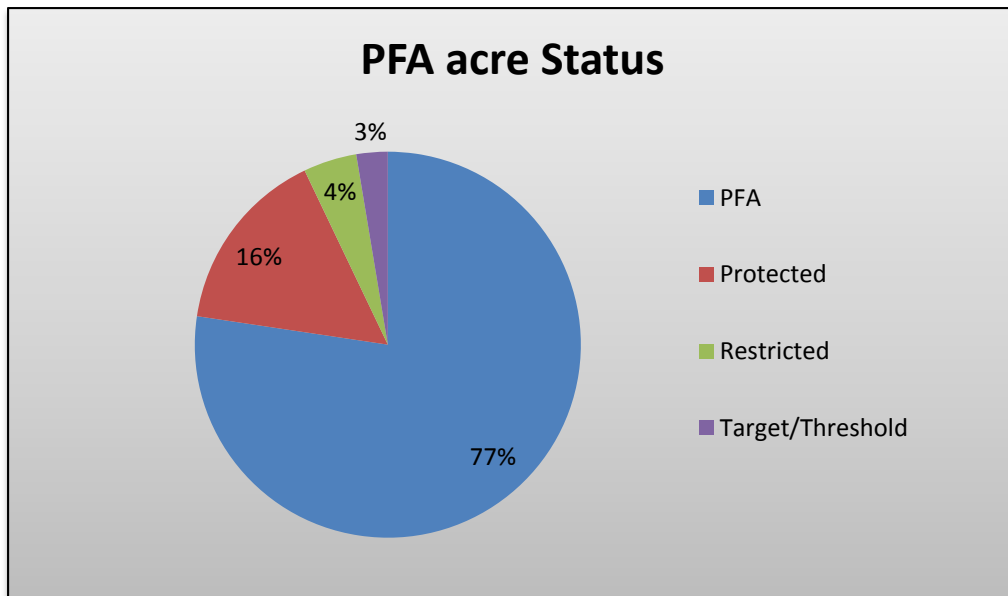


Figure 8. Goshawk PFA status by habitat type and percent of acres

For those areas across the landscape identified as potentially suitable future PFAs, or dispersal PFAs (dPFA), a slightly greater proportion of 30 percent is within MSO habitat (Figure 9).

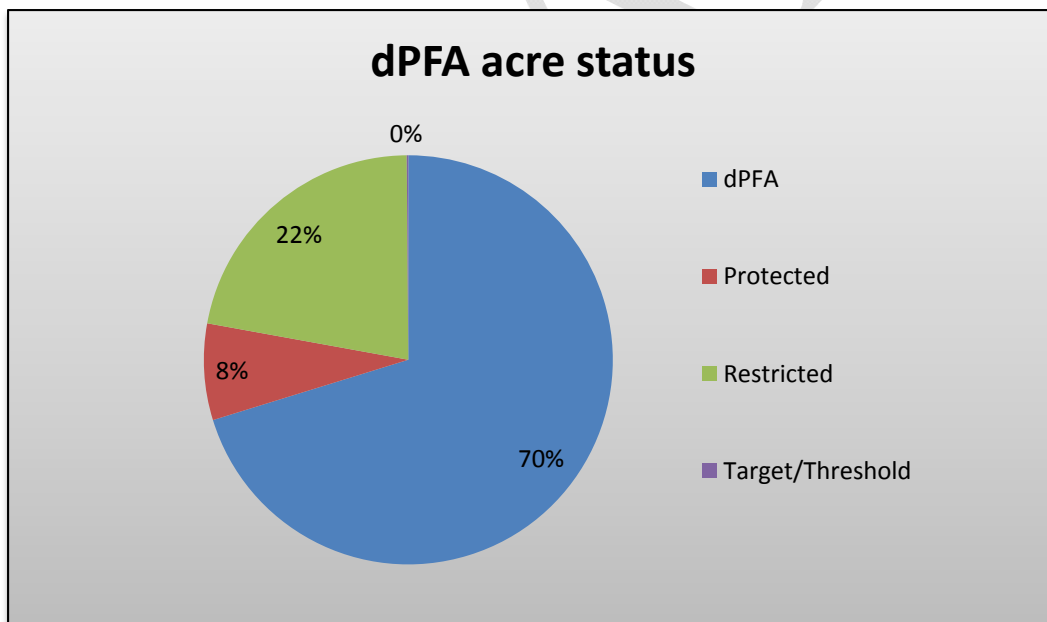


Figure 9. Goshawk dPFA status by habitat type and percent of acres

For the landscape outside of the PFA (LOPFA), where much of the foraging is done, the emphasis is on prey species habitat. Figure 10 (below) displays that just under a quarter, or 22 percent of the LOPFA is in MSO habitat.

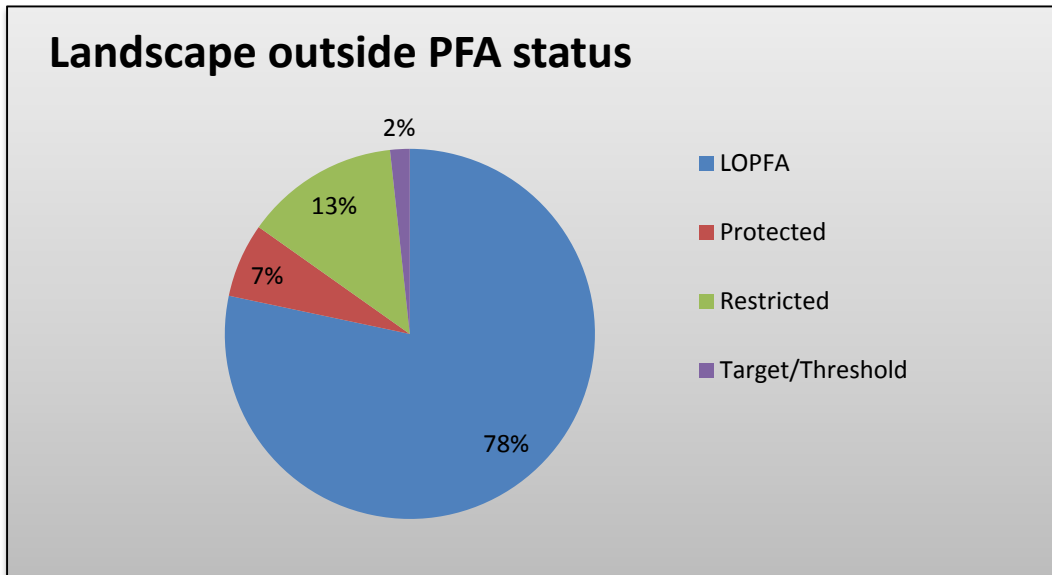


Figure 10. Goshawk landscape outside PFA status by habitat type and percent of acres

The conditions in those portions of the northern goshawk habitat that are within MSO habitat would tend to be older forests with more dense canopies and larger trees. These areas would provide quality nesting habitat for goshawks and snags, large trees, and down logs for certain goshawk prey species. The habitat conditions on the particular acres within MSO habitat may not be projected to change much from the existing conditions. However, moving the remaining portions (70 – 78%) of the respective goshawk habitat strata towards desired conditions would have positive impacts to both the northern goshawks and their prey species on the majority of their corresponding habitats.

Project Level Analysis

For the stands within nest/PFA/dPFA areas, all of the acres within the respective goshawk strata were included in the calculations for VSS and changes to VSS within these areas. For the LOPFA, only those acres that were managed to northern goshawk prescriptions were included, which would be about 78 percent of the acres.

The existing ratios of VSS within nest/PFA/dPFA stands at the project level are distributed with about 4/5 or 81 percent of the areas in the mid-seral VSS 3 and 4 (Figure 11). This is about double the acreage desired for mid-seral structure in goshawk habitat (Figure 12). Additionally, young seral forest is about a level of magnitude below desired conditions for the distribution of VSS classes across the landscape.

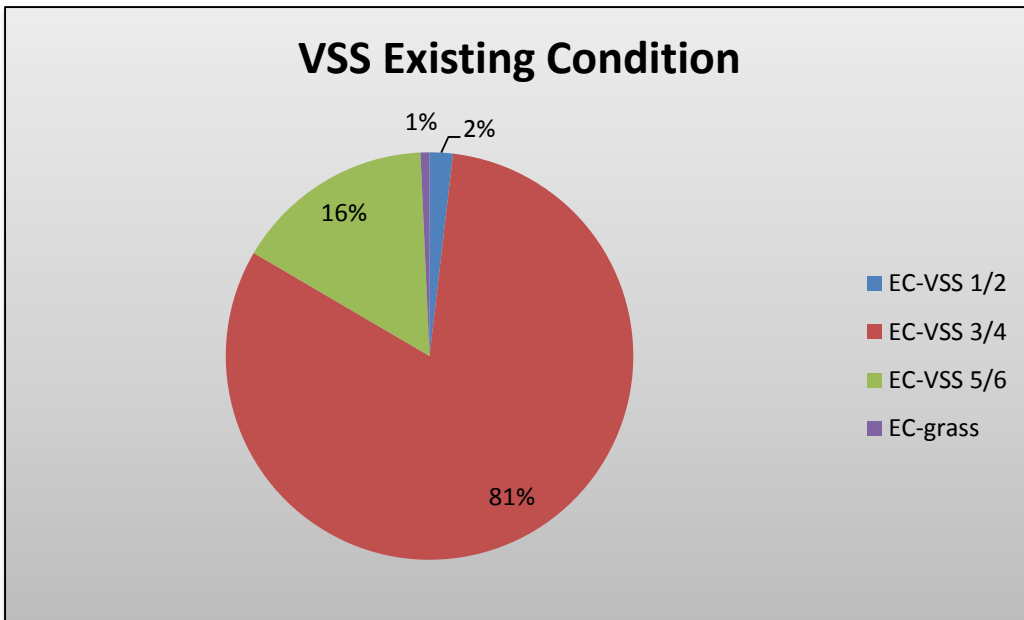


Figure 11. Existing VSS percent within goshawk nest/PFAs

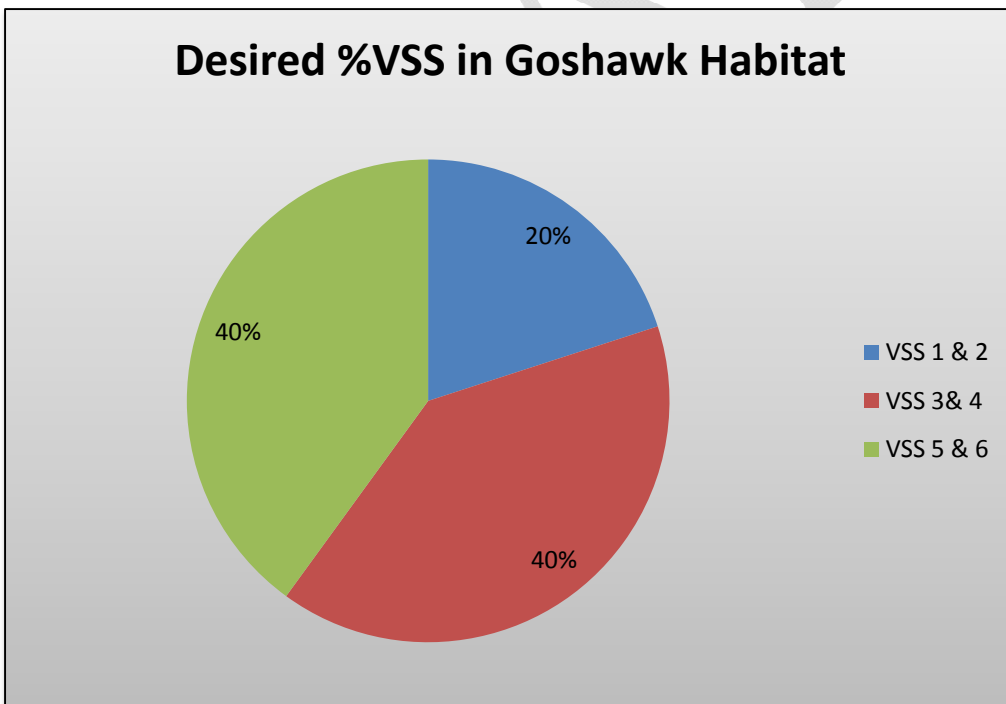


Figure 12. Desired VSS percent in goshawk habitat across the landscape

LOPFA acres, or those areas with an emphasis on foraging habitat, were analyzed in two parts based on stand structure of either even-aged or uneven-aged forest. About 44 percent of LOPFA areas are even-aged and 56 percent uneven-aged (Figures 13 and 14). Appendix 9 displays the

range in VSS classes for SU and RU for goshawk habitat in even- and uneven-aged stands. Even-aged stands do not meet the desired condition for goshawk habitat or for forest structure in general (see Silviculture report). Even-aged structure limits habitat diversity. As described above, even-aged stands are currently dominated by mid-seral forest, restricting the area of regeneration and young-seral forest. Eventually this will limit the succession of trees into the larger size-classes (see Silviculture report).

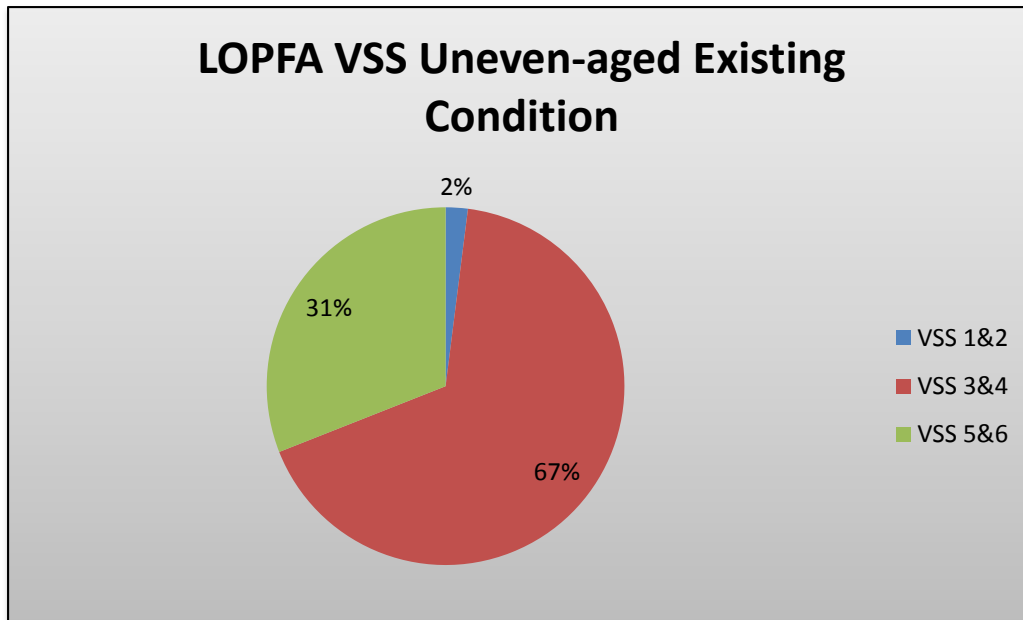


Figure 13. Percent of Uneven-Aged VSS within landscapes outside of PFAs (LOPFA)

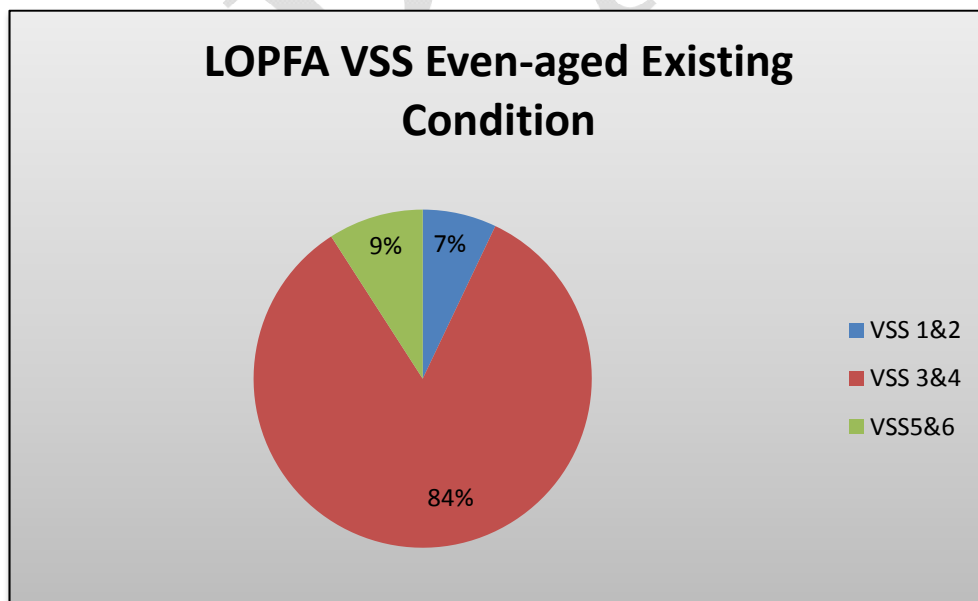


Figure 14. Percent of Even-Aged VSS within landscapes outside of PFAs (LOPFA)

Restoration Unit (RU) Level of Analysis

A visual picture of the relative changes to goshawk nesting habitat among the SUs can be seen in appendix 9. Appendix 10 displays pie charts of northern goshawk nest, PFA, and dPFA habitat by relative percent of VSS by RU for each alternative, including existing condition, the year 2020 (immediately post-treatment), and the year 2050 (thirty years post-treatment). The trends in changes are similar at all scales of analysis as are the reasoning for the resultant cause and effect. The VSS distribution for the RU level is thoroughly analyzed in detail in the silvicultural report. The VSS distribution is dominated by VSS 3 through VSS 6 in uneven-aged PFAs and LOPFAs. In even-aged PFA and LOPFA habitat, 80-100% of the stands are VSS 3 and 4. The only exception is RU-5 where 64% of the LOPFA are in VSS 3 and 4. Over a quarter of the LOPFA in RU-5 is VSS1 and the remainder is in VSS 5 and 6. The effects of the changes to the VSS on the northern goshawk are discussed in the analysis portion of this document.

Restoration Subunit Level of Analysis

The existing condition and analysis of VSS changes among subunits (SU) is discussed in the silviculture report for this project. The VSS distribution among the SUs reflects those discussed for the RUs with the uneven-aged areas showing greater diversity of VSS distribution than the even-aged stands which have primarily mid-seral conditions in VSSs 3 and 4. Appendix 9 displays the range in VSS classes for SU and RU for goshawk habitat in even- and uneven-aged stands.

Landscape Level of Analysis

For the landscape perspective, the ponderosa pine vegetation is addressed, encompassing the entire treatment area where changes would occur if 4FRI is implemented (Figure 15). The existing condition is not that different from the other goshawk strata analyzed above.

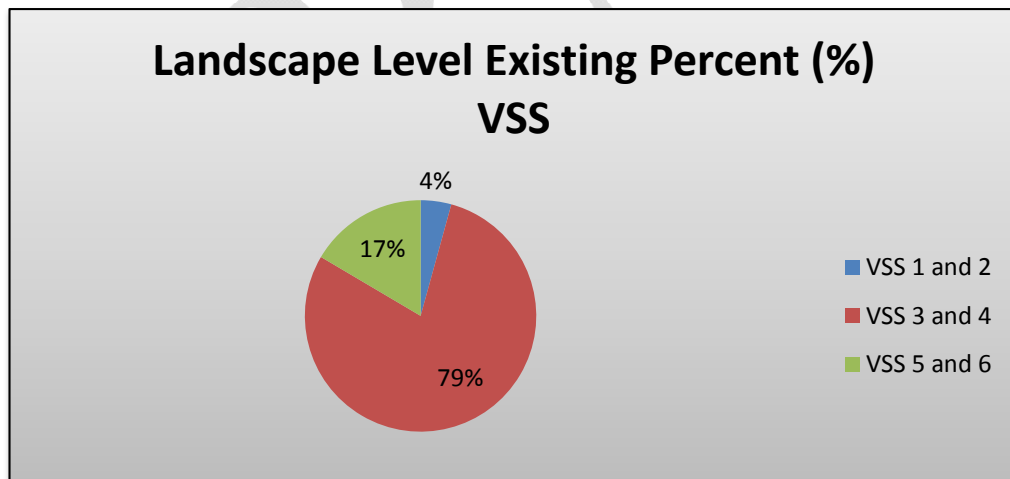


Figure 15. VSS Percentage at the landscape level (ponderosa pine extent)

Stand Density and Canopy Cover Requirements

The existing condition within the PFA and LOPFA (Post-fledging Family Area and Landscape Outside PFA) is considered to be high density or Zone 3 (see silviculture report for stand density discussion) with about 200 trees per acres across the ponderosa pine landscape. Zone 3 conditions

include: minimum forage production, severe competition among trees and active crown differentiation along with declining individual tree diameter growth at this tree density. Based on BA, SDI, and TPA, the dense, existing conditions meet forest plan guidance (Table 29). For more information on the relationships between BA, SDI, and TPA and canopy cover, see the silviculture report for the projected changes in these metrics at the various spatial scales.

Table 29. Forest structure values in goshawk habitat by forest by restoration unit

Forest by RU	Percent of Max SDI	Trees per Acre	Basal Area	CWD >12"	Snags >18"
CNF					
1	52	240	125	1.09	0.42
3	52	249	125	0.30	0.37
4	53	250	127	1.87	0.41
5	45	231	107	0.95	0.46
KNF					
3	43	178	105	0.26	0.39
4	42	177	103	0.21	0.37
6	29	150	63	0.27	0.31

The trends in changes for these metrics are similar among the strata, with more variability at the smaller scales. The following graphs (Figures 16 to 18) provide perspective for the expected changes to goshawk and prey habitat. Projected trends of various physical stand characteristics are based on FVS modeling (see silviculture report). The data for these graphs are compiled from individual stand data and aggregated up to the PFA/LOPFA at the landscape scale.

The existing condition within the PFA and LOPFA is considered to be high density or Zone 3 (Silviculture report). Some stand dynamics would include minimum forage production, severe competition among trees and active crown differentiation along with declining individual tree diameter growth at this %SDI. Alternative A increases the %SDI which would not alleviate these dynamics in both the PFA nesting habitat as well as the prey habitat in the LOPFA (Figure 16). The action alternatives move the entire landscape into Zone 2 which has less than full site occupancy with both intermediate forage production and individual tree diameter growth (Figure 16). The reduced %SDI makes more space and nutrients available for each tree, providing the requirements for the trees to grow to larger diameter in less time and retain more of their live crown ratios. These physical characteristics provide additional higher quality goshawk nesting substrate than Alternative A.

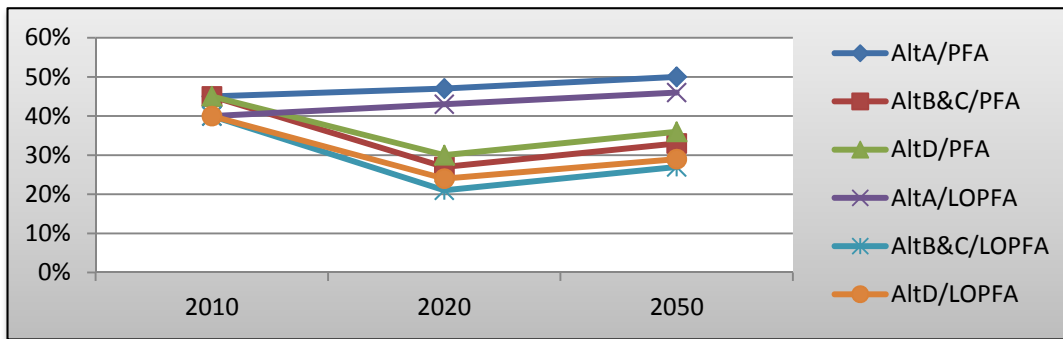


Figure 16. %max Stand Density Index (SDI) PFA/LOPFA by Alternative

The existing condition across the ponderosa pine landscape is about 200 trees per acre. The conditions in Alternative A would eventually reduce the TPA through density induced mortality from competition for limited space and resources (Figure 17). Alternatives B and C change the TPA in both the PFA and the LOPFA to slightly less than the TPA in Alternative D. Having fewer trees across the landscape reduces competition among trees for limited space and resources, providing opportunities for healthier and potentially larger trees for goshawks and their prey species.

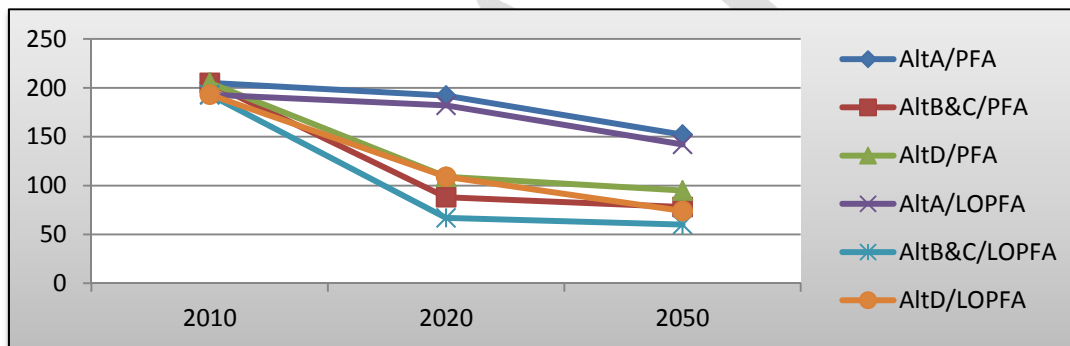


Figure 17. Trees per Acre (TPA) PFA/LOPFA by Alternative

Basal area is yet another way of measuring tree density. With no actions in Alternative A, the basal area would increase from the existing conditions, creating more dense stands of trees competing for limited space and resources (Figure 18). In Alternative A, the basal area would be found in the number of trees on the landscape. Alternatives B and C reduce the basal area slightly more than Alternative D immediately post-treatment in 2020. The basal area increases for the next 30 years in all action alternatives as the residual stands of trees grow with the created space and more available nutrients and water. For the action alternatives, the increased basal area would be found in larger trees on the landscape. There is less increase in Alternative D as a result of less prescribed burning leaving higher tree densities on site to compete for water and nutrients.

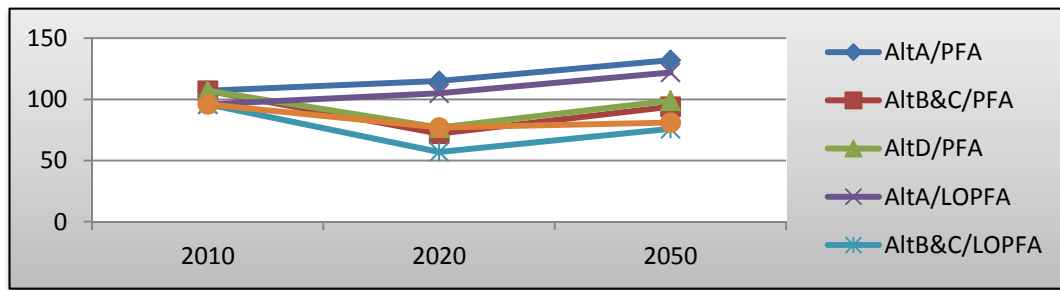


Figure 18. Basal Area (BA) PFA/LOPFA by Alternative

See the Silviculture report for the detailed analysis and explanation of canopy cover and how it is measured and calculated. Canopy cover relates to tree density, as do the measures for BA, TPA, and %SDI. Changing the distribution of trees, i.e., BA, TPA, and %SDI, changes canopy cover. The calculations in managing for canopy cover are incorporated within the stocking guides for silviculture. Based on these equations, canopy cover of 40 percent or more would be met in VSS 4, 5, and 6 in LOPFAs. Similarly, canopy cover of 50 or 55 percent would be met in VSS 4, 5, and 6 in PFAs. These canopy cover values reflect the expected measure across the stands, including interspaces between groups of trees. Therefore, canopy cover within tree groups would have to exceed stand averages to account of the canopy gaps. These dense groups of trees would continue to provide connected tree crowns for tassel-eared squirrels, a primary prey species for the goshawk. As the physical configuration of the features of the forested habitat are moved towards historic conditions, the quality of the habitat would be expected to increase for the native species associated with the ponderosa pine forest type.

Changes in biomass production would primarily occur as the result of creating openings in the forest canopy (decreasing %SDI), allowing light and water to reach the forest floor for herbaceous species to grow. Related to this is the reduction in the number of trees (TPA or BA) on the landscape competing for limited space and resources and suppressing understory development through abundant needle cast. The recurring theme in a literature review of the Ecological Relationships between Overstory and Understory Vegetation in Ponderosa Pine Forest of the Southwest (Smith 2011) focused on the ponderosa pine overstory having a strong inhibitory effect on the abundance and richness of understory species.

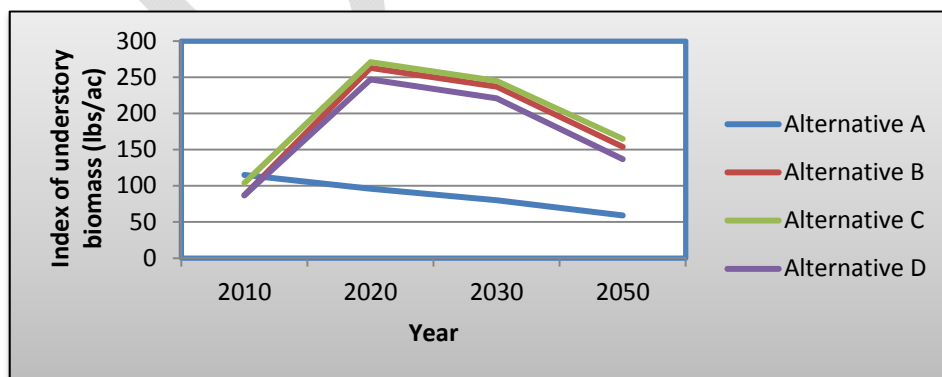


Figure 19. Index of Relative Biomass production on all habitats across the whole treatment area by alternative

The index of biomass production is directly proportional to herbaceous understory production measured in lbs/ac (Appendix 8). Based on the projected changes to tree densities displayed above, with all other climatic factors the same, the relative index of biomass production would be drastically increased comparably for the action alternatives. This would be seen in the amount of herbaceous and shrubby material produced after the treatments. The index of biomass production would slowly decrease after treatment as the crowns on the standing trees grew and once again closed. With no treatments to open the canopy or reduce the density of trees across the landscape, the index of biomass production for Alternative A would steadily decline across the landscape. This would mean less grasses, forbs and shrubs would be produced as food and habitat for prey species. Compounding the issue is the fact that today's level of understory production is only a fraction of pre-settlement herbaceous growth (Appendix 8).

Goshawk Prey Species

Salafsky et al (2005) suggested that prey density was an important limiting factor of goshawk productivity. Later, studies showed that increased prey density results in increased goshawk reproduction in ponderosa pine (Salafsky, et. al. 2007). Dewey and Kennedy (2001) reported that significantly heavier nestlings from nests with supplemental food had higher survival rates than nestlings in control nests. In 1996, Ward and Kennedy reported that although there was no significant difference in nestling sizes due to additional food availability, they did document higher nestling survival due to increased time spent at nest by female which consequently provided protection from predators. Wiens et. al. (2006) reported that food availability was the primary factor limiting juvenile survival and recommended forest treatments that provide forest structural conditions that allow goshawks to access their prey within breeding areas.

The Management Recommendations for the Northern Goshawk reviewed habitat needs and food habitats of important goshawk prey species based on reviews of relevant scientific literature (Reynolds et al. 1992). This assessment of the life history needs of these prey species identified physical habitat features associated within the forested environment. These physical habitat features were then used as the basis for developing desired conditions for each species. The assumption was that, by providing for the needs of an array of important prey species, goshawk populations be sustained as well.

There are 14 key prey species that were identified in the diets of northern goshawks in the southwestern United States (Reynolds et al. 1992):

- 12 prey species are associated with the ponderosa pine vegetation type where treatments in this project would occur
- All 12 species would be expected to occur within the project area (Patton 2011).
- Large trees are high/medium importance to 10 species
- Interspersion of VSS is high/medium importance to 10 species
- Herb, shrub, understory is of high/medium importance to 9 species

A simple, subjective rating system was used by Reynolds et al. (1992) to evaluate the importance of various habitat components to primary goshawk prey species in the southwest (Table 20). Eleven of the twelve prey species listed for the northern goshawk in the MRNG are associated with large tree vegetative structural stages (VSSs 5 and 6). Large trees are of medium/high importance as habitat components to ten of the twelve prey species for maintaining sustainable populations. Openings are important for maintaining sustainable populations for half of the

twelve prey species associated with ponderosa pine. Herbaceous and shrub components are of medium/high importance for nine of the twelve prey species. For ten of the twelve prey species in the pine type, an interspersed VSS is of medium/high importance to maintain sustainable populations. Interspersion is more prevalent in uneven-aged stand conditions than even-aged stand conditions. Large trees and/or herb/shrub/understory are of medium to high importance for all twelve prey species.

Table 20. Rating of habitat component importance¹ for twelve goshawk prey species

Species	Forest Type ²	Snags	Downed Logs	Woody Debris	Openings	Large trees ³	Herb, Shrub, Understory	Interspersion ⁴ of VSS
American robin	PP,MS,SF	None	None	Low	Medium	Low	High	High
Band-tailed pigeon	PP,MS	Low	None	None	High	Medium	Medium	Medium
Chipmunks	PP,MS,SF,PJ	Medium	High	High	Medium	Medium	High	Medium
Cottontails	PP,MS,PJ	Low	Medium	High	Medium	None	High	High
Hairy woodpecker	PP,MS,SF	High	Medium	Medium	None	High	None	Medium
Mantled ground squirrel	PP,MS,SF	Low	High	High	Medium	Medium	High	Medium
Mourning dove	PP,MS,SF	Low	None	Low	High	Medium	High	High
Northern flicker	PP,MS,SF,PJ	High	High	Low	Low	High	Medium	High
Red-naped sapsucker	PP,MS	High	Low	Low	None	Medium	Medium	Medium
Steller's jay	PP,MS,SF	Low	Low	Low	None	High	Low	Low
Tassel-eared squirrel	PP,MS	Low	Medium	Low	None	High	Low	Medium
Williamson's sapsucker	PP,MS	High	Medium	Medium	None	High	Medium	Low
Summary:	12 species associated with PP	4 – high 1-medium 6 – low 1 - none	3 - high 4-medium 2 – low 3 - none	3 – high 2-medium 6 – low 1 - none	2 – high 4-medium 1 – low 5 - none	5 – high 5-medium 1 – low 1 - none	5 – high 4-medium 2 – low 1 - none	4 – high 6-medium 2 – low 0 - none

P – ponderosa pine / MS – mixed species / SF – spruce-fir / PJ – pinyon-juniper (from MRNG)

¹ Large trees = live >18 inches DBH (MRNG)

²PP – ponderosa pine / MS – mixed species / SF – spruce-fir / PJ – pinyon-juniper (from MRNG)

³Large trees = live >18 inches DBH (MRNG)

⁴Interspersion measures the degree of intermixing of vegetation structural stages (MRNG)

Measures of vegetative features relevant to goshawk prey species habitat

Like goshawk habitat, prey habitat has specific structural components important to the respective prey species. These habitat components are listed below with their respective forest plan guidance for management objectives. Existing conditions for each component are identified in Table 21.

- **Snags:** Move toward/Meet Forest Plan direction - 2 snags (>18"dbh)/acre in all PIPO
- **Downed logs:** Move toward/Meet Forest Plan direction - 3 downed logs (>12"diameter X 8 ft. long)/acre
- **Woody debris:** Move toward/Meet Forest Plan direction - 5-7 tons (>3"diameter)/acre
- **Openings:** Prevalence of openings inversely corresponds with %SDI – also included as design feature
- **Large trees:** Large ≥ 18 "dbh (MRNG definition) – measured in acres of VSS 5 & 6
- **Herb, shrub, understory:** Quantity and quality directly correspond with relative biomass production in understory
- **Interspersion of VSS:** Degree of interspersion directly corresponds with extent of uneven-aged stand conditions

Table 21. Existing Conditions of MRNG prey species' habitat features

Prey Species Habitat Component	Measure	Existing Condition
Snags >18"dbh	Snags/ac	0.4/ac – pfa/outpfa
Downed Logs	CWD #/ac >12"diameter	0.7/ac – pfa 0.4/ac - outpfa
Woody Debris	Tons/ac	3.9/ac - pfa 3.5/ac - outpfa
Openings	Relevant to %SDI	45% - pfa 40% - outpfa
Large trees	% VSS 5 & 6	17% VSS 5&6
Herb, Shrub, Understory	lbs/ac biomass production	@ 100 lbs/ac
Interspersion of VSS	% age structure condition	43% - Even-aged 55% - Uneven-aged

In 2008, Beier et al. (2008), conducted a test of the MRNG and concluded that goshawk reproduction declined as forest structure in the breeding areas more closely resembled the forest structure prescribed in the MRNG. In response to this investigation, Reynolds et al (2012) looked at Beier et al.'s analysis and found several apparent errors. Beier et al.'s rebuttal paper in 2012 was more of a discussion of the issue and did not contain any new scientific information.

It should be noted that Beier et al. 2008 is based on a review of the General Technical Report RM-217 - Management Recommendations for the Northern Goshawk (MRNG) in the Southwestern United States (Reynolds et al. 1992). While the technical report and the 1996 Regional Amendment to all Region 3 Land Management Plans are not the same. The selected alternative for the 1996 Regional Amendment was the Mexican Spotted Owl Recovery Plan Integration Alternative. The standards and guidelines for northern goshawks in this alternative were developed in early May 1995, and considered all known information from the Goshawk Interagency Implementation Team recommendations, the joint Arizona and New Mexico game agencies letter that responded to the DEIS, and experience gained during the implementation of the interim direction (USDA 2006). These are the directions used in developing project alternatives unless the forest plan is specifically amended.

One of the discussion points in the Beier et al. (2008) was whether the assumption that the goshawk is a forest habitat generalist is correct. This is a fundamental assumption in the technical report and the 1996 plan amendment. The assumption was further supported in the Final Supplement to the Final Environmental Impact Statement (FSFEIS) for Amendment of Forest Plans (USDA 2006). The FSFEIS reviewed additional literature and concluded that the assumption was valid.

Beier et al. 2008 cited Greenwald et al. (2005) when discussing whether the goshawk was a habitat specialist. Greenwald et al. (2005) was reviewed in the FSFEIS.

Beier et al. (2008) concluded that the production of goshawk fledglings decreased as breeding areas more closely resembled habitat described in Reynolds et al. (1992). Reynolds et al. (2012) found study flaws in Beier et al. (2008) that led to a miscalculation of vegetation structural similarities and that introduced a systematic bias into their test by inadequately sampling breeding areas for reproduction. Reynolds et al. (2012) also found evidence of a basic misunderstanding the desired forest structures described in the technical report in Beier et al. (2008), including their assertion that the desired conditions in the MRNG differ markedly from pre-settlement forest structures when ongoing research by the Ecological Restoration Institute describes similar forest structure (see the summary for Ray (2011) below).

Beier and Ingradli (2012) acknowledged that sampling across a broader spectrum of similarity would provide a much stronger evaluation of the technical report and clarified their findings by stating “we carefully avoided inferring that the recommendations were ‘bad for goshawk.’ Instead we cautiously pointed out that our results provided no evidence that the recommendations improve goshawk nest productivity.”

Beier et al. (2008) itself identified: use of a small sample size; use of an observational rather than an experimental approach; and a small sample size.

The 1996 Plan amendment provides for integrated multiple use and sustained yield of goods and services from the Forest in a way that maximizes net public benefits in an environmentally sound manner while conserving goshawks in the southwestern United States.

Beier et al. (2008) did not address prey habitat or other needs of key prey species. Salafsky et al (2005) suggested that prey density was an important limiting factor of goshawk productivity. Later, studies showed that increased prey density results in increased goshawk reproduction in ponderosa pine (Salafsky, et. al. 2007). Dewey and Kennedy (2001) reported that significantly heavier nestlings from nests with supplemental food had higher survival rates than nestlings in

control nests. In 1996, Ward and Kennedy reported that although there was no significant difference in nestling sizes due to additional food availability, they did document higher nestling survival due to increased time spent at nest by female which consequently provided protection from predators. Wiens et. al. (2006) reported that food availability was the primary factor limiting juvenile survival and recommended forest treatments that provide forest structural conditions that allow goshawks to access their prey within breeding areas. Providing for the habitat needs of 14 key prey species of goshawks in the southwestern United States is why the MRNG is described as food-web-based conservation plan (Reynolds et al. 2008).

Greenwald et al. (2005) concluded that the MRNG may be inadequate to protect goshawks. Greenwald et al. (2005) based this conclusion on their review of 12 radio-telemetry-based studies of goshawk habitat selection and 5 nontelemetry studies that looked at the effects of vegetation structure on goshawk home ranges. Reynolds et al. (2008) reviewed the methodology used by Greenwald et al. (2005) and concluded their criticism of the MRNG appeared rooted in misunderstandings of goshawk habitats described in the MRNG, a discounting of the extent of variation in vegetation structural and seral stages used by goshawks, a limited understanding of the extent to which prey limits goshawks, a failure to recognize the dynamic nature of forests, and an incomplete review of the literature. Reynolds et al. (2008) concluded the MRNG are adequate because they maximize the sustainable amount of mature and old forests in goshawk home ranges and specify intermixtures of prey habitats within home ranges.

Ray (2011) modeled three management strategies for ponderosa pine forest, including: an evidence-based, thin from below followed by prescribed burning restoration treatment; retaining/creating small groups of different diameter classes to mimic the MRNG; and a blend of the two approaches applied to specific areas recommended for treatment by a collaborative group working with the Kaibab NF. The modeled approach for the MRNG did not account for prey habitat, including omission of forest plan direction for snags and coarse woody debris. He evaluated the probability of northern goshawk occupancy in the forest structure resulting from each modeled treatment type. All three strategies showed a decrease in the probability of occupied northern goshawk territories occurring. Results for the MRNG and restoration treatments were not statistically different and the blended approach produced the highest probability of use. Ray (2011) looked at a single point in time and did not model forest structure through time. Ray did reference the importance of the abundance and availability of prey species to goshawk reproduction and survival and concluded that goshawks are likely to persist while managers restore the ecological integrity of southwest ponderosa pine” (Ray pers. comm.).

Northern Leopard Frog

The northern leopard frog occurs in northeastern Arizona, usually in montane streams and wetlands that have aquatic vegetation, and also in wet meadows at higher elevations. This leopard frog is generally restricted to permanent waters, but is also found in semi-permanent and seasonal waters. In Arizona, northern leopard frogs are absent from most historical locations; other than the livestock tanks at and near Stoneman Lake (Subunit 1-6). Following metamorphoses, northern leopard frogs disperse away from their natal wetlands, and can move up to 800 meters in 2 to 3 days and have a tendency to move to the edges of permanent bodies of water. Mass emigrations can follow heavy rains. During dispersal, juvenile frogs can be found in upland forests, meadows and temporary water sources, whereas adult frogs remain closer to original water sources (ibid). Northern leopard frogs typically hibernate in ponds and lakes where they may sit on the bottom under rocks or logs, or in depressions in silty substrates. They may bury themselves in the mud or

may aggregate over underwater springheads. They are intolerant of freezing and low oxygen levels (ibid).

Although migration patterns in leopard frogs are not well understood, they are presumed to actively move between aquatic habitats. These movements are an important component of metapopulation dynamics for these species, promoting increased genetic flow and colonization of new habitats. Appropriate levels of cover are important, however, for migrating frogs, which are dependent upon cover to avoid desiccation and escape from predators (Chan-McLeod 2003 as cited in (USDI FWS 2007). Leopard frogs have been shown to avoid areas lacking cover and experience higher water loss when in disturbed areas lacking cover (Mazerolle and Desrochers 2005 as cited in USDI FWS 2007). Cover is therefore an important component of overland habitats when it does not present a physical barrier to movements.

The Coconino Wildlife Connectivity Assessment: Report on Stakeholder Input (AGFD 2011) identified one amphibian travelway (referred to herein as linkage) within the project area. The Ashurst/Kinnikinick – Mormon Lake linkage connects permanent and ephemeral lakes and wetlands. Northern leopard frogs are one of the amphibians identified within this linkage. Current threats/barriers within the linkage are off highway vehicle use and Lake Mary road. The linkage is within Subunits 1-2, 1-4 and 1-5. Appendix 4 and AGFD 2011 describe this linkage.

Chytrid fungus was identified by the CLF Recovery Plan (USDI USFWS 2007) as posing a high threat to systems supporting CLFs, and, presumably, NLFs. This fungus has been identified as causing the decline and extinction of frog populations (USDI USFWS 2007). The presence of Chytrid fungus in the action area is unknown. Transfer of Chytrid can occur when contaminated wet equipment or muddy vehicle tires are in contact with multiple aquatic sites. Risk of transfer can be reduced with the use of proper decontamination procedures.

In Arizona, northern leopard frogs are absent from most historic locations. Northern leopard frogs were reported from 11 Subunits (1-2, 1-3, 1-4, 1-5, 1-6, 3-4, 3-5, 4-4, 4-5, 5-1) on the project area. Their range within the project boundary is now limited to permanent waters around Stoneman Lake. A number of water bodies within the project area that may have provided suitable breeding habitat historically now have resident non-native predators such as bullfrog, green sunfish, or crayfish populations. There are six occupied/critical breeding sites and ten potential breeding sites in the project or within a ¼ mile of the project area boundary and they occur within subunits 1-2, 1-5 and 1-6. Best potential habitat within the project area is tanks and springs that provide permanent water. Potential threats to local populations of Northern leopard frogs include changes in wetlands, especially the alteration of marshy ponds to reservoirs and natural local extirpations as ponds dry up during years of low precipitation. Other threats include alteration of riparian vegetation by grazing, predation and competition by introduced bullfrogs and other non-native aquatic species and Chytrid fungus. Although potential habitat occurs in livestock waters in all cover types within Restoration Unit 1, 3, 4 and 5, the primary breeding and dispersal habitat occurs in Restoration Unit 1 where the amphibian linkage is designated. Restoration Unit 1 has 8,230 acres of grassland and 145,793 acres of ponderosa pine, 24 miles of riparian habitat and ephemeral streams and 32 springs.

Bald Eagle

The FWS removed the bald eagle in the lower 48 States of the United States from the Federal List of Endangered and Threatened Wildlife, as of August 8, 2007. Eagles are currently protected under the Golden and Bald Eagle Protection Act and are a Forest Service Sensitive species.

The FWS recommends using the *Conservation Assessment and Strategy for Bald Eagles in Arizona* (Driscoll et al. 2006) in conjunction with the *Bald Eagle National Management Guidelines* (USDI 2007) to protect bald eagles in Arizona.

Bald eagles in central Arizona prefer to nest on cliff ledges or pinnacles or in tall trees (USDI 1982). Bald eagles are habitat generalists and opportunistic feeders, typically taking the easiest and most abundant prey, regardless of whether it is dead or alive (Joshi 2009). They mainly forage on waterfowl and fish found along major streams, however, they do hunt in the uplands and forage on various mammal species, especially in the winter.

Nesting

There are two nesting pairs of bald eagles within the project boundary. One breeding area occurs above the Rim near Lower Lake Mary. The same pair has used two different nest locations along Lower Lake Mary. The area at the most consistently and recently used nest is naturally protected due to limited access to the area and is periodically monitored by Arizona Game and Fish Department and Northern Arizona Audubon Society. The alternate nest location is adjacent to FR 296A and has a higher level of disturbance within the area. The second breeding area is at Whitehorse Lake on the Kaibab Forest. This nest was first documented in May of 2012 and is located in an area of high recreation use. The nest was monitored by Arizona Game and Fish Department and confirmed active with 2 young nestlings.

Wintering

Bald eagles occurring on the Coconino and Kaibab NFs are primarily winter visitors. Bald eagles overwintering in northern Arizona are primarily migratory individuals that breed in the northern U.S. and Canada (Grubb et al. 1989). They are often seen scavenging on carrion, including large and small mammals, or around some of the waters supporting fish and waterfowl such as Lake Mary, Mormon, Ashurst and Kinnickinick Lakes on the Coconino NF and Kaibab Lake, White Horse Lake, and Sholz Lake on the Kaibab NF. Small to moderate-sized groups of bald eagles (typically 2-48) roost in clumps of large trees in protected locations such as drainages and hillsides (Grubb and Kennedy 1982, Dargan 1991). Bald eagle winter night roosts typically consist of clumps of large (average dbh of 30 inches) trees on steep slopes that tend to occur on east facing aspects (Joshi 2009). Group sites are typically in stands of ponderosa pine trees less than an acre up to 43 acres, most often on north or northeast-facing slopes close to daytime foraging areas (Dargan 1991). Day roosts are often trees or snags near water or roadways. Bald eagles are highly mobile in the winter and can fly great distances in search of aquatic or terrestrial prey and suitable nighttime roosting habitat. There are currently 38 eagle roosts spatially identified in GIS for the project area, of which 19 have confirmed use by bald eagles. The remaining 19 roosts are identified as characteristic roosts and do not have documented use by bald eagles. Bald eagle confirmed and characteristic winter roosts are found in 7 of the 23. With the assistance of a grant from the American Eagle Foundation a biologist working with the Four Forest Restoration Initiative is currently surveying and assessing characteristic bald eagle roosts to determine bald eagle use and the need for vegetation treatments and fuel reduction.

Coconino Forest Plan direction for Management Area (MA3) states that in ponderosa pine and mixed conifer habitats on less than 40% slopes bald eagle winter roosts are to be protected. In addition to the actual roost trees, a 300-foot radius no-cut zone should be delineated. Road development should avoid the roost and uncut zone (Coconino NF 1987) and human disturbance at roost sites should be avoided from October 15 to April 15 (Driscoll et al. 2006). Kaibab Forest Plan direction for GA 1 requires a 20-chain buffer (1320-feet) around existing and potential roosts. The Arizona Conservation Assessment and Strategy guidelines restrict human activity within 500 feet of a roost but allows for thinning to promote growth of large trees within roosts that are becoming less suitable due to loss of trees or snags (Driscoll et al. 2006). Potential habitat within the treatment area is 512,178 acres of ponderosa pine but is habitat is primarily within 2.5 miles from bodies of permanent water (i.e. Upper and Lower Lake Mary, Horseshoe Lake, Mormon Lake and Roger's Lake) and along major roadways (i.e. Interstate 17, 40, 89A and 89N and Federal Highway 3).

American Peregrine Falcon

The essential habitat for peregrine falcon includes rock cliffs for nesting and a large foraging area. Suitable nesting sites on rock cliffs have a mean height of 200 to 300 feet. The subspecies *anatum* breeds on selected isolated cliff ledges and is a permanent resident on the project area. Peregrines prey mainly on birds found in wetlands, riparian areas, meadows, parklands, croplands, mountain valleys, and lakes within a 10 to 20 mile radius from the nest site. There are 20 confirmed nesting pairs of peregrine falcons within the project area. Nests occur in 8 subunits (1-1, 1-6, 3-1, 3-4, 3-5, 4-3, 4-4 and 5-1). Known nest locations, tall cliffs, open waters and meadows provide potential habitat within the project boundary. Forest Plan guidelines prohibit disturbing activities in the vicinity of occupied peregrine falcon nesting habitat between March 1 and August 15. Foraging habitat in the treatment area is primarily 48,774 acres of grassland, 43 miles of riparian habitat and ephemeral streams, 74 springs and wetlands.

Clark's Grebe

Clark's grebe use marshes, lakes, and bays for nesting. They nest in colonies among tall emergent plants along the edge of large open waters. They feed on fish and aquatic invertebrates. Threats include unmanaged grazing, drought, and disturbance of nesting colonies. Populations are variable because some of the nesting locations are ephemeral. There is confirmed nesting at Mormon Lake, southeast of Flagstaff. Neither Clark's grebe nor their habitats have been identified on the Kaibab NF. The CNF FP guidelines are to maintain and improve nesting cover and waterfowl forage on existing waterfowl islands and shorelines. Wetlands and open water containing emergent vegetation which provide nesting habitat are protected from disturbing uses that will harass nesting birds or would damage nests or nesting habitat from May 1 to July 15. Most potential habitat is located on Anderson Mesa (Subunits 1-2 and 1-4), Marshall Lake (Subunit 1-3) and Mormon Lake (Subunit 1-5).

Western Burrowing Owl

Burrowing owls are found in flat, open, low-stature grasslands, sparsely vegetated desert shrub, and edges of human disturbed land. These owls take over burrows of prairie dogs and ground squirrels, and dens of coyote, fox and badger. They are also known to use artificial burrows. These owls also need perches, such as mounds and fence posts. They primarily eat insects and small mammals, but are known to take other small-sized species. Breeding Bird Atlas surveys

confirmed nesting from approximately 100 feet elevation near Gladsden to 6,600 feet elevation in a prairie dog colony near Flagstaff however burrowing owls have not been confirmed within the project area. Similar to prairie dogs, burrowing owls are associated with the Great Basin/Colorado Plateau grassland and steppe, montane subalpine and semi-desert grasslands. There are 48,774 acres of grassland habitat within the treatment area that provide potential habitat for prairie dogs and consequently, burrowing owls. There is no specific Forest Plan direction for burrowing owls or prairie dogs however guidelines for mountain grassland are to evaluate the need to maintain and improve meadows by eliminating competing conifers, stabilizing gullies to restore waters tables, and reseeding with desirable species.

Ferruginous Hawk

Ferruginous hawks historically nest in open shrublands, woodlands, and grasslands in southeastern and northern Arizona. Their habitat is comprised of open country, primarily prairies, plains and badlands; sagebrush, saltbush-greasewood shrubland, periphery of pinyon-juniper and other woodland, and desert. They need diverse early successional states of grasslands and herbaceous ground cover to support prey with low canopy cover. Prairie dog towns are wintering sites as they provide a concentrated prey source. The current distribution of breeding birds is restricted to Plains and Great Plains Basin grasslands in northern and northeastern Arizona. Ferruginous hawks range more widely in winter and are found throughout the state, often in agricultural areas and other open habitats (Latta et al. 1999). Breeding bird atlasers found nesting ferruginous hawks occupying a fairly narrow range of elevations, from 4,700 feet to 6,400 feet (Corman and Wise-Gervais 2005) with no documented nesting on the Coconino or Kaibab National Forest. Ferruginous hawks forage in montane subalpine grasslands in the Flagstaff vicinity. Prairie dogs were likely important in determining the historic breeding distribution of the ferruginous hawk in Arizona (Glinski 1998). Coupled with the loss of habitat, the widespread extirpation of these rodents has greatly reduced the hawk's nesting distribution (Corman and Wise-Gervais 2005). There are 48,774 acres of grassland habitat within the treatment area that provide potential habitat for prairie dogs and consequently, ferruginous hawks. There is no specific Forest Plan direction for ferruginous hawks or prairie dogs however guidelines for their habitat are to evaluate the need to maintain and improve meadows by eliminating competing conifers, stabilizing gullies to restore waters tables, and reseeding with desirable species.

Four Spotted Skipperling

This butterfly ranges throughout central and northern Arizona but has not been recorded within the project area. Four spotted skipperling habitat consists of moist meadows and streamsides in high elevation mountains. This species takes nectar in cool, deep canyons and along forested road margins. The species has also been seen congregating on moist cliffsides. *Dactylis glomerata* (Poaceae) is a strongly suspected food plant. Habitat fragmentation (the disruption of the herbaceous layer) can cause population isolation and therefore loss of gene flow which has been demonstrated to increase extinction risk in some butterflies (Appendix 8). The four spotted skipperling is associated with mixed broadleaf deciduous and montane willow riparian forest, wetland cienega and montane subalpine grasslands. Of these habitats only montane subalpine grassland and wetland cienega occur in the treatment area. There are 48,774 acres of montane subalpine grassland and 74 springs in the treatment area.

Nitocris Fritillary

This butterfly is known from Apache and Coconino (Kehls Spring, Clover Spring) Counties in Arizona however no locations are documented in the project area. Their habitat includes mixed conifer, ponderosa pine, spruce fir, montane willow riparian forests and wetland cienega vegetation types. Of these, only the ponderosa pine and wetland cienega occur in the project area. It is a sensitive species for the Coconino NF. It has not been recorded on the Kaibab NF and is not considered a sensitive species for the Forest where the habitat is too dry and water too ephemeral to provide habitat. Potential habitat within the project area is found throughout the 470,990 acres of ponderosa pine and 51 springs and 85 miles of riparian habitat in Restoration Units 1, 3, 4 and 5 within the treatment area.

Nokomis Fritillary

These butterflies are found near springs, seeps, wet meadows, and marshes (Opler and Wright 1999). The caterpillars are strongly associated with *Viola* and adults feed on nectar avidly at thistle. Within the project area they are known from drainages in the San Francisco Mountains. It is a sensitive species on the Coconino NF. It has not been recorded on the Kaibab NF and is not considered a sensitive species for the Forest where the habitat is too dry and water too ephemeral to provide habitat. Potential habitat within the project area is found in Restoration Units 1, 3, 4 and 5. Within these Restoration Units there are 51 springs and 85 miles riparian habitat and ephemeral streams that provide habitat in the treatment area. The main threat to the species is loss of habitat from draining or development.

Navajo Mogollon Vole

Hoffmeister (1986) delineated the range for this vole from Navajo Mountain southward to the western part of the Mogollon Plateau, extending from near Mormon Lake westward towards the town of Williams and up to the Tusayan Ranger District. They live in a variety of habitats from 3,800 to 9,700 feet in elevation, including ponderosa pine forest and montane subalpine grasslands. Whether or not Navajo Mogollon voles are found in forests, shrublands, or grasslands, they are associated with grassy vegetation (Hoffmeister 1971). They select drier habitats than long-tailed voles, which typically occupy moister habitats (Hoffmeister 1971). They occur within open forests and in larger grassland areas such as Garland and Government Prairies on the Williams Ranger District (Ganey and Chambers 2011). They typically nest underground with runways leading from the burrow entrance out to their foraging areas. They preferentially forage on cool season or C-3 photosynthesis grasses (Chambers and Doucett 2008, Ganey and Chambers 2011). Other grasses can also provide food and voles rely on other herbaceous species for cover. In a study evaluating understory vegetative cover, clumpy tree distribution, decreased pine basal area and snags greater than 16 inches in diameter were identified as strong drivers for Mogollon vole occupancy (Kalies et al. 2010). There are 512,178 acres of ponderosa pine and 48,774 acres of grassland within the treatment area.

Long-tailed vole

Most of the species range is outside of Arizona (Bowers et al 2004). But within Arizona the range includes Coconino, Apache-Sitgreaves and Kaibab Forests. This vole is widespread but usually uncommon in the west in areas with good cover such as forest edges, streamsides and thickets. The long-tailed vole has very localized populations in coniferous forest to rocky alpine tundra, sagebrush, semi-desert, marshes, moist meadows, and forest edges. Small mammal surveys have

not documented long-tail voles; however, they are expected to occur within the project area. Their habitat is montane subalpine grassland with minimal canopy cover, mixed conifer and spruce-fir with dispersion of structure and openings, including meadows with well-developed herbaceous understory and wet ground. They burrow in and use soil for cover. Long-tailed vole habitat can be found in alpine-tundra, mixed conifer, montane subalpine grassland, and spruce-fir. Potential habitat within the treatment area is 48,744 acres of grassland, 51 springs, 85 miles of riparian habitat and ephemeral streams.

Little is known about the population status of this insectivorous animal. It is considered critically imperiled in Arizona, but recent pit fall trapping efforts have substantially increased the number of known sites (NatureServe 07/23/2010). The species is known to occur on the San Francisco Peaks and White Mountains (Hoffmeister 1986) however shrews have not been documented in the project area. They also occur in habitats from alpine tundra to pinyon-juniper, including ponderosa pine forest. In addition, they occur in subalpine meadows, herbaceous wetlands, sedge marsh, dry brushy slopes, and arid short-grass prairie (NatureServe 07/23/2010). Rocky areas and down logs are important habitat components. Potential habitat within the treatment area is 25,658 acres of pinyon-juniper, 512,178 acres of ponderosa pine and 48,744 acres of grassland.

Their dentition and digestive tracts are adapted for crushing chitinous exoskeletons and consuming only minimal amounts of vegetative material. They are opportunistic predators and their diets tend to reflect the availability of insects. As a family, shrews primarily eat earthworms, larvae and adults of beetles, caterpillars, ants, true bugs, spiders, and grasshoppers (Martin et al. 1961, Merritt 2010).

Merriam's Shrew

Merriam's shrew is distributed throughout the west and Hoffmeister (1986) shows them distributed along the Mogollon Rim. They are associated with grassy areas in conifer forests, frequently near water, and grasslands interspersed or associated with water Hoffmeister (1986). Habitat components for Merriam's shrew include grassy cover, logs and coarse woody debris, and proximity to water. The shrew is associated with dry habitat, but in proximity to water. They eat a variety of arthropods, feeding principally on insects and worms. Merriam's shrew forage at ground level and beneath the leaf litter (Hoffmeister 1971). Herbaceous cover provides shelter for shrews and their prey and they would use runways established by meadow mice which, despite being larger than shrews, can also be a prey species. No surveys have been completed however Merriam's shrews are expected to occur in ponderosa pine forests within the project area. There are 512,178 acres of ponderosa pine within the treatment area.

Western Red Bat

The western red bat is thought to be a summer resident of northern Arizona. It primarily occurs along riparian corridors among oaks, sycamores, and cottonwoods at low elevations but may occur up to 7,200 feet where they roost in dense clumps of foliage. In the Grand Canyon Hoffmeister (1971) reports they were only known from the bottom of the Canyon near Phantom Ranch and along Bright Angel Creek approximately 6 miles from the project area. Summer habitat associations include coniferous forest (Western Bat Working Group 2005a). Although generally solitary, western red bats forage in close association with one another in summer and may migrate in groups. They typically feed along forest edges or in small openings. Large lepidopterans are considered main prey items, but homopterans, coleopterans, hymenopterans,

and dipterans have also been reported in their diets (Western Bat Working Group 2005a). On rare occasion, red bats have been documented near Kachina Village (Subunit 3-4) and upper West Clear Creek Wilderness and Page Springs Fish Hatchery, both outside of the project area. One bat was radio-tracked near Kachina Village within the project area and roosted in a clump of gambel oak in dry ponderosa pine forest (Chambers, *pers. comm.* 2010). They roost primarily in the foliage of trees or shrubs but also occasionally use caves. Given they are an uncommon summer resident on the Coconino NF, they could conceivably be a rare visitor on the Williams RD as well. However, extensive netting on both RDs failed to produce records of western red bats for either Williams or Tusayan.

Forest management treatments potentially benefiting bats and their prey include group selection – small groups of trees removed for regeneration of new age classes results in a mosaic of roosting habitat, small to medium gaps for foraging, and single tree selection - individual trees of all size classes removed fairly uniformly. These treatments maintain diverse forest structure and roost trees; create gaps which enhance edge habitat, and provide diverse vegetation structure increasing herbaceous vegetation important for bats' insect prey (Taylor 2006).

There are 34 caves within 300 feet of the treatment area boundary. Coconino Forest Plan guidelines recommend a 300 foot buffer around caves entrances, sinkhole rims and drainages leading to these features. This is a design feature at all known cave locations for all action alternatives Potential foraging habitat within the treatment area includes 512,178 acres of ponderosa pine and 48,774 of grassland. Roosting habitat may occur along the 43 miles of riparian habitat and ephemeral streams.

Allen's Lappet-browed Bat

Allen's lappet-browed bat is known to occur in a wide variety of habitats in the southwestern U.S. and Mexico. In Arizona, Allen's lappet-browed bats have been found in ponderosa pine, pinyon-juniper, Mexican woodland, white-fir forests and Mohave desert scrub. They are often associated with water. Hoffmeister (1986) documents Allen's lappet-browed bats occupying mine shafts or rocky areas and cliffs for roosts. A study conducted on the within the project area (Restoration Units 1, 3, and 6) documented lappet-browed bats using snags for maternity roosts. It appears that males segregate during the maternity season and use cliff habitat while females typically select taller snags with sloughing bark closer to forest roads for maternity roosts (Solvesky and Chambers 2009). Female roost trees were all within ponderosa pine forests Allen's lappet-browed bats forage on flying insects, often over open water bodies (including stock tanks) and wetlands where flying insects are abundant. However, foraging habitat can be diverse and includes ponderosa pine forest, forest openings, wet soils, and diverse herbaceous ground cover. They occur across the ponderosa pine belt on the Coconino and Kaibab NFs and have been documented in the project area in Subunits 1-5, 3-3, 5-1 and 6-3. Potential habitat within the treatment area is 512,178 acres of ponderosa pine and 25,658 acres of pinyon-juniper.

Forest management treatments potentially benefiting bats and their prey include group selection – small groups of trees removed for regeneration of new age classes results in a mosaic of roosting habitat, small to medium gaps for foraging, and single tree selection - individual trees of all size classes removed fairly uniformly. These treatments maintain diverse forest structure and roost trees; create gaps which enhance edge habitat, and provide diverse vegetation structure increasing herbaceous vegetation important for bats' insect prey (Taylor 2006).

Pale Townsend's Big-eared Bat

Townsend's big-eared bat occurs across a broad range in western North America. A 2007 bat roost inventory and monitoring project documented Townsend's big-eared bats on both the Kaibab and Coconino Forests (Solvesky and Chambers 2007). Pale Townsend's are known to occur in within the project area (Subunits 4-3, 5-2, 3-3, 1-3 and 3-5. They use a wide range of habitats, including ponderosa pine forest. Townsend's big-eared bats typically roost in rock structures (e.g., caves, mines, and lava tubes), and abandoned buildings, but will also use hollow trees. Pale Townsend's big-eared bats are apparently secure although loss of cave and mine habitat may be causing a decline in numbers and there is concern over loss of genetic variability within populations (Western Bat Working Group 2005b). Townsend's big-eared bats are sensitive to disturbance and roost sites have been abandoned because of human recreation. They feed on flying insects and often forage across over water bodies and wetlands where flying insects are abundant. The species is a moth specialist with over 90% of their diet composed of lepidopterans. They travel long distances while foraging and use edge habitat adjacent to or within forest habitat (Western Bat Working Group 2005b). Habitat features potentially benefiting prey species include pools, stock tanks, wet ground, herbaceous ground cover, and edge habitat. Forest management treatments potentially benefiting bats and their prey include group selection, small groups of trees removed for regeneration of new age classes results in a mosaic of roosting habitat, small to medium gaps for foraging, and single tree selection, individual trees of all size classes removed fairly uniformly. These treatments maintain diverse forest structure and roost trees; create gaps which enhance edge habitat, and provide diverse vegetation structure increasing herbaceous vegetation important for bats' insect prey (Taylor 2006). Potential habitat includes 512,178 acres of ponderosa pine and 48,774 acres of grassland within the treatment area.

There are 34 caves within 300 feet of the treatment area boundary. Coconino Forest Plan guidelines recommend a 300 foot buffer around caves entrances, sinkhole rims and drainages leading to these features. This is a design feature for all known caves within the treatment area for all action alternatives.

Greater Western Mastiff Bat

The range for this bat includes all Arizona counties, except Yavapai, Navajo, Apache and Santa Cruz. A specimen was collected after death near Flagstaff in 1992. Significant cliff features are associated with their distribution and provide roosting habitat. Maternity colonies can consist of 30 to several hundred individuals (typically fewer than 100) and they roost generally under exfoliating rock slabs (e.g., granite, sandstone or columnar basalt) (Western Bat Working Group 2005c). They have been documented roosting in the Grand Canyon and foraging across the Kaibab Plateau over 25 miles from the project area, Greater western mastiff bats are habitat generalists and foraging habitat includes open ponderosa pine forests, high elevation meadows surrounded by conifers, and grasslands. Potential habitat within the project area is 512,178 acres of ponderosa pine and 48,774 acres of grassland habitat. Their diet consists primarily of moths but can also include beetles, crickets, katydids, and hymenopterans (Western Bat Working Group 2005c). Openings and open forests with diverse herbaceous ground cover aids in supporting prey species. There are no known roost locations on the Coconino NF or the South Zone of the Kaibab NF although roost habitat may occur on or near the Tusayan RD (Restoration Unit 6) (Solvesky, pers. comm. 2008).

Spotted Bat

Historic records suggest that the spotted bat is widely distributed, rare across its range, but can be locally abundant. The historic range of the spotted bat includes Mexico and the Southwest and north up to Canada. In Arizona, spotted bats commonly roost singly in crevices in rocky cliffs and they have also been found in caves (Chambers, *pers. comm.* 2009). Cliff habitat and surface water are characteristic of localities where they occur. Spotted bats are lepidopteran specialists and will forage in upland meadows. Meadows, openings, and open forests with diverse herbaceous ground cover provide habitat for prey species. There are 512,178 acres of ponderosa pine and 48,774 acres of grassland within the treatment area.

Spotted bats have been captured in coniferous forests on the Kaibab Plateau over 25 miles from the project area and in other western states. Netting efforts did not result in captures on the Coconino NF or the Williams RD, but spotted bats were captured on the Tusayan RD, Restoration Unit 6, (Solvesky, *pers. comm.* 2008). There are no known roost locations within the project area. Surveys of abandoned mines and natural caves on the Districts did not detect any spotted bats (Corbett 2008).

Narrow-headed Garter Snake

The narrow-headed garter snake is the most aquatic of the garter snakes, seldom found far from quiet, rocky pools in large streams and rivers. It is primarily a Mexican species, but occurs in various areas along the Rim. On the Coconino NF, narrow-headed garter snakes are currently known from Oak Creek Canyon and a few sightings from the Verde River approximately five and eight miles respectively from the project area. Population numbers in Oak Creek Canyon have decreased significantly, particularly in the lower 1/3 of the canyon. Since the late 1980s they have been entirely absent downstream of Oak Creek Canyon. Historically, this species likely occurred throughout perennial riparian areas in the Verde Valley. Based on cottonwood/willow and mixed broadleaf riparian habitats, this species is considered a potential resident of all Coconino Ranger Districts. Neither this species nor its habitat occurs on the Kaibab NF. There are no known locations of narrow-headed garter snake within the project area; however, 42 miles of riparian habitat and ephemeral drainages could provide potential habitat. The entire area within Subunit 3-5 was considered for potential impacts to downstream habitat in Oak Creek.

Golden Eagle

All golden and bald eagles, regardless of status, are protected under the Bald and Golden Eagle Protection Act (Eagle Act). This analysis determines if take is likely to occur with implementation of the action alternatives. Take is defined as to “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb”. Disturb is further defined “to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.”

The U.S. Fish and Wildlife Service (FWS) recommends using Conservation Assessment and Strategy for Bald eagles in Arizona (Driscoll et. al. 2006) in conjunction with the Bald Eagle National Guidelines (USDI 2007) to protect bald eagles in Arizona. For golden eagles, the FWS has issued a report titled *Interim Golden Eagle Technical Guidance: Inventory and Monitoring*

Protocols; and Other Recommendations in Support of Golden Eagle Management and Permit Issuance (Pagel et. al 2010).

For bald eagles, details of the existing condition can be found in this document where bald eagles are addressed as a Forest Service Sensitive species.

Golden eagles are found nesting in a wide variety of habitats from arid desert scrub to open conifer forests. No matter what habitat they choose in the state, topography features include tall cliffs or canyon in which to construct a nest and nearby large open areas to forage for prey (Jacobson et al. 2005). Most golden eagles nesting in Arizona are primarily residents, remaining within or near their home range throughout the year. In Arizona, cliff ledges are the most common nesting substrate used by golden eagles, but they will also use tall trees (esp. ponderosa pine), junipers, rock outcrops, and in rare cases, transmission towers (Glinski et.al. 1998 in AGDF 2005).

Sightings of golden eagles have been documented, and winter surveys are conducted annually on the Flagstaff and Williams Ranger Districts within the project area. Bald eagle annual winter surveys also document golden eagle sightings. There are 18 confirmed golden eagle nests representing 17 nesting areas in the project area. There are 11 additional potential nests but they have not yet been confirmed. Potential and confirmed nesting golden eagles within the project are located in Subunits 1-1, 1-3, 1-6, 2-0, 3-1, 3-4, 3-5, 4-1, 4-2, 4-3, 4-4, 5-2 and 6-2. Golden eagles often nest in areas of high rabbit populations. Golden eagles are well known for subduing large prey; however most of their diet consists of ground squirrels, rabbits, and prairie dogs. Potential foraging habitat within the treatment area is primarily 48,774 acres of grassland.

Forest Service Management Indicator Species

The Coconino NF and Kaibab NF forest plans identified the same 17 wildlife species as MIS to monitor ecosystem health. The proposed project would occur within ponderosa pine, aspen, pinyon-juniper, ephemeral stream, springs, and sagebrush habitats. MIS or their respective habitat components that do not occur within the proposed 4FRI treatment area will not be analyzed in this report (Table 22). The presence of species carried forward for analysis was determined by surveys conducted on the forest and the FAAWN database (Patton 2011).

Table 22. MIS not Analyzed in the 4-Forest Restoration Initiative Project

Management Indicator Species	Key MIS Habitat Component Indicator for	Comments
Aquatic macroinvertebrates Kaibab NF only	Riparian	Only a indicator of stream quality in North Canyon Creek on the North Kaibab Ranger District, Kaibab NF. Outside of project area.
Mexican spotted owl (<i>Strix occidentalis lucida</i>)	Late-seral mixed conifer and spruce-fir	There is no mixed conifer or spruce fir habitat being treated in the proposed analysis area.
Red squirrel (<i>Tamiasciurus hudsonicus</i>)	Late-seral mixed conifer and spruce-fir	There is no mixed conifer or spruce fir habitat being treated in the proposed analysis area.

Management Indicator Species	Key MIS Habitat Component Indicator for	Comments
Yellow-breasted chat (<i>Icteria virens</i>)	Late-seral, low-elevation, riparian habitat (< 7,000 ft)	There is 6 miles of proposed ephemeral stream channel restoration with riparian vegetation on the Coconino NF; only a fraction of this habitat occurs below 7,000 feet elevation. Riparian vegetation within these ephemeral channels does not include woody vegetation. No stream restoration with riparian habitat will occur on the Kaibab NF. The proposed restoration will not remove woody riparian vegetation. Thinning and burning could increase water-yield for up to 5 years. This would not affect the late-seral riparian habitat.
Lucy's warbler (<i>Vermivora luciae</i>)	Late-seral, low-elevation, riparian habitat (< 7,000 ')	There is 6 miles of proposed ephemeral stream channel restoration with riparian vegetation on the Coconino NF; only a fraction of this habitat occurs below 7,000 feet elevation. Riparian vegetation within these ephemeral channels does not include woody vegetation. No stream restoration with riparian habitat would occur on the Kaibab NF. The proposed restoration would not remove woody riparian vegetation. Thinning and burning could increase water-yield for up to 5 years (see watershed report). This would not affect the late-seral riparian habitat.
Lincoln's sparrow (<i>Melospia lincolnii</i>)	Late-seral, high-elevation riparian habitat (> 7,000 ')	There is 6 miles of proposed ephemeral stream channel restoration with riparian vegetation on the Coconino NF; only a fraction of this habitat occurs below 7,000 feet elevation. Riparian vegetation within these ephemeral channels does not include woody vegetation. No stream restoration with riparian habitat would occur on the Kaibab NF. The proposed restoration would not remove woody riparian vegetation. Thinning and burning could increase water-yield for up to 5 years (see watershed report). This would not affect the late-seral riparian habitat.
Cinnamon teal (<i>Anas cyanoptera</i>)	Wetlands	There is no proposed activities within wetland habitat. The 6 miles of proposed ephemeral stream restoration with riparian habitat is not teal habitat. Thinning and burning could increase water-yield for up to 5 years. This would not affect the wetland habitat.

Ten MIS whose distribution on the forest encompasses part or all of the analysis area were included in the effects analysis (Table 23). The analysis is based also on the forest plan and projected changes in acreage of quality habitat under all of the alternatives.

Table 23. MIS Analyzed for the Four-Forest Restoration Initiative project

Management Indicator Species	Key MIS Habitat Component Indicator for	Habitat within analysis (project) area
Aquatic macroinvertebrates Coconino NF only	Riparian	See fisheries MIS section
Northern Goshawk (<i>Accipiter gentiles</i>)	Late-seral ponderosa pine	Ponderosa pine
Pygmy nuthatch (<i>Sitta pygmaea</i>)	Late-seral ponderosa pine	Ponderosa pine
Turkey (<i>Meleagris gallopavo</i>)	Late-seral ponderosa pine	Ponderosa pine
Abert's squirrel (<i>Sciurus aberti</i>)	Early seral ponderosa pine	Ponderosa pine
Rocky Mountain elk (<i>Cervus elaphus</i>)	Early seral ponderosa pine, mixed conifer, and spruce-fir	Ponderosa pine
Hairy woodpecker (<i>Picoides villosus</i>)	Snags in ponderosa pine, mixed conifer and spruce-fir	Snags in ponderosa pine
Red-naped sapsucker (<i>Sphyrapicus varius</i>)	Late-seral aspen and snags in aspens	Aspen and snags in aspen
Mule deer (<i>Odocoileus hemionus</i>)	Early seral aspen and pinyon-juniper	Aspen and pinyon-juniper
Juniper titmouse (<i>Baeolophus ridgwayi</i>)	Late-seral pinyon-juniper, and snags in pinyon-juniper	Pinyon-juniper and snags in pinyon-juniper
Pronghorn (<i>Antilocapra americana</i>)	Early and late seral grasslands	Grassland

MIS and the habitats they represent are listed in the most recent Kaibab NF (Forest Service 2010) and Coconino NF (Forest Service 2002) Forestwide Management Indicator Species reports. A draft update for the Coconino NF is currently being developed (Overby, *pers. comm.*) and was used where noted in association with discussions with the Coconino Forest Biologist. A thorough review of the best available science, including the biology, ecology, and effects of management on individual species was included in the 2010 update of the Kaibab NF Forestwide MIS report. Information on species, their population trends, and habitat trends presented in the MIS Forestwide reports are incorporated by reference for this document.

Determining MIS presence and associated trend calls included data from the annual songbird surveys conducted on both the Coconino and Kaibab NFs. Surveys were initiated on the Kaibab NF in 2005 and on the Coconino NF in 2006. Initially each forest conducted its own survey effort, starting the season with two weeks of field training. The Rocky Mountain Bird Observatory, a non-government organization that is a leader in avian population sampling and analysis, took over the sampling effort and associated data analysis in 2007. Data, monitoring reports, and information about the Rocky Mountain Bird Observatory and their western states monitoring program can be found at: <http://www.rmbo.org/public/monitoring>. One component of the bird survey effort is a sympatric tree squirrel survey. Initial results from this effort were included in the Abert's squirrel effects analysis.

Population status and trend updates for all game species were provided by the Arizona Game and Fish Department (AGFD) for the 4FRI (see Appendix 6). These updates by individual game species and initial assessment of 4FRI-related effects to each species were incorporated in the MIS analysis.

Goshawk surveys are completed annually on both the Coconino and Kaibab NFs. The goshawk field survey effort was coordinated between the two NFs in 2011 because of the scale of the restoration project and 6,485 acres were surveyed. The coordinated effort will continue in 2012.

The Forest Vegetation Simulator (FVS) tree growth model was used to determine changes in forest stand dynamics (for more information on FVS see the silviculture report). This information was used for changes in seral stages for ponderosa pine stands. Where possible, data on forest-wide vegetation was taken from the Forest-wide reports for MIS species. If acreages were not available than potential natural vegetative type (PNVT) acreage was used. PNVT acreage for different vegetation types was developed for each forest as part of the forest plan revision process. For the total acres of early and late seral ponderosa pine for the Coconino NF this analysis used the vegetation model (VDDT) from forest plan revision to determine available acres.

Late-seral Ponderosa Pine Species Indicators– northern goshawk, pygmy nuthatch, and wild turkey

The northern goshawk, pygmy nuthatch and wild turkey are all indicators for late-seral ponderosa pine habitat. There are documented goshawks nesting territories within the analysis area (see the Sensitive Species section). Pygmy nuthatches were recorded in the analysis area during forest-wide surveys for both forests. Wild turkeys have been seen within the analysis area during the Rocky Mountain Bird Observatory forest-wide surveys and during survey efforts coordinated by AGFD.

All presettlement ponderosa pine trees would be retained in all alternatives unless instances of human health and safety warrant removal. Similarly, large young trees could be removed to meet restoration objectives. Over time (see 2050 projected size class structure in silviculture report), all alternatives would increase VSS 5 and VSS 6 which is currently deficit in the project area. Most old and large trees are expected to be retained. Therefore, the main difference is how much acreage (by alternative) grows into late-seral habitat. The change in acreage by year and alternative is described in the silvicultural report and is summarized in Table 30 below. The acreage is based on no high severity wildfire occurring within the analysis area over the next 40 years.

Kaibab NF late-seral ponderosa pine habitat trend: The forest-wide habitat trend for the late-seral ponderosa pine is in an upward trend due to the forest emphasis on retaining groups of large trees and maintaining large-sized reserve trees (see appendix 12 for comprehensive list of projects with management objectives). Forest-wide, there are approximately 200,000 acres of ponderosa pine forest in trees greater than 18” dbh (Forest Service 2010). Within the analysis area there is approximate 27,921 acres of late-seral ponderosa pine on the Kaibab NF (see silviculture report), which is approximately 14 percent of this age class across the Forest. However, the analysis occurs on 189,407 acres of ponderosa pine habitat which is approximately 37 percent of the ponderosa pine cover type acreage for the Forest.

Coconino NF late-seral ponderosa pine habitat trend: The forest-wide habitat trend for late-seral ponderosa pine is declining. The age class distribution of ponderosa pine has remained essentially the same, dominated by mid-seral stage, with some loss of old-growth and older trees, and some early-seral stage habitat created by wildfire (Forest Service 2002). Based in the VDDT model there is approximately 80,773 acres of late-seral ponderosa pine available forest-wide. Within the analysis area there is approximate 56,615 acres of late-seral ponderosa pine (see silviculture report), which is approximately 70 percent of this age class across the Forest. However, the analysis occurs on 322,772 acres of ponderosa pine habitat which is approximately 41 percent of the ponderosa pine PNVNT acreage for the Forest.

Northern Goshawk

Kaibab NF

The Kaibab National Forest (KNF) lies in three disjunct parts; two portions south of the Grand Canyon and one part north of the Grand Canyon. The Tusayan and Williams Ranger Districts lie south of the Grand Canyon and are within the project area (see map). The North Kaibab Ranger District (NKRK) lies north of the Grand Canyon and is not within the project area. Of the 203 PFAs on the KNF, 135 are on the NKRK, 68 are on the southern portion of the KNF, and 36 are within the project area.

On the KNF, ponderosa pine forest covers approximately 515,148 acres (about 34 percent of the total Forest acreage) and occurs on all three Ranger Districts. Similarly, the corresponding PNVNT covers 541,000 acres, approximately 35 percent of the total land area.

Table 30. Kaibab NF Existing Conditions of late seral ponderosa pine (PIPO)

Kaibab NF Existing Condition Measure	Acres	Relevance
Acres PIPO forest-wide	515,148	Entire indicator vegetation type
Acres of late seral PIPO (1988)	Not available at the time the Forest Plan was implemented	Reference condition*
Forest-wide late seral (18”+) acres	200,000	39% of PIPO forest-wide
Project Area KNF PIPO acres	189,407	37% of PIPO forest-wide
Project Area KNF late seral (VSS 5&6) PIPO Acres	27,921	14% of the late seral PIPO forest-wide

*Acres of late seral ponderosa pines are from the MIS report see p. 105 and the graph on p. 116

Figure 24 is from the Kaibab forest-wide MIS report and displays TPA for ponderosa pine by size-class across the KNF. A natural pattern of tree size classes in an uneven-aged forest would show an abundance of small trees and decreasing numbers of trees as dbh increases. Tree patterns on the North Kaibab, which is outside the 4FRI area, resembles this pattern. The South Zone of the Kaibab NF, i.e., the portion in the 4FRI project area, displays a peak in mid-sized trees and low numbers of trees greater than 24 inches dbh. The pattern of tree size-classes is even more skewed for the Williams RD alone because logging on the Tusayan RD was of shorter duration (USDA 2010). The South Kaibab pattern matches the conclusions in the 4FRI silviculture report.

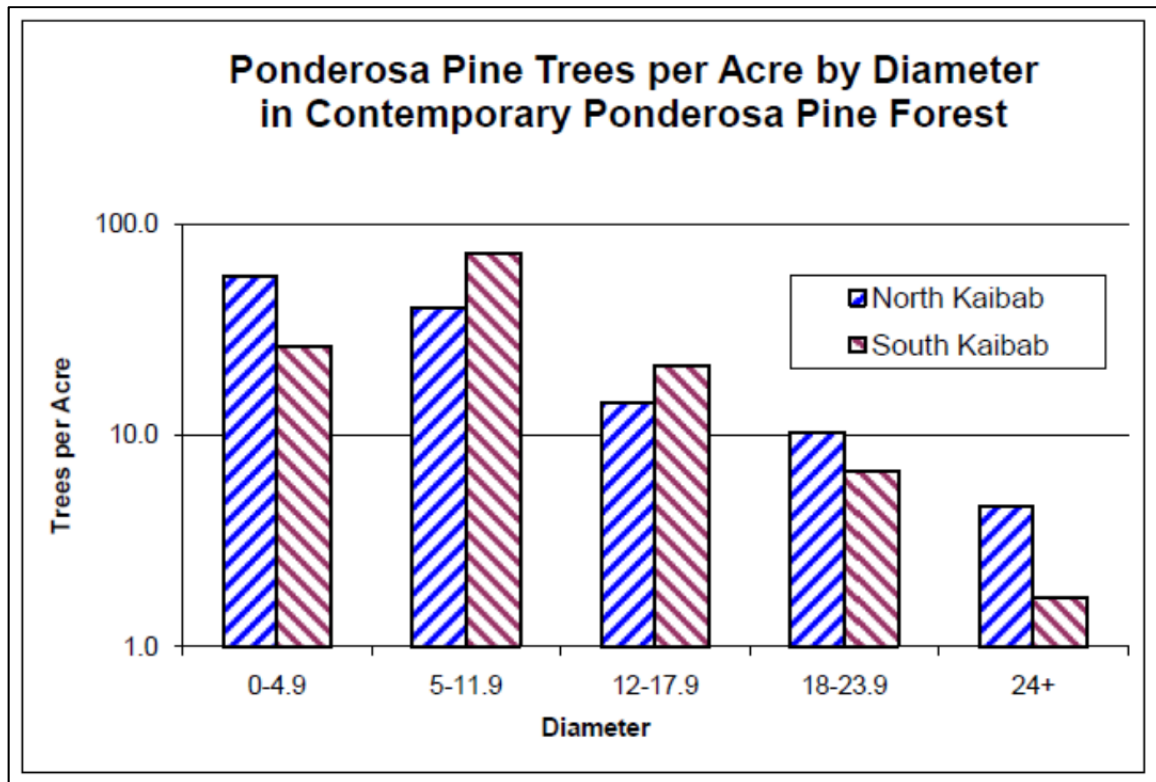


Figure 24. Tree densities by size class across the KNF (adapted from FIA data)

Kaibab NF goshawk population trend: The northern goshawk forest-wide population trend (Table 31) is considered to be declining at this time. This decline is thought to be due to drought affects to prey species abundance and the generally dense conditions of ponderosa pine forests in the being overstock with a high basal area (Forest Service 2010).

Table 31. Existing Trends from Current Kaibab National Forest level MIS Report (2010)

Species	Relevance	Indicator Habitat	Habitat feature	Habitat trend	Population trend
Northern goshawk	Subject species	Ponderosa pine	Late seral	Positive	Declining

Coconino NF

On the Coconino NF, there are close to 700,000 acres of the non-wilderness ponderosa pine cover type (which includes ponderosa pine-Gambel oak), and cover type acreages have remained essentially the same (Table 32). At the time the Forest Plan was developed (1987), there was not much late seral ponderosa pine. There has been some decline, particularly in the large tree component, due to both management activities and natural loss, since implementation of the Plan. See the project's appendix 12 which provides a comprehensive list of projects with management objectives. Forest-wide, the mid-seral stage continues to dominate forest structure, accounting for 70 percent or more of the acres (see silviculture report for additional detail). The remaining 30 percent would be divided between the early and late seral stages for ponderosa pine. No estimates of acres or percent are given for the late seral stage ponderosa pine in the current CNF MIS Report (2002) for reference conditions at the time of the Forest Plan or the date of the report. See map 1 for those portions of the CNF that lie within the project area. For the Coconino NF, there are 70 PFAs on the Forest and 38 of them are within the project area (Overby, pers. comm.).

Table 32. Coconino NF Existing Conditions of late seral ponderosa pine (PIPO)

Coconino NF Existing Condition Measure	Acres	Relevance
Acres PIPO forest-wide	700,000	Entire indicator vegetation type
Acres of late seral PIPO (1987)	Not Available at the time the Forest Plan was implemented	Reference condition*
Forest-wide late seral (18"+) acres	Unable to discern from MIS Report	
Project Area KNF PIPO acres	322,772	-46% of the PIPO forest-wide
Project Area KNF late seral (VSS 5&6) PIPO Acres	56,615	-8% of the PIPO forest-wide -- -18% of the PIPO on CNF in project area

* Acres of late seral ponderosa pines are from the MIS report see p. 105 and the graph on p. 116

Coconino NF goshawk population trend: BBS data (Sauer et al., 2011) for Arizona from 1966-2008 shows a positive population trend of 3.5% per year. For the ten-year period 1998-2008, trends for northern goshawk shows a 3% annual increase in observations. Saur and Link (2011) suggest that the long-term positive trends observed over the 1966-2008 period may be a function of increase in survey effort, but trend estimates for the period 1999-2009 show a 2.2% annual increase in observations of northern goshawk within Arizona (Saur 2011). For comparison, the trend estimate for the southern Rocky Mountain/Colorado Plateau region for the same time period is estimated at 2.4% annual increase. The limited number of observations of this species on BBS routes makes this figure less than reliable.

The forest-wide trend is inconclusive. Although the Forest has some information on territory occupancy and reproduction, these data are not designed to detect changes in population trend. The total number of territories has increased, and statewide BBS data indicate a significant increase, but some indicators of occupancy and productivity appear to be declining on the Forest.

Monitoring and surveys are ongoing on the Forest (Forest Service 2002). Table 33 displays the Coconino NF's habitat and population trend.

Table 33. Existing Trends from Current Coconino National Forest level MIS and draft Forest level MIS Reports (2002, 2012)

Species	Relevance	Indicator Habitat	Habitat feature	Habitat trend	Population trend
Northern goshawk	Subject species	Ponderosa pine	Late seral	Declining	Inconclusive

Pygmy Nuthatch

The pygmy nuthatches use snags or trees with dead portions suitable for excavation for nesting. They are primarily insectivorous and during the breeding season, their diet consists of 60 to 85 percent insects. They seem to prefer heterogeneous stands of well-spaced, old pines and vigorous trees of intermediate age. Little information is available on populations of pygmy nuthatches prior to fire suppression policies, but evidence from Arizona and New Mexico suggests that the species was abundant. Management strategies that move ponderosa pine forest closer to the historic range of variation should positively affect the species (Forest Service 2010).

Kaibab NF pygmy nuthatch population trend: The pygmy nuthatch is believed to be stable to declining forest-wide on the Kaibab National Forest. In areas that were treated with thinning and prescribed burns or have been thinned and burned naturally, pygmy nuthatches are likely stable to increasing (Forest Service 2010).

Coconino NF pygmy nuthatch population trend: The forest-wide trend is stable, although there are dramatic population fluctuations in the short term, and small, local populations, such as those in snowmelt drainages, may be temporarily extirpated (Forest Service 2002).

Turkey

Turkeys are selected as an indicator for late-seral ponderosa pine which is used for nesting and roosting, however, many different factors of the proposed project would affect population trends for the turkey. Turkey population trends are mostly impacted by the state hunting structure including number of tags and timing of hunts. Turkey roosts and nests are associated with groups of large pine trees on steep slopes, and they select foraging and loafing habitats within a mix of meadows, oak, and juniper. Turkeys roost in tree groups that average 36 trees with dbh > 16", where the roost tree is often >24" dbh. The high tree and canopy density within roosts is important for thermal protection, particularly in the winter. Uneven-aged canopy structure also helps provide thermal protection, however unlike in their nesting habitats turkeys select for a higher canopy base height (>24') when roosting.

Clumpy-groupy forest structure is also important for turkeys in their foraging habitats, where they select for small forest opening (0.28-0.31 acres) for feeding. Turkeys select areas with a higher percent cover of forbs and grasses for feeding, and they select areas with a higher plant and invertebrate richness during the poult-rearing phase. Acorn mast from Gambel oak can significantly increase the probability of overwinter survival and is connected to productivity in the following year.

Forage includes cone crops produced by mature ponderosa pine trees, hard mast from oak trees, juniper berries, seeds from grasses and forbs in early seral habitat, and invertebrates. Pine-oak habitats are particularly important for turkeys in the winter. Core home range size for turkeys is roughly 26-30 mi². Since turkeys are a relatively wide-ranging species, they are likely to respond to changes in forest management at small and large spatial scales.

Kaibab NF turkey population trend: Wild turkey population trend on the Forest is considered to be variable but overall increasing (Forest Service 2010). Turkeys are found primarily in ponderosa pine forest with a mix of meadows, oak and juniper. They use larger older trees for nesting and roosting.

Coconino NF turkey population trend: The forest-wide population trend is increasing. The trend was variable in the early part of Forest Plan implementation period (late 80s and early 90s), although AGFD standard survey procedures did not provide good data due to low number of observations along survey routes. AGFD developed a better index of turkey populations in the mid-1990s. Data from 1997-2001 indicate a modestly increasing trend. For the last five years (1997-2002), GMU 7 shows a relatively stable trend, with all other GMUs showing a general increasing trend for both percent of archery elk hunters seeing turkeys and the number of turkeys seen per day (Forest Service 2002; also see Appendix 6).

Species Indicators for Early-seral Ponderosa Pine – Elk and Abert's squirrel

Elk and Abert's squirrels are indicators for early-seral ponderosa pine habitat. Abert's squirrels have been seen in the analysis area during Forest-wide surveys on both forests. Since both of these species are part of the state permitted hunt structure, this will affect population trends both species at the state and local levels. Elk forest-wide populations are managed primarily by the state through their permitted hunt structures.

Kaibab NF early-seral ponderosa pine habitat trend: There is approximately 40,000 acres of early-seral ponderosa pine habitat across the forest. Current habitat trend for early-seral ponderosa pine is considered stable at this time (Forest Service 2010). Within the analysis area there is approximate 7,411 acres of early-seral ponderosa pine (see silviculture report), which is approximately 18 percent of this age class across the forest. However, the analysis occurs on 189,407 acres of ponderosa pine habitat which is approximately 37 percent of the ponderosa pine cover type acreage for the forest.

Coconino NF early-seral ponderosa pine habitat trend: Forest-wide trend for early-seral ponderosa pine is stable. The age class distribution of ponderosa pine has remained essentially the same, dominated by mid-seral stage stands, with some loss of old growth and older trees, and some early seral stage habitat created by wildfire (Forest Service 2002). Based in the VDDT model there is approximately 152,836 acres of late-seral ponderosa pine available forest-wide. Within the analysis area there is approximate 14,525 acres of early-seral ponderosa pine, which is approximately 10 percent of this age class across the forest. However, the analysis occurs on 322,772 acres of ponderosa pine habitat which is approximately 41 percent of the ponderosa pine PNVN acreage for the forest.

Elk

Elk are indicator of early-seral conifer habitat which is used for foraging, however, many different factors of the project would affect population trends for the elk. Elk are habitat generalists. In

addition to occupying ponderosa pine forests, they graze grassland and woodland habitats as well as aspen and riparian areas. On both forests, elk occupy mountain meadows and forests in summer and move to lower-elevation pinyon-juniper woodland, conifer forest, and grasslands in winter.

Forage availability is important to help provide good body condition. Foraging areas are primarily openings in the forest canopy where perennial grasses and forbs are more readily available. Elk also forage in stands dominated by Gambel oak and quaking aspen where they feed on sprouts and ramets. Forest management practices that create an interspersed forest tree groups and openings tend to improve habitat conditions for elk by increasing grassland primary productivity while still providing cover nearby.

According to the AGFD, the 4FRI project area includes portions of four elk herds. One herd includes Game Management Units (GMU) 5A/5B/6A and occurs on the Coconino NF. The second herd includes 6B, 8, and Camp Navajo, which overlaps with both forests. The third is contained within GMU 7, which overlaps with both forests. GMU 7 has some population exchange with the fourth herd in GMU 9, which occurs primarily on the Tusayan Ranger District of the Kaibab NF. It is important to note that elk that intermix among herds do not always go back to their respective GMU after winter, which complicates interpretation of both population- and habitat-utilization data for this species.

Kaibab NF Elk Population trend: During the analysis for the forest-wide elk population trend in 2010, the population trend was considered to be stable at that time (Forest Service 2010.) Analysis (see figure 1 and 2) using current data from the AGFD shows that the elk population is in a decreasing trend (Appendix 6). Both forests have been working with AGFD to decrease the amount of elk on the forest for protection of forest resources. The elk numbers have primarily been affected by the hunting and the amount and type of hunting tags issued.

Coconino NF Elk Population trend: The Forest-wide population trend is stable based on the analysis done in 2002. Elk numbers on the Forest increased in the early to mid-1990s, with a gradual decline through 2001 to roughly the 1980's level (Forest Service 2002). However, analysis (see figure 25 and 26) using current data from the AGFD shows that the elk forest wide population is in a decreasing trend (Appendix 6). Figure 1 numbers are collected during annual surveys. Figure 2 trends in populations includes Game Management Units 5A, 5B, 6A, 6B, Camp Navajo, 7, 8, and 9. All data are unpublished but available from AGFD Flagstaff Regional Office.

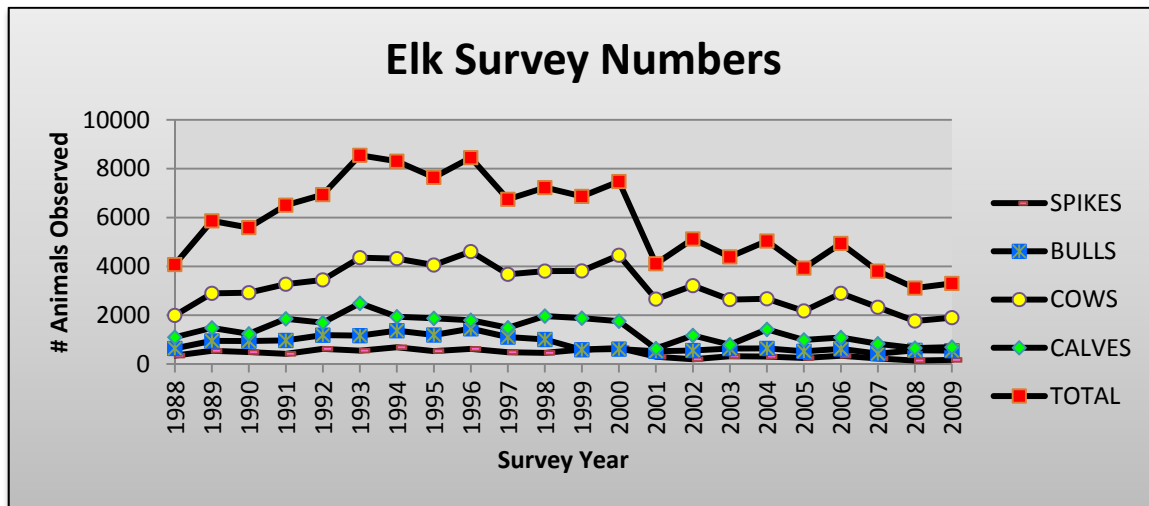


Figure 25. Elk survey trends on the Coconino and Kaibab National Forests

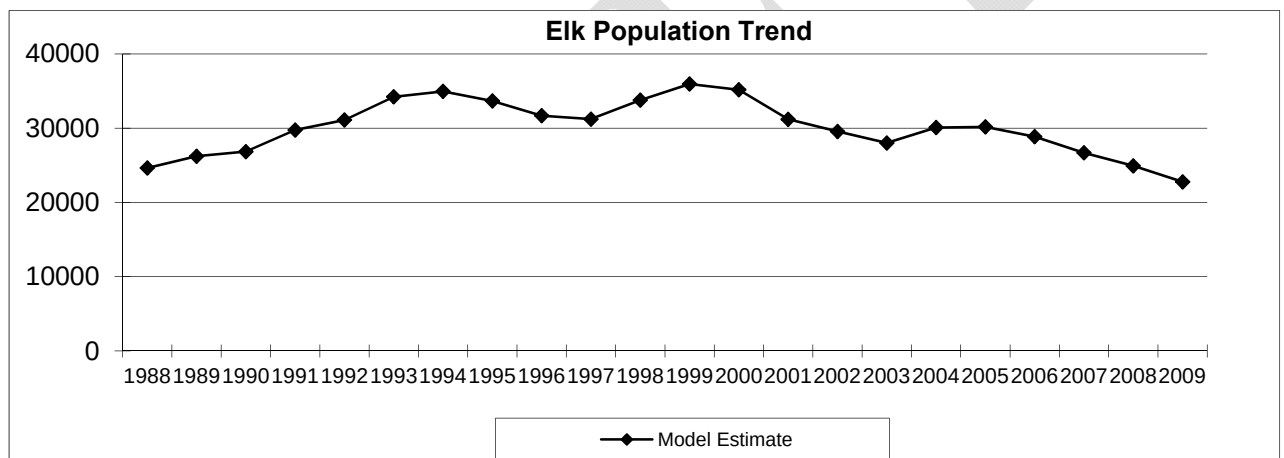


Figure 26. Trend in Estimates Elk Populations for the Coconino and Kaibab National Forests from 1988 – 2009

Abert's Squirrel

While Abert's squirrels were selected for early-seral ponderosa pine, they preferred habitat structure is composed of intermediate to older aged forest (trees 9-22+ inches dbh). Forest structure and composition is probably the most important habitat attribute for tassel-eared squirrels. AGFD feeding sign survey data shows that areas with higher basal area and canopy cover as well as interlocking canopies contain the highest densities of squirrels. The squirrel's ability to access the growing pine shoots it depends on for food, as well as its ability to escape predators, is dependent on interlocking tree canopies especially during winter when snow accumulation can impede ground travel. When snow is absent, tassel-eared squirrels will forage on the forest floor primarily for mycorrhizal fungi ('truffles') associated with pine tree roots. Tassel-eared squirrels also depend on ponderosa pine cones to meet their nutritional demand.

Prather et al. (2006) found that local basal area explained squirrel density in nine northern Arizona studies, and Dodd et al. (1998) estimated optimal basal area for squirrels to be greater

than 150 ft² per acre. Stand-level canopy cover of 40-50 percent probably represents a threshold for optimal tree squirrel habitat and is particularly important for recruitment. At the scale of the stand and the restoration unit, a continuously dense forest is not required for squirrels as long as denser patches of forest are retained for foraging, nesting, and escaping predators.

Kaibab NF Tassel-eared Squirrel Population trend: The tassel-eared squirrel was selected as an indicator of early-seral ponderosa pine forest (Forest Service 2010). For this project, the Abert's squirrel (*Sciurus aberti aberti*) represents the species. Tassel-eared squirrel were first selected as an indicator for mid-seral ponderosa pine which was later dropped and incorporated with early-seral ponderosa pine, which is not primary habitat for the tassel-ear squirrel. Forestwide the tassel-eared squirrel population is currently stable (Forest Service 2010.)

Coconino NF Abert's Squirrel Population trend: Forest-wide population trend is inconclusive since there is little Forest-specific data. Statewide information indicates a stable trend for hunter harvest of squirrels (Forest Service 2002). Additional population trend information is available for the Coconino NF, AGFD feeding sign surveys were conducted from 2005 - 2010 in association with Forest Service vegetation management projects in the Flagstaff wildland-urban interface (Appendix 6). Figure 27 displays the feeding sign survey results from 2005- 2010 in Fort Valley (FV), Kachina North (KN), Kachina South (KS), Mountainaire (MN), Woody Ridge (WD), and Airport (AP) study sites in the Flagstaff Wildland-Urban Interface. Treated refers to areas having received recent fuels reduction treatment in the form of mechanical thinning and/or prescribed fire. Untreated refers to areas not having received recent fuels reduction treatment.

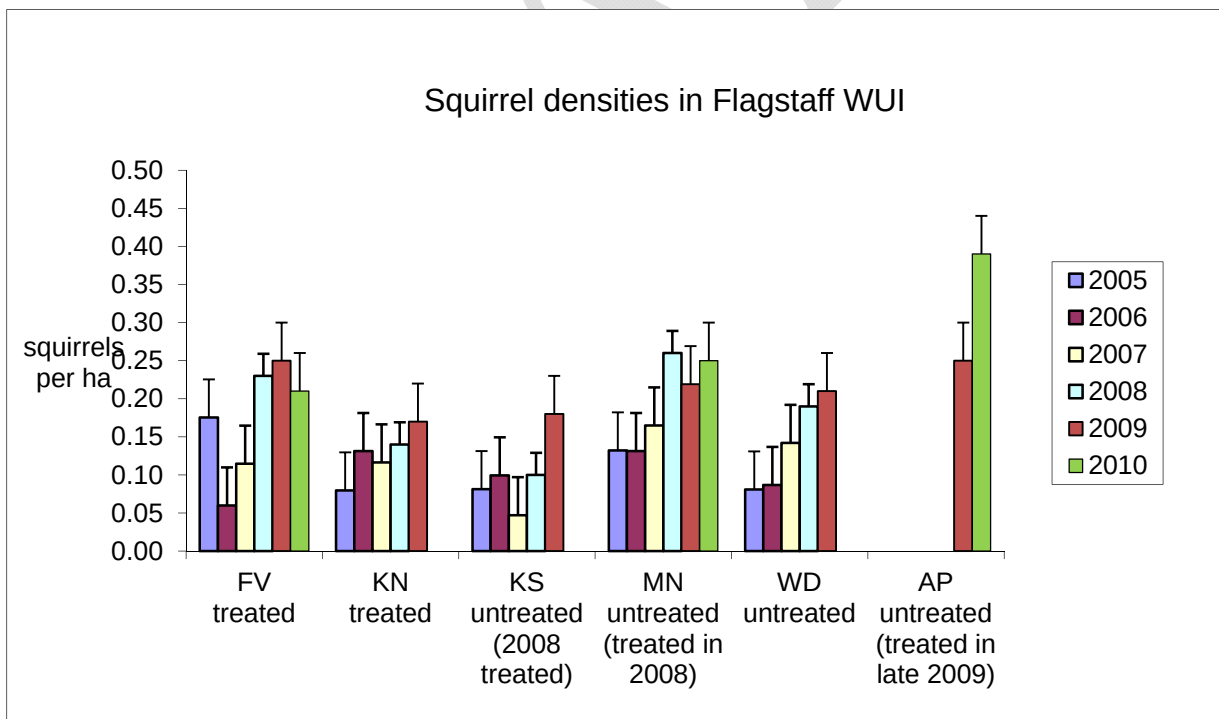


Figure 27. Feeding sign survey results in the Flagstaff Wildland Urban Interface (2005 to 2010)

Species Indicators for Snags in Ponderosa Pine – Hairy woodpecker

Hairy woodpecker

Hairy woodpecker was selected as an indicator for snags in ponderosa pine, mixed conifer, and spruce-fir forest types (Forest Service 2002 and 2010). Hairy woodpeckers are common in ponderosa pine forests as well as other forest and woodland types on the both forest. The hairy woodpecker has been found within the analysis area during Forestwide surveys on both forests. For this project only ponderosa pine habitat will be discussed.

The hairy woodpecker is widely distributed wherever there are mature forests with substantial snags. The species are strongly associated with burned areas, an important historical component of northern Arizona's forests resulting from a frequent fire interval. As primary cavity nesters, hairy woodpeckers are dependent on dead and dying portions of live trees and snags for nesting. Preferred nest tree size varies but 13.8" is typical in western conifer forests (Forest Service 2010).

Kaibab NF Hairy Woodpecker Habitat and Population Trends: Based on FIA data for the Kaibab National Forest, snags in all three cover types (ponderosa pine, mixed conifer & spruce-fir) types have increased between 1995 and 2007. It is believed that this habitat is in an increasing trend. There is approximately 681,158 acres of hairy woodpecker habitat currently available on the forest (Forest Service 2010). The analysis area contains 189,407 acres of ponderosa pine, which is approximately 28 percent of the PNVF for the three cover types across the Forest. The hairy woodpecker forest-wide population trend is considered to be stable (Forest Service 2010.)

Coconino NF Hairy Woodpecker Habitat and Population Trends: In 2002 the Forest estimated that trends for snags in ponderosa pine habitats were probably declining (Forest Service 2002). However, a recent study by Ganey and Vojta (2007) conducted on the Coconino suggest that within ponderosa pine and mixed conifer habitats, model projections suggest that, at least in the short term, snag numbers will continue to increase and densities of large snags will increase. Despite these increases, densities of large snags, > 18" dbh, would remain below Forest Plan guidelines. The PNVF data for acreage in ponderosa pine, mixed-conifer and spruce-fir for the forest is approximately 900,426 acres. The project area contains 322,772 acres for ponderosa pine, which is approximately 36 percent of the PNVF for the three cover types across the forest.

The Forest-wide population trend for the hairy woodpecker is stable, or slightly increasing. Minor population decreases occur on a short term scale of 1-3 years, but are generally followed by a recovery (Forest Service 2002).

Species Indicators for Late-seral Aspen and Snags in Aspens – Red-naped sapsucker

Red-naped sapsucker

Red-naped sapsucker was selected as an indicator for late-seral aspen forest and snags (Forest Service 2002 and 2010). This species has a limited distribution on the both forests because the distribution of aspen and for the Kaibab NF many of the aspen stands are small in size. The red-naped sapsucker has been recorded during forest-wide surveys for both forests in the project area.

The red-naped sapsucker will use both snags and live trees with heart rot, with minimum size of trees on average of 10 inches or greater. Larger trees are preferred, possibly because they allow sapsuckers to excavate more cavities up the bole of the tree in successive years. The rate of aspen regeneration loss is estimated at 97 percent for sites below 7,500 feet elevation, 50 percent at

7,500-8,500 feet and 25 percent above 8,500 feet. Much of the older aspen is now dying due to weather and insect interactions or being converted to conifer from lack of natural disturbance agents, mainly fire (Forest Service 2010).

Kaibab NF Red-naped sapsucker Habitat and Population Trends: There are approximately 28,500 acres of aspen on the Forest. These stands are a mixture of early to late seral aspen and it is not possible to define late various early seral habitat stands. The forest-wide habitat trend for the red-naped sapsucker is believed to be stable at this time. Due to lack of aspen recruitment at this time there is potential for a decrease in the future (Forest Service 2010.) Condition of the aspen stands on the Williams RD is poor. These stands have a high incidence of bole scarring on mature trees resulting from elk scraping with their lower incisors to feed on aspen cambium. Disease is prevalent in older aspen trees. There is essentially no aspen recruitment occurring in these stands because of high ungulate browse rates on aspen suckers. Ponderosa pines are shading and competing with aspen in these stands also. There is less than four acres of aspen stands on the Tusayan RD and these stands would not be impacted with the proposed project (see silviculture report). The population trend for the red-napped sapsuckers is believed to be stable to increasing on the Forest (Forest Service 2010.)

Coconino NF Red-naped sapsucker Habitat and Population Trends: The forest plan (USDA Forest Service 1987) lists 10,000 acres of aspen habitat on the Forest. Larger stands of aspen are located primarily within the mixed conifer PNV. A small proportion of aspen is found as small, localized patches within the ponderosa pine PNV. The forest-wide habitat trend is declining. This decline is primarily related to fire suppression over the last century. Some early seral stage stands are being created through wildfire and management activities, but recruitment is limited primarily due to grazing by animals. Management activities have not been implemented on a level, or even enough area, to prevent loss of aspen patches and provide for adequate recruitment. Aspen occurs mostly at higher elevations in the analysis area. Ungulate browsing and rubbing of aspen regeneration is present in all stands. Successful regeneration is occurring in the higher elevation stands and clumps. Aspen clumps at lower elevations have little regeneration success, and some are becoming old and decadent (Forest Service 2002). The forest-wide population trend for the red-naped sapsucker is stable. Populations on the Forest fluctuate over time, but show no indication of increasing or decreasing populations (Forest Service 2002).

Species Indicators for Early-seral Aspen and Pinyon-juniper – Mule deer

Mule Deer

Mule deer was selected as an indicator species for early-seral aspen and pinyon-juniper (Forest Service 2002 and 2010). Mule deer typically summer at higher elevations in aspen, mixed conifer, and ponderosa pine forests, and transition to winter in pinyon-juniper woodlands found at lower elevations. Mule deer are browsers and prefer leaves and twigs from shrubs and trees over grasses. Home range size varies, depending upon availability of forage and cover. Mule deer in the vicinity of the Tusayan and Williams Ranger Districts (Kaibab NF) have an estimated home range 141.1 mile² (± 48.3). Since mule deer are relatively wide-ranging species, they are likely to respond to changes in forest management at small and large spatial scales. Forest-wide and local population trends for mule deer are influenced more by hunting than by forest management.

While mule deer are indicators of early-seral aspen and pinyon juniper, they are affected mainly by other proposed activities. High diversity and productivity of shrubs and young trees are important

habitat components for mule deer, best represented within early-successional forests and maintained by natural disturbances such as fire (see Appendix 6).

Carrying capacity of winter range habitats is often the limiting factor for mule deer populations. Winter range for mule deer occurs primarily in pinyon-juniper communities which are largely outside the scope of the 4FRI project since the project includes approximately 2% of each forest pinyon-juniper habitat. However, summer range for mule deer occurs throughout the project in areas of ponderosa pine, pine-oak, pine-sage, aspen, and at springs and ephemeral channels, particularly when water is available (appendix 6).

High levels of interspersed cover and openings are favored by mule deer, particularly when a shrub, oak, or aspen component is present. When openings or low-density forests are present in a matrix of higher-density forest patches, mule deer will forage in open and sparsely-treed areas at night but spend the majority of their daylight hours on bed sites located within denser hiding and thermal cover. In addition, mule deer prefer smaller openings and show fidelity to forested edge. As such, landscape-scale forest restoration practices that favor heterogeneity in forest opening ratios and promote oak, sage, and aspen should improve habitat for mule deer in the short and long term.

Kaibab NF Mule Deer Habitat and Population Trends: There are approximately 28,500 acres of aspen on the forest. These stands are a mixture of early to late seral aspen. The forest-wide habitat trend for the mule deer is currently declining due to lack of aspen recruitment at this time (Forest Service 2010.) Condition of these stands on the Williams Ranger District is poor. There is essentially no aspen recruitment occurring in these stands because of especially high ungulate browse rates on aspen suckers. Ponderosa pines are shading and competing with aspen in these stands also. There is less than four acres of aspen stands on the Tusayan RD and these stands will not be impacted with the proposed project (see silviculture report). There is approximately 389 acres of stands mapped as aspen within the analysis area this is approximately 1 percent of the aspen habitat forest-wide. All action alternatives would mechanical thin and burn 858 acres and burn only 17 acres, therefore, all action alternatives would have the same effects to habitat trends.

Pinyon-juniper habitat trend for mule deer is considered to be stable. There is currently approximately 657,900 acres of pinyon-juniper habitat on the forest (Forest Service 2010). It is not possible to determine at this time how much is early-seral stage due to the highly variable conditions of the pinyon-juniper stands. There is approximately 12,560 acres of pinyon-juniper habitat within the analysis area, which is approximately 2 percent of the pinyon-juniper on the forest. Of the acreage in the analysis area approximately 5,245 acres is to be managed as early-seral stage (see silviculture report), this is approximately less than 1 percent of the forest-wide acreage of pinyon-juniper.

Mule deer populations on the Kaibab NF vary by ranger districts/GMU. The south zone of the forest appears to be following the statewide trend of decreasing numbers. Deer on the Kaibab Plateau are variable to increasing and if not for hunting, would likely be higher. Overall, mule deer forest-wide population trend are considered to be stable to increasing (Forest Service 2010).

Coconino NF Mule Deer Habitat and Population Trends: Forest-wide trend for aspen is declining (Forest Service 2002). This decline is primarily related to fire suppression over the last century. Some early seral stage stands are being created through wildfire and management activities, but recruitment is limited primarily due to grazing by animals. Management activities

have not been implemented to a level, or over enough area, to prevent loss of aspen patches and provide adequate aspen recruitment. The forest plan (USDA Forest Service 1987) lists 10,000 acres of aspen habitat on the Forest. Larger stands of aspen are located primarily within the mixed conifer PNV. A small proportion of aspen is found as small, localized patches within the ponderosa pine PNV. Management activities have not been implemented on a level, or even enough area, to prevent loss of aspen patches and provide for adequate recruitment. See project appendix 12 for a comprehensive list of projects with management objectives.

Aspen occurs mostly at higher elevations in the analysis area. Ungulate browsing and rubbing of aspen regeneration is present in all stands. Successful regeneration is occurring in the higher elevation stands and clumps. Aspen clumps at lower elevations have little regeneration success, and some are becoming old and decadent (Forest Service 2002). Alternative B and C would treat approximately 1,064 acres and 1,083 acres respectively of aspen within the project area which is approximately 11 percent of the aspen habitat forest-wide for both alternatives. Alternative D would treat 875 acres of aspen, which is approximately 9 percent of aspen forest-wide (see silviculture report).

For pinyon-juniper the forest-wide trend is stable. The age class distribution has remained relatively stable. Less than 5 percent of pinyon-juniper on the Forest has been converted to grassland through wildfire or management actions. Most pinyon-juniper habitat within the Forest is late seral stage. There is currently approximately 630,000 acres of pinyon-juniper habitat on the Forest (Forest Service 2002). There is approximately 10,786 acres of pinyon-juniper habitat within the analysis area, which is approximately 2 percent of the pinyon-juniper forest-wide. Of this acreage approximately 2,475 acres is to be managed as early-seral stage (see silviculture report), this is less than 1 percent of the forest-wide acreage of pinyon-juniper.

The forest-wide population trend for mule deer is declining. The number of deer seen per hour and the number of fawns per 100 does from 1985 through 2001 varies, but the trend is declining (Forest Service 2002). In good years, fawn production has been at levels minimal to sustaining populations, but in poor precipitation and forage years, fawn production has not kept up with mortality rates. Mule deer populations are starting to stabilize with a slightly increasing trend (Appendix 6). Based on the data provide above in figures 28 and 29, the forest-wide population trend appears to be stable.

Analysis including more current data from AGFD seems to show the forest-wide trend is still correct. Data are displayed by Game Management Unit (GMU; figures 5 and 6). For the Coconino NF, data are relevant from GMUs 5A and 5B (combined only for mule deer analysis), 6A, 6B, 7, and 8. For the Kaibab NF, data are relevant from GMUs 6B, 7, 8, and 9. All GMUs are relevant to the 4FRI project area. Overall, the declining to stable trend in mule deer surveyed over the last decade on the Coconino and Kaibab NFs is consistent with the statewide trend. The fawn to doe ratios indicates relatively stable trends in doe productivity over time across both Forests.

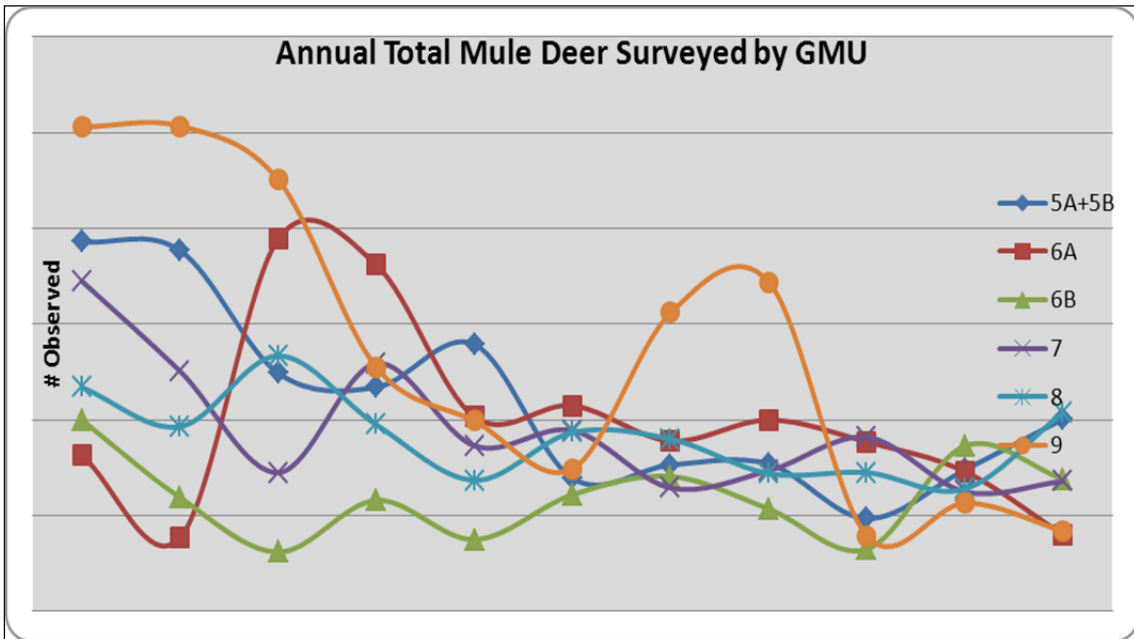


Figure 28. Total number of mule deer surveyed by number observed and GMU, 2000 – 2010

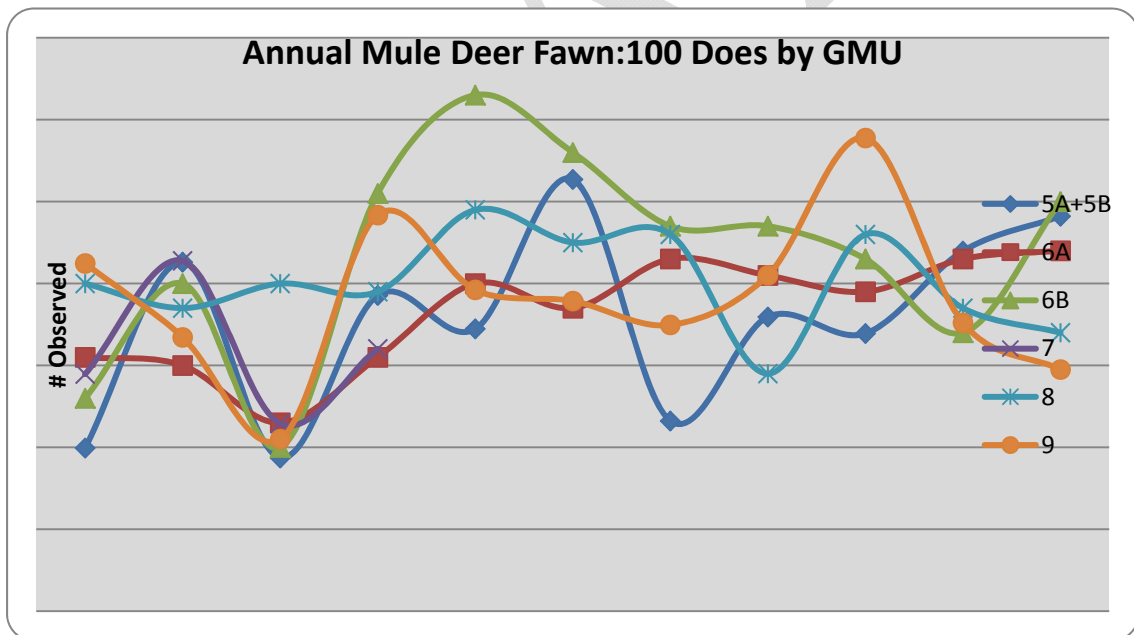


Figure 29. Ratio of mule deer fawns per 100 does by GMU, 2000 – 2010

Species Indicators for Late-seral Pinyon-juniper and Snags in Pinyon-juniper

Juniper titmouse

Juniper titmouse was selected as an indicator for late-seral pinyon-juniper woodland and snags in pinyon-juniper woodland (Forest Service 2002 and 2010). The juniper titmouse has been found in the general area of the project area during the forest wide surveys for birds.

Juniper titmice are most common where juniper is dominant and large, mature trees are present to provide natural cavities for nesting. Tree density used by breeding juniper titmice ranged from 155 to 380 trees per hectare. Mature stands of pinyon-juniper are characterized by low densities of mature trees with allows for developed understory. The birds tend to favor habitat that has areas of high density of dead limbs with a high level of ground cover. Fire suppression has changed pinyon-juniper woodlands from open diverse communities of trees and understory to dense woodlands. Dense forest limits the development of large mature trees and subsequent creation of snags, important breeding habitat components for this species (Forest Service 2010).

Kaibab NF Juniper Titmouse Habitat and Population Trends: There has been an increasing trend for juniper titmouse habitat on the forest. There is currently approximately 657,900 acres of pinyon-juniper habitat on the forest (Forest Service 2010). It is not possible to determine at this time how much is late-seral stage due to the highly variable conditions of the pinyon-juniper stands. There is approximately 12,560 acres of pinyon-juniper habitat within the project area, which is approximately 2 percent of the pinyon-juniper on the Forest. Of the acreage in the analysis area approximately 7,315 acres are to be managed as late-seral stage (see silviculture report), this is approximately 1 percent of the forest-wide acreage of pinyon-juniper. It is believed that the juniper titmouse populations are decreasing. This trend is likely a reflection of long term habitat trends in pinyon-juniper ecosystems across their range (Forest Service 2010.)

Coconino NF Juniper Titmouse Habitat and Population Trends: The forest-wide habitat trend for pinyon-juniper is stable. The age class distribution of pinyon-juniper has remained relatively stable throughout the Forest Plan implementation period. A very small portion of total pinyon-juniper acres has been converted to grasslands or early seral stage pinyon-juniper through wildfire or management actions. Since the age class distribution of pinyon-juniper has not changed much, the snag component has probably remained relatively stable. Firewood cutting has probably reduced snag densities of both pinyon and juniper snags, especially close to Flagstaff. The loss of older pinyon pine trees due to drought creates new snags, but insect attacks result in rapid deterioration of snags, affecting their longevity and value to wildlife. There is currently approximately 630,000 acres of pinyon-juniper habitat on the forest (Forest Service 2002). There is approximately 10,786 acres of pinyon-juniper habitat within the analysis area, which is approximately 2 percent of the pinyon-juniper forest-wide. Of this acreage approximately 8,311 acres is to be managed as late-seral stage (see silviculture report), this is approximately 1 percent of the forest-wide acreage of pinyon-juniper.

The forest-wide population trend for the juniper titmouse is stable to slightly decreasing. BBS (breeding bird survey) trend data for Arizona indicate a slightly decreasing trend between 1996 and 2000. Christmas bird count data indicate a stable to slightly declining trend for wintering juniper titmice on the Forest (Forest Service 2002).

Species Indicators for Early and Late-seral Grasslands

Pronghorn

Pronghorn was selected as an indicator species for early- and late-seral grassland (Forest Service 2002 and 2010). Pronghorn have been seen in the analysis area. Pronghorn populations in Arizona have declined substantially from historic times. Forest-wide and local populations are affected through state permitted hunt structure.

Pronghorn are associated with grasslands, meadows, and savannas on the Coconino and Kaibab National Forests and are typically found in flat or rolling areas, along foothills, in mountain valleys, and on plateaus. Pronghorn prefer ecosystems with a mixture of grasses, forbs, and shrubs to provide for forage requirements and fawning areas. They evolved to avoid predation through sight and flight; habitats with low-growing vegetation and/or sparse tree density are important for pronghorn. Pronghorn avoid areas with high tree density and cover. Several local studies and plans have recognized the importance of grass, forb, and shrub diversity for sustaining pronghorn nutritional needs throughout the year as well as providing hiding cover for fawns. These studies recommend removal of encroaching woody tree species from grasslands and savannas as well as prescribed burning to reinvigorate production and diversity of understory forbs which have the highest nutritional value during fawning. Since pronghorn are relatively wide-ranging species, they are likely to respond to changes in forest management at small and large spatial scales.

Pronghorn avoid areas of high tree and/or tall shrub density, preferring areas with less than 30 percent tree/shrub cover and where vegetation height is less than 0.61 m tall. Woody plant invasion into grasslands and meadows has been identified as one of the leading factors reducing habitat quality for pronghorn, sometimes leading to isolation of populations when combined with other sources of habitat fragmentation such as fences and roads. A recent study of habitat quality in and around Camp Navajo Army National Guard, which is centrally located within the 4FRI project area, found that pronghorn habitat quality was significantly limited by high ponderosa pine densities and encroachment into meadows and grasslands (Waddell et al. 2005). Of particular note was the encroachment of pine trees into Garland Prairie; a critically important grassland used for pronghorn fawning.

Kaibab NF Pronghorn Habitat and Population Trends: Currently the habitat trend for grassland habitat is considered stable on the Forest. There is approximately 216,000 acres of grassland cover type on the Forest. The Forest-wide population trend for pronghorn is considered to be declining (Forest Service 2010.) However, current analysis of AGFD data indicates a stable trend for the pronghorn. Figures 30 and 31 show the estimated population trends for the GMU on the Kaibab within the project area. In figure 8 Game Management Units 7 and 8 relate to the Williams Ranger District and Unit 9 is for the Tusayan Ranger District. Data are unpublished but available from the AGFD Flagstaff Regional Office (McCall, *pers. comm.* 2011).

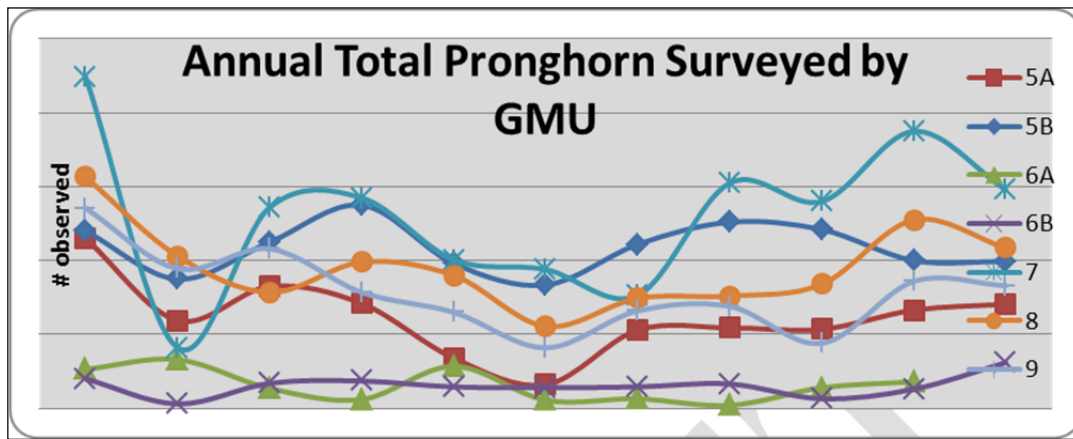


Figure 30. Total number of pronghorn surveyed by GMU within the 4FRI project area, 2001 – 2011

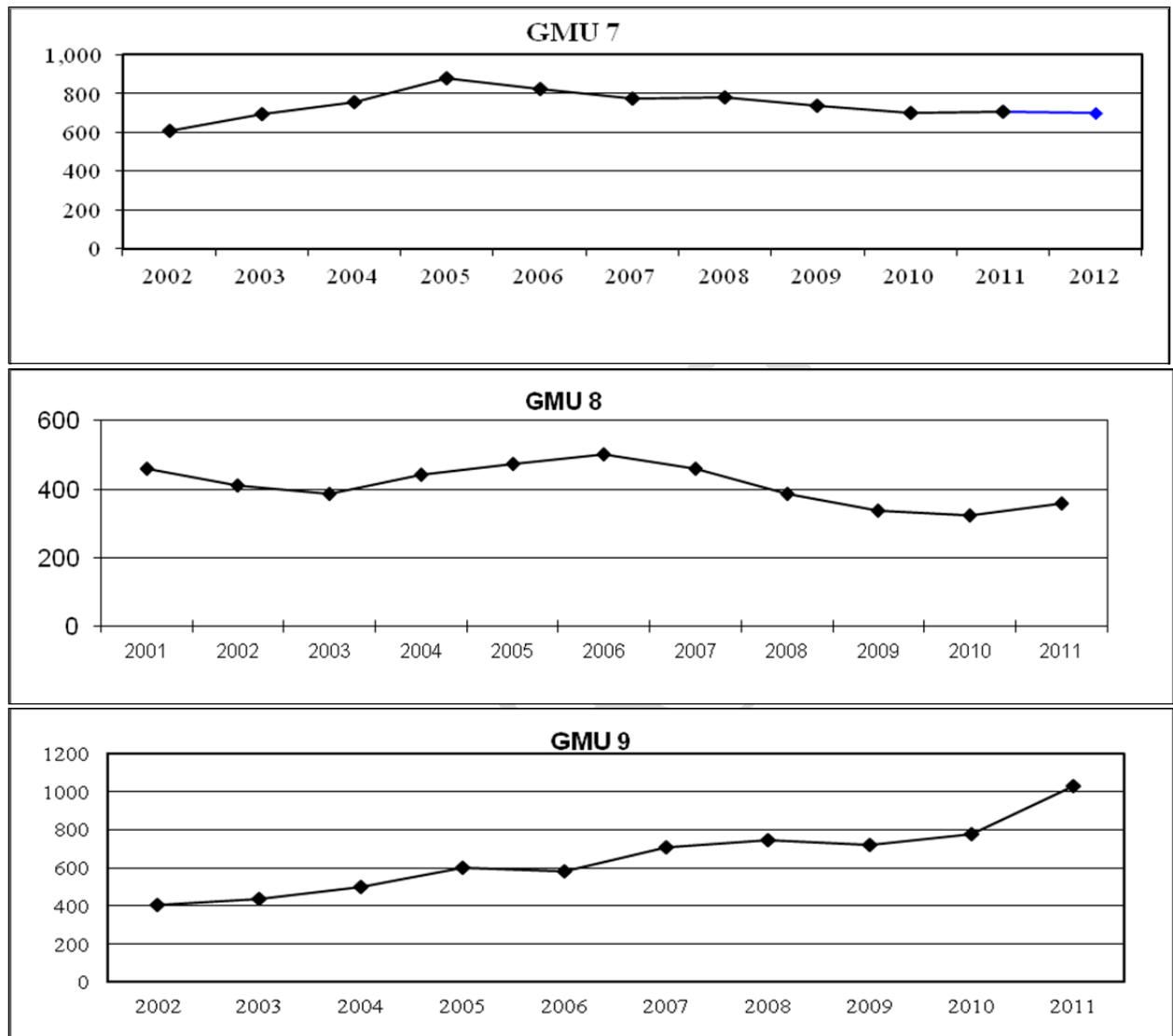


Figure 31. Kaibab NF estimated population trends for pronghorn, 2002-2011 in GMU 7-9

Coconino NF Pronghorn Habitat and Population Trends: Habitat trend is stable to declining. Although the total amount of grassland habitat has generally remained stable, habitat quality is stable to declining due to tree encroachment, fire suppression, long term climatic changes, short term drought, and ungulate grazing (Forest Service 2002). There is approximately 260,050 acres of grassland habitat on the Forest

The forest-wide population trend for pronghorn is declining. Declining numbers of animals observed and fawn to doe ratios below a breakeven of 20-35 fawns per 100 does is documented for all GMU's on the Forest except GMU 7 (Forest Service 2002). However, current analysis of AGFD data indicates a stable trend for the pronghorn. Figures 32 and 33 show the estimated population trends for the GMU on the Coconino within the project area. Figure 33 displays estimated population trends for pronghorn, 2002-2011, on the Peaks Ranger District of the

Coconino National Forest, including Game Management Units 5A, 5B, 6A, 6B, and 7. Data are unpublished but available from the AGFD Flagstaff Regional Office (McCall, pers. comm. 2011).

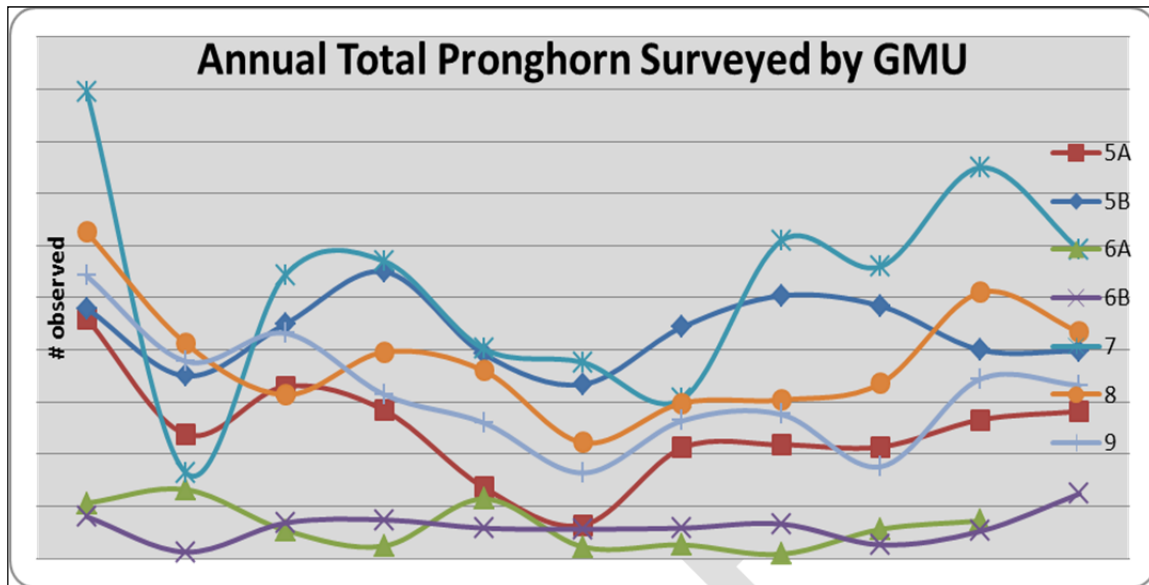


Figure 32. Total number of pronghorn surveyed by GMU within the 4FRI project area, 2001 – 2011

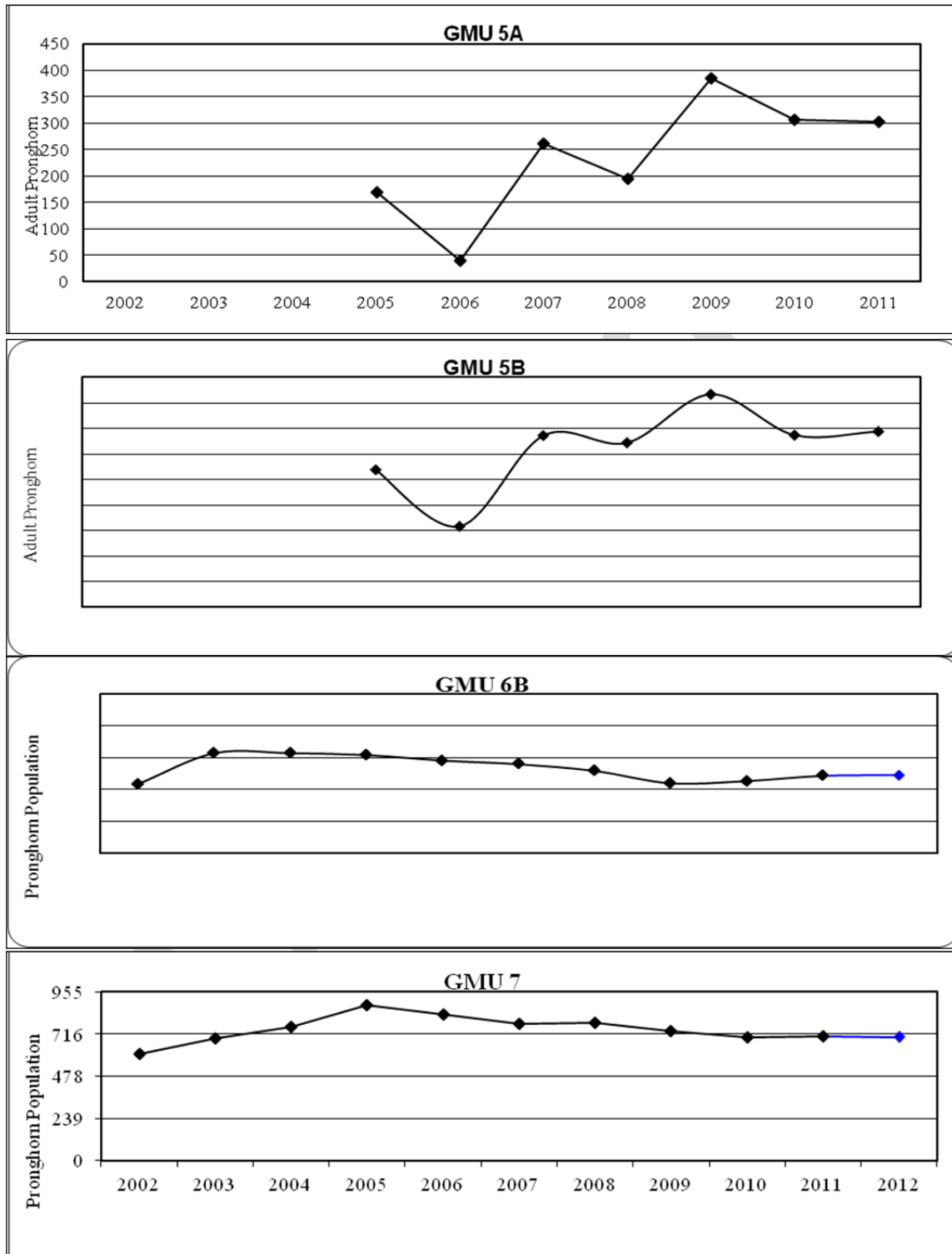


Figure 33. Estimated population trends for pronghorn, 2002-2011, on the Peaks Ranger District of the Coconino National Forest, including Game Management Units 5A, 5B, 6A,

6B, and 7. Data are unpublished but available from the AGFD Flagstaff Regional Office (McCall, pers. comm. 2011) (appendix 6).

Migratory Birds and Important Bird Areas

Affected Environment

Arizona Partners in Flight (APIF) identifies physiographic areas and priority migratory bird species by broad habitat types (Latta et al. 1999). In March 2008, the U.S. Fish and Wildlife Service released its 2008 “Birds of Conservation Concern Report” (USFWS 2008). The Coconino and Kaibab NF occur within the two bird conservation regions (BCR): the Southern Rockies/Colorado Plateau (BCR #16) and Sierra Madre Occidental (BCR #34). For the Kaibab NF, the analysis area only occurs within BCR #34. This analysis considered high priority bird species from both the APIF and the USFWS birds of conservation concern (Table 34).

Table 34. Priority Bird Species Analyzed Under the Migratory Bird Treaty Act

PIF High Priority Species and FWS BCC	Important Habitat Features and Life History Considerations
Ponderosa Pine Forest	
Northern Goshawk	See “Sensitive Species” section for effects to pine habitat and to the species.
Flammulated Owl	Secondary cavity nester. Most closely associated with open ponderosa pine forest. Almost exclusively insectivorous.
Olive-sided Flycatcher	Multi-level, mature forest, fairly open canopy, “clumpiness” prefers forest edges and openings. Dead branches for foraging. Often occur at edge of early post-burned areas for foraging and singing. Live mature pines for nesting. Snags are an important habitat feature.
Cordilleran Flycatcher	Prefers moist and shaded forest for breeding habitat. Nest sites include rock crevices, hollows formed by scars in trunks, exposed tree roots, cavities in small trees, and in forks of small branches. Most abundant in stands with >50% canopy cover. Abundance increase with snag density. Habitat strategy is to maintain dense canopy closure in mid- to late-successional stages of dense, shady forest with an understory of oak and sufficient dead and down trees for nesting.

PIF High Priority Species and FWS BCC	Important Habitat Features and Life History Considerations
Grace's Warbler	Prefers ponderosa pine forest, sometimes with a scrub oak component. Considered a mature pine obligate. Feeds in the upper portions of robust pines on branches; nests found in trees from 20 to 60 feet (6 to 18 meters) above the ground. Prefers mature ponderosa pine savanna; open meadow; and uneven-aged ponderosa pine and other trees, with an oak understory. Research notes pine forests that mimic naturally open parklands with stands of large, mature trees, will eventually benefit this species.
Lewis's Woodpecker	Uses open pine savanna habitat. Breeding habitat includes open canopy, bushy understory offering ground cover, dead or down woody material, available perches and abundant insects. Logged or burned pine forests are also preferred habitat for breeding. Diet varies with seasonal abundant of food items, primarily free-living (non-wood boring) insects, acorns and other nuts, and fruit.
Purple Martin	Open canopy; often prefers habitat near open water; nests in tree cavities excavated by woodpeckers Open mid-story cover and open understory cover. Prefers high snag density and tall snags adjacent to open areas.
Cassin's Finch	Nesting preference is for open coniferous forests. Dry, relatively open mature ponderosa pine forest. Nests tend to be placed >16' above ground, often out on lateral branches or near the trunk within about 3 feet of tree tops.
Aspen	
Red-naped sapsucker	Preferred nest sites are live trees with heart-rot, which facilitates excavation and leaves the nest cavity enclosed in harder surrounding wood. Will also use dead trees for nesting. Minimum dbh for nest tree is 10" and minimum height is usually 15'. Manage for groups of aspen stands of different age classes, in a larger forest complex, to ensure continual availability of older trees and snags for nesting. Use fire or silvicultural treatments to ensure continual regeneration of new stands.
Pinyon-Juniper Woodland	
Gray Vireo	Uses open mature pinyon-juniper woodlands, typically with a broadleaf shrub component. Nests low in a small tree or shrub 2 to 6' above ground. Fire can be used to maintain existing habitat matrix and to prevent stands from becoming too dense.

PIF High Priority Species and FWS BCC	Important Habitat Features and Life History Considerations
Pinyon Jay	Pinyon cone crop is important factor for successful breeding. Needs mature trees for cone production Nests are typically 3 to 26' high and tend to be south-facing. Pairs will renest up to 5 times in a breeding season if earlier nesting attempts fail.
Juniper Titmouse	Restricted to pinyon-juniper woodlands. Uses late successional pinyon-juniper woodlands. Tends to favor areas with a high density of dead limbs and high degree of ground cover. An obligate secondary cavity nester. Nest cavity height ranges from 4 to 15' above ground. Nest tree dbh range from 5 to 18".
Black-throated Gray Warble	Primarily associated with pinyon pine and juniper woodlands in northern Arizona. Canopy cover of 13 to 26% in mid to late successional woodlands. Breeding habitat is frequently characterized by a brushy undergrowth of scrub oak, ceanothus, manzanita, or mountain mahogany. Nests are typically placed on a horizontal tree branch or near the main stem of a shrub. Nest height varies from 2 to 15' above ground.
Gray Flycatcher	Most common in larger and taller stands of pinyon pine and/or juniper with open understory. May need some ground cover to support insect populations for foraging. Nest are placed primarily 2 to 11' high in a shrub or crotch of a juniper or pinyon pine.
High Elevation Grasslands	
Swainson's Hawk	Stick nests constructed in scattered, lone trees within grasslands. Typical nest trees in Arizona are cottonwood, juniper, mesquite, ironwood and oak. Primary food source is insects. They also feed on small mammals, lizards, and snakes especially during breeding season. Prefer open grassland for foraging, shrubs/brushy areas are not preferred habitat.
Ferruginous Hawk	See "Sensitive Species" section for effects to nesting habitat and to the species.
Burrowing Owl	See "Sensitive Species" section for effects to nesting habitat and to the species.

PIF High Priority Species and FWS BCC	Important Habitat Features and Life History Considerations
Grasshopper Sparrow	Prefers pure grassland habitat without trees or emergent shrubs. Requires abundant thatch and dry grass for concealment. Apparent low site-fidelity. May avoid recently burned grassland sites for ≥ 2 years post-burning. Nests are often partially domed with dry grass and placed in a depression on the ground at the base of vegetation so the rim is nearly flush to the ground. This species often raises two broods per year. Primarily feeds on insects during the breeding seasons. Grass seeds are important in colder months when insect activity is low.
Bendire's Thrasher	Prefers relatively open grassland with large scattered shrubs and/or trees (cholla, junipers, or sagebrush are usually present); may use dense vegetated washes or riparian areas. Breeds in relatively open, degraded grasslands with a moderate to dense shrub component. Nests are typically placed 2 to 5 feet above the ground in semi-desert shrubs, cacti, or trees.

The following habitats would be affected in the analysis area. Not all bird species described have been located within the analysis area, but they have the potential of occurring here. While riparian habitat and cliffs/rock habitats are found in the analysis area, the proposed activities will not affect these habitat types.

Ponderosa Pine Habitat Type

For the purpose of Arizona Partners in Flight (APIF), pine forest refers to northern Arizona ponderosa pine forests, including pure ponderosa pine and pine with Gambel oak (Latta et al. 1999). It is estimated that approximately 3,680,000 acres of ponderosa pine forest exists in Arizona, representing approximately 5% of the total land area of the state. It occupies much of the mountain and plateau country above 6,500 feet elevation, replaced by mixed conifer forest above 8,500 feet (Latta et al. 1999). The analysis area contains approximately 512,178 acres of ponderosa pine habitat. The analysis area is approximately 14 percent of the ponderosa pine habitat in Arizona and 38 percent of the ponderosa pine PNVT cover type on both forests.

Aspen Habitat Type

In some areas, aspen forms extensive pure stands. In others, aspen is a minor component of the forest landscape, and can be found in ponderosa pine, and mixed conifer stands (Latta et al 1999). It is estimated that approximately 79,000 acres of aspen exist in Arizona. Aspen stands typically have a maximum life span of 200 years. Without a substantial disturbance such as high-severity fire or overstory removal to stimulate early seral renewal, the aspen will die out and as it becomes dominated by conifers (Latta et al 1999). The analysis area contains approximately 1,471 acres of aspen habitat. The analysis area is approximately 4% of the aspen on both forests.

Pinyon-Juniper Habitat Type

It is estimated that approximately 13,167,460 acres of pinyon-juniper forest exists in Arizona. Pinyon-juniper is cold-adapted evergreen woodland situated above desert or grassland vegetation and below ponderosa pine forests. The habitat is characterized by varying co-dominance of juniper species and pinyon pine. Typically, pinyon-juniper exhibits an open woodland arrangement with well-spaced trees. However, depending on site variables, pinyon-juniper may range from an openly-spaced savanna to a closed woodland (Latta et al. 1999). The analysis area contains approximately 25,658 acres of pinyon-juniper habitat. The analysis area is less than 1% of the pinyon-juniper habitat on both forests.

High Elevation Grasslands Habitat Type

The High Elevation Grassland habitat type is defined in APIF as subalpine-alpine grasslands/montane meadows and Plains/Great Basin Grasslands. Upland grasslands in northern Arizona comprise all grass-dominated sites from the lower limits of the montane zone up to alpine tundra. There is an estimated 20,230 acres of upland grasslands in the state. Plains/Great Basin Grasslands occur in northern Arizona. While they cover a much larger area than upland grasslands, there are no current estimates for acreage (Latta et al. 1999). The analysis area contains approximately 48,774 acres of grassland habitat. The analysis area is approximately 10 percent of the grassland habitat on both forests.

Important Bird Areas

Anderson Mesa is the only Important Bird Area (IBA) within the project area. The IBA covers approximately 167,843 acres. This site serves as a principle stopover for migrating waterfowl, water birds, and wading birds in Arizona, particularly for dabbling ducks (e.g., cinnamon teal) during spring migration. It also has habitat for pinyon jays, a species of conservation concern. More than 230 avian species occur in the area. Drought is listed as the highest threat to the IBA. Other threats include: fire, invasive plants, some timber harvest projects, disturbance to birds, certain recreation activities, and water transfer through surface water abstraction. See the Arizona Important Bird Areas Program website for more information at <http://aziba.org>.

There are 63,157 acres of the project area within the IBA, covering about 38 percent of the Anderson Mesa IBA. About 43,195 to 44,751 acres of habitat will be treated within the project area, equaling about 26 to 27 percent of the IBA. While most of the acres treated are within ponderosa pine habitat, treatments will also occur in grassland, aspen and pinyon juniper habitats. In addition, 53 miles of road decommissioning, restoration of six springs, and 7.5 miles of ephemeral stream channel restoration activities are proposed within the IBA.

Wildlife design features will help mitigate impacts from treatments and hauling harvested materials from other treatment areas and include:

- Bald eagle winter concentration areas, retain the tallest snags >18" dbh.
- No vegetation treatments would occur within a ½ mile (2,500 ft), unless mitigated by topography, of an occupied bald or golden eagle nest between March 1 and August 31. Other project activities will be assessed by the district biologist and limited activities may be acceptable.
- No mechanical treatments will occur around confirmed bald eagle roost sites (300' radius around roosts on the Coconino NF).

- No project activities will occur within 500 feet of confirmed bald eagle communal roosts from October 15 – April 15.
- Raptor nests located during project surveys will be monitored prior to project activities. Known nest trees for any raptor species would be prepped prior to prescribed burning. Buffers will be provided if nests are active:
 - o Sharp-shinned hawk = no mechanical treatment buffer of 10 acres around occupied nests;
 - o Cooper’s hawk = no mechanical treatment buffer of 15 acres around occupied nests;
 - o Osprey = no mechanical treatment buffer of 20 acres around nest sites (occupied or unoccupied) and all logging activities will be restricted within ¼ mile of active nests from March 1 to August 15;
 - o Other raptors = 50 ft around occupied nest;
- Great blue herons: No dominant or co-dominant trees will be cut in rookeries. Known sites will be prepped prior to prescribed burning and fire ignition mitigations will apply. Timing will avoid mechanical tree harvest while birds are in the nest. Activities will be coordinated with the local biologist.

Description of Alternatives

The Forest Service analyzed four alternatives, including no action, the proposed action and two additional alternatives in response to public comment (Table 35). The alternatives are provided in summary form. See silviculture report for additional details.

Table 35. Summary of Action Alternatives

Proposed Activity	Alternative B	Alternative C	Alternative D
Silviculture Treatments (UEA, IT, SI, savanna)	388,489 acres Responds to P/N and 8 months of collaboration and public involvement	434,038 acres Increases grassland treatment acres, Includes proposed RNA acres, Drops 2,860 acres of mechanical due to wildlife and watershed research	388,489 acres
Prescribed Burning	587,923 acres	593,211 acres Includes 2,860 acres of prescribed burning from research and acres from RNA burning	178,790 acres prescribed fire (responds to smoke issue)

Proposed Activity	Alternative B	Alternative C	Alternative D
Research	N/A	Construct 15 weirs (max of 3 acres) in restoration unit 1, 3, and 4 (see changes to silviculture and prescribed burning acres above)	N/A
MSO PAC Habitat	Mechanically thin up to 16" dbh in 18 PACs Prescribed burn 72 MSO PACs (no core areas burned) 2 forest plan amendments	Mechanically thin up to 18" dbh in 18 PACs Prescribed burn 72 MSO PACs (including 56 core areas) 3 forest plan amendments	Mechanically thin up to 16" dbh in 18 PACs No burning in PACs 2 forest plan amendments
MSO Protected Habitat	Thin by hand and prescribed fire on 99 acres of protected habitat		
Spring, seep,	74 springs/up to 4 miles of fencing		
Channel Restoration	39 miles of ephemeral channel restoration		
Road Decommission	904 miles		
Temporary Road Construction	245 miles of new temp roads 272 miles of existing roads		
Road Reconstruction	10 miles		
Mechanically treat and burn Aspen	Mechanically treat 1,229 acres, prescribed fire, and construct up to 82 miles of protective fencing		Mechanically treat 1,229 acres, and construct construct up to 82 miles of protective fencing, and 32 acres of prescribed fire only
Old Tree Retention Strategy (OTRS)	Included in purpose and need and in design features (see DEIS)		
Large Tree Retention Strategy	Not included LTRS in project record as document submitted during scoping	Modified LTRS included in P/N, design features, project record,	Not included LTRS in project record as document submitted during scoping

Alternative A - No Action

No mechanical treatment or prescribed burning is being proposed under this alternative. Wildfire would continue to be managed with protection and/or resource benefit objectives as appropriate. A high risk of crown fire remains. Mexican spotted owl habitats would not move towards recovery and Forest Plan guidelines. Northern goshawk habitats would not be managed towards

desired VSS Class distributions with a productive understory herbaceous and shrub component for prey base.

Alternative B– Proposed Action

The Coconino and Kaibab NFs propose to conduct approximately 587,923 acres of restoration activities over approximately 10 years or until objectives are met. Approximately 20,000 to 30,000 acres of vegetation would be treated annually and up to 40,000 acres would be prescribed burned annually across the forests. Restoration activities would:

- Mechanically cut trees on approximately 388,489 acres, including mechanically thinning up to 16-inch dbh within 18 MSO PACs and cutting 99 acres of trees by hand on slopes greater than 40 percent
- Following mechanical treatment, prescribe burn approximately 388,489 acres, including prescribed burning within 72 MSO PACs (excluding nest areas) and on 99 acres of slopes greater than 40 percent
- Prescribe burn-only on approximately 199,435 acres
- Decommission 770 miles of existing system and unauthorized roads on the Coconino NF
- Decommission 134 miles of unauthorized roads on the Kaibab NF
- Construct 245 miles of temporary roads for haul access and decommission when treatments are complete
- Open (construct) approximately 272 miles of existing, decommissioned road and return to decommissioned status when treatments are complete
- Reconstruct up to 10 miles of existing, open roads for resource and safety concerns
- Restore 74 springs and construct up to 4 miles of protective fencing
- Restore 39 miles of ephemeral channels
- Construct up to 82 miles of protective (aspen) fencing
- Allocate as old growth 40 percent of ponderosa pine and 77 percent of pinyon-juniper woodland on the Coconino NF and 35 percent of ponderosa pine and 58 percent of pinyon-juniper on the Kaibab NF

Two non-significant forest plan amendments (see [appendix X, Alternative B of the DEIS](#)) would be required on the Coconino NF to implement the proposed action. A variance would be provided to: (1) use mechanical treatments to improve habitat structure and treat up to 16 inch dbh within 18 MSO PACs, (2) clarify that canopy cover would be measured and met at the group level, and, add language to define/describe interspace and the relationship between interspaces, openings, and vegetation structural stage (VSS) classes, and, manage 29,017 acres of goshawk non-PFA habitat for less than 40 percent canopy cover and less than 3 to 5 reserve trees per acre.

One non-significant forest plan amendment (see [appendix X, Alternative B of the DEIS](#)) would be required on the Kaibab NF to implement the proposed action. A variance would be provided to: (1) clarify that canopy cover would be measured and met at the group level, add language to define/describe interspace and the relationship between interspaces, openings, and vegetation structural stage (VSS) classes, and, manage 27,675 acres of goshawk non-PFA habitat for less than 40 percent canopy cover in VSS 4 to 6 and less than 3 to 5 trees per acre.

Table 15 of the DEIS provides acres to be mechanically treated by treatment type. Please refer to the glossary ([Appendix X of the DEIS](#)) for treatment definitions. Individual resource sections in Chapter 3 describe how actions were evaluated at various scales. Figure 36 displays alternative B's vegetation and prescribed fire treatments at a course scale. Table 16 provides information on road treatment acres by restoration unit for Alternative B-D and Figure 37 provides the course-scale overview. Table 17 provides information on acres of springs, ephemeral channels and aspen treatments for alternative B-D and Figure 38 provides the course scale overview. Table 18 and Table 19 display vegetation and prescribed burning treatment acres in goshawk and MSO habitat specific to Alternative B and Figure 39 provides a course-scale map for treatments in these habitats. Table 20 and Table 21 display the old growth allocation for Alternative B-D and Figure 40 provides the course-scale overview.

Alternative C

Alternative C responds to issue 2 (conservation of large trees) and other comments and recommendations received during scoping. The alternative includes a large tree implementation plan, adds acres of grassland treatments on the Kaibab NF, incorporates wildlife and watershed research on both Forests, and adds both mechanical treatment and prescribed burning to the proposed Garland Prairie RNA on the Kaibab NF. It proposes thinning up to 18-inch dbh in 18 MSO PACs and includes prescribed burning with 72 MSO PACs, including 56 core areas (see "Alternative Development Process" section for additional information).

The Coconino and Kaibab NFs would conduct restoration activities on approximately 593,211 acres over a period of 10 years or until objectives are met. Approximately 20,000 to 30,000 acres of vegetation would be treated annually and up to 40,000 acres would be prescribed burned annually on the forests. Restoration activities would:

- Mechanically cut trees on approximately 434,001 acres, including thinning up to 18-inch dbh within 18 MSO PACs and cutting trees by hand on 99 acres on slopes greater than 40 percent
- Following mechanical treatment, prescribe burn approximately 434,001 acres including prescribed burning within 72 MSO PACs (including 56 core areas)
- Prescribe burn-only on approximately 159,211 acres
- Decommission 770 miles of existing system and unauthorized roads on the Coconino NF
- Decommission 134 miles of unauthorized roads on the Kaibab NF
- Construct 245 miles of temporary roads for haul access and decommission when treatments are complete
- Open (construct) approximately 272 miles of existing, decommissioned road and return to decommissioned status when treatments are complete
- Reconstruct up to 10 miles of existing, open roads for resource and safety concerns
- Restore 74 springs and construct up to 4 miles of protective fencing
- Restore 39 miles of ephemeral channels
- Construct up to 82 miles of protective (aspen) fencing
- Construct up to 15 weirs and 20 weather stations (up to 3 total acres of disturbance) to support watershed research

- Allocate as old growth 40 percent of ponderosa pine and 77 percent of pinyon-juniper woodland on the Coconino NF and 35 percent of ponderosa pine and 58 percent of pinyon-juniper on the Kaibab NF

Two non-significant forest plan amendments (see [appendix X of the DEIS](#)) would be required on the Coconino NF to implement alternative C. A variance would be provided to: (1) use mechanical treatments to improve habitat structure and treat up to 18-inch dbh within 18 MSO PACs, use prescribed fire within 56 MSO PAC no-treatment areas, and, manage 6,321 acres of MSO restricted habitat at a minimum basal area of 110 to 150 square feet per acre, and, (2) clarify that canopy cover would be measured and met at the group level, add language to define/describe interspace and the relationship between interspaces, openings, and vegetation structural stage (VSS) classes, and, manage 29,017 acres of goshawk non-PFA habitat for less than 40 percent canopy cover and less than 3 to 5 reserve trees per acre.

Two non-significant forest plan amendments (see [appendix X of the DEIS](#)) would be required on the Kaibab NF to implement the proposed action. A variance would be provided to: (1) clarify that canopy cover would be measured and met at the group level, add language to define/describe interspace and the relationship between interspaces, openings, and vegetation structural stage (VSS) classes, manage 27,675 acres of goshawk non-PFA habitat for less than 40 percent canopy cover in VSS 4 to 6 and less than 3 to 5 trees per acre, and, (2) mechanically treat and prescribe burn approximately 400 acres in the proposed Garland Prairie RNA.

Alternative D

Alternative D responds to issue 2 (prescribed burning smoke) by decreasing the acres to be prescribed burned. All other components of the alternative are the same as described in alternative B (see pages 136 to 137 above).

The Coconino and Kaibab NFs would conduct restoration activities on approximately 567,279 acres over a period of 10 years or until objectives are met. Approximately 20,000 to 30,000 acres of vegetation would be treated annually on the forests. Restoration activities would:

- Mechanically cut trees on approximately 388,489 acres, including mechanically thinning up to 16-inch dbh within 18 MSO PACs and cutting 99 acres of trees by hand on slopes greater than 40 percent. Slash would be disposed of through various methods including chipping, shredding, mastication and removal of biomass off-site
- Cut trees by hand and pile and burn slash on slopes greater than 40 percent on approximately 99 acres
- Prescribe burn-only on approximately 178,790 acres
- Decommission 770 miles of existing system and unauthorized roads on the Coconino NF
- Decommission 134 miles of unauthorized roads on the Kaibab NF
- Construct 245 miles of temporary roads for haul access and decommission when treatments are complete
- Open (construct) approximately 272 miles of existing, decommissioned road and return to decommissioned status when treatments are complete
- Reconstruct up to 10 miles of existing, open roads for resource and safety concerns
- Restore 74 springs and construct up to 4 miles of protective fencing
- Restore 39 miles of ephemeral channels

- Construct up to 82 miles of protective (aspen) fencing
- Allocate as old growth 40 percent of ponderosa pine and 77 percent of pinyon-juniper woodland on the Coconino NF and 35 percent of ponderosa pine and 58 percent of pinyon-juniper on the Kaibab NF

Two non-significant forest plan amendments (see **appendix X, Alternative B of the DEIS**) would be required on the Coconino NF to implement the proposed action. A variance would be provided to: (1) use mechanical treatments to improve habitat structure and treat up to 16 inch dbh within 18 MSO PACs, (2) clarify that canopy cover would be measured and met at the group level, and, add language to define/describe interspace and the relationship between interspaces, openings, and vegetation structural stage (VSS) classes, and, manage 29,017 acres of goshawk non-PFA habitat for less than 40 percent canopy cover and less than 3 to 5 reserve trees per acre.

One non-significant forest plan amendment (see **appendix X of the DEIS, Alternative B**) would be required on the Kaibab NF to implement the proposed action. A variance would be provided to: (1) clarify that canopy cover would be measured and met at the group level, add language to define/describe interspace and the relationship between interspaces, openings, and vegetation structural stage (VSS) classes, and, manage 27,675 acres of goshawk non-PFA habitat for less than 40 percent canopy cover in VSS 4 to 6 and less than 3 to 5 trees per acre.

Design Features, Best Management Practices and Mitigation

Applicable Forest Plan standards and guidelines, Best Management Practices, and Forest Service Manual and Handbook direction will be incorporated in project design and implementation. Additional vegetation design features result from the 4FRI being an ecologically based project with partial funding from the Collaborative Forest Landscape Restoration Program (Pub. L. 111-11 Title IV March 30, 2009). This program is a science-based ecosystem restoration effort for treatments on National Forest system lands. As such, the intent of the Recovery Plan would be met through pro-active design rather than after the fact mitigation. See Table X of the DEIS for a complete list of design features and associated Best Management Practices.

Design features guiding project implementation include:

Vegetation Design Features - Common to All Treatment Types

- Treatments are designed to move vegetation toward the desired condition as outlined in the Coconino NF and Kaibab NF forest plans.
- Treatments are designed to create tree groups and interspaces that stimulate grass, forbs and increase residual tree growth.
- Priority location for interspace is in currently non-stocked areas and in areas that lack pre-settlement evidence.
- Treatments will focus on reducing the most abundant tree size classes and maintaining the under-represented tree size classes in order to achieve and/or set the project area on the trajectory to attain greater diversity (heterogeneity) in spatial patterns and size class distribution.
- Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Old trees would not be targeted for cutting. See “old tree retention strategy”.

- Treatments are designed to decrease the potential for undesirable fire behavior and effects.
- Snags would be managed to meet forest plan requirements and move towards desired conditions.
- Snags or hazard trees within a distance of twice their height from private land boundaries or along key roads may be felled. In all other areas conifer snags >12" dbh would be retained except in cases of human health and safety.
- Live conifer trees with potential to provide nesting habitat cavities (due to trunk decay) will be favored for retention.
- Coarse woody debris (CWD) would be managed for an average of 5 to 7 tons per acre after treatment.
- Project created slash may be mechanically treated, removed, lopped and scattered, piled, burned or retained for soil stabilization, wildlife values, or other resource benefits. Existing surface fuels may also be treated by prescribed burning, relocation or removal to reduce fire hazard if quantities are above forest plan guidelines. Slash beetle prevention measures may be implemented as necessary.
- Prescribed burns are designed to maintain desired forest structure, tree densities, snag densities and CWD levels.
- Gambel oak, juniper and pinyon species >5" dbh may be considered as residual trees in the target group spacing and stocking.

Silvicultural and prescribed burn treatments were designed to meet the objectives of the respective MSO habitat classification under consideration.

Vegetation design features common to all treatment types within MSO habitat

- Manage for 15% or more of the stand density index in ponderosa pine trees between 12 and 18" dbh, 15% or more of the stand density index in ponderosa pine trees between 18 and 24" dbh, 15% or more of the stand density index in ponderosa pine trees ≥ 24 " dbh, and ≥ 20 TPA ≥ 18 " dbh.
- No trees 24 inches dbh or larger would be removed.
- Manage for snags ≥ 18 " dbh and down logs ≥ 12 ".
- Gambel oak, juniper and pinyon species will not be cut as part of the treatments. These species may only be cut as necessary to facilitate logging operations (skid trails and landings).

Core areas are 100-acre or greater areas that encompass known nest or roost sites or the best nesting and roosting habitat available. Designated core areas would not receive mechanical treatments. Outside core areas, trees may be thinned in selected PACs. **The following vegetation design features would apply to PACs:**

- Thinning objectives would be the release of large pine and Gambel oak from uncharacteristic densities of young pine trees, reduce fuels and mitigate fuel hazards where feasible, release young oak, move stands towards uneven-aged conditions, and improve prey habitat

- In stands where thinning has been identified as potentially improving MSO habitat, each stand within each PAC treated would have an upper diameter limit ranging from 9 to 18 inches dbh, depending on the alternative and the stand itself. All trees above that limit would be retained
- Treatments are designed to increase residual tree health and vigor and maintain greater than or equal to 150 BA where present
- Irregular tree spacing would be used to create canopy gaps to move toward or facilitate stand conditions that improve forest resiliency and create conditions more conducive to low intensity prescribed fire treatment. Canopy gaps would enhance understory development and enhance prey habitat
- Light prescribed burns to treat fuels and mitigate fuel hazards would be conducted where feasible. The objectives of prescribed burns in PACs are to reduce surface fuels and raise crown base height, thereby reducing flame length and surface fire intensity. Prescribed fire would reduce coarse woody debris, total oak BA, and snags, but these losses would be mitigated through burn prescriptions, ignition techniques, or other techniques.

Treatments in target and threshold habitat were designed to maintain existing elements of MSO habitat where they exist and move forests towards those habitat features where they are lacking. Treatments are designed to be in accord with Recovery Plan objectives by retaining oak and large trees, improving MSO habitat through increased tree growth rates, increased stand resiliency, improved prey habitat, and reduced fire threat. **Treatments in target and threshold habitats are designed to achieve the following:**

- Increase residual tree health and vigor and reduce fire hazard through intermediate thinning
- maintain, where present, BA greater than or equal to 150, with a portion of the acres totaling 170 or greater BA
- Irregular tree spacing would be used to create canopy gaps to move toward or facilitate stand conditions that may be more conducive to low intensity prescribed fire treatment and to provide food and cover for prey species
- At least 20 trees or more per acre measuring 18 inches dbh or greater would be retained or moved towards that goal in shorter timeframes than if left untreated

Treatments are designed to achieve the following in MSO **restricted habitat outside of target and threshold habitats:**

- Develop uneven-aged forest structure, irregular tree spacing and variable patch size by thinning tree groups and establishing interspace openings adjacent to tree groups to improve forest resiliency; these actions will move forest structure towards the historical range of variation and move towards or create stand conditions more conducive to low-intensity prescribed fire treatments
- Crown spacing between tree groups (interspace) would average 25 to 60 feet distance, providing for forest health, prey habitat development, and to move towards or facilitate stand conditions more conducive to low-intensity prescribed fire treatments
- On average, tree groups would range from 0.1 to 1 acre in size; northerly aspects and highly productive microsites would have larger average group sizes compared to southerly aspects

- Tree thinning on southerly aspects would target 60 to 80 BA; thinning on northerly aspect would target 80 to 100 BA. The goal is manage for a sustainable range of density and structural characteristics
- In order to recruit new age classes and move towards or maintain uneven-aged conditions, regeneration openings would be created on 10 to 20 percent of the area; openings would average 0.3 to 0.8 acres in size. However, in specific areas where ponderosa pine mistletoe infections are heavy, openings may extend up to 4 acres
- Manage for uneven-aged conditions by retaining individual trees and clumps of vigorous ponderosa pine seedlings, sapling and poles within larger mid-aged, mature or old tree groups
- Manage moderate to heavy dwarf mistletoe infection centers that are not intended for regeneration openings for improved tree vigor and growth by retaining the best growing dominant and co-dominant trees with the least amount of mistletoe to retain current habitat diversity through time
- No trees greater than 24 inches dbh would be cut and existing old growth attributes would be retained
- To maintain and develop large Gambel oak trees, conifers up to 18 inches dbh that do not meet the “old tree” definition would be removed within 30 feet of oak greater than or equal to 10 inches dbh to reduce competition for moisture, nutrients, and sunlight from ponderosa pine trees established after wildfire was limited or eliminated from the landscape
- Light prescribed burns to treat fuels and mitigate fuel hazards would be conducted where feasible. The objectives of prescribed burns in PACs are to reduce surface fuels and raise crown base height, thereby reducing flame length and surface fire intensity. Prescribed fire would reduce coarse woody debris, total oak BA, and snags, but these losses would be mitigated through burn prescriptions, ignition techniques, or other techniques
- The following features are design elements that further detail management actions, mitigate environmental consequences, and establish priorities for implementation relative to wildlife (Table 36). Environmental consequences have been evaluated with all features, practices, and mitigation considered.

Table 36. Wildlife Design Features incorporated into 4FRI implementation planning.

Species	Where/When	What	Programs Affected	Forest Requirement
Mexican Spotted Owl	Restricted and protected habitat	Trees greater than 24” dbh would not be harvested.	Silviculture	Yes
Mexican Spotted Owl	Restricted and protected habitat	MSO surveys in the project area the year of implementation or one year prior to determine if new areas are occupied by owls.	Silviculture	Yes

Species	Where/When	What	Programs Affected	Forest Requirement
Mexican Spotted Owl	Restricted and protected habitat	Pre- and post-treatment habitat monitoring would occur as specified in the MSO recovery plan	Silviculture and Fire	Yes
Mexican Spotted Owl	Protected Activity Centers	Spring restoration will not occur during the breeding season (March 1 to August 31), if occupied, in Rocktop, Sawmill Spring, Red Raspberry and Weimer Spring PACs (i.e., 4 out of 78 proposed spring restoration sites will be affected).	Watershed	Yes
Mexican Spotted Owl	Protected Activity Centers	Ephemeral stream restoration will not occur during the breeding season (March 1 to August 31), if occupied, in Bear Seep, Clark, Holdup, Coulter Ridge and Meadow Tank MSO PACs	Watershed	Yes
Mexican Spotted Owl	Protected Activity Centers	Road construction, obliteration, relocation, and maintenance would not occur during the breeding season (March 1 to August 31) if occupied.	Engineering	Yes
Mexican Spotted Owl	Protected Activity Centers	No treatments would occur in PACs within a 1/4 mile of nests and roosts (potentially adjusted by topography) during the breeding season (March 1 to August 31) if occupied. If nest or roosts are not known no treatments will occur within ¼ mile of nest buffer boundaries unless surveys indicate the PAC is unoccupied.	Fire and Silviculture	Yes
Mexican Spotted Owl	Protected Activity Centers	Hauling will not occur within PACs during the breeding season (March 1 to August 31) unless specific analysis has documented that impacts will not lead to adverse effects.	Silviculture	Yes
Mexican Spotted Owl	Protected Activity Centers	No new wire fencing will be constructed in PACs. Other alternatives will be used for aspen, seep, spring and ephemeral drainage restoration exclosures. Alternatives will be coordinated with other specialists. If suitable alternatives cannot be identified restoration work will be postponed.	Watershed and Silviculture	No
Mexican Spotted Owl	Protected Activity Centers	Coordinate burning spatially and temporally to limit smoke impacts to nesting owls, particularly for PACs with nests in draws & canyons (Effective March 1 to August 31).	Fire	Yes

Species	Where/When	What	Programs Affected	Forest Requirement
Northern Goshawk	Nest Stands	Prescribed burn plans will be designed and implemented to minimize smoke impacts to nesting birds and minimize loss of nest trees.	Fire	Yes
Northern Goshawk	Post-Family Fledging Areas	Harvest Activities will not occur in occupied PFAs during the breeding season unless specific analysis has documented impacts will not trend to listing or loss of viability. PFAs can be cleared if pre-treatment surveys determine the area is no longer occupied.	Silviculture	Yes
Northern Goshawk	Post-Family Fledging Areas	Loaded logging trucks will not exceed 25 mph when traveling through PFAs during the nesting season (March 1 to July 31).	Silviculture	No
Northern Goshawk	Post-Family Fledging Areas	Spring and ephemeral drainage restoration projects would not occur in the Barney Spring, Tree Spring, Schultz Pass, Squaw, Marteen, Coxcombs, Pumphouse, Walnut, Faye, Marshall Mesa, Newman, Cherry Canyon and Monument 36 PFAs during the breeding season (March 1 to September 30) if occupied. However, work could potentially occur on an individual basis through coordination with the District biologist if specific analysis has documented that impacts will not trend to listing or loss of viability.	Watershed	Yes
Northern Goshawk	Post-Family Fledging Areas	Road construction, obliteration, relocation, and maintenance would not occur during the breeding season (March 1 to September 30) if occupied.	Engineering	Yes
Turkey	Foraging and roosting cover	Retain medium to high canopy cover in pine stringers in the pinyon-juniper transition zone and target low severity burns to retain yellow pine and roosting cover.	Silviculture and Fire	Yes
Deer	Known fawning areas	Because of declining trends in populations, defer logging activities between May 15 and August 31.	Silviculture	Yes
Pronghorn	Migration routes	Avoid thinning and burning within the known travel way on the Williams RD during the 1st major snowfall of a given year to allow for seasonal migration. See Appendix 4	Silviculture and Fire	No

Species	Where/When	What	Programs Affected	Forest Requirement
General	Dependable waters	Hiding cover will be maintained near dependable waters by not targeting drainages for interspaces and openings and through implementation of watershed bmps.	Silviculture and Fire	No
General	Snags & logs	Protect snags and logs wherever possible through site prep, implementation planning, and ignition techniques to retain snags >18" dbh and ≥3 logs with >12" mid-point diameter in MSO protected & restricted habitat.	Silviculture and Fire	Yes
General	Snags & logs	Protect snags and logs wherever possible through site prep, implementation planning, and ignition techniques to retain snags >12" dbh and ≥3 logs with >12" mid-point diam. + 5-10 tons/ac of CWD (>3" diam) in MSO Critical Habitat retain.	Silviculture and Fire	Yes
General	Snags & logs	Protect snags and logs wherever possible through site prep, implementation planning, and ignition techniques to retain >2 snags/ac ≥30' high and ≥18" dbh + ≥3 logs ≥8' long and ≥12" mid-point diam. + 5-7 tons of CWD (>3" diam)/ac outside MSO habitat in PIPO.	Silviculture and Fire	Yes
General	Snags & logs within the pinyon-juniper cover type	Snags would be managed for 1/acre over 75% of the area (current direction is 1/acre over 50% of the area) and coarse woody debris would be managed for an after treatment average of 1 - 3 tons per acre. Where available, CWD would include 2 logs ≥10 inches mid-point diameter and ≥10 feet in length.	Silviculture and Fire	No
General	Snags	Retain trees ≥18" dbh with dead tops, cavities, and lightning strikes wherever possible to provide cavity nesting/foraging habitat (i.e., the living dead).	Silviculture and Fire	No
General	Snags	Emphasize retention of snags exhibiting loose bark to provide habitat for roosting bats.	Silviculture and Fire	No
Bald Eagles	Bald eagle winter concentration areas	Retain the tallest snags >18 "dbh	Silviculture and Fire	Yes

Species	Where/When	What	Programs Affected	Forest Requirement
Bald Eagles	Nest sites	No mechanical treatments will occur within a 300 ft. radius of bald eagle nest trees (there is 1 bald eagle nest within 300 feet of the project boundary).	Silviculture	Yes
Bald and Golden Eagles	Nest sites	No vegetation treatments would occur within a ½ mile (2,500 ft), unless mitigated by topography, of an occupied bald or golden eagle nest between March 1 and August 31 (there are 2 bald eagle nests and 19 golden eagle nests within a ½ mile of the project analysis area). Other project activities will be assessed by the district biologist and limited activities may be acceptable.	Silviculture and Fire	Yes
Bald and Golden Eagles	Nest sites	Burn plans within 1 mile of eagle nest sites will be coordinated with the district wildlife biologist to insure nesting eagles will not be adversely impacted from smoke	Fire	No
Bald Eagles	Winter Roost sites	No mechanical treatments will occur around confirmed bald eagle roost sites (300' radius around roosts on the Coconino NF and a 10 chain radius on the Kaibab NF).	Silviculture	Yes
Bald Eagles	Communal Roost sites	No project activities will occur within 500 feet of confirmed bald eagle communal roosts from October 15 – April 15.	Silviculture and Fire	Yes
Northern Leopard Frogs	Designated occupied/ critical breeding sites (6 sites)	A no-treatment buffer (no thinning, no direct ignition) ¼ mile distant from tanks or designated along logical topographic breaks. (see Table X in Appendix Y for a list of location/sites within ¼ mile buffers). In some cases, the district wildlife biologist may work with implementation teams to determine the habitat protection buffer boundary	Silviculture and Fire	Yes

Species	Where/When	What	Programs Affected	Forest Requirement
Northern Leopard Frogs	Potential breeding sites	Seasonal restrictions (April 15 through September 15) for all proposed activities will be implemented within a 200 ft buffer (or along logical topographic breaks) at all designated important water sites (i.e., 10 sites in Restoration Unit 1) (See Table X in Appendix Y) for a list of locations and sites. In some cases, the district wildlife biologist may work with implementation teams to determine the habitat protection buffer boundary.	Silviculture and Fire	Yes
Northern Leopard Frogs	Dispersal habitat	A 200-ft protection zone (100 feet either side of the stream) will be established around designated stream courses (see the protected stream course map in Appendix X for more details). There would be no thinning and no direct ignition of prescribed burning within the protection zones. Designated skid trail crossings through the buffer zone are allowed. Fall burning and burn plans should be coordinated with district wildlife biologists in Subunits 1-2, 1-4, 1-5 and 1-6.	Silviculture and Fire	Yes
Bats	Caves, karst, and sink holes	A 300-ft no treatment buffer will be designated around cave entrances and sink hole rims to protect cave ecosystems (including microclimate, hydrology, and entrance vegetation) from siltation and reduce potential disturbance to roosting bats.	Silviculture and Fire	Yes
Great blue herons	Rookeries	No dominant or co-dominant trees will be cut in rookeries. Nest trees will be prepped prior to prescribed burning and fire ignition mitigations will apply. Timing will avoid mechanical tree harvest while birds are in the nest. Activities will be coordinated with the local biologist.	Fire	No

Species	Where/When	What	Programs Affected	Forest Requirement
Other raptors	Nest sites	Forest Plan direction will be met for all raptor species: Raptor nests located during project surveys will be monitored prior to project activities. Known nest trees for any raptor species would be prepped prior to prescribed burning. Buffers will be provided if nests are active: Sharp-shinned hawk: no mechanical treatment buffer of 10 acres around occupied nests; Cooper's hawk: no mechanical treatment buffer of 15 acres around occupied nests; Osprey: no mechanical treatment buffer of 20 acres around nest sites (occupied or unoccupied) and all logging activities will be restricted within ¼ mile of active nests from March 1 to August 15; Use site specific analysis to determine no-treatment zone around nest site; restrict activities within ¼ mile of nest sites from March 1 to August 15; Other raptors 50 ft around occupied nest;	Silviculture and Fire	Yes
Black-footed Ferrets	Prairie dog towns	Prairie dog surveys will be completed in documented prairie dog towns within treatment areas to determine if towns are active. If active towns form a large enough complex to support ferrets, black-footed ferret surveys will be completed prior to implementation within prairie dog towns. Coordinate with local biologists.	Silviculture and Fire	ESA Compliance
Miscellaneous	VSS 4s, 5s, & 6s	Within Group Density - Manage mid-aged tree groups for a range of density and structural characteristics by thinning approximately 50% of the mid-aged groups to the lower range of desired stocking conditions, approximately 20% each to the middle and upper range of desired stocking conditions and approximately 10% remain unthinned. Within Group Structure - Enhance and maintain mid-aged, mature or old group structure by retaining individual and clumps of vigorous ponderosa pine seedlings, sapling and poles within the larger group.	Silviculture	No

Species	Where/When	What	Programs Affected	Forest Requirement
Miscellaneous	Wildlife cover and stand heterogeneity	Gambel oak, juniper and pinyon species may only be cut as necessary to facilitate logging operations (skid trails and landings) and by design as follows: Areas within UEA, IT, SI and WUI mechanical treatment, seedling/sapling, young and mid-aged pinyon and juniper may be cut within a 40' radius of individual or groups of old ponderosa pine (as defined in the old tree retention strategy). Areas within Savanna and WUI PJ mechanical treatment, seedling/sapling, young and mid-aged pinyon and juniper may be cut.	Silviculture	No
Miscellaneous	New fences	Attach bird flight diverters (as provided by AGFD) to exclosure fencing around springs, channels, and aspen stands to avoid wildlife collisions.	Silviculture and Watershed	No
Miscellaneous	Burn Plans & Ignition techniques	Apply fire prescriptions to maintain Forest Plan levels of coarse woody debris and to maintain the sage in the understory community in pine-sage habitat.	Fire	CWD = Yes Sage = No
Miscellaneous	Burn Plans	Rotate season of burn so a given area does not burn in successive seasons or have repeat burns occurring in the same season of the year.	Fire	No
Miscellaneous	Mixed conifer	4FRI activities will not include mechanical or fire treatments in mixed conifer habitat. Mixed conifer stands occurring as inclusions within ponderosa pine forest will not be treated, (e.g., nest and roost buffers in Bear Seep and Red Raspberry PACs). Similarly, islands of pine occurring within mixed conifer forest will not be treated. For example, the MSO PAC on Sitgreaves Mtn was dropped from treatment consideration; although there are contiguous stands of ponderosa pine within the PAC, they are surrounded by mixed conifer forest.	All	No

Assumptions Used to Evaluate No Action and Action Alternatives Common to All Species Analyses

Unknown or open-ended elements of the project had to be defined to facilitate the analysis alternative effects. The following assumptions were identified and agreed to by the IDT:

- Grazing management would be in compliance with the respective Annual Operating Plan and Allotment Management Plan
- Arizona Game and Fish Department would adjust harvest levels where elk impacts hinder meeting resource objectives
- “Short Term” would be 1 to 10 years in length
- “Long Term” would, in general, be 11 to 20 years, unless under specific circumstances, it is defined differently
- The probability of large high-severity wildfires would continue to increase in light of climate change and if no action occurred
- Understory development would be maximized when $BA \leq 50$

Treatment effects have been modeled and assessed in the following manner:

- Forest stand characteristics were equilibrated for the year 2010, therefore 2010 represents time zero in modeling (i.e., “existing conditions”)
- Mechanical treatments would be complete within a 10-year period and would average 30,000 acres treated per year, the modeled year for tree cutting was 2012
- VSS 1 resulting from group selection would move to VSS 2 in year 2040 and from VSS 2 to VSS 3 in year 2060
- The 1st prescribed burn would occur in 2015 after mechanical treatments are completed and the 2nd (maintenance) prescribed burn would occur in 2019 and, on average, 40,000 acres would be prescribed burned per year; note that aspen was only burned once in 2012
- Post-treatment vegetation condition trends would be displayed in 2020, 2030, and 2050
- Old trees are assumed to be at least 18 inches dbh or larger
- No trees 24 inches dbh or larger would be cut in MSO habitat
- 15 percent of the bole wood and 10 percent of the branch wood would be left on site
- Snag and coarse wood estimates are based on inventory where available or FVS default values (adjusted for southwest forests) if data does not exist
- Prescribed fire in PACs was modeled for lower burn severity

In the ponderosa pine, no Gambel oak, pinyon pine, or juniper species would be cut. However, trees will be lost due to mechanical damage, fire, and if growing adjacent to large/old trees targeted for release from competition.

Environmental Consequences

A review of environmental consequences serves to highlight effects or unintended consequences that may occur from the proposed actions. Environmental consequences are presented below. First there is a discussion of climate change and a review of the alternatives. A description of general cumulative effects follows; aspects of cumulative effects relevant to particular species can be found in the individual species analyses. Species analyses begin with Federally Threatened and Endangered Species, followed by Forest Service Sensitive Species, Management Indicator Species, migratory birds and effects to Important Bird Areas. A review of how treatments would affect hiding and thermal cover is at the end of the report. Much of the science supporting these analyses is identified in the literature cited and the appendices.

Climate Change Common to All Alternatives

The following information is taken primarily from USFS Southwestern Region May 2010 document entitled: Southwestern Region Climate Change Trends and Forest Planning – A Guide for Addressing Climate Change in Forest Plan Revisions for Southwestern National Forests and National Grasslands. Also referenced is a climate change review document developed for the Kaibab National Forest forest plan revision (Leonard 2012). This document can be found at: <http://www.fs.usda.gov/detail/kaibab/landmanagement/planning/?cid=STELPRDB5106605>.

Background

Climate scientists agree that the earth is undergoing a warming trend, and that human-caused elevations in atmospheric concentrations of carbon dioxide (CO₂) and other greenhouse gases are among the causes of global temperature increases. The observed concentrations of these greenhouse gases are projected to increase. Climate change may intensify the risk of ecosystem change for terrestrial and aquatic systems, affecting ecosystem structure, function, and productivity.

In the Southwest, intense debate is likely to occur over resource allocation and conservation of available water supplies. Populations in Arizona and New Mexico are growing at an unprecedented rate. As of the latest American Communities Survey in 2006, Arizona's population was over 6 million. The total increase for Arizona between 1980 and 2006 was 123 percent. The combination of population growth and climate change would likely exacerbate climatic effects, putting even greater pressure on wildlife and wildlife habitat. Climate change could have long-term impacts on many of the amenities, goods, and services from forests, including: productivity of locally harvested plants such as berries or ferns; local economics through land use shifts from forest to other uses; forest real estate values; and tree cover and composition in urban areas and associated benefits and costs (Leonard 2011).

Ecological Impacts of Climate Change in the Southwest

Climate influences the distribution and abundance of plant and animal species through changes in resource availability, habitat connectivity, fecundity, and survivorship. Between 1984 and 2006, an estimated 18 percent of southwestern coniferous forest has been lost to increased fire and bark-beetle outbreaks likely resulting from drought and high average temperatures (Williams et al. 2010). Long-term shifts in vegetation patterns are expected as a result of climate change (Westerling et al. 2006, Millar et al. 2007), including greater vulnerability to invasive insects, plants, fungi, and vertebrates (Joyce et al. 2008). New environmental conditions can lead to a different mix of species that tend to favor plants and animals that can adapt their biological functions or are aggressive in colonizing new territories. Locally, nonnative invasive species, such as cheatgrass are expected to continue to increase in numbers and extent (Leonard 2011). Cold-tolerant vegetation may move upslope or disappear in some areas. Migration of some tree species to the northern portions of their range may occur (CLIMAS 2011) while other species' ranges may become a patchwork mosaic where only suitable micro-climates are occupied. An overall decrease in forest productivity could ensue as a result of reduced precipitation (USDA Forest Service 2010a). Shifts in the timing of snowmelt have already been observed which, along with increases in summer temperatures, may seriously impact survival of riparian species and challenge efforts to reintroduce species into their historic range (Joyce et al. 2008, Millar et al. 2007).

Climate change can potentially affect biodiversity by pressuring the distribution, viability, and migration patterns of wildlife populations through increasing temperatures, water shortages, and changing ecological conditions (USDA 2010, Leonard 2011). Some species are inherently more vulnerable than others, particularly species with specialized niches, limited mobility, and limited physiological adaptability. Certain habitats are more vulnerable to a changing climate. For example, springs are a valuable natural water source for a variety of birds and mammals, particularly in arid environments. These areas may offer critical refugia for rare and narrow endemic species. However, springs are sensitive to variable precipitation and likely to dry up during prolonged drought. As such, the unreliability of natural water resources would make it harder for wildlife species to persist, pushing the limits of their natural range.

The USFS Southwestern Region includes a high degree of biodiversity and an unusually large number of plant and animal species that are endemic (USDA 2010). It is expected that large changes in the structure and species composition of plant communities would occur due to the warming air temperatures and altered hydrological cycles. Many of the region's plant, animal, and insect species depend on precise phenological events based on climatic conditions for migration, flowering, and timing for foraging and reproductive activities. It is currently unknown how many species will successfully adapt to changing conditions. The ability of plant and animal species to migrate under climate change would be strongly influenced by their dispersal abilities and by disturbances to the landscape.

Current knowledge of possible climate change impacts on specific vegetation types remains limited. However, projected and observed climate change effects are being studied at the broad-scale habitat level throughout the Southwest. The mild nature of climate gradients among lower life zones of the Southwest, and protracted ecotonal bands, make woodland plant communities particularly vulnerable. Many of the Southwestern Region's plant and animal species are associated with these key habitats, and are therefore important when considering the potential impacts of climate change on ecosystems managed by the National Forests of the southwest. Southwestern forests are particularly sensitive to drought and increasing temperatures (Williams et al. 2010). If temperature and aridity continue to rise as projected, trees will experience substantially reduced growth rates this century with ecotones and dense forest stands particularly vulnerable to mortality from fire and drought-induced die-offs (Williams et al. 2010). Similarly, declines in deciduous trees and shrubs have occurred within the coniferous forests of Arizona as snowfall has declined (Martin and Maron 2012). Major long-term decreases in stem densities of deciduous woody plants were strongly associated with 25 years of declining snowfall (Martin and Maron 2012). The additive effects of multiple years of declining snowfall accounted 85 percent of the documented decline in plant densities. Declines in woody plants, in turn, were associated with declines in five of six songbird species that nest on the ground or in the understory (Martin and Maron 2012).

Currently there appears to be broad agreement among climate modelers that the Southwestern U.S. is experiencing a drying trend that will continue well into the later part of the 21st century. The Kaibab NF considering the following potential climate effects locally:

- Increased extreme weather related forest disturbances (floods, drought, wind-throw)
- Water stresses (groundwater, runoff, and timing), aquatic biota
- Wildfire risks
- Shifts in major vegetation types for the Southwest

- Threatened, endangered, and sensitive species
- Forest insects and disease
- Weather related stresses on human communities (temperature, air quality)
- Outdoor recreation
- Wildlife movement and biodiversity

Based on current projections, the primary regional-level effects of climate change most likely to occur in the Southwest that will have an effect on forest vegetation include warmer temperatures, decreasing precipitation, and increased extreme weather events (USDA 2010). These changes could result in immediate vegetation disturbance due to wind or flooding, increased wildfire risks, increased outbreaks of insects, diseases, and spread of invasive species, increased drought related mortality and changes in plant species composition.

Potential Climate Change Strategies for the Kaibab NF

In developing strategies for managing future changes, the range of possible approaches could be quite broad. The strategies which follow are focused on recommendations from recent research studies, including the U.S. Climate Change Science Program which balances effectiveness, feasibility, and available resources, and is appropriate for the Southwestern Region. Although some strategies contain new ideas, most of these management strategies include practices that are already in effect, can serve multiple needs, and may just need to be adjusted or expanded to respond to climate changes during the next 15 years. Using an adaptive management approach will allow NF managers to adopt and adjust strategies as new information is available, conditions change, and staff and resources are available.

Key concerns for the effects of climate change on wildlife habitat are the impacts of decreased water availability the effects of habitat changes on wildlife connectivity (Leonard 2011). Managing for landscape connectivity will be important, as connectivity facilitates movement of species among habitats. “Connectivity” includes structural and biological components. Structural connectivity addresses the spatial structure of a landscape and can be described from map elements. Biological connectivity is the response of individuals to the scale of the landscape features. Reducing fragmentation and planning at landscape scales to maximize habitat connectivity will become increasingly important.

Actions to address climate change factors of most concern locally are those that:

1. Reduce vulnerability by restoring and maintaining resilient native ecosystems;
2. Anticipate increases in forest recreation;
3. Use markets and demand for wood and biomass for restoration, renewable energy, and carbon
4. sequestration;
5. Enhance adaptation by anticipating and planning for intense disturbances;
6. Conserve water; and
7. Monitor climate change influences.

Restoring and maintaining resilience would likely improve the potential for ecosystems to retain or return to desired conditions after being influenced by climate change related impacts and variability. Managing for resistance (e.g., maintenance thinning to prevent catastrophic fire, forest

insect or disease pandemics) and resilience (e.g., noxious weed control) offer meaningful responses to climate change.

Potential Climate Change Strategies for the 4FRI

The Nature Conservancy (TNC) hosted a series of climate change workshops in southwestern states in 2010. The Arizona workshop was held in Flagstaff on 7-8 April, to help inform the 4FRI planning effort. The Flagstaff workshop was attended by 44 representatives from 15 state and federal agencies, local governments and non-governmental organizations. The objective was to address climate change questions related to forest and wildlife health and impacts to communities within the 4FRI area. Speakers from TNC, the University of Arizona, the Wildlife Conservation Society, National Center for Atmospheric Research, US Geological Survey Colorado Plateau Research Station, Merriam Powell Center for Environmental Research and the Ecological Restoration Institute at Northern Arizona University, and the USFS Rocky Mountain Research Station led presentations on changes in local climate that have contributed to increases in wildfire frequency and severity, tree mortality, and insect outbreaks, and declines in quality of wildlife habitat and watersheds. Attendees then participated in a formal decision-support framework to develop a set of strategic actions that can be implemented to promote resilience and realignment of ponderosa pine forests and their fire regimes, watershed function, and resident Mexican spotted owls.

Long-term (2040 – 2060), high priority strategic recommendations from the workshop included:

- Thin to create a mosaic of clumps and groups of trees with intermixed openings
- Treat more acres with prescribed burns
- Allow more wildland fire to burn

Summary

By managing for resistant and resilient ecosystems, promoting landscape connectivity, and implementing concepts of adaptive management, land and resource management can respond to new information and changing conditions related to climate change that have the potential to increase ecosystem risks. Addressing potential consequences of climate change on the endangered, threatened, and candidate species in the 4FRI area is challenging. The USFS Southwestern Region and the Kaibab NF have developed guidance for addressing climate change which are broad and general in scope and which rely on adaptive management as climate change science evolves. Recent work locally that focused on the 4FRI landscape supported these findings.

Relationship of Climate Change to Alternatives

Alternative A

Alternative A would not prevent, delay, or ameliorate predicted effects of climate change. The dense forest conditions resulting from the no action alternative are at a high risk to density related and bark beetle mortality and have limited resilience to survive and recover from potential large scale impacts. Under drier and warmer weather conditions, the potential impacts of these risks to the ecosystem would be increased. Individual tree growth would be limited to the point of stagnation. As tree density increases, many areas would experience higher mortality. Species requiring closed canopy forest conditions or old or large tree, snag, and log structure would be

negatively impacted in the long-term. Open forest, savanna, and meadow and grassland habitats would potentially increase in the long-term.

Alternative B

Risks associated with dense forest conditions would be reduced and forest resiliency large scale disturbance under drier and warmer conditions would be improved by implementing the treatments proposed under alternative B. Individual tree growth would improve, resulting in larger average tree sizes. Species requiring habitat elements associated with closed canopy forest conditions or old or large tree, snag, and log structure would be more sustainable as forest resiliency improved. Open forest, savanna, and meadow and grassland habitats would remain stable in the long-term.

Alternative C

Risks associated with dense forest conditions would be reduced and resilience to the impacts of large scale disturbance under drier and warmer conditions would be improved by implementing the treatments proposed under alternative C. Individual tree growth would improve, resulting in larger average tree sizes. Species requiring habitat elements associated with closed canopy forest conditions or old or large tree, snag, and log structure would be more sustainable as forest resiliency improved. Open forest, savanna, and meadow and grassland habitats would remain stable in the long-term. The increased acres of mechanical and prescribed burning under this alternative would be expected to increase forest health and resiliency more than the alternatives B or D.

Alternative D

Risks associated with dense forest conditions would be reduced and resilience to the impacts of large scale disturbance under drier and warmer conditions would be improved by implementing the treatments proposed under alternative D. Individual tree growth would improve, resulting in larger average tree sizes. Species requiring habitat elements associated with closed canopy forest conditions or old or large tree, snag, and log structure would be more sustainable as forest resiliency improved. Open forest, savanna, and meadow and grassland habitats would remain stable in the long-term. The limited acres of prescribed burning under this alternative would be expected to maintain higher fuel loadings, resulting in the smallest increases in forest health and resiliency relative to alternatives B and C.

All Alternatives - Cumulative Effects

Cumulative effects are the potential changes to existing conditions due to past, present, and future activities, including the effects of the alternative being discussed. The effects of past actions are incorporated into the description of existing conditions. Present and reasonably foreseeable actions that are relevant to wildlife resources are described below for all Alternatives. The cumulative effects analysis area for terrestrial wildlife resources is the Project boundary. Projects listed within the 4 FRI Cumulative Effects Analysis Baseline were considered as reasonably foreseeable actions (Appendix 12).

Present and reasonable foreseeable actions that can affect wildlife resources include the reauthorization of livestock grazing allotments, fuels reduction projects, forest thinning, prescribed burning, recreation management (obliteration of social trails and dispersed campsites,

designation of trails and campsites), lands special use permits (new issuances and maintenance on existing structures), Travel Management Rule for Tusayan and Williams Ranger Districts and the Coconino National Forest, and aspen restoration. While these activities can directly and indirectly affect wildlife species and their habitats, these projects typically are planned to minimize or eliminate negative effects through design features, mitigation measures and Best Management Practices.

The spatial context being considered for the cumulative effects is the 988,764 acre project area. Cumulative effects are discussed in terms of wildfire and vegetation management activities that have occurred in the past, are ongoing, or are reasonably foreseeable, including the effects of the alternatives discussed below. Reasonably foreseeable actions are considered for approximately 10 years into the future. At that time the majority of the actions proposed will have been completed and the vegetation response to these actions should have occurred. Project impacts to wildlife are summarized below (Table 37). These effects are summarized by project types and their potential effects on wildlife and wildlife habitat. Because effects from changes in habitat vary so much by species (e.g., opening the canopy can restore the habitat for one species while eliminating habitat for another species), cumulative effects to individual species are addressed in the respective species analysis. Additional information on the projects and their effects is available in Appendix 12.

Table 37. Cumulative Effects to Wildlife and Habitat from Present and Reasonable Foreseeable Projects (Project Column is Typically Identified in Acres)

Project Type	General Effects to Habitat	General Effects to Wildlife	Extent
Thinning without diameter limit	Move landscape toward desired conditions for interspersed age & size class distribution	Short-term spatial and temporal disturbance to wildlife; long-term improvements to habitat; forest plans include breeding season timing restrictions for MSO, goshawks, and fawning grounds	Occurs across both forests
Thinning with diameter limit	Typically results in even spacing ("jail bar spacing"), versus a groupy/clumpy structure, and lacks interspaces; benefits in understory response and decreased fire risk are quickly lost due to resulting tree growth (less than 10 yrs); leads to loss of habitat structure	Short-term spatial and temporal disturbance to wildlife; long-term loss of habitat structure; ; forest plans include breeding season timing restrictions for MSO, goshawks, and fawning grounds	Occurs across both forests

Project Type	General Effects to Habitat	General Effects to Wildlife	Extent
Prescribed Burning	Reduces fine fuels, litter, and duff; provides a nutritional flush to trees and understory; decreases coarse woody debris (immediate response) and creates CWD (scorching and killing trees); may create canopy openings; short-term loss of snags with long-term increase in snag numbers, but includes replacing persistent snags with more ephemeral snags, long term decrease in large oaks, increased sprouting of shrubby oaks; mixed severity prescribed burns yield patchy mosaic of habitat; effective in grassland and meadow restoration; fuels reduction decrease threat of high severity fire and subsequent habitat loss.	Short-term spatial and temporal disturbance to wildlife; maintenance of habitat aids in persistence of wildlife populations that evolved with frequent fire return intervals; increases in understory biomass benefits most landbirds and small mammals; Forest Plan parameters including breeding season timing restrictions for raptors and ungulates	Occurs across both forests
TMR – Coconino	Habitat effectiveness increased across the forest due to reductions in disturbance except in fall when big game retrieval is allowed	Habitat effectiveness improvements will benefit most wildlife species; increase in vehicular traffic directly related to 4FRI will be off-set from decrease in general vehicular traffic; decrease in illegal cutting of snags	4,474 miles of roads and motorized routes are no longer open; motorized elk retrieval open across most of 4FRI area GMUs 5a & 5b closed to big game retrieval on the Mogollon Rim
TMR – Kaibab	Localized increases in habitat effectiveness, but little change overall, particularly during big game retrieval; exception is in in grasslands where motorized use will be decreased	Decrease in disturbance in grasslands combined with forest restoration could provide more contiguous swaths of functional habitat for grassland and savanna dependent species; other benefits to wildlife will be limited, localized, and very site specific; limited decrease in illegal cutting of snags	143 miles of road on Tusayan have restricted use; 15 miles of road constructed; 380 miles of road on Williams have restricted use; 34 miles of road constructed; most of the 2 Districts are open to motorized big game retrieval

Project Type	General Effects to Habitat	General Effects to Wildlife	Extent
Private Land development	Net effect is loss in habitat and/or habitat effectiveness; private lands in grasslands and savannahs are typically developed as home sights; GFFP works closely with the CNF and non-Federal land owners & managers	Net loss of habitat & displacement: open-habitat species tend to be displaced; land development within forest may shift habitat use, but impacts likely to be less than in open habitats	Occurs across both forests
Thinning and Burning on State, DOD, and private lands	Vegetation treatments on State, other federal and private lands typically reduce TPA, increase openings, increase biomass production, and decrease risk of fire.	Short-term spatial and temporal disturbance to wildlife; long-term improvements to habitat on State and DOD lands; thinning on private home sites (GFFP) not likely to provide much long-term habitat but decrease in fire risk benefits adjacent lands	GFFP – 635 ac DOD – 19,816 ac
Forestwide dead and down fuel wood collection	Includes potential impacts from loss of snags, logs, and CWD; localized areas may be deficit in snags logs, and CWD; fuel wood activities may disturb wildlife in localized areas	Disturbance and displacement of animals spatially and temporally, including nesting and fawning seasons for a wide range of species; habitat loss for some species;	CNF: the public is not allowed to travel cross country to search for fuelwood, but may drive off-road to gather cut wood. KNF: the public is allowed to drive off-road to collect fuelwood within designated areas only.
Fuelwood sales	Habitat removal – generally used as a restoration tool such as cutting trees to restore grasslands;	Disturbance and displacement of animals spatially and temporally, including nesting and fawning seasons for a wide range of species; habitat loss for some species/habitat gain for others;	Occurs across both forests
Recreation	Localized decrease in habitat quality due to the loss of understory vegetation (trampling, removal) associated with camping; disturbance from motorized use and hikers	Localized disturbance and displacement of animals spatially and temporally, although many species have likely acclimated to areas with regular use (	Occurs across both forests

Project Type	General Effects to Habitat	General Effects to Wildlife	Extent
Grazing	Ongoing and future grazing should maintain plant species composition and diversity; there may be short-term effects to plant height, except around water and key grazing areas where trampling and effects to plant height are long-term; elk use is factored into grazing utilization standards and is part of the baseline; grazing affects 80% of the project area	Pastures that are grazed in early summer may affect small mammal populations while animals are nesting or young are dispersing; pastures receiving spring use vary annually	790,985 acres of 988,764 total acres within the project area are classified as grazing allotments
ROW clearing	Removes key habitat elements like snags and woody shrubs along right of way; maintains early seral vegetation, provides open habitat; and decreases connectivity of closed canopy habitat	Negatively affects cavity nesters, shrub nesters, Abert's squirrels, and deer; positively affects understory development, small mammals, arthropods, and elk.	Occurs across both forests with more activity on the CNF
Annual road maintenance	Maintenance of existing roads; noise disturbance likely lower in intensity than many mechanical sources of noise due to equipment staying on or adjacent to roads and typically slowly moving.	Timing restrictions on the Kaibab NF and Coconino NF in MSO PACs apply; potential noise disturbance to other wildlife	About 500 miles of road work per year across the 4FRI area
Aspen restoration	Removes snags and overstory trees in short-term; Improves and maintains aspen habitat in the long-term	Localized disturbance in short-term; long-term provides habitat heterogeneity in the overstory and understory within the relatively homogeneous ponderosa pine for a range of birds species and small mammals	Occurs across both forests
Grassland/savannah restoration	Typically includes removing encroaching trees and prescribed burning for maintenance	Positively affects populations of grassland associated birds and small mammals; restores, maintains, and improves habitat for pronghorn	Occurs across both forests
Water development maintenance	Increase effective areas available for resident elk; impacts of elk browsing likely to increase in areas already impacted by elk	Oak, sage, and young conifers already clubbed from winter browsing; increased use likely to increase impacts to birds, small mammals, and deer	KNF = 24 recent waters on Tusayan RD

Project Type	General Effects to Habitat	General Effects to Wildlife	Extent
Weed treatments	Improving habitat quality by reducing/eliminating non-native plant species	– not related to elk trends as these are determined by state management – hunt guides overwhelm measureable effects of habitat changes;	Occurs across both forests
Pinyon-juniper thinning and burning	Removes woodland vegetation encroaching on grassland, shrubland, and savanna	Decreases habitat for woodland dependent species and increases habitat for open habitat-dependent species	Occurs across both forests

¹ CNF = Coconino National Forest; DOD = Dept of Defense; GFFP = Greater Flagstaff Forest Partnership; KNF = Kaibab National Forest

Existing Conditions

Past actions accounted for include various vegetation management treatments, fuels treatment and prescribed burning, and wildfires that have occurred within the project area from 2001 to 2010 (Table 38). In general, effects of mechanical treatments predating this time would not be expected to have much influence on wildlife habitat except for the deficit of large trees common across the analysis area. Mechanical vegetation management activities have mainly consisted of tree harvest. Projects include treatments with a fuels reduction emphasis (50,940 acres) and ponderosa pine restoration emphasis (15,700 acres) to improve forest structure, health and growth. There has also been 12,560 acres of tree removal to restore ponderosa pine savannas and encroached grasslands, 2,650 acres of removal of dead, damaged or dwarf mistletoe infected trees to improve forest health, 100 acres of tree removal to restore aspen inclusions and 1,935 acres of habitat improvement treatments that reduced tree density within pronghorn travel corridors. Within the project area there has been 640 acres of tree and vegetation removal associated with powerline corridor management and protection.

Table 38. Approximate Acres of Vegetation Management Activities and Wildfire within the Project Area from 2001 to 2010

Treatment	Treatment Type	Approximate Acres
Mechanical Vegetation Management	Thinning – Fuels Reduction Emphasis	50,940
	Thinning – Restoration Emphasis	15,700
	Savanna/Grassland Restoration	12,560
	Sanitation/Salvage	2,650
	Aspen Restoration	100
	Habitat Improvement	1,935
	Powerline Hazard Tree Removal and Right of Way	640
Total Mechanical:		84,525

Treatment	Treatment Type	Approximate Acres
Fuels Treatments (With Mechanical)	Mechanical Fuels Treatment	3,910
	Pile and Burn	5,070
	Broadcast Burn	59,640
Total Fuels Treatments:		68,620
Prescribed Burn (Burn Only)		47,970
Wildfire		108,160

Fuels treatments that have been accomplished in association with the above listed mechanical treatments included 3,910 acres of mechanical fuels treatments (slash lopping, crushing, piling and jackpot burning), 5,070 acres of machine piling and burning and 59,640 acres of broadcast burning. The primary focus of these treatments was to rearrange and reduce activities generated fuels.

Fire treatments include prescribed burns (47,970 acres) intended to reduce natural fuels accumulations and reintroduce fire to fire adapted ecosystems and wildfire. Wildfires from 2001 to 2010 have burned on approximately 108,160 acres of the project area. Of these acres, it is estimated that the overall average burn severity to the vegetation was 20 to 45 percent high severity (estimated from the rapid assessment of vegetation conditions after wildfire [RAVG] database; see fire ecology report) 30 percent mixed severity, and 50 percent low severity (silviculture report). There is wide variability among these percentages from fire to fire.

Specific past projects and their associated management components are displayed in Appendix 12.

Forest Structure and Diversity - Mosaic of interspaces and tree groups

The thinning with a restoration emphasis and savanna restoration treatments were designed to reestablish forest openings and attain a mosaic of interspaces and tree groups of varying sized and shapes. Both categories of treatments lead to increased understory development, lasting until overstory canopies again close. Thinning treatments with restoration objectives were very similar to the goshawk habitat and MSO restricted other habitat treatments proposed under this EIS and have resulted in similar diversity in age and size class. Results from all other treatments listed were incidental to this desired condition.

Fuels reduction, including prescribed precommercial and commercial thinning generally had a dbh limit, resulting in a “thin from below” approach. The main objective of thinning with a fuels reduction emphasis was to reduce canopy fuels and the potential for crown fire initiation. Generally, this type of treatment focused on removal of trees in the subordinate crown positions and retaining those trees in the dominate and co-dominate crown positions and any pre-settlement trees. This type of treatment resulted in a moderately open canopy, even aged forest structure with very little age and size class diversity. When treatments are based on tree diameters there is little to no consideration for tree grouping, spacing, and rooting space, typically resulting relatively evenly spaced and evenly sized trees. Post-treatment stands have limited tree size-classes and

age-classes with a virtual removal of overstory habitat consisting of diameters below the specified limit. Understory response is typically limited and of short duration because the treatments were designed to maximize individual tree growth without providing for openings.

Mixed severity wildfires resulted in a mosaic of tree mortality and a pattern with indiscriminate interspaces and tree groups. The remaining treatments and low severity wildfire resulted in some irregular tree spacing.

Forest Structure - All age and size classes represented

Associated prescribed burning and mechanical fuels treatments associated with the above thinning treatments resulted in periodic tree mortality of seedling/sapling size trees and susceptible pre-settlement trees further reducing age class diversity. Understory improvements would not be expected to last for more than a short-term boost in productivity. High- and mixed-severity wildfires caused large scale mortality across all age and size classes resulting in a non-stocked or single age class representation. Wildfires that burned with a low severity and prescribed burn only treatments had similar effects to forest structure as the post thinning prescribed fires.

Thinning treatments retained pre-settlement trees and the largest post-settlement trees. Sanitation treatments likely removed old forest structure. Prescribed burning and low severity wildfire resulted in periodic tree mortality of susceptible pre-settlement trees. Mixed- and high-severity wildfire killed a large proportion of the old forest structure. Powerline treatments removed any old forest structure that was a hazard to the powerline. Most of the managed acres retained large and old trees while wildfires would typically result in the loss of large and old trees.

Forest Resilience

Thinning treatments resulted in low to moderate density forest density zones. This in turn had a beneficial effect of improved forest growth, reducing the potential for density and bark beetle related mortality. Thinning treatments also removed dwarf mistletoe infected trees reducing the percent of trees infected as well as creating conditions that slowed or inhibited mistletoe spread. Prescribed fire and low severity wildfire also led to localized reduction of forest density and dwarf mistletoe infection.

Vegetation Diversity and Composition – Maintain and Promote

Grasslands – The savanna/grassland restoration treatments implemented restored historic grasslands, savannas and forest openings by removing ponderosa pine tree canopy that was shading out understory herbaceous vegetation. Thinning treatments with a restoration objective also restored historic forest openings.

Oak – Removing conifer competition with mid and understory oak as part of the thinning contributed to maintaining and improving oak growth and vigor. Mixed and high severity wildfire killed large oaks that were replaced by oak sprouts thereby changing oak structure from old to young.

Aspen – Aspen restoration treatments were very similar to the aspen treatments proposed under this EIS and have resulted in aspen regeneration and age class diversity.

Pine Sage – Some of the fuels reduction thinning within pine sage on the Tusayan district removed overtopping young pines and improved conditions for understory sage.

Current, Ongoing and Foreseeable Projects and Actions

There are many on-going or planned projects that thin ponderosa pine habitat (Table 39). These thinning treatments vary greatly and include noncommercial thinning, group selection, sanitation thinning, and shelterwood cuts (Appendix 12). Typically the trees being removed are mid-aged. Recreating interspaces and regeneration is a priority. Rarely are mature or old trees targeted for removal in ongoing or future thinning projects. There is an estimated 83,940 acres of thinning from other projects within the treatment area. There will also be 11,130 acres of ponderosa pine savannah restoration occurring in the project area. Grassland restoration treatments include removal of encroaching conifers and prescribed burning to rejuvenate grasses and forbs. Pinyon-juniper thinning and burning is occurring on both forests.

Table 39. Approximate Acres of Present and Foreseeable Vegetation Management Activities within the Project Area

Treatment	Treatment Type	Approximate Acres
Mechanical Vegetation Management	Thinning – Fuels Reduction Emphasis	6,670
	Thinning – Restoration Emphasis	77,270
	Thinning – Stand Improvement	0
	Savanna/Grassland Restoration	11,130
	Sanitation/Salvage	4,290
	Aspen Restoration	5,130
	Habitat Improvement	0
	Powerline Hazard Tree Removal and Right of Way	500
Total Mechanical:		104,990
Fuels Treatments (With Mechanical)	Mechanical Fuels Treatment	0
	Pile and Burn	0
	Broadcast Burn	98,800
Total Fuels Treatments:		98,800
Prescribed Burn (Burn Only)		5,950

Slash treatments associated with the above thinning consists of prescribed burning. In addition, there are also burn-only treatments within the ponderosa pine habitat. Many past projects have maintenance burns occurring on five to 20-year cycles and hence qualify as past and ongoing projects. There is an estimated 104,750 acres of burning in the treatment area.

Both forests are actively trying to restore aspen stands. The majority of the aspen on the Coconino NF is variable sized stands within wilderness areas. Aspen on the south zone of the Kaibab NF usually occurs in small patches scattered within the ponderosa pine forest. Aspen restoration is planned for high priority areas outside of wilderness. Cumulatively, restoration of these areas across both forests will treat stands that are at high risk of being dying in the near future. There is a total of 5,130 acres of aspen treatments planned within the project area.

Both the Coconino and Kaibab NFs have implemented travel management within the analysis area. These efforts will affect impacts from fuelwood cutting, hunting, and recreational camping across both forests. On the Coconino NF, the public is no longer allowed to travel cross country to search for fuelwood, but may drive off-road to gather cut wood. This will likely limit effects of wood cutting in any one area while distributing effects across broader areas. On the Kaibab NF, the public is only allowed to drive off-road to collect fuelwood within designated areas. The Kaibab NF will only allow off-road travel in designated fuelwood areas and will thus limit habitat impacts to localized areas. Areas within fuelwood designated areas (short-term) and along roads (long-term) may fall short of forest plan guidelines for dead woody material. The rule change on both forests will likely leave higher densities of dead and down woody material in areas further from roads than under previous rules. While there are species-specific rules for cutting dead trees, it is not uncommon for larger snags to be cut. This occurs closer to roads and decreasing miles of open road should decrease the loss of this resource.

The Kaibab NF will allow for large game retrieval during hunting season in all GMUs while the Coconino will allow for elk-only retrieval in all GMU except 5a and 5b (the Mogollon rim District). The Coconino NF will allow people to camp up to 300-feet away from roads in designated corridors. The Kaibab will allow camping up to 35 feet away from all open roads, but does not have designated areas for camping further from roads.

Both forests have on-going maintenance of right of ways (ROW) for power, gas, and oil lines and associated infrastructure. This involves thinning and burning within the ROWs to keep the area clear of trees and shrubs. ROW maintenance prevents forest development, retaining early seral habitat in linear swaths across the landscape. ROWs include 32,344 acres with the majority of the area on the Coconino NF. Currently there are 500 acres proposed for ROW clearing.

Grazing is an on-going activity. Only allotments within the project area have been considered. Of the 988,764 acres of this project area, 790,985 are within grazing allotments and 197,779 acres that are not grazed by livestock. Within the project area there are 49 livestock grazing allotments, 47 are active allotments and two are vacant. Of these 49 allotments, 40 permit cattle grazing and nine permit sheep grazing. The amount of each allotment lying within the project area averages 65 percent, and varies from less than one percent to 100 percent. There are 229 main pastures (i.e., large pastures that are used more than 30 days per year by livestock) located within the project area. Timing and conditions vary by allotment. On average, 30-40 percent of the forage is allowed for utilization by livestock and wildlife. There is no proposal to increase livestock numbers within these allotments. Therefore there is no additional affects beyond existing conditions.

There is approximately 150,000 acres of non-Forest Service administered lands within the project area. These areas include primary residences and vacation homes, Navajo Army Depot and other Department of Defense lands, and ranchland. The Navajo Army Depot is planning development of new training ranges and thinning and prescribed burning. The Department of Defense is

planning 17,049 acres of thinning and burning in ponderosa pine and some grasslands restoration. The Greater Flagstaff Forest Partnership is planning to burn and thin 535 acres of ponderosa pine habitat around the Flagstaff area.

Federally Listed Threatened, Endangered, Sensitive, and Proposed Species and Critical Habitat

Mexican Spotted Owls (Threatened)

Environmental consequences are based on the application of design features, mitigation, and assumptions described on pages 133 to 143 of this report. Environmental consequences are provided by MSO habitat type (protected and restricted) and designated critical habitat.

Evaluation Criteria – Protected, Restricted, and Critical Habitat

Large trees, including ponderosa pine and Gambel oak, large snags, and large logs are important to MSOs and many of their prey species. These structural elements need to be distributed both spatially and temporally. Spatially in the sense of MSO habitat elements designated across the pine-oak forest. A temporal distribution includes maintaining large and old trees while setting a trajectory for future recruitment into larger size classes. Habitat elements used to evaluate the alternatives for MSO include:

Forest Structure and Density

- A range of tree sizes and ages emphasizing trees greater than 12 inches dbh (at least 15% of the trees with a dbh of 12 inches or greater, 15% of the trees with a dbh of 18 inches or greater, and 15% of the trees with a dbh of 24 inches or greater) in nesting, roosting, target, and threshold habitats and 30 to 45% of the trees with a dbh of 12 inches or greater in other protected and restricted habitat and with an overall goal of uneven-aged structure)
- A preponderance of large trees (> 18" dbh) suitable for perching or roosting (goal of at least 20 per acre)
- BA and density of pine (goal of at least 150 ft² per acre in nesting and roosting habitat) and Gambel oak (goal of at least 20 ft² per acre)
- Percent canopy cover (goal of 40% or more) and changes in canopy structure

MSO Prey Habitat

- Large dead trees (snags with diameters of 18 inches dbh or greater)
- Changes in prey habitat, including high volume of fallen trees and other woody debris, species richness in the herbaceous layer, plant abundance and the ability to regenerate and produce fruits and seeds, and other improvements to prey habitat

Fire Risk

- Changes in fire condition classes and fire behavior (i.e., the ability to retain forest structure through time)

Other Habitat Changes

- Springs, ephemeral channels, meadows, and aspen
- Road decommissioning, construction, and maintenance

Disturbance

- Project duration and disturbance associated with project activities, including mechanical harvesting and hauling of materials out of the forest (spatial and temporal duration)
- Prescribed burning activities, including , preparation, implementation, smoke and fire impacts (spatial and temporal duration)

Primary Constituent Elements in Critical Habitat

Critical habitat designations are intended to identify, to the extent known using the best scientific and commercial data available, areas that provide essential life cycle needs of the species (i.e., areas on which are found the primary constituent elements). The primary constituent elements essential to the conservation of the owl include those physical and biological features that support nesting, roosting, and foraging. The primary constituent elements which occur for the MSO within pine-oak forest that provide one or more habitat needs for nesting, roosting, foraging, and include:

Forest Structure:

- A range of tree species of different sizes and ages;
- Thirty to 45% of the trees with a dbh of 12 inches or greater;
- Shade canopy of 40% or more;
- Snags of 12 inch or greater dbh; and

MSO Prey Habitat:

- High volume of fallen trees and other woody debris;
- A wide range of tree and plant species, including hardwoods;
- Adequate levels of residual plant cover to maintain fruits, seeds, and plant regeneration.

Critical habitat includes both protected and restricted habitat, as defined the Recovery Plan.

The Silviculture Specialist Report provides a complete description for silviculture treatments for alternatives B, C, and D and conifer removal within existing ungulate enclosure in Garland Prairie (alternative C). Prescribed burning (alternatives B, C, and D) is detailed in the Fire Specialist Report.

In the discussions within the action alternatives below, the proposed actions are first introduced by topic (e.g., thinning and/or burning, changes to roads, restoration of special habitats like meadows and springs, etc.). These proposed changes are then tracked sequentially within MSO habitat, i.e., the amount of thinning or burning or changes to roads is first reviewed in the context of protected habitat, then restricted habitat, etc. This includes the effects of the proposed activities on forest structure and prey habitat by individual MSO habitat. Each alternative concludes with a summary of the actions and an effects determination. Analyses are frequently presented at the restoration unit level in an attempt to simplify reporting out of effects. More detail, e.g., effects to individual PACs or subunits, is presented in the following appendices.

A key component of prey habitat is the herbaceous understory. Understory vegetation provides food and cover for most small mammals and many avian species. It also supports the arthropod community that provides a direct source of food for many vertebrate species and, indirectly, provides ecosystem services such as pollination of flowering plants and parasitism of forest pest species. A review and evaluation of understory response to overstory treatments is presented in

Appendix 8. The evaluation includes a relative index of herbaceous biomass response to the various treatments using equations from the published literature. These biomass values are not predictions of actual biomass yield, but an index developed to compare the relative degree of change between alternatives. Background on how thinning, burning, and wildfire can affect understory vegetation and associated arthropods, along with the equations used to develop the index values, can be found in Appendix 8.

Alternative A (No Action)

As required by 40 CFR 1502.14(c)) the no action alternative (alternative A) has been analyzed to contrast the impacts of the action alternatives with the current condition and expected future condition if the proposed action were not implemented.

Forest Structure and Density in MSO Habitat

This alternative includes no new mechanical or prescribed burning in any habitat, including ponderosa pine, pine-oak, aspen, meadows, springs, ephemeral channels, or any road decommissioning within the project area. None of these different wildlife habitats would be restored or moved towards restoration. Alternative A would not decrease the overabundance of mid-aged trees, increase survival and growth rates of older trees, and would not create additional recruitment of young trees. The distribution of tree size classes remains highly skewed towards trees 12 to 17.9 inches dbh in both the short- and long-term. Trees 18 to 23.9 inches dbh are close to desired conditions, exceeding recommended levels by the year 2050. However, trees greater than 24 inches dbh remain well below the distribution described in the Recovery Plan in both the short- and long-term (Table 40). Numbers of TPA 18 inches dbh and greater are below the recommended minimum of 20 or more TPA across all RUs in 2020, although average values are close to the minimum in target and threshold habitats. Nearly all RUs are above 20 TPA by 2050.

The percentage of Gambel oak remains low across the landscape in both the short- and long-term, particularly in protected habitat (Table 40). Canopy structure would remain dense, with low crown base height and high canopy cover. No mechanical treatments would sharply limit new regeneration and therefore decrease the number of trees available for eventual recruitment into larger size-classes.

Table 40. Alternative A: Mexican Spotted Owl Habitat Forest Structure and Habitat Components Modeled Out for the Years 2020 and 2050

RU	Basal Area		% Max SDI		Avg. Percent of Total SDI by Size Class						Avg. TPA 18"+		Avg. Gambel Oak BA Percent of Total BA		Tons CWD >12"		Snags >18"	
					12.0 – 17.9"		18.0 – 23.9"		24.0" +									
	20	50	20	50	20	50	20	50	20	50	20	50	20	50	20	50	20	50
RU 1	164	181	80	81	31	28	16	22	8	11	17.5	27.3	13	13	1	2.3	0.7	1.6
RU 3	177	192	84	84	31	27	17	23	9	12	20.8	30.1	11	11	1.5	2.9	0.9	2
RU 4	109	131	51	56	35	38	14	23	5	8	10.8	19.8	7	8	0.7	1.6	0.4	1.3
RU 5	147	170	71	75	31	26	17	22	9	13	16.9	26.3	11	11	1.5	2.7	0.7	1.7
All	164	181	80	81	31	28	16	22	8	11	17.8	27.5	12	12	1.1	2.4	0.7	1.7
RU 1	173	191	86	88	28	28	16	21	7	9	19.1	26.3	21	20	1.8	2.8	0.6	1.4
RU 3	168	189	86	89	26	23	17	20	8	11	18.8	26	26	25	1.1	2.2	0.7	1.6
All	171	190	86	88	27	26	16	20	7	10	19	26.2	23	22	1.5	2.5	0.6	1.5
RU 1	148	170	71	75	31	30	14	20	7	10	14	22.5	13	14	0.6	1.4	0.4	1.1
RU 3	147	169	73	77	29	26	15	21	7	10	14.2	23	19	20	0.7	1.6	0.5	1.2
RU 4	141	165	71	75	27	24	15	20	9	11	14.1	21.9	22	23	0.6	1.4	0.6	1.3
RU 5	115	146	56	64	26	28	11	15	10	11	9.8	16	10	14	0.3	0.8	0.4	0.7
All	147	169	72	76	30	28	14	20	7	10	14.1	22.7	17	18	0.7	1.5	0.5	1.1

On average, BA approaches or exceeds the minimum recommended level of 150 square feet per acre for nesting and roosting habitat across all habitats (Table 17, page 65). The maximum BA for nesting and roosting habitat recommended in the current recovery plan (170 square feet per acre) is met or exceeded in all RUs supporting target and threshold habitat and in three of four RUs containing protected habitat. Most MSO habitat acreage is not intended to be managed for the very dense forests conditions associated with nesting and roosting habitat. These dense conditions are reflected in high percentage of maximum SDI occurring in MSO habitat. A sustainable percentage of maximum SDI is 55 or less and most MSO habitat would be above 75 percent by 2050 (Table 17, page 65). The sustainability of old and large pine and oak would be compromised by density-related mortality associated with competition from younger, more vigorous trees and, in the case of large oak, overtopping by ponderosa pine. Forest health and resiliency would continue to erode and the risk from natural disturbances, including insects, disease, and high-severity crown fire, would increase across the landscape.

Combined, these factors would limit or stagnate tree growth rates, maintaining slow recruitment into large size-classes. Within stand mortality would remain high due to tree densities. Fire risk would remain high and increase as stand dynamics led to increasingly unhealthy forest conditions. Combined, this would lead to increasingly unsustainable MSO habitat conditions.

MSO Prey Habitat

Snags, Down Logs, and Coarse Woody Debris

All habitats and all RUs show an increase in CWD and snags greater than 18 inches dbh (Table 40). While creation of large snags would continue, the decreasing numbers of large trees through time would maintain deficit of large snags beyond the year 2050. Pulses of large snag creation may occur at any time as a result of fire, insects, and disease. Large snags resulting from uncharacteristic levels of stochastic events would result in large-scale decreases of big trees, which are already underrepresented across the landscape. Small mammal habitat in terms of logs and CWD would be maintained through time under this alternative.

Understory

Herbaceous forage and cover for prey species would be limited in both the short- and long-term. Canopy development combined with lack of fire and needle accumulation would cause a continued decline in understory through time. The continued loss of and fragmentation of understory vegetation could limit invertebrate populations. In the long-term, a potential cascading effect could occur if arthropod species richness and abundance continued to decline along with understory biomass, causing additive effects to MSO prey species (see Appendix 8). Combined, decreases in understory vegetation and associated arthropod communities could affect MSO directly (lack of flying insects as prey) and indirectly (food availability for prey species such as mice, voles, birds, and bats). Understory vegetation would remain at low levels of productivity and would continue to decrease through time, except in areas where fire, insect, and/or disease opened the canopy.

Moore et al. (2004) relocated and remeasured a subset of the Woolsey Plots, the oldest known forest inventory plots in the American Southwest. Originally established between 1909 and the 1920s, these plots were used to evaluate changes in forest structure and ecosystem function, including understory production. Plot readings were consistently taken from 1910 through 1950. Allometric equations developed from ponderosa pine stands occurring in and adjacent to what is

now the proposed 4FRI treatment area were used to estimate understory production previous to 1910 (Moore et al. 2004). Conditions in the 1870s reflect understory production (in kg per ha) when fire return intervals were uninterrupted from anthropogenic activities. Plots were harvested in 1910, demonstrating full site potential for understory production. Current and historical BA values from the Woolsey plots demonstrate, on average, the uncharacteristically low levels of understory production in today's forests (Figure 34). If the no action alternative were selected, the decline would be expected to continue for the long-term, minimizing food and cover for wildlife in general and MSO prey species specifically (Figure 35).

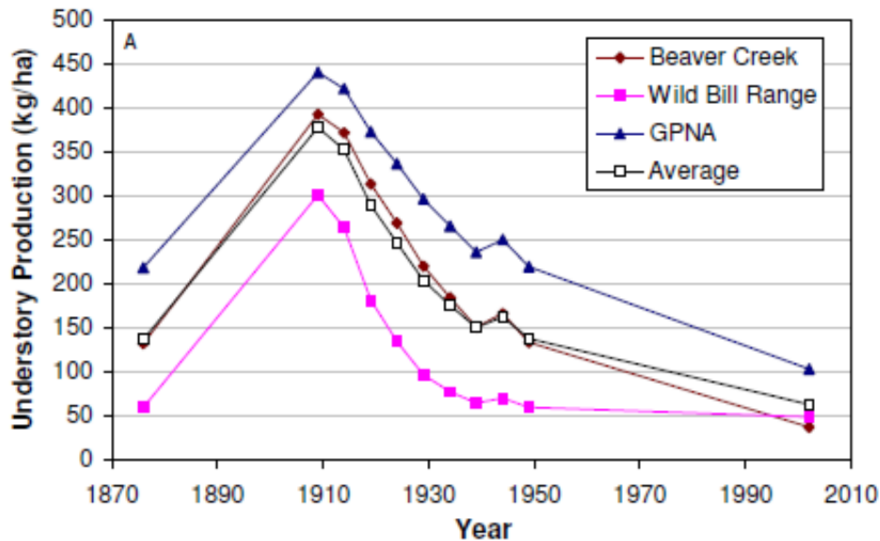


Figure 34. Changes in understory production between 1876 and 2002 (from Moore et al. 2004); all models were developed within or adjacent to the 4FRI project area

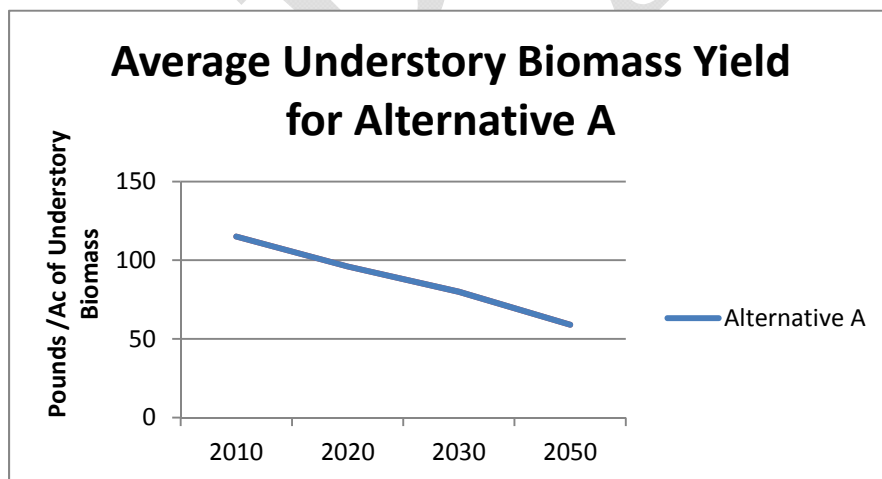


Figure 35. Relative changes in biomass indices through time for alternative A (see Appendix 8 for details)

Fire Risk

Maintaining current forest conditions would maintain a high risk of uncharacteristic fire. In terms of the general treatment area, more of the ponderosa pine forest would continue moving towards

Fire Regime Condition Class 3 under alternative A (Table 41). These conditions increase the risk of high-severity crown fire and decrease the odds of managing unplanned ignitions for resource benefits. Overall, this increases the fire risk to MSO habitat. The risk to key habitats such as nesting and roosting would remain higher in alternative A as a result of the general landscape remaining at higher risk.

Table 41. Fire Regime Condition Class (FRCC) Ratings in Ponderosa Pine Forest Through Time

Conditions	Year	Measure	FRCC1	FRCC2	FRCC3
Existing	2010	Acres	70,680	136,311	297,866
		Percent	14	27	59
Alt. A	2020	Acres	55,534	95,923	353,400
		Percent	11	19	70
	2050	Acres	5,049	136,311	363,497
		Percent	1	27	72

Surface fuels would also be maintained at current levels, which exceed the historical range of variation (see fire ecology report). High surface fuel loading burns with a higher severity with a potential to negatively impact understory resources such as seed banks, soil flora, and arthropod populations (Appendix 8). Surface fuels in restricted habitat are, in general, similar to overall levels in the ponderosa pine forest. Surface fuels in in protected habitat, particularly core areas, are well above conditions in the general ponderosa pine forest (Figure 36). Surface fuels can negatively affect MSO prey populations by altering understory response and negatively affecting food and cover for prey species. Additionally, the threat of surface fire transitioning into crown fire would remain high.

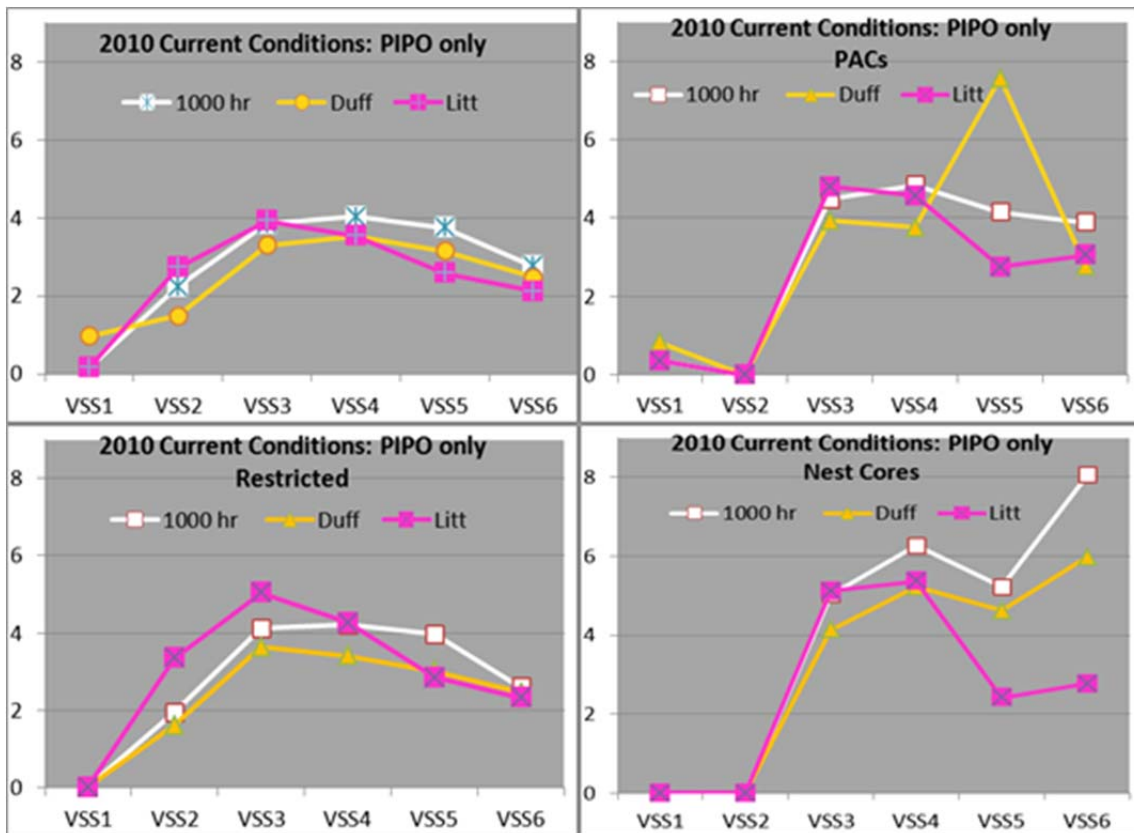


Figure 36. Surface Fuel Levels (Tons Per Acre) in Ponderosa Pine Forest and MSO Habitat Within the 4FRI Treatment Area

Maintaining current forest conditions would maintain a high risk of crown fire. Nearly half the acres of MSO habitat would likely burn as crown fire under alternative A in both protected and restricted habitats (Table 42). All crown fire would burn with high severity.

No reduction in fire threat would occur, with over 90 percent of MSO habitat remaining highly departed from the historical range of variation (Fire Severity Class 3). About 27, 33, and 31 percent of MSO habitat would remain at risk of active crown fire for protected, target and threshold, and restricted “other” habitats, respectively. The likelihood of high severity fire and the size of wildfires producing undesirable effects would continue to increase. Alternative A does not follow Recovery Plan guidance for retaining management flexibility for abating high fire risk (USDI FWS1995).

Table 42. Fire Behavior in Mexican Spotted Owl Habitat in the year 2020 - Alternative A

MSO Habitat	Surface Fire (Ac)	Passive Crown Fire (Ac)	Active Crown Fire (Ac)	Conditional Crown Fire (Ac)	Surface Fire (%)	Passive Crown Fire (%)	Active Crown Fire (%)	Conditional Crown Fire (%)
Protected	19,072	3,069	8,949	5,507	52	8	24	15
Restricted (All)	41,541	8,886	20,744	4,787	55	12	27	6

Alternative A does not meet the purpose and need for the project. MSO habitat would continue to degrade over time in terms of forest structure and health. Development of the large tree component would continue to be compromised by density-dependent competition and mortality. Understory development would be maintained at uncharacteristically low levels and continue to decline. Other specialty habitats important to prey species such as meadows, aspen, springs, and ephemeral channels would continue to degrade or be lost entirely over the long-term. MSO habitats would be on a trajectory moving further from desired conditions as described in the Coconino and Kaibab forest plans.

Other Habitat Changes

Springs, Ephemeral Channels, Meadows, and Aspen

No spring or ephemeral stream channels would be restored. Twenty three springs and associated prey habitat would remain degraded within MSO habitat, including five springs in five different PACs. Similarly, wildlife habitat associated with almost 5 miles of ephemeral stream channels would remain degraded, including about 1.7 miles of ephemeral stream channel in six PACs. The grasses, forbs, and shrubs that could potentially occupy these sites would remain absent or limited in both species richness and abundance.

No meadow or aspen treatments would occur, allowing these important habitats to continue to decline from encroachment and competition with ponderosa pine trees. As these interspersed habitats decline within the ponderosa pine and Gambel oak forest matrix, so does overall understory biomass. As food and cover decline for small mammals, potential source populations of important MSO prey species would be expected to decline in the long-term.

Roads

Current road miles would not change under this alternative. About 164 miles of roads would not be decommissioned in MSO habitat, including about 121 miles of roads (15 percent) within MSO Critical Habitat. Nearly 76 miles of temporary road would not be required, including about 6 miles of temporary road that would not be constructed in MSO habitat. About 70 miles of roads currently on the landscape within MSO habitat that would not receive maintenance. T

Decommissioning would occur for roads closed or under the Travel Management Rule or on unauthorized routes. As such, these roads should not receive use regardless of the status of the decommissioning. Road decommissioning could take many forms, from simply adding signage, placing boulders to obstruct access, to ripping and recontouring roadbeds. Not knowing which

technique would be used where prohibits an effects analysis other than to say that habitat recovery would be delayed in the long-term.

The lack of road maintenance would avoid disturbance from road equipment and, indirectly, potentially decrease long-term road use in MSO habitat, assuming public use would decrease as road conditions worsened. An additional 1.2 miles of road currently impacting ephemeral stream channels in MSO habitat would not be relocated, thereby continuing the degradation of vegetation associated with this limited but important prey habitat.

Direct and Indirect Effects: With no treatments occurring, there would be no direct increase or decrease of MSO protected, restricted, or Critical Habitat in the short-term. In the long-term, MSO habitat would decrease as a result of declines in forest health and resiliency.

The lack of mechanical thinning and low severity prescribed burning would maintain forest development on its current trajectory. Dense forests would maintain closed canopy conditions and continue to exhibit reduced growth rates. The abundance of young and mid-aged forest would continue to dominate the landscape. Competition for limited water and nutrients would continue as a result of dense stands of young to mid-aged trees to the detriment of old trees and Gambel oak.

Determination Effect: Based on the above discussion, alternative A would have **no effect to the Mexican spotted owl or its critical habitat**. Currently, about 353,400 acres of ponderosa pine forest, including all pine-oak habitat, is in FRCC3. By 2050 FRCC3 will increase to about 363,500 acres. This alternative will not reduce the threat of high severity crown fire, which is a primary concern for recovery for this species. Surface fuels will continue to increase and understory vegetation will continue to decrease. Alternative A would not contribute to improving forest health or vegetation diversity and composition, or sustaining old forest structure over time, or moving forest structure toward the desired conditions.

Actions Common to All Action Alternatives

Protected Habitat

Springs and Ephemeral Channels

Five springs are proposed for restoration in MSO protected habitat. All five springs are in PACs occurring in Restoration Unit 1 on the Coconino NF (Lee Spring, Mud Spring, Rock Top, Sawmill Springs, and Weimer Springs). The springs in two PACs (Mud Spring and Weimer Springs) are in meadows and the other three PACs have springs in pine-oak forest. A total of nearly 1.7 miles of ephemeral stream channel restoration would occur in six PACs on the Coconino NF (Bear Seep, Clark, Coulter Ridge, Holdup, Lucida, and Meadow Tank). Ephemeral stream channel restoration reaches would average about 0.28 miles in length (range equals 0.02 to 0.72 miles). Only Holdup PAC has riparian vegetation within the ephemeral stream reach, but no woody vegetation is present. Recontouring of channels could also take place, depending on site conditions. Removal of encroaching trees and treating noxious weeds would be evaluated in a site-specific manner for both spring and channel restoration. All springs and ephemeral channels restored in PACs would be protected from ungulate browsing by non-wire fencing to avoid unintentional harm to MSOs. All restoration activities would happen outside the breeding season.

Meadow and aspen treatments would not include mechanical tree removal within PACs. Operational burning, where the objective is get fire into adjacent stands without creating firebreaks in non-ponderosa pine habitat rather than actually change habitat structure, would occur on 135 acres of meadow habitat within 12 PACs. Aspen treatments would consist of prescribed burning on 190 acres in six PACs (five PACs on the Coconino NF and Kendrick PAC on the Kaibab). Prescribed burning would have site-specific objectives in aspen (versus operational burning), but the nature of aspen understories and the lack of mechanical vegetation manipulation means a patchy, low severity fire would be expected with little or no change in competing and overtopping pine trees. The subsequent shading of aspen and competition for water and nutrients would continue. The expected result would be a potential, small increase in aspen suckering and a slight and very short-term improvement to understory biomass. However, because of the dense nature of nesting and roosting habitat and the value of logs and CWD to prey habitat, burn prescriptions are expected to result in light treatments with low severity.

At the scale of 4FRI, improvements to prey habitat through spring, ephemeral channel, meadow, and aspen treatments within protected habitat are limited and site specific. However, these treatments would enhance prey habitat. MSO reproductive success appears tied to prey availability. MSOs in the UGM feed primarily on peromyscid mice and voles (Ganey et al. 2011) and restoration treatments can benefit these species (Kalies et al. 2012, Martin and Maron 2012). Other small mammals, birds, and nocturnal flying insects (primarily lepidopterans and coleopterans) are also prey for MSOs and overall prey abundance may be very important to nesting MSOs, particularly during years when a key species may be limited (Ganey et al. 2011). In general, small mammals, birds, and arthropods increase after burning and thinning in ponderosa pine forests (Appendix 8). This is particularly true for key habitat components like springs and ephemeral channels where herbaceous response would be expected to exceed that under dense forest canopies. Therefore, improvements to spring, ephemeral channel, meadow, and aspen treatments within protected habitat would improve prey habitat and potentially benefit resident MSO.

Roads

About 48 miles of roads in protected habitat would be decommissioned across 12 different subunits (Table 43). About 20 percent of the total road miles in 57 PACs would be decommissioned (Appendix 13). Decommissioning roads in PACs would occur outside the breeding season and average 0.8 miles of road per PAC (range = 0.02 to 3.8 miles in individual PACs). One PAC with road decommissioning is on the Kaibab NF (Sitgreaves with 0.8 miles proposed for decommissioning) and the remaining PACs are on the Coconino NF. Road decommissioning would occur in 14 core areas, including about five out of nearly 25 total road miles in core areas (20 percent). An average of 0.35 miles of road would be decommissioned per core area (range = 0.01 to 0.93 miles in individual core areas). All 14 core areas are on the Coconino NF. Timing restrictions would avoid potential noise disturbance to nesting and roosting MSOs.

Table 43. Road Miles Proposed for Decommissioning Within Protected Habitat

Forest	Subunit	Road Miles Proposed For Decommission	Total Road Miles	Percent of Roads Decommissioned
CNF	1-1	0.1	1.7	5
	1-3	8.8	46.9	19
	1-4	1.2	11.7	10
	1-5	20.0	120.7	17
	3-3	0.7	2.9	23
	3-4	5.4	7.6	72
	3-5	1.7	17.7	10
	4-3	1.3	1.6	76
	4-4	0.2	0.2	100
	5-1	6.2	19.3	32
	5-2	3.3	16.1	21
KNF	4-4	0.1	2.2	4
Total		49	251	20 (Avg)

Road maintenance (nearly 98 miles) and temporary road construction (about 7 miles) would affect almost 105 miles of roads in PAC habitat (Table 44). Roads currently causing damage to ephemeral stream channels in 3 PACs, totaling less than 1/10th of a mile would be relocated. Road maintenance, construction, and relocation within PACs would all take place outside of the breeding season. The term “temporary roads” in this instance includes non-system roads that currently function as open roads on the landscape. These roads would also be decommissioned after 4FRI project implementation.

Table 44. Road Maintenance, Construction, and Relocation in Mexican spotted owl Habitats Within the 4FRI

MSO Habitat	Road Maintenance	Temporary Road Construction	Road Relocation	Total Miles of Road Work
Protected Total	97.6	7.2	0.1	104.9
Target/Threshold Total	40.9	5.3	0.1	46.3
Restricted	319.1	63.5	1.0	383.5
Total	457.6	76.0	1.2	534.7

Restricted Habitat

Springs and Ephemeral Channels

Eighteen springs are proposed for restoration in MSO restricted habitat. Ten springs are proposed for restoration on the Coconino NF and eight springs on the Kaibab NF. All springs proposed for restoration occur in either Restoration Unit 1 or 3. Just over 3.3 miles of ephemeral channel restoration would occur in restricted habitat. Approximately $\frac{3}{4}$ of a mile is in target and threshold habitat on the Coconino NF. About 2.4 of the 2.48 miles of ephemeral channel restoration in restricted “other” habitat is proposed for the Coconino NF and less than $\frac{1}{10}$ th of a mile is on the Kaibab NF.

About 3,870 acres of meadow treatments would occur in restricted habitat. Under alternative B, all meadow treatments are operational burn only; none of the burn treatments represent prescriptions for site-specific objectives related to meadow restoration other than allowing fire to cross non-ponderosa pine habitat, thus [precluding the need for digging firebreaks. Large meadows can blend into small grasslands and some of the meadows treatments likely represent grassland habitat rather than true openings within forest habitat. Nevertheless, portions of grassland treatments would likely still function as MSO foraging habitat, e.g., areas where owls could forage some distance in from forest edges or from groups of trees within portions of the grassland. Meadow and an unknown percentage of grassland treatments would be expected to improve understory conditions for MSO prey species. However, operational burning is only expected to cause minimal tree mortality (e.g., seedlings but not necessarily saplings) and would not change overstory canopy and hence changes in understory response may be limited in many meadows.

Aspen treatments include about 200 acres of prescribed burning and about 740 acres of aspen restoration. Prescribed burning would decrease litter and potentially kill young pine, essentially helping to maintain or slow the decrease in aspen clone viability. Aspen restoration would be expected to improve the health and resiliency of aspen clones and move stands towards multiple canopy layers. Prescribed burning in aspen would be expected to provide limited benefits to MSO because of the patchy nature of burning in this habitat, which limits exposure of young pine trees to fire, and the small degree of change expected in the overstory which would continue shading the ground. The burn-only treatments are not likely to initiate much suckering and would not include fencing or other barriers to prevent ungulate grazing within the aspen clone. Little change to prey habitat or long-term improvements in aspen health is expected. Burn-only aspen treatments would result in a slight and short-term only improvement in understory vegetation in 21 percent of the aspen with little change expected in aspen sustainability (200 acres). Aspen restoration would open the overstory, create surface fuels to better carry fire, and would subsequently be fenced or include other barriers to ungulates. The resulting effects to prey habitat would include both short- and long-term improvements in understory vegetation and overstory aspen health and sustainability in 79 percent of the treated aspen (740 acres).

Roads

About 115 miles of roads in restricted habitat would be decommissioned across 15 different subunits, including nearly 17 miles within target and threshold habitat (Table 45).

Table 45. Proposed Road Decommissioning in Restricted Habitat Inside and Outside Target and Threshold Habitats (T/Th) by Subunit

Forest	Restoration Sub-unit	Restricted Other Habitat			Target and Threshold Habitats		
		Road Miles Decommissioned	Total Road Miles	Percent of Total Roads Decommissioned	Proposed Road Miles for Decommission	Total Road Miles	Percent of Total Roads Decommissioned
CNF	1-1	6.29	21.15	30	0.93	1.74	53
	1-2	0.73	3.42	21			
	1-3	10.43	62.90	17	5.05	15.66	32
	1-4	0.27	2.97	9	0.11	0.11	100
	1-5	14.48	92.41	16	4.57	14.11	32
	3-3	2.82	9.68	29	0.54	2.04	26
	3-4	5.40	19.88	27	2.09	3.23	65
	3-5	29.00	133.06	22	1.00	20.76	5
	4-5	0.17	0.61	28			
	5-1	3.92	8.24	48	0.11	0.72	15
	5-2	3.19	9.96	32	0.68	1.29	53
	3-1	8.24	126.05	7	0.07	7.01	1
	3-2	7.06	53.86	13	1.34	7.65	18
	3-3	4.39	70.23	6	0.43	7.47	6
	4-3	0.15	0.55	27			
KNF	4-4	1.43	8.91	16	0.00	0.31	0
	Total	98.0	623.9	16	16.9	82.1	21

Road maintenance (over 62 miles) and temporary road construction (about 69 miles) would occur in restricted habitat (Table 46). About a mile of road would be relocated to protect ephemeral stream channels. Road segments would be relocated in 4 subunits, including a 1/10th mile segment in target and threshold habitat.

Table 46. Miles of Road Work in Restricted Habitat

MSO Restricted Habitat	Road Maintenance	Temporary Road Construction	Total
Target/Threshold Total	8.54	5.31	46.22
Restricted "Other"	53.80	63.45	382.51
Total	62.34	68.76	428.74

Critical Habitat***Springs and Ephemeral Channels***

Spring restoration would occur in two CHUs (Table 47): eight springs are proposed for restoration in UGM-11 (all on the Coconino NF) and nine in UGM-13 (two on the Coconino NF and seven on the Kaibab NF). Ephemeral stream channel restoration would occur in CHUs UGM-11, -12, -13, and -14 (Table 48). Ephemeral stream channel restoration in these Recovery Units would total 4.02 miles on the Coconino NF and 0.08 miles on the Kaibab NF (UGM-13).

Table 47. Proposed Spring Restoration by Critical Habitat Unit (CHU) Within the 4FRI Treatment Area

Forest	CHU	Name	Total
Coconino	UGM-11	Howard Spring	1
		Lee Spring	1
		Mud Spring	1
		Rock Top springs	1
		Sawmill Springs	1
		Sedge Spring	1
		Van Deren Spring	1
		Weimer Spring	1
			8
	UGM-13	Lockwood Spring	1
		Scott Spring	1
			2
Kaibab	UGM-13	Andrews Spring	1
		Hat Tank lower unnamed spring	1
		Hat Tank upper unnamed spring	1
		rocky Tule spring unnamed	1
		Stewart Spring	1

Forest	CHU	Name	Total
		weed unnamed spring	1
		Wild Horse Spring	1
			7
Total			17

Table 48. Miles of Proposed Ephemeral Channel Restoration by Critical Habitat Unit (CHU) Within the 4FRI Treatment Area

CHU	Miles
UGM-11	2.26
UGM-12	0.48
UGM-13	0.68
UGM-14	0.67
Total	4.10

Roads

Road decommissioning would occur in every CHU within the treatment area. Eight to 11 percent of the total roads will be decommissioned in the different CHUs (Table 49). Three CHUs, UGM-11, 13, and 17, would have segments of roads relocated to protect ephemeral channels.

Table 49. Roads Proposed for Decommissioning Under the 4FRI by Mexican spotted owl Critical Habitat Unit (CHU)

National Forest	CHU	Miles of Roads Proposed for Decommissioning	Total Road Miles by CHU	Percent of Total Roads Proposed For Decommissioning
CNF	UGM-11	51	308	17
	UGM-12	6	15	40
	UGM-13	31	174	18
	UGM-14	13	46	28
	UGM-15	1	2	50
KNF	UGM-13	19	245	8
	UGM-15		1	0
	UGM-17	0.2	2	11
Grand Total		121	793	15

Temporary road construction and road maintenance would occur in all CHUs within the 4FRI area, totaling about 423 miles (Table 50). Road segments totaling about one mile would be relocated in Critical Habitat to protect ephemeral stream resources.

Table 50. Temporary Road Construction and Road Maintenance Critical Habitat

National Forest	Critical Habitat Unit	Road Maintenance	Temporary Road Construction	Total Miles of Road Work
CNF	UGM-11	181.2	26.6	207.7
	UGM-12	3.6	4.9	8.5
	UGM-13	52.0	6.4	58.4
	UGM-14	9.4	1.2	10.6
	UGM-15	0.7	0.2	0.9
CNF Total		246.8	39.4	286.2
KNF	UGM-13	108.5	27.5	136.0
	UGM-15	0.3		0.3
	UGM-17	0.7	< 0.1	0.7
KNF Total		109.4	27.5	136.9
Grand Total		356.3	66.9	423.1

Spring restoration would occur in two CHUs: eight springs are proposed for restoration in UGM-11 and nine in UGM-13 (Table 51). Ephemeral stream channel restoration would occur in CHUs UGM-11, -12, -13, and -14 (Table 52). Ephemeral stream channel restoration in these Recovery Units would total 4.02 miles on the Coconino NF and 0.08 miles on the Kaibab NF (UGM-13).

Table 51. Proposed Spring Restoration by Critical Habitat Unit (CHU) Within the 4FRI Treatment Area

Forest	CHU	Name	Total
Coconino	UGM-11	Howard Spring	1
		Lee Spring	1
		Mud Spring	1
		Rock Top springs	1
		Sawmill Springs	1
		Sedge Spring	1
		Van Deren Spring	1

Forest	CHU	Name	Total
		Weimer Spring	1
			8
	UGM-13	Lockwood Spring	1
		Scott Spring	1
			2
Kaibab	UGM-13	Andrews Spring	1
		Hat Tank lower unnamed spring	1
		Hat Tank upper unnamed spring	1
		rocky Tule spring unnamed	1
		Stewart Spring	1
		weed unnamed spring	1
		Wild Horse Spring	1
			7
Total			17

Table 52. Miles of Proposed Ephemeral Channel Restoration by Critical Habitat Unit (CHU) Within the 4FRI Treatment Area

CHU	Miles
UGM-11	2.26
UGM-12	0.48
UGM-13	0.68
UGM-14	0.67
Total	4.10

Meadow and aspen treatments in Critical Habitat are described above under restricted habitat.

Disturbance

Potential disturbance could occur from project implementation, such as noise from harvest-related machinery, transporting forest products, preparing for prescribed burning, and smoke settling during burning operations. Delaney and Grubb (2004) determined that spotted owls appear to be capable of hearing sounds from road maintenance equipment to distances of at least 400 meters (0.25 miles). However, in an experimental study with a conspecific raptor on the Kaibab NF, Grubb et al. (2012) found no evidence that the awareness of noise generated from logging trucks was correlated with actual negative effects to nesting northern goshawks. The observed response

from nesting goshawks was limited to, at most, looking in the direction of the hauling road (Grubb et al. 2012).

Haul routes for transporting forest materials were evaluated to identify routes that would avoid potentially harassing nesting or roosting MSOs in the vicinity of each of the 72 PACs in the treatment area. A haul road network was identified, including secondary roads associated with harvest units, and primary roads leading off-forest. The following criteria were used to select routes in and near PACs:

1. Roads were selected to avoid PACs
2. Where hauling in PACs could not be avoided, roads greater than a ¼ mile from core areas were selected (Woods PAC)
3. Where these criteria could not be met, timing restrictions were applied to prevent disturbance to MSO during the nesting season

Therefore, while MSO may hear the sound of trucks, the design features and mitigations employed during implementation are expected to avoid adverse effects to nesting or roosting owls from road-related noises. In a study coordinated between the FS, the U.S. Army, and a private sound consultant noise disturbance from logging trucks was monitored for nesting goshawks, a similar-sized and sympatric raptor in northern Arizona. Results from this controlled experiment found no evidence of negative effects. Observed goshawk response to the truck noise was limited to, at most, looking in the direction of the hauling road (Grubb et al. 2012).

Most project activities would be conducted during daylight hours and most MSO activity is nocturnal. There remains some risk of disturbance to foraging owls outside of PACs during crepuscular hours. Noise associated with early morning and late evening activities related to mechanical thinning, actions related to prescribed burning, road use, maintenance operations, and etc. may disturb foraging MSOs. Disturbance would be site-specific and could cause owls to shift to areas that provide undisturbed foraging opportunities. No nesting or roosting owls inside PACs would be disturbed from noise because of implementation planning and timing restrictions.

Burning would focus on reducing surface fuels, particularly pine litter, and increase tree crown base heights while retaining adequate levels of down logs and coarse woody debris through prescription and ignition techniques. This is expected to reduce surface fire intensity and flame lengths. Prescribed burning across extensive acreages is intended to move forests towards the desired condition of supporting frequent, low-severity fire. Increasing crown base heights decreases the risk of potential crown fire. Because of the denser forest conditions in MSO habitat, prescriptions would be designed to burn at a lower severity than treatments outside MSO habitat. An expected outcome of this approach is patchier burning, attaining a broader mosaic of habitat conditions for MSOs and their prey. Burning in PACs would occur outside the MSO breeding season (i.e., September 1 through February 28).

The presence of smoke may temporarily disturb MSO within and adjacent to the treatment area. Burning proximate to PACs during the breeding season (March 1 – August 31) would be conducted in a manner that limits smoke settling into PACs. Burning would not occur within 1/8 to ¼ mile buffers during nesting season. The distance will be decided based on site specific parameters including topography, amount of surface fuels, and wind and weather patterns. Site specific decisions will be made after discussions between biologists, fuels specialists, and in association with the USFWS. Prevailing southwest winds and the topography of the area typically

act to lift smoke, carrying it away from ignition sites. Most PACs on cinder cones and other raised topographic features (e.g., Kendrick, Sitgreaves, Mormon Mountain, etc.) and most PACs in or immediately adjacent to Sycamore or Oak Creek Canyons and the Mogollon Rim are not expected to have smoke settle in them long enough to cause discernible effects to MSOs because of the air movement in these landscape-scaled features. Conversely, PACs with core areas occurring in small canyons (e.g., James, Kelly, Walnut, etc.) may have smoke settle in nesting and roosting habitat for one or more consecutive days. Smoke from prescribed fire would comply with ADEQ requirements. ADEQ considers the cumulative effects of smoke emissions from multiple jurisdictions prior to approving daily prescribed burning activities. This mitigates the potential for severe smoke effects from multiple prescribed fire projects across the entire treatment area.

When smoke settles into low-lying areas it typically does not last more than 1 or 2 nights. Limited smoke within PACs would be expected to expose adult MSO to negligible effects as this would repeat an aspect of their evolutionary environment. However, on occasion dense smoke may settle into core areas. Dense smoke settling into nest stands early in the season (March through June) could disturb brooding females. If the female flushed long enough to affect incubation this could result in loss of viability of the eggs. Dense smoke settling for multiple consecutive nights could affect developing lungs of nestlings. Unlike mammals, damaged avian lungs do not repair themselves through time (Hedwall *pers. comm.* 2012). Causing the female to discontinue incubating eggs or affecting lung development of nestlings would cause long-term adverse effects. Outside of these examples, smoke settling in PACs would typically be short-term and not likely to cause adverse effects.

See Table 35, page 129 for a summary of actions by alternative.

Alternative B – Proposed Action

Under alternative B, mechanical treatments would occur in portions of all MSO habitats except for core areas (see protected habitat below). The minimum post-treatment BA for nesting and roosting habitat would be 150 ft² per acre, in line with the current recovery plan (USDI FWS 1995). Low severity prescribed burning would be applied to all MSO habitats, including core areas (Table 53). No trees greater than 24 inches dbh would be removed and tree groups with diameters averaging 18 inches dbh or greater would not be cut for regeneration. A comparison of treatments in MSO habitat by alternative is displayed in Appendix 14. Alternative B would mechanically treat 84,177 acres and prescribe burn 107,696 acres in protected and restricted habitat (Table 53).

Table 53. Alternative B Summary of Treatments in MSO Pine-Oak Habitat

Treatment Type*	MSO Habitat Type			
	Protected	Restricted	Target/ Threshold	Total Acres
Burn Only	20,864	2,354	301	23,519
MSO Restricted – Group Selection & Intermediate Thinning + Burning		65,024		65,024
MSO Target – Intermediate Thinning + Burning			6,518	6,518

Treatment Type*	MSO Habitat Type			
	Protected	Restricted	Target/ Threshold	Total Acres
MSO Threshold – Intermediate Thinning + Burning			1,894	1,894
PAC – Intermediate Thinning ≤16" + Burning	10,741			10,741
Total	31,605	67,378	8,713	107,696

An overview of immediate post-treatment results (year 2020) and long-term changes to habitat structure (year 2050) are displayed at the RU-level in Table 54. BA and percent maximum SDI would both remain high in target and threshold habitat and in protected habitat, reflecting the desired condition in nesting and roosting habitat and the light intensity of the proposed treatments. Increases in percent area for trees greater than 18 inches dbh, including trees greater than 24 inches dbh would occur. Trees 12 to 18 inches dbh would decrease in all habitat classifications but remain above 20 percent in target and threshold habitat and in protected habitat and above 15 percent in restricted “other” habitat. The number of average trees per acre 18 inches or greater increased across all habitats in all RUs. The percent of oak BA typically remained the same or decreased by a percent in protected and target and threshold habitats and decreased by a percentage point in restricted “other” habitat. CWD increased across all RUs. Snags greater than 18 inches dbh increased in target and threshold habitat and in protected habitat and typically remained unchanged in restricted “other” habitat.

Table 54. Alternative B - 2020 and 2050 Mexican Spotted Owl Habitat Forest Structure and Habitat Components Based on Weighted Stand Averages

RU	Basal Area				% Max SDI				Avg. Percent of Total SDI by Size Class						Avg. TPA 18”+		Avg. Gambel Oak BA Percent of Total BA		Tons CWD >12”		Snags >18”	
									12.0 – 17.9”		18.0 – 23.9”		24.0” +									
	20	50	20	50	20	50	20	50	20	50	20	50	20	50	20	50	20	50				
Restricted Target/ Threshold																						
RU 1	144	175	73%	81%	29%	24%	20%	25%	9%	11%	19.6	28.4	25%	24%	1.2	2.1	.5	1.4				
RU 3	149	181	78%	85%	25%	21%	19%	21%	9%	12%	19.0	26.7	29%	28%	.7	1.8	.7	1.6				
All	146	178	75%	83%	28%	23%	20%	23%	9%	11%	19.3	27.6	27%	26%	1.0	1.9	.6	1.5				
Restricted Other																						
RU 1	74	107	35%	46%	22%	19%	22%	19%	19%	20%	11.4	16.7	19%	18%	.7	1.5	.8	.8				
RU 3	81	114	38%	50%	22%	18%	22%	19%	17%	18%	11.6	17.3	24%	23%	.8	1.7	1.0	.9				
RU 4	80	115	39%	52%	20%	17%	21%	17%	19%	19%	11.4	16.4	26%	25%	.7	1.6	1.0	1.0				
RU 5	64	98	30%	42%	21%	21%	17%	15%	21%	18%	8.3	12.9	13%	15%	.4	1.0	.6	.6				
All	78	111	37%	49%	22%	19%	22%	19%	18%	19%	11.5	17.0	22%	21%	.8	1.6	.9	.9				

RU	Basal Area				% Max SDI				Avg. Percent of Total SDI by Size Class						Avg. TPA 18"+		Avg. Gambel Oak BA Percent of Total BA		Tons CWD >12"		Snags >18"	
									12.0 – 17.9"		18.0 – 23.9"		24.0" +									
	20	50	20	50	20	50	20	50	20	50	20	50	20	50	20	50	20	50				
	Protected																					
RU 1	154	175	72%	75%	32%	28%	17%	25%	9%	12%	17.8	28.0	13%	14%	.7	2.0	.7	1.7				
RU 3	168	189	79%	82%	31%	26%	18%	24%	10%	13%	20.9	31.0	12%	12%	1.0	2.5	.8	1.9				
RU 4	106	128	50%	55%	35%	38%	14%	24%	5%	8%	10.9	19.8	8%	8%	.5	1.5	.4	1.3				
RU 5	143	168	68%	74%	31%	26%	17%	22%	9%	13%	16.9	26.5	11%	11%	1.0	2.4	.7	1.7				
All	154	175	72%	76%	32%	27%	17%	24%	9%	12%	18.0	28.2	13%	13%	.8	2.1	.7	1.7				

Mechanical thinning and prescribed burning would take place at different times in different locations. Spotted owl habitat could be affected by mechanical treatments in one area and prescribed burning in another in any one time period. It is expected implementation of the entire project will require 10 or more years to complete. If work were completed in 10 years, on average about 8,700 acres of MSO habitat would be mechanically treated and 10,855 acres prescribed burned each year under alternative B. No mechanical treatments would occur on slopes greater than 40 percent in MSO habitat.

Protected Habitat

MSO PAC field and data reviews and vegetation simulation modeling indicate mechanical treatment greater than 9 inch dbh would move 18 PACs towards desired conditions. Optimal size classes for trees removed would range from less than 9 inches dbh up to the limit of 16 inches dbh in this alternative (Table 55). Within the 18 PACs, approximately 3,616 acres (32 percent of the total treated acres) would be improved with mechanical treatments limited to 9 inch dbh (Table 55). Treatments were adjusted as follows to move PACs towards desired conditions for MSO habitat:

- Fifteen PACs (Archies, Bar M, Bonita Tank, Foxhole, Frank, Holdup, Iris Tank, Knob, Lake No. 1/Seruchas, Lee Butte, Red Hill, Red Raspberry, Rock Top, Sawmill Springs, and T6 Tank) would require thinning up to 12 inch dbh on 1,423 acres,
- Seventeen PACs (Archies, Bar M, Bonita Tank, Crawdad, Foxhole, Frank, Holdup, Iris Tank, Knob, Lake No. 1/Seruchas, Lee Butte, Mayflower Tank, Red Hill, Red Raspberry, Rock Top, Sawmill Springs, and T6 Tank) would require thinning up to 14 inch dbh on 4,331 acres, and,
- Fifteen PACs (Bar M, Bear Seep, Bonita Tank, Crawdad, Foxhole, Frank, Holdup, Iris Tank, Knob, Lake No. 1/Seruchas, Lee Butte, Mayflower Tank, Red Hill, Red Raspberry, Rock Top, Sawmill Springs, and T6 Tank) would require thinning up to 16 inch dbh on 1,902 acres.

Modeled treatments were developed to reduce BA, but remain at or above 150 feet² per acre in stands currently supporting 150 BA or greater. Modeled tree removal started in the smallest size classes first. The vegetation model retained trees in each size class so that current owl habitat characteristics were retained while improving potential future habitat, i.e., modeling was not a simple thin from below exercise. Models were run at each of several size classes for each stand. Optimal treatments were defined as those that met the basal area target and produced the best growth rates. Stands with incomplete data were not proposed for thinning above 9 inches dbh.

Table 55. General Description and Acres of Mechanical Treatment in Alternative B by PAC (all mechanically treated PACs occur on the Coconino NF)

PAC Name	General Description	MSO PAC Mechanical Treatment and Prescribed Burning (dbh and acre)			
		Treat up to 9" dbh (Acres)	Treat up to 12" dbh (Acres)	Treat up to 14" dbh (Acres)	Treat up to 16" dbh (Acres)
Lake No. 1/Seruchos	Dense thickets of VSS3 pine, oak is competing with pine for nutrition, sunlight and moisture, need to grow larger trees over time, enhance oaks, create small openings	123	66	50	0
Archies	Pine-oak with strong oak component but few large oak – many pines < 9" dbh	444	41	11	0
Red Hill	Scrappy habitat that has been treated with an overstory removal in the past, dense pockets of ponderosa pine with heavy mistletoe infection in areas, thin pine to grow larger trees and reduce fire threat, enhance oak where present, grow larger trees over time and reduce competition	170	207	486	0
Crawdad	Oak is suppressed by high densities of pine, need for creating gaps around oak and releasing individual oak trees	138	0	342	120
Holdup	Most of PAC is pure pine, thin around any existing oak and provide areas for oak to establish	57	197	264	18
Bonita Tank	Treatments to grow larger trees and release oaks are needed in southern portion of PAC outside of ridges and draws	37	203	429	127

PAC Name	General Description	MSO PAC Mechanical Treatment and Prescribed Burning (dbh and acre)			
		Treat up to 9" dbh (Acres)	Treat up to 12" dbh (Acres)	Treat up to 14" dbh (Acres)	Treat up to 16" dbh (Acres)
Red Raspberry	Diverse topography, protect microclimates from fire, high percentage of VSS 3 and VSS 4, need for enhancing openings, create, retain, and enhance larger trees	426	30	249	61
Bear Seep	PAC is pure ponderosa or oak, high density of trees > 9 inch dbh	453	0	0	153
Mayflower Tank	PAC has steep slopes, heavy fuels, limited number of small trees	312	0	139	217
Knob	PAC has limited habitat, generally pure pine and open with some dense dog-hair thickets	273	26	252	114
T-Six Tank	PAC has dense regeneration, need for removing dense patches of ponderosa pine, maintaining Gambel oak, and thinning dense pine doghair thickets	126	116	279	160
Iris Tank	PAC has dense pine with pockets of doghair thickets; oak is present in all size classes but is suppressed by pine, need to release oaks and thin dense pockets of pine and reduce fuels southwest of the nest core	172	13	261	150

PAC Name	General Description	MSO PAC Mechanical Treatment and Prescribed Burning (dbh and acre)			
		Treat up to 9" dbh (Acres)	Treat up to 12" dbh (Acres)	Treat up to 14" dbh (Acres)	Treat up to 16" dbh (Acres)
Frank	PAC has areas of pure pine with dense pockets of VSS3 and VSS4, need to release any oaks present and encourage recruitment of oaks, reduce pine densities and increase diameters of both pine and oak	297	130	212	62
Rock Top	Treat in pure pine to increase the amount of oak and grow larger trees	118	57	506	90
Lee Butte	Treat in dense pine to increase the amount of oak, reduce tree density, and increase tree diameter on slopes to improve habitat and protect nest core	121	1	328	314
Foxhole	Dense thickets of pine with some oak, need for enhancing oak and thinning groups	41	124	136	178
Bar M	PAC is part of the mega-cluster of PACs within the Bar-M area, break up contiguous fuels in areas of pure pine, thin out dense clumps of pine and release oaks within clumps, release oaks, provide openings for forage and grow larger trees	119	149	199	66
Sawmill Springs	All size classes of pine and oak present, need for large dbh size classes to enhance and maintain habitat structure	192	63	190	71
Total Mechanical Treatment Acres		3,616	1,423	4,331	1,902

Mechanical treatments would take place within 18 of the 110 PACs occurring within a ¼ mile of the project area boundary (16 percent) under alternative B. This includes 11,272 acres out of 36,455 total PAC acres in the treatment area (31 percent). Only the 18 PACs receiving mechanical treatments are proposed for prescribed burning. Although the implementation schedule is not yet known, an average of 1.8 PACs would be treated per year if 4FRI implementation lasted 10 years. On average, this equals less than one percent of the PACs across the two forests treated in a given year. Changes in forest structure by individual PAC are shown in Appendix 15.

Forest Structure and Density in MSO Habitat

Large Trees

Treatments would be expected to release large trees from competition with unnaturally dense groups of young pine trees. Expected results would include increasing the ability to retain large trees on the landscape and increasing growth rates of existing and future large trees. Mechanical treatments would be, by design, conservative in protected habitat. Therefore treatment results would be less in protected habitat than they would in restricted “other” habitat. Because of the low intensity of the treatments, only limited differences in distribution of tree size classes between mechanically treated and untreated PACs would be apparent by the year 2050 (Table 56). The percentages of trees 18 to 23.9 inches dbh would show the most improvement, although increases in mechanically treated PACs would typically be less than five percent at the subunit level compared to the no action alternative (Appendix 15). Abundance of trees greater than 24 inches dbh would also show consistent improvement in mechanically treated PACs (Appendix 15). Compared to alternative A, increases in the larger size-classes would result from reducing the over-abundance of trees in the 12 to 17.9 inch size-class as well as improved growth rates in larger trees. More important at the site scale would be the increased ability to retain existing large trees after treatment. Likewise, results for TPA greater than 18 inches dbh would be similar but consistently higher after treatments when compared to untreated PACs.

The percent distribution of larger tree size classes would remain unchanged in the burn-only PACs, although TPA greater than 18 inches dbh would increase slightly (Table 56). Modeling does not reflect benefits to vegetation from the nutrient pulse after burning or the benefit of reducing litter and raising the crown base height in these dense stands.

Basal Area

Pine BA would be reduced by about 12 percent in mechanically treated PACs at the RU level (Table 56). The minimum BA for nesting and roosting habitat described in the Recovery Plan is 150 BA, which limits the degree of treatment. Pine BA slightly lowered by only two percent in the burn-only PACs. Gambel oak BA slightly about the same at the PAC and RU levels for all alternatives. However, prescribed burning would contribute towards reducing competition by removing small trees. Total BA would be 148 in thin and burn PACs and 150 in burn-only PACs. Three of four RUs would have BA values of 168 or greater in protected habitat (Table 54 above). While the low intensity treatments in PACs should add to large tree resiliency, protected habitat remains in the “extremely high density” zone 4 where individual tree growth would be minimal and stand mortality would increase.

Canopy Structure

Based on BA and percent maximum SDI, canopy cover would remain dense. Canopy cover would be 50 percent or greater at the stand level, based on BA, TPA, and tree dbh (see silviculture report for details). Therefore, canopy cover within tree groups alone would be higher. Existing

variability in overstory species diversity present before treatment would remain by design. Burning in PACs should improve sub-canopy flight space for MSOs by lifting crown base height. Combined, these factors should maintain the elements of canopy structure such as cover, density, flight space, and species diversity.

Overall, changes in the above structural elements are limited under alternative B, but would move PAC towards desired conditions (Table 56). While treated PACs would show limited change, the objectives behind the treatments were primarily the release of large oak and pine from competition, create irregular spacing, and increase growth rates of the large tree cohort. The fact that the decrease is minimal when averaged across PACs is a reflection of the “light touch” designed for work in MSO PACs. Changes to forest structure by individual PAC are summarized in Appendix 15.

Table 56. Changes in Forest Structure Attributes Within MSO PACs By Alternative. Values Shown Are Model Results for the Year 2050

Forest Attribute	Alternative A ¹	Alternative B ²
PACs With Thinning Outside Core Areas (n = 18)		
12 – 18” dbh (%)	28	27
18 – 23.9” dbh (%)	22	26
≥ 24” dbh (%)	11	13
TPA ≥ 18” dbh	26	28
Ponderosa Pine BA	134	122
Gambel Oak BA	27	26
PACs With Prescribed Burning Outside Core Areas (n = 54)		
12 – 18” dbh (%)	27	27
18 – 23.9” dbh (%)	22	22
≥ 24” dbh (%)	12	12
TPA ≥ 18” dbh	27	28
Ponderosa Pine BA	125	123
Gambel Oak BA	27	27

¹ = No Action Alternative

² = No Treatments Within Core Areas

MSO Prey Habitat

Snags, Logs and Coarse Woody Debris

Total snags greater than 12 inches dbh would decline (Table 57), but snags greater 18 inches dbh would more than double by 2050 (Table 54 above). There would be more than 5 snags per acre greater than 12 inches dbh in PACs with mechanical treatments and over 7 snags per acre in the burn-only PACs. Retaining and improving growth rates of large trees would provide a more robust cohort of trees 18 inches dbh and greater and would thus provide replacement snags in the future.

Logs would decrease by about one per acre in treated PACs (Table 57). The decrease would vary by individual PAC (Appendix 15). Similarly CWD provide consistently decrease by about one to five tons per acre in individual PACs (Appendix 15). Overall, CWD provide decrease an average of about 4 tons per acre in treated PACs. Changes in both metrics provide be a result of the light mechanical treatments and prescribed burning. Both variables provide remain within or above forest plan direction post-treatment, indicating treatments will sustain these components of prey habitat.

Understory Index

Understory response would be slightly higher under alternative B compared to the no action alternative (Table 57). Nevertheless, understory production would remain very low post-treatment as a result of maintaining high canopy cover in nesting and roosting habitat. Therefore, little if any change would be expected in prey populations as a result of these treatments. The modeling for understory does not include the post-fire nutrient pulse or benefits from reducing the pine litter layer. Nevertheless, increased biomass production would represent increased grass and forb development during the growing season, potentially providing site specific improvements in food and cover for arthropods, small mammals and birds. In turn, this could increase localized prey availability, diversity, and total prey biomass for resident MSOs.

Overall, changes in the above structural elements would be moderate in this alternative, providing limited improvements to prey habitat. Relative to the other alternatives, alternative B would treat less than alternative C and more than alternative D. Affects to prey habitat are summarized by PAC in Appendix 15.

Table 57. Changes in Prey Habitat Attributes Within MSO PACs. Values Shown for Logs per Acre and Coarse Woody Debris (CWD) are for the Year 2050; Understory Index (pounds per acre) Results are for the Year 2020.

Forest Attribute	Alternative A1	Alternative B2
PACs With Thinning Outside Core Areas (n = 18)		
Snags/ Ac $\geq$ 12" dbh	6.7	5.6
Logs/ Ac	5.8	5.0
CWD (tons/ac)	10.1	6.7
Understory Index	40	52

Forest Attribute	Alternative A1	Alternative B2
PACs Prescribed Burning (n = 54)		
Snags/ Ac $\geq 12''$ dbh	7.7	7.4
Logs/ Ac	8.2	7.2
CWD (tons/ac)	12.2	9.0
Understory Index	46	55

¹ = No Action Alternative

² = No Treatments Within Core Areas

Fire Risk

Prescribed burning would occur in all 72 PACs in the treatment area (Appendix 16). About 87 percent of PAC acres (31,605 of 36,455 acres) would be burned, including the 18 PACs with mechanical treatments and 54 PACs receiving no other treatments. Expected results from these burns would include lower levels of surface fuels, particularly reduction or elimination of accumulated pine needles. In addition, average canopy base height would likely increase. This would effectively raise the level of the lowest branches in the canopy, raising the crown base height. Reduction of surface fuels and raising canopy base height would reduce the risk of a ground fire becoming a canopy fire. Raising the crown base height would also improve sub-canopy flight space for hunting MSOs.

The amount of ponderosa pine forest occurring in FRCC 3 across the general treatment area would decrease by almost 277,700 acres under alternative B by the year 2020 (Table 58). This would greatly decrease the risk of high-severity crown fire from moving into protected habitat and would increase the odds of managing unplanned ignitions for resource benefits. Combined, this would decrease the fire risk to MSO habitat. While the risk to nesting and roosting habitat would remain high, the decrease in FRCC 3 across the landscape would help mitigate the threat of losing this habitat to high-severity fire.

Table 58. Fire Regime Condition Class (FRCC) Ratings in Ponderosa Pine Forest Through Time Under Alternative B

Conditions	Year	Measure	FRCC1	FRCC2	FRCC3
Existing	2010	Acres	70,680	136,311	297,866
		%	14	27	59
Alt. B	2020	Acres	90,874	393,788	20,194
		%	18	78	4
	2050	Acres	75,729	247,380	181,749
		%	15	49	36

Burning in PACs would occur outside the nesting season. Burning in PACs with the associated design features would be expected to maintain most large logs and CWD (Table 54 above). In addition, future recruitment of large logs would be improved by retaining and enhancing the large tree cohort and improving large tree recruitment.

Fire behavior would shift as a result of prescribed burning. Predicted surface fire would increase in protected habitat by over 23 percent (8,700 acres) in the year 2020 under alternative B (Table 59). Active crown fire would decrease by 21 percent (about 7,796 acres) after treatments. All crown fires are projected to burn as high-severity. Reducing the total acres of crown fire would allow more flexibility in managing future fire to better meet desired conditions, thereby enhancing and maintaining MSO habitat. Prescribed burning in PACs outside core areas would also lower the threat of future fire behavior inside core areas. Appendix 16 displays MSO habitat by type of fire for each alternative.

Table 59. Predicted Fire Behavior in Protected Habitat Under Current Conditions and After Implementation of Alternative B in 2020

MSO Habitat	Total (Ac)	Surface Fire (Ac)	Passive Crown Fire (Ac)	Active Crown Fire (Ac)	Conditional Crown Fire (Ac)	Surface Fire (%)	Passive Crown Fire (%)	Active Crown Fire (%)	Conditional Crown Fire (%)
Existing Condition									
Ponderosa Pine	512,481	313,423	48,523	113,203	31,910	61	9	22	6
Protected	36,757	18,610	3,141	9,930	4,917	51	9	27	13
Alternative B									
Ponderosa Pine	512,481	481,209	16,133	4,573	5,144	94	3	1	1
Protected	36,757	27,319	2,191	2,134	4,953	74	6	6	13

Restricted Habitat

Mechanical treatments would occur on about 73,436 acres or 97 percent of total restricted acres in the treatment area. This includes about 97 percent of the total target and threshold acres. Although the implementation schedule is not yet known, on average 7,344 acres would be treated per year if 4FRI implementation lasted 10 years. On average, this equals about 10 percent of the total restricted habitat treated each year. All restricted habitat (100%) would be treated with prescribed burning.

Forest Structure and Density in MSO Habitat

Treatments in restricted habitat would be expected to maintain and create replacement nesting and roosting habitat while providing a diversity of stand conditions and stand sizes across the landscape. Treatments were designed to develop uneven-aged forest structure, irregular tree spacing, various group sizes, and reestablishing interspace adjacent to tree groups. Large trees and Gambel oak would be released from competition with unnaturally dense groups of young pine trees.

Large Trees

Mechanical treatments would, by design, be conservative in target and threshold habitat and focused on increasing the percent of larger tree size-classes and increasing tree growth rates, in accordance with the Recovery Plan. Therefore treatment results would be of a lower intensity in these habitat classifications than they are in restricted “other” habitat. In target and threshold habitat, the percentage of trees less than 18 inches dbh would decrease by three to five percent while trees 18 to 23.9 inches dbh and trees greater than 24 inches dbh would both increase by one to three percent (Table 60). Overall, each subunit displayed consistent increases in large trees (i.e., greater than 18 inches dbh) under alternative B (Appendix 14). Increases would be higher for threshold habitat in subunits 1-5 and 3-5 where trees 18 to 23.9 inches dbh increased by eight and six percent, respectively (Appendix 14). Results would be similar for TPA greater than 18 inches dbh with modest but consistent improvements: subunit 1-3 would increase by one tree per acre and subunits 1-5 and 3-5 would increase by 5 and 3 TPA, respectively; subunit 3-1 would decrease by 1 tree per acre and subunits 3-2 and 3-3 would not change. The intensity of the treatments are such that target and threshold habitat would remain in density zone 4, at risk from competition-induced mortality and lacking resiliency to large scale stochastic events. Nevertheless, treatments would improve MSO habitat by increasing growth rates of large trees and increasing the percentage of large trees across target and threshold habitat.

Large tree results would also be consistent in restricted “other” habitat across RUs: large decreases (10 to 13 percent) would occur in BA for trees less than 18 inches dbh, indicating the selection of mid-sized trees in the treatment design. The distribution of trees in this size-class would remain at about 15 percent; trees 18 to 23.9 inches dbh would decrease by 2 to 3 percent; and trees greater than 24 inches dbh would more than double. TPA greater than 18 inches dbh would decrease by about half. The results displayed the higher level of treatment intensity that would be applied in restricted “other” habitat. This is the component of MSO habitat outside of nesting and roosting habitat. Increasing the treatment intensity in restricted “other” habitat would allow the creation and maintenance of canopy gaps, uneven-spacing, and uneven-aged forest. Increasing forest heterogeneity while increasing the large tree component would improve MSO habitat by providing for current and future nesting and roosting structure while also increasing foraging potential for prey species. In addition, this would assist in lowering fire risk.

Basal Area

Pine BA would decrease in restricted habitats (Tables 60 and 61). Gambel oak BA would increase in target and threshold habitat and decrease in restricted “other” habitat (Table 60 and 61). Treatments would move stands towards uneven spacing with canopy gaps. Reduced BA and intermittent openings would increase light, moisture, and nutrient availability for herbaceous understory species. These changes would increase forest health and resiliency by moving this habitat to zone density 3, reducing competition-induced mortality and increasing resiliency to large scale stochastic events.

Canopy Structure

Based on BA and percent maximum SDI, canopy cover would remain dense. Canopy cover would be 50 percent or greater at the stand level, based on BA, TPA, and tree dbh (see silviculture report for details). Therefore, canopy cover within tree groups alone would be higher. Existing variability in overstory species diversity would remain by design. Burning in PACs should improve sub-canopy flight space for MSOs by lifting crown base height. Combined, these factors should improve the elements of canopy structure such as cover, density, flight space, and maintain species diversity in the overstory.

Table 60. Changes in Forest Structure Attributes Within MSO Target and Threshold Habitat By Alternative. Values Shown Are Model Results for Subunits Averaged By Restoration Unit for The Year 2050

Forest Attribute	Alternative A	Alternative B
Restoration Unit 1		
12 – 18” dbh (%)	26	21
18 – 23.9” dbh (%)	25	28
≥ 24” dbh (%)	11	13
TPA ≥ 18” dbh	31	33
Ponderosa Pine BA	135	110
Gambel Oak BA	43	47
Restoration Unit 3		
12 – 18” dbh (%)	23	20
18 – 23.9” dbh (%)	23	24
≥ 24” dbh (%)	11	12
TPA ≥ 18” dbh	30	31
Ponderosa Pine BA	116	100
Gambel Oak BA	52	56

Table 61. Changes in Forest Structure Attributes Within MSO Restricted “Other” Habitat by Alternative. Values Shown are Model Results for Subunits Averaged by Restoration Unit for the Year 2050

Forest Attribute	Alternative A	Alternative B
Restoration Unit 1		
12 – 18” dbh (%)	29	17
18 – 23.9” dbh (%)	18	15
≥ 24” dbh (%)	9	20

Forest Attribute	Alternative A	Alternative B
TPA $\geq$ 18" dbh	20	10
Ponderosa Pine BA	121	56
Gambel Oak BA	30	16
Restoration Unit 3		
12 – 18" dbh (%)	27	16
18 – 23.9" dbh (%)	20	16
$\geq$ 24" dbh (%)	9	19
TPA $\geq$ 18" dbh	23	11
Ponderosa Pine BA	114	55
Gambel Oak BA	39	21
Restoration Unit 4		
12 – 18" dbh (%)	25	15
18 – 23.9" dbh (%)	22	18
$\geq$ 24" dbh (%)	12	23
TPA $\geq$ 18" dbh	23	13
Ponderosa Pine BA	109	59
Gambel Oak BA	33	17
Restoration Unit 5		
12 – 18" dbh (%)	29	16
18 – 23.9" dbh (%)	18	15
$\geq$ 24" dbh (%)	12	23
TPA $\geq$ 18" dbh	20	11

Forest Attribute	Alternative A	Alternative B
Ponderosa Pine BA	114	57
Gambel Oak BA	22	11

MSO Prey Habitat

Snags, Logs and Coarse Woody Debris

Snags greater than 18 inches dbh would about double in target and threshold habitat and remain relatively unchanged in restricted “other” habitat. Large snags are currently well below forest plan guidelines and would remain low. Snags greater than 12 inches dbh would decrease, but would remain above 4.7 snags per acre in target and threshold habitat (Table 62). In restricted “other” habitat, snags greater than 12 inches dbh would decrease from about 4 to 5 snags per acre to 1.2 to 1.6 snags per acre. Snags are an important component of nesting and roosting and foraging habitats. The impact of seemingly low snag densities to prey habitat, relative to forest plan guidance, is unclear because of the uncertainty regarding “natural snag levels” in southwest ponderosa pine forests.

Logs would increase in restricted “other” habitat and decrease in target and threshold habitats, but would remain within or above forest plan direction (Table 62). Mechanical treatments likely added to the accumulation of down wood while burning decreased available wood. The changes were somewhat variable by individual subunit (Appendix 14). Projected decreases would still maintain their habitat value for prey species.

Understory Index

Understory response in target and threshold habitat would slightly increase, reflecting the more conservative treatments in this habitat (Table 62, Appendix 14). On average, these changes would equal an increase of about 10 to 20 pounds or more per acre at the RU level compared to the no action alternative. The more pronounced changes in BA and canopy cover in restricted “other” habitat would lead to a much stronger response in understory biomass. Relative understory production increased by 186 to 298 pounds per acre, except for subunit 1-1 where understory biomass increased by about 490 pounds per acre (Appendix 14). On average, this equaled a 4 to 5 fold increase in understory production per acre compared to no action (Table 63). These improvements in understory production would be a short-term increase that would gradually decline as canopies expanded and new trees became established. Increased biomass production represents grass and forb development during the growing season, providing food and cover for arthropods, small mammals and birds. In turn, this can increase prey availability, diversity, and biomass for MSOs.

By separating future potential nesting and roosting habitat into target and threshold habitat, restricted “other” habitat largely provides foraging and dispersal habitat for MSOs. It therefore shows the greatest change in MSO habitat components after treatments. Combined with target, threshold, and protected habitat, treatments in restricted “other” habitat would provide diversity in habitat structure, enhanced prey populations, and increased forest resiliency while still providing for owl dispersal.

Table 62. Changes in Prey Habitat Attributes Within MSO Target and Threshold Habitat by Alternative. Values Shown are Model Results for Subunits Averaged by Restoration Unit. Results for Logs Per Acre and Coarse Woody Debris (CWD) are for the Year 2050; Understory Index Results (lbs per acre) are for the Year 2020

Forest Attribute	Alternative A	Alternative B
Restoration Unit 1		
Snags/ Ac $\geq 12''$ dbh	6.5	4.7
Logs/ Ac	9.1	6.7
CWD (tons/ac)	12.3	6.9
Understory Index	36	55
Restoration Unit 3		
Snags/ Ac $\geq 12''$ dbh	6.7	5.0
Logs/ Ac	7.6	6.0
CWD (tons/ac)	11.5	6.9
Understory Index	32	45

Table 63. Changes in Prey Habitat Attributes Within MSO Restricted “Other” Habitat by Alternative. Values Shown are Model Results for Subunits Averaged by Restoration Unit. Results for Logs Per Acre And Coarse Woody Debris (CWD) are for the Year 2050; Understory Index Results (lbs per acre) are for the Year 2020.

Forest Attribute	Alternative A	Alternative B
Restoration Unit 1		
Snags/ Ac $\geq 12''$ dbh	5.1	1.3
Logs/ Ac	3.8	4.0
CWD (tons/ac)	8.0	4.6
Understory Index	77	364

Forest Attribute	Alternative A	Alternative B
Restoration Unit 3		
Snags/ Ac $\geq$ 12" dbh	5.6	1.4
Logs/ Ac	4.7	4.8
CWD (tons/ac)	8.7	5.2
Understory Index	53	305
Restoration Unit 4		
Snags/ Ac $\geq$ 12" dbh	5.1	1.6
Logs/ Ac	4.4	4.8
CWD (tons/ac)	7.7	4.8
Understory Index	61	262
Restoration Unit 5		
Snags/ Ac $\geq$ 12" dbh	4.1	1.2
Logs/ Ac	2.9	3.5
CWD (tons/ac)	6.5	3.9
Understory Index	65	283

Fire Risk

Prescribed burning, along with mechanical treatments, would occur across 76,091 acres of restricted habitat, including 8,713 acres of target and threshold habitat. An additional 2,655 acres of burn-only treatments would occur in restricted habitat with just over 300 acres of burn-only prescriptions in target and threshold habitat.

The amount of ponderosa pine forest occurring in FRCC 3 across the general treatment area would decrease to zero in 2020 under alternative C, a reduction of nearly 298,000 acres (Table 64). This change would greatly decrease the risk of high-severity crown fire moving into protected habitat and increase the odds of managing unplanned ignitions for resource benefits. Combined, this would decrease the fire risk to MSO habitat. While the risk within nesting and

roosting habitat would remain high, the decrease in FRCC 3 across the landscape would help mitigate the threat of losing this habitat to high-severity fire.

Table 64. Fire Regime Condition Class (FRCC) Ratings in Ponderosa Pine Forest Through Time Under Alternative B

Conditions	Year	Measure	FRCC1	FRCC2	FRCC3
Existing	2010	Acres	70,680	136,311	297,866
		%	14	27	59
Alt. B	2020	Acres	95,923	408,934	0
		%	18	78	4
	2050	Acres	80,777	257,477	166,603
		%	15	49	36

The threat of crown fire in restricted habitat would be reduced in the year 2020 compared to existing conditions, with a 37 and 46 percent reduction in target and threshold and restricted “other” habitats, respectively (Table 65). All crown fire is expected to burn as high-severity (fire ecology report). The dominance of surface fire in restricted habitat (90 and 95 percent in restricted “other” and target and threshold habitats, respectively) reduces the risk of stand replacing fire in MSO habitat. Overall, thinning and burning treatments are projected to move restricted habitat towards the restoration of low-severity fire behavior. Appendix 16 displays MSO habitat and fire behavior for each alternative.

Table 65. Predicted Fire Behavior in Restricted Habitat Under Current Conditions and After Implementation of Alternative B in 2020

MSO Habitat	Total (Ac)	Surface Fire (Ac)	Passive Crown Fire (Ac)	Active Crown Fire (Ac)	Conditional Crown Fire (Ac)	Surface Fire (%)	Passive Crown Fire (%)	Active Crown Fire (%)	Conditional Crown Fire (%)
Existing Condition									
Ponderosa Pine	512,481	313,423	48,523	113,203	31,910	61	9	22	6
Target/Threshold	8,713	4,292	926	2,854	625	49	11	33	7
Restricted	67,378	35,465	6,608	20,764	4,423	53	10	31	7
Alternative B									
Ponderosa Pine	512,481	481,209	16,133	4,573	5,144	94	3	1	1
Target/Threshold	8,713	8,236	109	243	110	95	1	3	1
Restricted	67,378	60,373	6,512	357	18	90	10	1	0

More mechanical treatments and the more open nature of foraging habitat (versus nesting and roosting habitat) would allow for fire to achieve more fuels reduction in restricted habitat outside of target and threshold habitat (67,378 acres). In addition, treated areas outside of MSO habitat would be moved closer towards the historical range of variation, thereby decreasing the threat of high-severity crown fire reaching MSO habitat.

Other Habitat Changes

Meadows and Aspen

Meadow and aspen treatments would not include mechanical tree removal within PACs. Operational burning would occur on 135 acres of meadow habitat within 12 PACs. This would represent an average of 11 acres of meadow burned in each PAC (range = 1 to 11 acres). Operational burns would be conducted in areas where the objective is get fire into adjacent ponderosa pine stands without creating additional firebreaks in non-ponderosa pine habitat. This is different from vegetation-based prescriptions that include actually changing elements of habitat structure. No encroaching trees would be removed from meadow habitats.

Aspen treatments would consist of prescribed burning only on 191 acres in six PACs (five PACs on the Coconino NF and Kendrick PAC on the Kaibab). Returning fire into these habitats would be expected to improve understory vegetation. However, because of the nature of nesting and roosting habitat, burn prescriptions are expected to be light so that burn severity remains low. Prescribed burning would have site-specific objectives in aspen (versus operational burning), but with the nature of aspen understories and the lack of mechanical vegetation manipulation, a patchy, low severity fire can be expected with little or no effects to competing and overtopping pine trees. Therefore, no change would be expected in terms of shading aspen and the competition for water and nutrients. Litter levels would be reduced within aspen clones. The expected results from aspen and meadow treatments in PACs would be a small increase in aspen suckering and a small and short-term increase in understory biomass. These changes would provide small and short-term benefits in localized prey habitat.

At the scale of 4FRI, improvements to prey habitat through spring, ephemeral channel (common to all alternatives), meadow, and aspen treatments within protected habitat would be limited and site specific. However, these treatments would enhance prey habitat and benefit resident owls. MSO reproductive success appears tied to prey availability. MSOs in the UGM RU feed primarily on peromyscid mice and voles (Ganey et al. 2011) and restoration treatments can benefit these species (Kalies et al. 2012). Other small mammals, birds, and nocturnal flying insects (primarily lepidopterans and coleopterans) are also prey for MSOs and overall prey abundance may be very important to nesting MSOs, particularly during years when key species may be limited (Ganey et al. 2011). In general, small mammals, birds, and arthropods would increase after burning and thinning in ponderosa pine forests (Appendix 8). This is particularly true for key habitat components like meadows, springs, etc., where herbaceous response would be expected to exceed that under dense forest canopies, providing large increases in food and cover in localized patches of prey habitat.

At least 6,124 acres of grassland and meadow treatments would occur in restricted habitat. Under alternative B, about 3,870 acres of grassland treatments would be operational burn only. Tree encroachment would not be expected to be addressed in grassland habitat. Nevertheless, benefits to meadows would occur by reducing surface fuels and creating a nutrient pulse into the mollisol soils. In addition, this would preclude the need to create firelines to prevent prescribed fire from

neighboring ponderosa pine forest from entering into this entering non-ponderosa pine habitat. Large meadows can blend into small grasslands, hence some of the grassland acreage represents meadows habitat that would be more likely used by MSOs. In addition, portions of grassland treatments would likely function as MSO foraging habitat, e.g., areas where owls could forage some distance in from forest edges or from groups of trees within portions of the grassland. In addition, Navajo Mogollon voles may disperse from grasslands into surrounding forest. Therefore, meadow and an unknown percentage of grassland treatments would be expected to improve understory conditions for MSO prey species. However, operational burning is only expected to cause minimal tree mortality and would not change overstory canopy, limiting the potential vegetative response in meadows. An additional 2,254 acres of grassland/meadow habitat that currently functions as pine forest would be restored, including both mechanical removal of trees and prescribed burning. These acres would provide additional habitat where understory vegetation would be expected to respond strongly, providing food and cover for MSO prey species.

Aspen treatments would include about 200 acres of prescribed burn-only and about 740 acres of aspen restoration in restricted habitat. Prescribed burning alone would decrease litter and potentially kill young pine, essentially helping to maintain or slow the decrease in aspen clone viability whereas aspen restoration would include mechanical removal of encroaching pine, scarifying soils to stimulate aspen suckering, and to increase surface fuels to better carry fire beneath aspen overstories where fuel loading can be patchy. This difference would be expected to improve the health and resiliency of aspen clones, move stands towards multiple canopy layers, and provide for a more robust understory response. Fencing or other barriers would be constructed after treatments to prevent ungulate grazing within aspen clones. The resulting effects to prey habitat would include both short- and long-term improvements in understory vegetation and overstory aspen health and sustainability in 79 percent of the treated aspen (740 acres).

Burn-only treatments in aspen would be expected to provide limited benefits to MSO because of the patchy nature of burning in this habitat and the limited mortality response of pine trees. The limited change in the overstory would continue the competition between pine and aspen and understory vegetation, limiting aspen and understory response. Burn-only treatments would not require fencing or other barriers to prevent ungulate grazing within aspen clones. Little change to prey habitat or long-term improvements in aspen health is expected. Burn-only aspen treatments would result in a slight and short-term only improvement in understory vegetation in 21 percent of the aspen with little change expected in aspen sustainability (200 acres).

Disturbance

Disturbance could occur as a result of project-related activities including moving and operating harvest machinery, hauling forest materials, building fire line, managing prescribed burns, smoke, personnel in the field, and road maintenance and construction. Noise disturbance from project activities may disturb MSO. Alternative B would mechanically treat 84,177 acres.

Noise would not be expected to disturb nesting or roosting MSO because of project planning intended to minimize disturbance to nesting and roosting owls. Haul routes either avoid PACs, occur more than a ¼ mile from core areas, or employ timing restrictions to avoid disturbance during the nesting season.

Alternative B would prescribe burn 107,696 acres. Roads, natural barriers, or new fire line would be built to prevent fire from entering core areas. Building line would occur outside the nesting

season. Noise and smoke related to burning could disturb owls. Design features would include timing restrictions so that habitat in and around PACs would not be prescribed burned during the breeding season (March 1 to August 31). The area excluded from burning around PACs would be determined on a PAC by PAC basis. Roads, topography, and prevailing weather patterns would be identified so that an adequate buffer would be defined around PACs. Burning within the buffer would be conducted in association with PAC burning outside the breeding season. Site-specific buffers would be designed so that noise and settling smoke from burning outside the buffer would not disturb resident owls in the PACs during the breeding season. Appropriate distances for individual PACs would be decided by biologists, fuels specialists, and the USFWS. As a result, smoke and noise are not expected to result in negative effects to MSO.

Direct and Indirect Effects

Treatment design, project design criteria, and mitigation would be implemented to be compliant with Recovery Plan guidelines and forest plans as amended. Management activities in PACs and protected habitat are designed to retain and improve nesting and roosting structure. Thinning treatments within PACs are designed to increase growth and retention of large pine and oak trees, benefiting PACs most threatened with loss of these habitat components. Treatments within PACs would occur outside of the breeding season. Mechanical thinning and prescribed burning activities would provide for long-term sustainability of MSO habitat components. Core areas would not be treated mechanically or with prescribed fire in alternative B. Therefore nesting and roosting habitat within PACs would continue to develop slower, relative to treated stands of similar habitat, and old trees would continue to be at risk due to forest health issues. Surface fuels would remain high in core areas, potentially creating higher severity fire effects if these stands were to burn. However, reduced threat of high severity crown fire from outside MSO habitat, combined with reductions in wildfire threat within MSO habitat, increases sustainability of these habitats. Vegetation associated with springs and ephemeral channels within PACs would be increased, providing food and cover for prey species. Meadows and aspen would be burned in protected habitat, potentially benefiting habitat for prey species. Short-term impacts may occur to individual MSO, e.g., owls foraging outside of PACs during crepuscular hours. Long-term benefits to MSO habitat and prey habitat would occur in terms of improved forest structure and reduced threats from stochastic events. Smoke from prescribed fire could potentially affect nesting owls and developing nestlings.

Restricted habitat would be managed for sustainable long-term forest stand structure by implementing combinations of group selection cuttings arranged to spatially distribute groups of trees and canopy openings, moving towards Recovery Plan and forest plan guidelines, as amended. The proposed changes to forest structure in restricted habitat are designed to retain or develop MSO nesting and roosting habitat in target and threshold stands while moving towards habitat sustainability, thereby decreasing the risk of large scale stochastic events. In restricted “other” habitat. MSO prey habitat would benefit from the creation of openings between tree groups, meadow improvement, and conducting aspen restoration in restricted habitat, all of which would increase understory food and cover.

The combination of mechanical treatments and low severity burning would lessen potential fire behavior after treatments are implemented. Post-treatment fires would be more likely to burn as surface fires rather than crown fires which more closely resemble the historical range of variation.

Road decommissioning would reduce disturbance to MSOs, improving owl habitat quality in the long-term. Work related to road maintenance, construction, and relocation inside of PACs would

occur outside the nesting season, but could create noise, potentially disturbing roosting owls in the short-term. Haul routes for removing harvested materials would avoid areas within a quarter mile of core areas or implement timing restrictions. By phasing project activities, not all MSO habitats would be treated simultaneously, thus lessening the impacts.

Activities associated with spring, ephemeral channel restoration, and meadow and aspen treatments in PAC habitat would occur outside the nesting season, but could create noise that could potentially disturb roosting MSOs. Because project implementation will be phased, not all MSO habitats would be treated simultaneously, lessening disturbance to MSOs.

Mechanical thinning and low severity prescribed burning would result in little change to overall forest structure in protected habitat. However, thinning is designed to release large oak and pine and increase growth rates of trees greater than 18 inches dbh. Treatments would increase long-term development and retention of this limited component of MSO habitat. Prescribed burning would reduce litter and increase crown base height. Combined, these changes should decrease future fire severity. Thinning and low severity prescribed burning would bring slight improvements to prey habitat in terms of understory vegetation in protected, target, and threshold habitats in the short-term. Understory biomass would increase by 100s of pounds of forage in restricted “other” habitat relative to the other MSO habitats and would persist longer due to creation of interspaces. Increasing growth rates of mature and old growth trees and retaining existing large trees will indirectly contribute to maintaining large snags, logs, and CWD across the landscape in the long-term.

Proposed changes to forest structure in restricted habitat are designed to retain or enhance MSO nesting and roosting habitat in target and threshold stands while moving towards the ecological capacity in restricted “other” habitat. These changes would primarily result from reductions of mid-aged trees 12 to 18 inches dbh. Impacts to MSO from implementation would be reduced by phasing project activities across the treatment area.

Fire risk would decrease in PACs as a result of treatments, but the decrease would be much less than in other habitats because of the small scale of change in forest structure. Reducing the potential for canopy fire increases the ability to manage unplanned ignitions and increases the potential for additional fuels reduction in future maintenance burns. Increasing the potential for future managed fire decreases the long-term risk of stand-replacing stochastic events.

An additional indirect benefit of the fire treatments is additional inputs of soil nutrients, benefiting both over- and understory vegetation and thereby improving the habitat of MSOs and their prey. Prescribed burning across MSO habitats also reduces litter, thereby improving the potential for improvements in the understory. These improvements would include 72 PACs outside core areas. PACs are the most heavily used portion of an owl pair’s territory. Improvements in prey habitat within PACs should indirectly benefit nesting owls. Moving towards the desired condition in MSO habitat would include reductions in total BA, increasing relative contributions of Gambel oak to soil resources, and increased solar radiation reaching the understory, all of which should improve prey habitat.

Road closures, road relocations, and improvements and restoration of key habitats would also improve habitat for prey species by decreasing human disturbance and increasing habitat serving as food and cover. Large snag longevity would, on average, increase with decreased access by firewood cutters. Grasses, sedges, flowering forbs, and woody shrubs would benefit from spring

and channel restoration and meadow/grassland and aspen treatments, all of which would benefit MSO prey. While small in scale and limited in scope, these actions target site-specific micro-habitats important to small mammals, birds, and arthropods and so increase total prey biomass. Improving connectivity of herbaceous undergrowth could improve arthropod populations. This in turn could indirectly benefit MSO prey species through increased food availability (i.e., arthropod availability) and improved habitat (from increased pollinator populations). Total treated acres in these prey habitats are nearly the same in alternatives B and C, only differing by 19 fewer acres of aspen treatment. However, meadow and grassland treatment intensity is much lighter in alternative B, largely consisting of operational burns only. Therefore, expected benefits to herbaceous vegetation is less under this alternative than in alternative C. Understory response would be expected to be stronger in restricted habitat where, in general, greater reductions in canopy cover, and more openings would be created. Improvements in prey habitat should benefit prey species. Increases in prey populations should indirectly benefit MSOs.

Alternative B - Determination of Effects for MSO

The determination of effects for the Mexican spotted owls and their habitat is based on design criteria, mitigation, proposed forest plan amendments, the above effects discussion, and the following:

- By design, mechanical thinning and prescribed burning within MSO protected habitat would follow the intent of the MSO Recovery Plan and respective forest plan guidelines as amended; prescribed burning would not occur within or adjacent to PACs during the breeding season
- By design, mechanical thinning and low severity prescribed burning within threshold, target, and other restricted habitat would follow MSO Recovery Plan and respective forest plan guidelines as amended
- Mechanical thinning in 18 PACs and low severity prescribed burning in 72 PACs, excluding core areas, may cause short-term displacement to foraging and roosting MSOs outside the breeding season
- Improving stand structural and spatial conditions would meet short-term objectives of improving overall forest health and long-term objectives of increased forest resiliency
- Fire behavior in protected habitat would be changed in this alternative, with 74 percent of the area supporting surface fire in 2020 and only six percent of the area at risk from active crown fire
- About 20 percent of the total road miles in 58 PACs would be decommissioned after treatment activities, lessening the amount of long-term disturbance to MSOs and their prey that is associated with access; road segments in three PACs, including core habitat in one PAC, and in restricted habitats would be relocated to provide long-term protection for ephemeral stream channels and the habitat they support
- Fire and smoke effects from prescribed burning may disturb individual birds in and adjacent to the treatment area, but timing restrictions and low severity burn prescriptions would reduce impacts and largely lead to no or only short-term effects; however, the amount of burning across the landscape under this alternative creates the potential of smoke settling into a PAC which, if this did occur, could potentially lead to adverse effects to individual owls

- Post-treatment growth rates of trees would increase, tree resiliency to drought and insects would improve, and more of the total BA would be occurring in larger size classes, improving MSO habitat components in both the short- and long-term
- Large snags (greater than 18 inches dbh) are currently below forest plan guidelines; future snag recruitment is expected through existing insect and disease activities and impacts of low severity prescribed burning. Snag development is expected to occur as more trees attain larger size-classes and meet the size-class distribution recommended in the Recovery Plan; snag retention would improve through road decommissioning; over the long-term, snag development and retention is expected to improve after project implementation
- Key sites that can support diverse and abundant understory vegetation within MSO habitats would be improved or restored for both the short- and long-term around 28 springs, along 5 miles of ephemeral channels, in 3,870 acres of meadows, and 940 acres of aspen stands
- The development of 8,412 acres of restricted target and threshold habitat would be managed towards meeting 150-170 BA for long-term MSO nest and roost habitat as recommended in the existing Recovery Plan (USDI FWS 1995)
- Total treatments in MSO habitat include 84,177 acres of mechanical thinning and 107,696 acres of low severity prescribed burning and would provide for understory grass/forb/shrub release to improve habitat components for MSO prey species; improvements would be maximized in the short-term and while improvements would decline, they would be maintained above existing conditions over the long-term
- Thinning and low severity prescribed fire on 67,378 acres of restricted “other” habitat would provide for “groupy” tree structure and canopy gaps resembling historical conditions at spatial scales capable of reestablishing understory regeneration and reducing risk of active crown fire over both the long- and short-term
- Implementing both mechanical and prescribed burn treatments would reduce hazardous fuel loads, reducing the potential for future stand replacing, high-severity crown fire and also protecting soil resources by reducing severity of ground fires over both the long- and short-term; however, these benefits would decrease in the long-term without maintenance burning
- Alternative B would preserve current old growth habitat and develop old growth components in 100 percent of the stands within MSO protected, target, and threshold habitats (45,168 acres) and additional acreage in restricted other stands meeting specific criteria (see Silviculture report), sustaining key MSO habitat components over the long-term
- Forest conditions within the historical range of variability (FRCC 1) would be returned to 18 percent of the landscape by the year 2020, thus reducing the potential for large-scale MSO habitat loss from high-severity crown fire; while this benefit decreases in the long-term, the amount of area in FRCC 1 remains higher in alternatives B and C compared to existing conditions or alternative D, providing both short- and long-term benefits
- Forest conditions moderately altered from the historical range of variability (FRCC 2) would be returned to 78 percent of the landscape by the year 2020, thus reducing the potential for large-scale MSO habitat loss from high-severity crown fire; while this benefit decreases in the long-term, the amount of area in FRCC 2 remains higher compared to existing conditions, providing both short- and long-term benefits

- Alternative B reduces the FRCC 3 to four percent in the year 2020 and by 2050 about a third of the ponderosa pine forest (36 percent) would move into FRCC 3, providing both short- and long-term benefits relative to the historical range of variability

MSO stratified habitat will provide for a mosaic of desired stand structure conditions post-treatment, improving habitat heterogeneity and vegetative diversity in both short- and long-term. This mosaic would allow for a diversity of future fire effects, thereby increasing opportunities for the maintenance of forest structure and function using planned and unplanned ignitions into the future (up to 30 years).

Based on the above discussion, it is my determination that implementing alternative B would provide and sustain long-term nesting and roosting habitat while reducing potential risk of high severity wildland fire and other stochastic events. To mitigate adverse effects associated with treatments within protected habitat, no treatments would occur during the breeding season and no activities would occur within the core area. Unintended smoke settling in PACs could adversely affect egg development by flushing the incubating female or affect nestling development. Overall, actions related to vegetation manipulation, burning, and noise disturbance while **implementing alternative B may affect, but are not likely to adversely affect the Mexican spotted owl.**

Alternative C

Under alternative C, the minimum post-treatment BA for nesting and roosting habitat would be 110 ft² per acre, in line with the draft recovery plan (USDI FWS 2011). No trees greater than 24 inches dbh would be removed and tree groups with diameters averaging 18 inches dbh or greater would not be cut for regeneration. Meadow and aspen treatments in MSO habitat would occur in this alternative. Mechanical treatments and two low-severity prescribed burns would occur within the project timelines. Mechanical treatments would occur in portions of all MSO habitats except for core areas. Low severity prescribed burning will be applied to all MSO habitats, including core areas (Table 66).

Table 66. Alternative C Summary of Burning and Mechanical Treatments in MSO Pine-Oak Habitat

Treatment Type*	MSO Habitat Type			
	Protected	Restricted	Target/ Threshold	Total Acres
Burn Only	25,714	4,187	301	30,202
MSO Restricted – Group Selection & Intermediate Thinning + Burning		63,191		63,191
MSO Target – Intermediate Thinning + Burning			6,518	6,518
MSO Threshold – Intermediate Thinning + Burning			1,894	1,894
PAC – Intermediate Thinning ≤18" + Burning	10,741			10,741
Total	36,455	67,378	8,713	112,546

Alternative C mechanically treats 82,344 acres and prescribe burns 112,546 acres of prescribed burning in protected and restricted habitat (Appendix 14). This is 1,835 fewer acres of mechanical treatment in restricted habitat and 4,850 additional acres of prescribed burning in protected habitat than alternative B. Fewer acres of mechanical treatment are a result of 4FRI support for research addressing fundamental aspects of the ecology in ponderosa pine systems (see page XXX of the DEIS). The additional burn-only acres are 56 PAC core areas excluded from treatment in the other alternatives. An overview of immediate post-treatment results (year 2020) and long-term changes to habitat structure (year 2050) are displayed at the RU-level in Table 67.

BA and percent maximum SDI would both remain high in target and threshold habitat and in protected habitat, reflecting the desired condition in nesting and roosting habitat and the light intensity of the proposed treatments. Although this alternative would treat PACs using a lower minimum value in PAC habitat relative to the other action alternatives, only 18 PACs are proposed for treatment, so the effect would be limited when averaged across all the remaining PACs. BA and percent maximum SDI values would be slightly lower in alternative C, but the differences between this and the other action alternatives are within several percentages. Increases in percent area for trees greater than 18 inches dbh, including trees greater than 24 inches dbh would occur. Trees 12 to 18 inches dbh would decrease in all habitat classifications but remain above 20 percent in target and threshold habitat and in protected habitat and above 15 percent in restricted “other” habitat. The number of average trees per acre 18 inches or greater increased across all habitats in all RUs. The percent of oak BA typically remained the same or decreased by a percent in protected and target and threshold habitats and decreased by a percentage point in restricted “other” habitat. CWD increased across all RUs. Snags greater than 18 inches dbh increased in target and threshold habitat and in protected habitat and typically remained unchanged in restricted “other” habitat.

Table 67. Alternative C - 2020 and 2050 Spotted Owl Habitat Forest Structure and Habitat Components

RU	Basal Area		% Max SDI		Avg. Percent of Total SDI by Size Class						Avg. TPA 18”+		Avg. Gambel Oak BA Percent of Total BA		Tons CWD >12”		Snags >18”	
					12.0 – 17.9”		18.0 – 23.9”		24.0” +									
	20	50	20	50	20	50	20	50	20	50	20	50	20	50	20	50	20	50
Restricted Target/ Threshold																		
RU 1	132	167	68%	79%	23%	22%	20%	21%	10%	12%	18.4	24.2	28%	27%	1.3	2.0	.5	1.2
RU 3	142	176	75%	84%	22%	20%	19%	19%	10%	13%	18.3	24.2	31%	30%	.8	1.7	.7	1.4
All	136	171	71%	81%	23%	21%	20%	20%	10%	12%	18.3	24.2	29%	28%	1.1	1.9	.6	1.3
Restricted Other																		
RU 1	74	107	35%	46%	22%	20%	22%	19%	19%	19%	11.3	16.7	19%	18%	.8	1.5	.9	.8
RU 3	81	115	38%	50%	22%	19%	22%	19%	17%	18%	11.5	17.4	24%	23%	.8	1.7	1.0	1.0
RU 4	80	115	39%	52%	20%	17%	21%	17%	19%	19%	11.4	16.4	26%	25%	.7	1.6	1.0	1.0
RU 5	64	98	30%	42%	21%	21%	17%	15%	21%	18%	8.3	12.9	13%	15%	.4	1.0	.6	.6
All	78	112	37%	49%	22%	19%	22%	19%	18%	19%	11.4	17.0	22%	21%	.8	1.6	1.0	.9

RU	Basal Area		% Max SDI		Avg. Percent of Total SDI by Size Class						Avg. TPA 18''+		Avg. Gambel Oak BA Percent of Total BA		Tons CWD >12''		Snags >18''	
					12.0 – 17.9''		18.0 – 23.9''		24.0'' +									
	20	50	20	50	20	50	20	50	20	50	20	50	20	50	20	50	20	50
Protected																		
RU 1	151	173	70%	74%	32%	27%	18%	25%	9%	13%	17.8	28.2	14%	14%	.7	2.0	.7	1.7
RU 3	166	188	78%	82%	31%	26%	18%	24%	10%	13%	20.9	31.2	12%	12%	.9	2.4	.8	1.9
RU 4	105	128	49%	55%	35%	38%	14%	24%	5%	8%	10.9	19.9	8%	8%	.4	1.4	.4	1.3
RU 5	143	168	68%	74%	31%	26%	17%	22%	9%	13%	16.9	26.5	12%	11%	.9	2.3	.7	1.7
All	152	174	71%	75%	32%	27%	18%	25%	9%	13%	18.1	28.4	13%	14%	.7	2.1	.7	1.7

Mechanical thinning and prescribed burning would take place at different times in different locations. Spotted owl habitat could be affected by mechanical treatments in one area and prescribed burning in another in any one time period. It is expected implementation of the entire project will require 10 or more years to complete. If work were completed in 10 years, on average about 8,700 acres of MSO habitat would be mechanically treated and 11,255 acres prescribed burned each year under alternative C. No mechanical treatments would occur on slopes greater than 40 percent in MSO habitat.

Protected Habitat

MSO PAC field and data reviews and vegetation simulation modeling indicate mechanical treatment greater than 9 inch dbh would move 18 PACs towards desired conditions. Optimal size classes for trees removed would range from less than 9 inches dbh up to the limit of 18 inches dbh in this alternative (Table 68). Approximately 3,616 acres (32 percent of the total treated acres) would be improved with mechanical treatments removing trees up to 9 inches dbh (Table 68). Treating up to 18 inches dbh in this alternative would allow a greater reduction in competition between large trees (pine and oak) and uncharacteristic competition from smaller size-classes. This would result in better growth rates for large trees in ten separate PACs (634 total acres). These same ten PACs (634 acres) would have 16 inch dbh limits in alternative B. Treatments were adjusted as follows to move PACs towards desired conditions for MSO habitat:

In order to move towards desired conditions for MSO habitat:

- Fifteen PACs (Lake 1/Seruchas, Archies, Red Hill, Holdup, Bonita Tank, Red Raspberry, Knob, T-Six Tank, Iris Tank, Frank, Rock Top, Lee Butte, Foxhole, Bar M, Sawmill Springs) would require thinning up to 12" dbh on 1,423 acres;
- Seventeen PACs (Lake 1/Seruchas, Archies, Red Hill, Holdup, Bonita Tank, Crawdad, Red Raspberry, Knob, T-Six Tank, Iris Tank, Frank, Rock Top, Lee Butte, Mayflower Tank, Foxhole, Bar M, Sawmill Springs) would require thinning up to 14 inch dbh on 4,331 acres,
- Thirteen PACs (Holdup, Red Raspberry, Bear Seep, Crawdad, Knob, Rocktop, Foxhole, Frank, Holdup, Iris Tank, Lee Butte, Mayflower Tank, Rock Top, Bar M, and T-Six Tank) would require 1,268 acres to be thinned up to 16" dbh, and,
- Ten PACs (Bear Seep, Bonita Tank, Crawdad, Frank, Iris Tank, Lee Butte, Mayflower Tank, Red Raspberry, Sawmill Springs, and T-Six Tank) would require thinning up to 18 inch dbh on 634 acres.

The minimum BA targeted for PAC treatments in alternative C is based on recommendations from the USFWS (Hedwall pers. comm. 2011) to use the value reported in the draft MSO Recovery Plan (USDI FWS 2011) of 110 feet² per acre. This revised value is based on the best available science brought forward in the new plan compared to the existing Recovery Plan published in 1995. The change is more of a clarification in analysis than an actual change in recommendations. Originally, the Recovery Team used data from plots and extrapolated that to stand values. Stand values represent a step up in spatial scale from plot data. Any given stand has dense areas (e.g., 150 BA or greater) and open areas that would result in very different plot values. The stand value is an average of multiple plots and therefore can be lower than individual plot values. By using plots selected by MSO, the original analysis inadvertently biased their estimates of stand BA. See **Amendment X** and the draft MSO Recovery Plan (USDI 2011) for more details.

Treatments modeled in alternative C were developed to reduce BA, but remain at or above 110 feet² per acre in stands currently supporting 110 BA or greater. Modeled tree removal started in the smallest size classes first. The vegetation model retained trees in each size class so that current owl habitat characteristics were retained while improving potential future habitat, i.e., modeling was not a simple thin from below exercise. Models were run at each of several size classes for each stand. Optimal treatments were defined as those that met the basal area target and produced the best growth rates. Stands with incomplete data were not proposed for thinning above the 9 inches dbh.

Table 68. General Description and Acres of Mechanical Treatment in Alternative C by PAC (all mechanically treated PACs occur on the Coconino NF)

PAC Name	General Description	MSO PAC Mechanical Treatment and Prescribed Burning (dbh and acres)				
		Treat up to 9" dbh (Acres)	Treat up to 12" dbh (Acres)	Treat up to 14" dbh (Acres)	Treat up to 16" dbh (Acres)	Treat up to 18" dbh (Acres)
Lake No. 1/Seruchos	Dense thickets of VSS3 pine, oak is competing with pine for nutrition, sunlight and moisture, need to grow larger trees over time, enhance oaks, create small openings	146	66	50	0	0
Archies	Pine-oak with strong oak component but few large oak – many pines < 9" dbh	547	41	11	0	0
Red Hill	Scrappy habitat that has been treated with an overstory removal in the past, dense pockets of ponderosa pine with heavy mistletoe infection in areas, thin pine to grow larger trees and reduce fire threat, enhance oak where present, grow larger trees over time and reduce competition	170	207	486	0	0

PAC Name	General Description	MSO PAC Mechanical Treatment and Prescribed Burning (dbh and acres)				
		Treat up to 9" dbh (Acres)	Treat up to 12" dbh (Acres)	Treat up to 14" dbh (Acres)	Treat up to 16" dbh (Acres)	Treat up to 18" dbh (Acres)
Crawdad	Oak is suppressed by high densities of pine, need for creating gaps around oak and releasing individual oak trees	240	0	342	99	21
Holdup	Most of PAC is pure pine, thin around any existing oak and provide areas for oak to establish	159	197	264	18	0
Bonita Tank	Treatments to grow larger trees and release oaks are needed in southern portion of PAC outside of ridges and draws	137	203	429	0	127
Red Raspberry	Diverse topography, protect microclimates from fire, high percentage of VSS 3 and VSS 4, need for enhancing openings, create, retain, and enhance larger trees	489	30	249	46	16
Bear Seep	PAC is pure ponderosa or oak, high density of trees > 9 inch dbh	560	0	0	144	10
Mayflower Tank	PAC has steep slopes, heavy fuels, limited number of small trees	412	0	139	118	99
Knob	PAC has limited habitat, generally pure pine and open with some dense dog-hair thickets	374	26	252	114	0

PAC Name	General Description	MSO PAC Mechanical Treatment and Prescribed Burning (dbh and acres)				
		Treat up to 9" dbh (Acres)	Treat up to 12" dbh (Acres)	Treat up to 14" dbh (Acres)	Treat up to 16" dbh (Acres)	Treat up to 18" dbh (Acres)
T-Six Tank	PAC has dense regeneration, need for removing dense patches of ponderosa pine, maintaining Gambel oak, and thinning dense pine doghair thickets	230	116	279	72	88
Iris Tank	PAC has dense pine with pockets of doghair thickets; oak is present in all size classes but is suppressed by pine, need to release oaks and thin dense pockets of pine and reduce fuels southwest of the nest core	275	13	261	48	102
Frank	PAC has areas of pure pine with dense pockets of VSS3 and VSS4, need to release any oaks present and encourage recruitment of oaks, reduce pine densities and increase diameters of both pine and oak	297	130	212	28	33
Rock Top	Treat in pure pine to increase the amount of oak and grow larger trees	222	57	506	90	0

PAC Name	General Description	MSO PAC Mechanical Treatment and Prescribed Burning (dbh and acres)				
		Treat up to 9" dbh (Acres)	Treat up to 12" dbh (Acres)	Treat up to 14" dbh (Acres)	Treat up to 16" dbh (Acres)	Treat up to 18" dbh (Acres)
Lee Butte	Treat in dense pine to increase the amount of oak, reduce tree density, and increase tree diameter on slopes to improve habitat and protect nest core	224	1	328	247	67
Foxhole	Dense thickets of pine with some oak, need for enhancing oak and thinning groups	146	124	136	178	0
Bar M	PAC is part of the mega-cluster of PACs within the Bar-M area, break up contiguous fuels in areas of pure pine, thin out dense clumps of pine to release oaks within clumps, provide openings for forage and grow larger trees	231	149	199	66	0
Sawmill Springs	All size classes of pine and oak present, but thinning would enhance and maintain large dbh size classes	305	63	190	0	71
Total Mechanical Treatment Acres		3,616	1,423	4,331	1,268	634

Mechanically treatments would take place within 18 of the 110 PACs occurring within a ¼ mile of the project area boundary (16 percent) under alternative C. This includes 11,272 acres out of 36,455 total PAC acres in the treatment area (31 percent). Low severity prescribed burning would occur in all PACs within the treatment area (72), including 18 PACs treated mechanically 54 PACs remaining that would receive burn-only treatments. Although the implementation schedule is not yet known, on average 1.8 PACs would be mechanically treated per year if 4FRI implementation lasted 10 years. On average, this equals less than one percent of the PACs across the two forests getting treated in a given year. About 5.4 PACs (less than 3 percent) would, on

average, be prescribed burned each year. Affects to forest structure within individual PACs is summarized by alternative in Appendix 15.

Forest Structure and Density in MSO Habitat

Large Trees

Treatments would be expected to release large trees from competition with unnaturally dense groups of young pine trees. Expected results would include increasing the ability to retain large trees on the landscape and increasing growth rates of existing and future large trees. Mechanical treatments would be, by design, conservative in protected habitat. Therefore treatment results would be lower in protected habitat than they would in restricted “other” habitat. Because of the low intensity of the treatments, only limited differences in distribution of tree size classes between mechanically treated and untreated PACs would be apparent by the year 2050 (Table 69). The percentages of trees 18 to 23.9 inches dbh would show the most improvement, although increases in mechanically treated PACs were typically less than five percent at the subunit level compared to the no action alternative (Appendix 15). Abundance of trees greater than 24 inches dbh would show consistent improvement in mechanically treated PACs (Appendix 15). Compared to alternative A, increases in the larger size-classes would result from reducing the over-abundance of trees in the 12 to 17.9 inch size-class as well as improved growth rates in larger trees. More important at the site scale is the increased ability to retain existing large trees after treatment. Likewise, results for TPA greater than 18 inches dbh would be similar but consistently higher after treatments when compared to untreated PACs. Gambel oak BA would remain unchanged (Table 69). Prescribed burning would contribute towards reducing competition by reducing numbers of small trees.

The percent distribution of larger tree size classes would remain unchanged in the burn-only PACs, although TPA greater than 18 inches dbh would increase slightly (Table 69). Modeling does not reflect benefits to vegetation from the nutrient pulse after burning or the benefit of reducing litter and raising the crown base height in these dense stands.

Basal Area

Pine BA would be reduced more in alternative C than any other alternative. Overall, it would be lowered to 116 BA, compared to 134 BA in alternative A (Table 69). This reflects using the new recommendation by the MSO Recovery Team of a minimum of 110 BA. Pine BA would be lowered by only three percent in the burn-only PACs. Gambel oak BA was about the same at the PAC and RU levels for all alternatives (Table 69). At the RU scale, three of four RUs would still have BA values of 168 or greater (Table 67 above). While the low intensity treatments in PACs would add to habitat resiliency, protected habitat would remain in the “extremely high density” zone 4 where individual tree growth slightly minimal and stand mortality would increase.

Canopy Structure

Based on BA and percent maximum SDI, canopy cover would remain dense. Canopy cover would be 50 percent or greater at the stand level, based on BA, TPA, and tree dbh (see silviculture report for details). Therefore, canopy cover within tree groups alone would be higher. Existing variability in overstory species diversity would remain by design. Burning in PACs should improve sub-canopy flight space for MSOs by lifting crown base height. Combined, these factors should maintain the elements of canopy structure such as cover, density, flight space, and species diversity.

Overall, changes in the above structural elements would be limited, but alternative C would move PAC habitat more towards desired conditions than other action alternatives (Table 69). While treated PACs would show limited change, the objectives behind the treatments were primarily the release of large oak and pine from competition, create irregular spacing, and increase growth rates of the large tree cohort. The fact that the decrease is minimal when averaged across PACs is a reflection of the “light touch” designed for work in MSO PACs. Changes to forest structure by individual PAC are summarized in Appendix 15.

Table 69. Changes in Forest Structure Attributes Within MSO PACs By Alternative. Values Shown Are Model Results for the Year 2050

Forest Attribute	Alternative A1	Alternative C2
PACs With Thinning Outside Core Areas (n = 18)		
12 – 18” dbh (%)	28	26
18 – 23.9” dbh (%)	22	27
≥ 24” dbh (%)	11	14
TPA ≥ 18” dbh	26	28
Ponderosa Pine BA	134	116
Gambel Oak BA	27	27
PACs With No Thinning (n = 54)		
12 – 18” dbh (%)	27	27
18 – 23.9” dbh (%)	22	22
≥ 24” dbh (%)	12	12
TPA ≥ 18” dbh	27	28
Ponderosa Pine BA	125	122
Gambel Oak BA	27	28

¹ = No Action Alternative

² = Only Prescribed Burning Would Occur Within Core Areas

MSO Prey Habitat

Snags, Logs and Coarse Woody Debris

Total snags greater than 12 inches dbh would decline (Table 70), but snags greater 18 inches dbh would more than double by 2050 (Table 67 above). There would be more than 5 snags per acre

greater than 12 inches dbh in PACs with mechanical treatments and over 7 snags per acre in the burn-only PACs. Retaining and improving growth rates of large trees would provide a more robust cohort of trees 18 inches dbh and greater and would thus provide replacement snags in the future. This important component of MSO and prey habitat would improve through time under this alternative.

Logs would decrease by about one per acre (Table 70). The decrease was variable by individual PAC (Appendix 15). Similarly CWD would consistently decrease by about one to five tons per acre in individual PACs (Appendix 15). Overall, CWD would decrease an average of about 4 tons per acre in treated PACs. Changes in both metrics would be a result of mechanical treatment and prescribed burning, but both variables would remain within or above forest plan direction post-treatment, indicating treatments would sustain these habitat components for MSO prey species.

Understory Index

Understory response would be highest in alternative C. Nevertheless, understory production would remain very low post-treatment. This is a reflection of the high canopy cover in protected habitat. The modeling for understory does not include the nutrient pulse or benefits of reducing the pine litter layer (Appendix 8). However, the resulting nutrient pool would likely benefit the overstory. The trees would presumably increase their nutrient translocation into the canopy, limiting the understory response. Individual PACs receiving both mechanical and prescribed burning treatments would show more variety in understory response, but increases in biomass production would typically be limited to 5 to 15 pounds per acre (Appendix 15). Nevertheless, increased biomass production would represent increased grass and forb development during the growing season, potentially providing site specific improvements in food and cover for arthropods, small mammals and birds. In turn, this could increase localized prey availability, diversity, and total prey biomass for resident MSOs.

Overall, changes in prey habitat structural elements in protected habitat would be moderate, but higher in alternative C than in any other alternative because the greater number of acres treated and higher treatment intensity. Affects to prey habitat are summarized by PAC in Appendix 15.

Table 70. Changes in Prey Habitat Attributes Within MSO PACs. Values Shown for Logs per Acre and Coarse Woody Debris (CWD) are for the Year 2050; Understory Index (pounds per acre) Results are for the Year 2020.

Forest Attribute	Alternative A ¹	Alternative C ²
PACs With Thinning Outside Core Areas (n = 18)		
Snags/ Ac ≥ 12" dbh	6.7	5.2
Logs/ Ac	5.8	4.9
CWD (tons/ac)	10.1	5.9
Understory Index	40	57
PACs With No Thinning (n = 54)		

Forest Attribute	Alternative A ¹	Alternative C ²
Snags/ Ac $\geq$ 12" dbh	7.7	7.3
Logs/ Ac	8.2	7.0
CWD (tons/ac)	12.2	8.2
Understory Index	46	55

¹ = No Action Alternative

² = Only Prescribed Burning Would Occur Within Core Areas

Fire Risk

Prescribed burning would occur in all 72 PACs in the treatment area, including 56 core areas (Appendix 14). Prescribed burning would occur on all 36,455 total PAC acres in the treatment area. Core acres in wilderness, mixed conifer forest, other project areas, or canyons would be excluded from treatment under the 4FRI, even if the treatment area contains most of the PAC acres. Expected results from these burns would include lower levels of surface fuels, particularly reduction or elimination of accumulated pine needles. In addition, average canopy base height would increase. This would effectively raise the level of the lowest branches in the canopy, raising the crown base height. Reduction of surface fuels and raising canopy base height would reduce the risk of a ground fire becoming a canopy fire. Raising the crown base height can also improve sub-canopy flight space for hunting MSOs.

The amount of ponderosa pine forest occurring in FRCC 3 across the general treatment area would decrease to zero in 2020 under alternative C, a reduction of nearly 298,000 acres (Table 71). This change would greatly decrease the risk of high-severity crown fire moving into protected habitat and increase the odds of managing unplanned ignitions for resource benefits. Combined, this would decrease the fire risk to MSO habitat. While the risk within nesting and roosting habitat would remain high, the decrease in FRCC 3 across the landscape would help mitigate the threat of losing this habitat to high-severity fire.

Table 71. Fire Regime Condition Class (FRCC) Ratings in Ponderosa Pine Forest Through Time Under Alternative C

Conditions	Year	Measure	FRCC1	FRCC2	FRCC3
Existing	2010	Acres	70,680	136,311	297,866
		Percent	14	27	59
Alt. C	2020	Acres	95,923	408,934	0
		Percent	19	81	0
	2050	Acres	80,777	257,477	166,603
		Percent	16	51	33

Burning in PACs would occur outside the nesting season. Burning in PACs with the associated design features would be expected to maintain most large logs and CWD (Table 67 above). In addition, future recruitment of large logs would be improved by retaining and enhancing the large tree cohort and improving large tree recruitment.

Fire behavior would shift as a result of prescribed burning. Predicted surface fire would increase in protected habitat by over 27 percent (9,915 acres) in the year 2020 under alternative C (Table 72). Active crown fire would decrease by 23 percent (almost 8,600 acres) after treatments. All crown fires are projected to burn as high-severity. Reducing the total acres of crown fire would allow more flexibility in managing future fire to better meet desired conditions, thereby enhancing and maintaining MSO habitat. Prescribed burning in PACs, including core areas, would lower the threat of future predicted fire behavior in core areas. Appendix 16 displays MSO habitat and fire behavior for each alternative.

Table 72. Predicted Fire Behavior in Protected Habitat Under Current Conditions and After Implementation of Alternative C in 2020

MSO Habitat	Total (Ac)	Surface Fire (Ac)	Passive Crown Fire (Ac)	Active Crown Fire (Ac)	Conditional Crown Fire (Ac)	Surface Fire (%)	Passive Crown Fire (%)	Active Crown Fire (%)	Conditional Crown Fire (%)
Existing Condition									
Ponderosa Pine	512,481	313,423	48,523	113,203	31,910	61	9	22	6
Protected	36,757	18,610	3,141	9,930	4,917	51	9	27	13
Alternative C									
Ponderosa Pine	512,481	482,879	15,508	3,710	4,962	94	3	1	1
Protected	36,757	28,525	1,908	1,335	4,828	78	5	4	13

Restricted Habitat

Mechanical treatments would occur on about 71,603 acres or 94 percent of total restricted acres in the treatment area. This includes about 97 percent of the total target and threshold acres. Although the implementation schedule is not yet known, on average 7,344 acres would be treated per year if 4FRI implementation lasted 10 years. On average, this equals about 10 percent of the restricted getting treated in a given year. All restricted habitat (100%) would be prescribed burned.

Forest Structure and Density in MSO Habitat

Treatments in restricted habitat would be expected to maintain and create replacement nesting and roosting habitat while providing a diversity of stand conditions and stand sizes across the landscape. Thinning objectives in target and threshold habitat would decrease overall BA to between 110 and 150 ft² per acre, as recommended in the draft Recovery Plan. Treatments in restricted habitat would be expected to maintain and create replacement nesting and roosting habitat while providing a diversity of stand conditions and stand sizes across the landscape. Treatments would be designed to develop uneven-aged forest structure, irregular tree spacing and

various patch sizes by thinning tree groups and reestablishing interspace adjacent to tree groups. Large trees and Gambel oak would be released from competition with unnaturally dense groups of young pine trees.

Large Trees

Mechanical treatments would, by design, be conservative in target and threshold habitat and focus on increasing the percent of larger tree size-classes and increasing tree growth rates, in accordance with the Recovery Plan. Therefore treatment results would be of a lower intensity in these habitat classifications than they would be in restricted “other” habitat. Under alternative C, target and threshold habitat would typically have fewer trees in the 12 to 23.9 inches dbh size-classes than the other alternatives and fewer TPA greater than 18 inches dbh as a result of the lower BA objectives (Table 73). Conversely, alternative C would also have more trees greater than 24 inches dbh. This is a result of lower BA targets allowing higher growth rates in the largest trees. Average values by RU are similar among action alternatives.

Large tree results would also be consistent in restricted “other” habitat across RUs: large decreases (10 to 13 percent) would occur in BA for trees less than 18 inches dbh, indicating the selection of mid-sized trees in the treatment design. The distribution of trees in this size-class would remain at about 15 percent; trees 18 to 23.9 inches dbh would decrease by 2 to 3 percent; and trees greater than 24 inches dbh would more than double. TPA greater than 18 inches dbh would decrease by about half. The results display the higher level of treatment intensity that would be applied in restricted “other” habitat. This is the component of MSO habitat outside of nesting and roosting habitat. Increasing the treatment intensity in restricted “other” habitat allows the creation and maintenance of canopy gaps, uneven-spacing, and uneven-aged forest. These changes would improve MSO habitat by increasing forest health and resiliency by moving this habitat to zone density 3, reducing competition-induced mortality and increasing resiliency to large scale stochastic events.

Basal Area

Pine BA would decrease in restricted habitats (Table 73). Pine BA in target and threshold habitat is currently below desired conditions. Gambel oak BA would increase in target and threshold habitat and decrease in restricted “other” habitat (Table 74). Treatments would target uneven spacing with canopy gaps. Alternative C consistently had the lowest BA for pine and the highest BA for Gambel oak compared to the other alternatives. Treatments would target uneven spacing with canopy gaps, thereby improving tree growth in MSO habitat and prey habitat (see below).

Canopy Structure

Based on BA and percent maximum SDI, canopy cover would remain dense. Canopy cover would be 50 percent or greater at the stand level, based on BA, TPA, and tree dbh (see silviculture report for details). Therefore, canopy cover within tree groups alone would be higher. Existing variability in overstory species diversity would remain by design. Burning in PACs should improve sub-canopy flight space for MSOs by lifting crown base height. Combined, these factors should improve the elements of canopy structure such as cover, density, flight space, and species diversity.

Table 73. Changes in Forest Structure Attributes Within MSO Target and Threshold Habitat By Alternative. Values Shown Are Model Results for Subunits Averaged By Restoration Unit for The Year 2050

Forest Attribute	Alternative A	Alternative C
Restoration Unit 1		
12 – 18” dbh (%)	26	20
18 – 23.9” dbh (%)	25	24
≥ 24” dbh (%)	11	14
TPA ≥ 18” dbh	31	28
Ponderosa Pine BA	135	99
Gambel Oak BA	43	50
Restoration Unit 3		
12 – 18” dbh (%)	23	19
18 – 23.9” dbh (%)	23	22
≥ 24” dbh (%)	11	13
TPA ≥ 18” dbh	30	28
Ponderosa Pine BA	116	93
Gambel Oak BA	52	58

Table 74. Changes in Forest Structure Attributes Within MSO Restricted “Other” Habitat by Alternative. Values Shown are Model Results for Subunits Averaged by Restoration Unit for the Year 2050

Forest Attribute	Alternative A	Alternative C
Restoration Unit 1		
12 – 18” dbh (%)	29	17
18 – 23.9” dbh (%)	18	15

Forest Attribute	Alternative A	Alternative C
≥ 24" dbh (%)	9	20
TPA ≥ 18" dbh	20	10
Ponderosa Pine BA	121	56
Gambel Oak BA	30	16
Restoration Unit 3		
12 – 18" dbh (%)	27	16
18 – 23.9" dbh (%)	20	16
≥ 24" dbh (%)	9	18
TPA ≥ 18" dbh	23	12
Ponderosa Pine BA	114	56
Gambel Oak BA	39	21
Restoration Unit 4		
12 – 18" dbh (%)	25	15
18 – 23.9" dbh (%)	22	18
≥ 24" dbh (%)	12	23
TPA ≥ 18" dbh	23	13
Ponderosa Pine BA	109	59
Gambel Oak BA	33	17
Restoration Unit 5		
12 – 18" dbh (%)	29	16
18 – 23.9" dbh (%)	18	15
≥ 24" dbh (%)	12	23

Forest Attribute	Alternative A	Alternative C
TPA $\geq$ 18" dbh	20	11
Ponderosa Pine BA	114	57
Gambel Oak BA	22	11

MSO Prey Habitat

Snags, Logs, and Coarse Woody Debris

Snags greater than 18 inches dbh would about double in target and threshold habitat and remain relatively unchanged in restricted “other” habitat. Large snags are currently well below forest plan guidelines and would remain low. Snags 12 to 18 inches dbh would decrease, but would remain above 3.8 snags per acre in target and threshold habitat (Table 75). In restricted “other” habitat, snags greater than 12 inches dbh would decrease from about 4 to 5 snags per acre to 1.2 to 1.6 snags per acre (Table 76). The impact of seemingly low snag densities to prey habitat, relative to forest plan guidance, is unclear because of the uncertainty regarding “natural snag levels” in southwest ponderosa pine forests.

Logs would increase in restricted “other” habitat and decrease in target and threshold habitats, but would remain within or above forest plan direction (Tables 75 and 76). Mechanical treatments would likely add to the accumulation of down wood while burning decreased available wood. The changes would be variable by individual subunit (Appendix 15). The patterns in these values would be similar to, but consistently lower than alternative B. The difference in alternatives for both metrics was related to the additional prescribed burning in restricted habitat in alternative C. The values for both logs and CWD would remain within or above forest plan direction post-treatment, ensuring the maintenance of prey habitat.

Understory Index

Understory response in target and threshold habitat would increase by 19 to 32 pounds per acre in target and threshold habitat, reflecting the more conservative treatments in this habitat (Table 75). Understory response was greater in target habitat (from about 10 to 76 pounds of biomass per acre) than in threshold habitat (from about 8 to 22 pounds of biomass per acre) (Appendix 15). Overall values would remain low due to the tree density and canopy cover goals associated with nesting and roosting habitat (Appendix 15).

Relative understory production would increase to 262 to 362 pounds per acre in restricted “other” habitat (Table 76). Understory biomass would increase by about 490 pounds per acre in subunit 1-1 (Appendix 15). The changes in BA and canopy cover would lead to a much stronger response in understory biomass in restricted “other” habitat. Increased biomass production represents grass and forb development during the growing season, providing food and cover for arthropods, small mammals and birds. In turn, this can increase prey availability, diversity, and biomass for MSOs.

By separating future potential nesting and roosting habitat into target and threshold habitat, restricted “other” habitat largely provides foraging and dispersal habitat for MSOs. It therefore shows the greatest change in MSO habitat components after treatments. Combined with target, threshold, and protected habitat, treatments in restricted “other” habitat would provide diversity in

habitat structure, enhanced prey populations, and increased forest resiliency while still providing for owl dispersal.

Table 75. Changes in Prey Habitat Attributes Within MSO Target and Threshold Habitat by Alternative. Values Shown are Model Results for Subunits Averaged by Restoration Unit. Results for Logs Per Acre and Coarse Woody Debris (CWD) are for the Year 2050; Understory Index Results (lbs per acre) are for the Year 2020

Forest Attribute	Alternative A	Alternative C
Restoration Unit 1		
Snags/ Ac $\geq 12''$ dbh	6.5	3.8
Logs/ Ac	9.1	6.4
CWD (tons/ac)	12.3	6.6
Understory Index	36	68
Restoration Unit 3		
Snags/ Ac $\geq 12''$ dbh	6.7	4.4
Logs/ Ac	7.6	5.9
CWD (tons/ac)	11.5	6.8
Understory Index	32	51

Table 76. Changes in Prey Habitat Attributes Within MSO Restricted “Other” Habitat by Alternative. Values Shown are Model Results for Subunits Averaged by Restoration Unit. Results for Logs Per Acre And Coarse Woody Debris (CWD) are for the Year 2050; Understory Index Results (lbs per acre) are for the Year 2020.

Forest Attribute	Alternative A	Alternative C
Restoration Unit 1		
Snags/ Ac $\geq 12''$ dbh	5.1	1.3
Logs/ Ac	3.8	4.0
CWD (tons/ac)	8.0	4.6

Forest Attribute	Alternative A	Alternative C
Understory Index	77	362
Restoration Unit 3		
Snags/ Ac $\geq 12''$ dbh	5.6	1.5
Logs/ Ac	4.7	4.8
CWD (tons/ac)	8.7	5.3
Understory Index	53	301
Restoration Unit 4		
Snags/ Ac $\geq 12''$ dbh	5.1	1.6
Logs/ Ac	4.4	4.8
CWD (tons/ac)	7.7	4.8
Understory Index	61	262
Restoration Unit 5		
Snags/ Ac $\geq 12''$ dbh	4.1	1.2
Logs/ Ac	2.9	3.5
CWD (tons/ac)	6.5	3.9
Understory Index	65	283

Fire Risk

Prescribed burning, along with mechanical treatments, would occur across 71,601 acres of restricted habitat, including 8,410 acres of target and threshold habitat. An additional 4,490 acres of burn-only treatments would occur in restricted habitat with just over 300 acres of burn-only prescriptions in target and threshold habitat. The threat of active crown fire in restricted habitat would be reduced in the year 2020 compared to existing conditions, with over a 30 percent reduction in restricted “other” habitat and nearly a 30 percent reduction in target and threshold habitats (Table 77). All crown fire would be expected to burn as high-severity (fire ecology report). The dominance of surface fire in restricted habitat (90 and 94 percent in restricted “other”

and target and threshold habitats, respectively) would reduce the risk of stand replacing fire in MSO habitat. Overall, thinning and burning treatments are projected to move restricted habitat towards the restoration of low-severity fire behavior. Appendix 16 displays MSO habitat and fire behavior for each alternative.

Table 77. Predicted Fire Behavior in Restricted Habitat Under Current Conditions and After Implementation of Alternative C in 2020

MSO Habitat	Total (Ac)	Surface Fire (Ac)	Passive Crown Fire (Ac)	Active Crown Fire (Ac)	Conditional Crown Fire (Ac)	Surface Fire (%)	Passive Crown Fire (%)	Active Crown Fire (%)	Conditional Crown Fire (%)
Existing Condition									
Ponderosa Pine	512,481	313,423	48,523	113,203	31,910	61	9	22	6
Target/ Threshold	8,713	4,292	926	2,854	625	49	11	33	7
Restricted	67,378	35,465	6,608	20,764	4,423	53	10	31	7
Alternative C									
Ponderosa Pine	512,481	482,879	15,508	3,710	4,962	94	3	1	1
Target/ Threshold	8,713	8,194	126	292	85	94	1	3	1
Restricted	67,378	60,623	6,270	349	17	90	9	1	0

More mechanical treatments and the more open nature of foraging habitat (versus nesting and roosting habitat) would allow for fire to achieve more fuels reduction in restricted habitat outside of target and threshold habitat (67,378 acres). In addition, treated areas outside of MSO habitat would be moved closer towards the historical range of variation, thereby decreasing the threat of high-severity crown fire reaching MSO habitat.

Other Habitat Changes

Meadows and Aspen

Meadow and aspen treatments would not include mechanical tree removal within PACs. Operational burning would occur on 100 acres of meadow habitat within 12 PACs. Three of these PACs would include a total of 35 acres of mechanical thinning and burning (i.e., 35 acres of meadow treatment occurs in PACs proposed for mechanical treatments). The combination of mechanical treatments and prescribed burning would be focused on true meadow restoration rather than simply improving meadow habitat. Only alternative C proposes meadow restoration. All meadow treatments combined would average 11 acres of treatment (range = 1 to 11 acres).

Aspen treatments would consist of prescribed burn-only on 209 acres in seven PACs. Returning fire into these habitats would be expected to improve understory vegetation. However, because of

the nature of nesting and roosting habitat, burn prescriptions are expected to be light so that burn severity remains low. Prescribed burning would have site-specific objectives in aspen (versus operational burning), but with the nature of aspen understories and the lack of mechanical vegetation manipulation, a patchy, low severity fire can be expected with little or no effects to competing and overtopping pine trees. Therefore, no change would be expected in terms of shading on aspen and the competition between aspen and pine for water and nutrients. Litter levels would be reduced within aspen clones. The expected results from aspen and meadow treatments in PACs would be a small increase in aspen suckering and a small and short-term increase in understory biomass. These changes would provide small and short-term benefits in localized prey habitat.

At the scale of 4FRI, improvements to prey habitat through spring, ephemeral channel (common to all alternatives), meadow, and aspen treatments within protected habitat would be limited and site specific. However, these treatments would enhance prey habitat and benefit resident owls. MSO reproductive success appears tied to prey availability. MSOs in the UGM RU feed primarily on peromyscid mice and voles (Ganey et al. 2011) and restoration treatments can benefit these species (Kalies et al. 2012). Other small mammals, birds, and nocturnal flying insects (primarily lepidopterans and coleopterans) are also prey for MSOs and overall prey abundance may be very important to nesting MSOs, particularly during years when key species may be limited (Ganey et al. 2011). In general, small mammals, birds, and arthropods increase after burning and thinning in ponderosa pine forests (Appendix 8). This is particularly true for key habitat components like meadows, springs, etc., where herbaceous response would be expected to exceed that under dense forest canopies, providing large increases in food and cover in localized patches of prey habitat.

At least 6,124 acres of grassland and meadow treatments would occur in restricted habitat. Under alternative C, about 135 acres of grassland/meadow treatments would be operational burn only. Tree encroachment would not be expected to be addressed in grassland habitat. Nevertheless, meadows and an unknown percentage of grassland treatments would be expected to improve understory conditions for MSO prey species. However, operational burning is only expected to cause minimal tree mortality and would not change overstory canopy, limiting the potential vegetative response in meadows. About 5,990 additional acres of grassland/meadow would be restored by using both mechanical removal of trees and prescribed burning. These acres would provide additional habitat where understory vegetation would be expected to respond strongly, providing food and cover for MSO prey species, potentially improving prey numbers within grasslands and meadows and allowing for dispersal into surrounding forest.

Aspen treatments in restricted habitat would include about 200 acres of prescribed burn-only and about 740 acres of aspen restoration. Prescribed burning alone would decrease litter and potentially kill young pine, essentially helping to maintain or slow the decrease in aspen clone viability whereas aspen restoration would include mechanical removal of encroaching pine, scarifying soils to stimulate aspen suckering, and increase surface fuels to better carry fire beneath aspen overstories where fuel loading can be patchy. This difference would be expected to improve the health and resiliency of aspen clones, move stands towards multiple canopy layers, and provide for a more robust understory response. Fencing or other barriers would be constructed after treatments to prevent ungulate grazing within aspen clones. The resulting effects to prey habitat would include both short- and long-term improvements in understory vegetation and overstory aspen health and sustainability in 79 percent of the treated aspen (740 acres). MSOs would be expected to benefit from increases in prey abundance.

Burn-only treatments in aspen would be expected to provide limited benefits to MSO because of the patchy nature of burning in this habitat and the limited mortality response of pine trees. The limited change in the overstory would continue the competition between pine and aspen and understory vegetation, limiting aspen and understory response. Burn-only treatments would not require fencing or other barriers to prevent ungulate grazing within aspen clones. Little change to prey habitat or long-term improvements in aspen health is expected. Burn-only aspen treatments would result in a slight and short-term only improvement in understory vegetation in 21 percent of the aspen with little change expected in aspen sustainability (200 acres).

Disturbance

Disturbance could occur as a result of project-related activities including moving and operating harvest machinery, hauling forest materials, building fire line, managing prescribed burns, smoke, personnel in the field, and road maintenance and construction. Noise disturbance from project activities may disturb MSO. Alternative C would mechanically treat 82,344 acres of MSO habitat, about 1,833 acres less than alternatives B or D.

Noise would not be expected to disturb nesting or roosting MSO because of project planning intended to minimize disturbance to nesting and roosting owls. Haul routes either avoid PACs, occur more than a ¼ mile from core areas, or employ timing restrictions to avoid disturbance during the nesting season.

Alternative C would prescribe burn 112,546 acres of MSO habitat. Burning within PACs would include core areas, eliminating the need to build fire lines intended to prevent fire from entering core areas. Noise and smoke related to burning could disturb owls. Design features would include timing restrictions so that habitat in and around PACs would not be prescribed burned during the breeding season (March 1 to August 31). The area excluded from burning around PACs would be determined on a PAC by PAC basis. Roads, topography, and prevailing weather patterns would be identified so that an adequate buffer would be defined around PACs. Burning within the buffer would be conducted in association with PAC burning outside the breeding season. Site-specific buffers would be designed so that noise and settling smoke from burning outside the buffer would not disturb resident owls in the PACs during the breeding season. Appropriate distances for individual PACs would be decided by biologists, fuels specialists, and the USFWS. As a result, smoke and noise are not expected to result in negative effects to MSO.

Direct and Indirect Effects

Treatment design, project design criteria, and mitigation would be implemented to be compliant with Recovery Plan and forest plan guidelines as amended. Management activities in PACs and protected habitat are designed to retain and improve nesting and roosting structure. Thinning treatments within PACs are designed to increase growth and retention of large pine and oak trees, benefiting PACs most threatened with loss of these habitat components. Treatments within PACs would occur outside of the breeding season. Thinning PACs up to 18 inches dbh with an average BA of 110 or more would provide growth rates and retention of large trees at levels exceeding that of any other alternative. Mechanical thinning and prescribed burning activities would provide better long-term sustainability of MSO habitat components than other alternatives.

Core areas would not be treated mechanically but would be treated with prescribed fire in alternative C. Nesting and roosting habitat within PACs would continue to develop slower, relative to treated stands of similar habitat, and old trees would continue to be at risk due to forest health issues. However, development and retention of these attributes would be more pronounced

under alternative C than in any other alternative due to prescribed fire treatments. Surface fuels would be reduced and crown base height raised in core areas, potentially lowering future wildfire severity. The reduced threat of high severity crown fire from outside MSO habitat, combined with reductions in wildfire threat within MSO habitat, including lower tree densities in this alternative, increases sustainability of these habitats.

Vegetation associated with springs and ephemeral channels within PACs would be increased, providing food and cover for prey species. Meadows and aspen would be burned in protected habitat, potentially benefiting habitat for prey species. Short-term impacts may occur to individual MSO, e.g., owls foraging outside of PACs during crepuscular hours. Long-term benefits to MSO habitat would occur in terms of improved forest structure and reduced threats from stochastic events. Smoke from prescribed fire could potentially affect nesting owls and developing nestlings.

Restricted habitat would be managed for sustainable long-term forest stand structure by implementing combinations of group selection cuttings arranged to spatially distribute groups of trees and canopy openings, moving towards Recovery Plan and forest plan guidelines, as amended. The proposed changes to forest structure in restricted habitat are designed to retain or develop MSO nesting and roosting habitat in target and threshold stands while moving towards habitat sustainability, thereby decreasing the risk of large scale stochastic events. In restricted "other" habitat. MSO prey habitat would benefit from the creation of openings between tree groups, meadow improvement, and conducting aspen restoration in restricted habitat, all of which would increase understory food and cover. Overall benefits to MSO restricted habitat would be more pronounced due to lower BA objectives for thinning in alternative C than in the other alternatives.

The combination of mechanical treatments and low severity burning would lessen potential fire behavior after treatments are implemented. Post-treatment fires would be more likely to burn as surface fires rather than crown fires which more closely resemble the historical range of variation. The reduction in risk of habitat loss from future fires is expected to be higher in alternative than other alternatives due to the greater reduction in BA and burn treatments in core areas associated with this alternative.

Road decommissioning would reduce disturbance to MSOs, improving owl habitat quality in the long-term. Work related to road maintenance, construction, and relocation inside PACs would occur outside the nesting season, but could create noise, potentially disturbing roosting owls in the short-term. Haul routes for removing harvested materials would avoid areas within a quarter mile of core areas or implement timing restrictions. By phasing project activities, not all MSO habitats would be treated simultaneously, thus lessening the impacts.

Activities associated with spring, ephemeral channel restoration, and meadow and aspen treatments in PAC habitat would occur outside the nesting season, but could create noise that could potentially disturb roosting MSOs. Because project implementation will be phased, not all MSO habitats would be treated simultaneously, lessening disturbance to MSOs.

Mechanical thinning and low severity prescribed burning would result in little change to overall forest structure in protected habitat. However, thinning is designed to release large oak and pine and increase growth rates of trees greater than 18 inches dbh. Thinning treatments in alternative C are designed to maximize these benefits in PACs most threatened with loss of these habitat

components by treating some PAC stands up to 18 inches dbh and reducing BA to levels currently recommended by the Recovery Team. Prescribed burning would primarily reduce litter and increase crown base height. Combined, these changes should decrease future burn severity and the risk of crown fire in PACs, including core areas. Thinning and low severity prescribed burning would bring slight improvements to prey habitat in terms of understory vegetation in protected, target, and threshold habitats in the short-term. Understory biomass would increase by 100s of pounds of forage in restricted “other” habitat relative to the other MSO habitats and would persist longer due to creation of interspaces. Increasing growth rates of mature and old growth trees and retaining existing large trees will indirectly contribute to maintaining large snags, logs, and CWD across the landscape in the long-term.

Proposed changes to forest structure in restricted habitat are designed to retain or enhance MSO nesting and roosting habitat in target and threshold stands while moving towards the ecological capacity in restricted “other” habitat. These changes will primarily result from reductions of mid-aged trees 12 to 18 inches dbh and lower BA values post-treatment. Impacts to MSO from implementation would be reduced by phasing project activities across the treatment area.

Fire risk will decrease in PACs as a result of treatments, but the decrease will be much less than in other habitats because of the small scale of change in forest structure. Thinning in the 18 selected PACs would go up to 18 inches dbh with a minimum BA of 110 feet² per acre and prescribed fire would be used in all PACs occurring in the treatment area. Reducing the potential for canopy fire increases the ability to manage unplanned ignitions and increases the potential for additional fuels reduction in future maintenance burns. Increasing the potential for future managed fire decreases the long-term risk of stand-replacing stochastic events. The ability to use future fire to better protect MSO habitat will be most effective under alternative C as a result of the minimum BA adopted in protected, target, and threshold habitats, the increased dbh limits designed to maximize benefits in PACs, and prescribed fire treatments in core area that are all part of this alternative.

An additional indirect benefit of the fire treatments is additional inputs of soil nutrients, benefiting both over- and understory vegetation and thereby improving the habitat of MSOs and their prey. Prescribed burning across MSO habitats also reduces litter, thereby improving the potential for improvements in the understory. These improvements would include 72 PACs and 56 core areas. PACs and core areas are the most heavily used portion of an owl pair’s territory. Benefits to nesting owls as a result of improvements in prey habitat within PACs are greatest in this alternative. Moving towards the desired condition in MSO habitat would include reductions in total BA, increasing relative contributions of Gambel oak to soil resources, and increased solar radiation reaching the understory, all of which should improve prey habitat and are maximized in alternative C.

Road closures, road relocations, and improvements and restoration of key habitats would also improve habitat for prey species by decreasing human disturbance and increasing habitat serving as food and cover. Large snag longevity would, on average, increase with decreased access by firewood cutters. Grasses, sedges, flowering forbs, and woody shrubs would benefit from spring and channel restoration and meadow/grassland and aspen treatments, all of which would benefit MSO prey. While small in scale and limited in scope, these actions target site-specific micro-habitats important to small mammals, birds, and arthropods and so increase total prey biomass. Improving connectivity of herbaceous undergrowth could improve arthropod populations. This in turn could indirectly benefit MSO prey species through increased food availability (i.e., arthropod

availability) and improved habitat (from increased pollinator populations). Total treated acres in these prey habitats are nearly the same in alternatives B and C, only differing by 19 fewer acres of aspen treatment. However, meadow and grassland treatment intensity is higher in alternative C, combining mechanical and prescribed burning. Therefore expected benefits to herbaceous vegetation is greater in alternative C. Understory response would be expected to be stronger in restricted habitat where, in general, greater reductions in canopy cover, and more openings would be created. Improvements in prey habitat should benefit prey species. Increases in prey populations should indirectly benefit MSOs.

Alternative C - Determination of Effects for MSO

Alternative C proposes the most treatments in MSO habitat. As a result, more acres of habitat are moved towards desired conditions than under any other alternative. The determination of effects for the Mexican spotted owl habitats is based on design criteria, mitigation, proposed forest plan amendments, the above effects discussion, and the following:

- By design, mechanical thinning and low severity prescribed burning within MSO protected habitat would follow the intent of the MSO Recovery Plan and respective forest plan guidelines as amended; prescribed burning would not occur within or adjacent to PACs during the breeding season
- By design, mechanical thinning and low severity prescribed burning within threshold, target, and other restricted habitat would follow MSO Recovery Plan and respective forest plan guidelines as amended
- Mechanical thinning in 18 PACs and low severity prescribed burning in 72 PACs, including core areas, may cause short-term displacement to foraging and roosting MSOs outside the breeding season
- Improving stand structural and spatial conditions would meet short-term objectives of improving overall forest health and long-term objectives of increased forest resiliency
- Fire behavior in protected habitat would be changed in this alternative, with 78 percent of the area supporting surface fire in 2020 and only four percent of the area at risk from active crown fire
- About 20 percent of the total road miles in 58 PACs would be decommissioned after treatment activities, lessening the amount of long-term disturbance to MSOs and their prey that is associated with access; road segments in three PACs, including core habitat in one PAC, and in restricted habitats would be relocated to provide long-term protection for ephemeral stream channels and the habitat they support
- Fire and smoke effects from prescribed burning may disturb individual birds in and adjacent to the treatment area, but timing restrictions and low severity burn prescriptions would reduce impacts and largely lead to no or only short-term effects; however, the amount of burning across the landscape under this alternative creates the potential of smoke settling into a PAC, potentially leading to adverse effects to individual owls
- Post-treatment growth rates of trees would increase, tree resiliency to drought and insects would improve, and more of the total BA would be occurring in larger size classes, improving MSO habitat components in both the short- and long-term
- Large snags (greater than 18 inches dbh) are currently below forest plan guidelines; future snag recruitment is expected through existing insect and disease activities and impacts of low severity prescribed burning. Snag development is expected to occur as

more trees attain larger size-classes and meet the size-class distribution recommended in the Recovery Plan; snag retention would improve through road decommissioning; over the long-term, snag development and retention is expected to improve after project implementation

- Key sites that can support diverse and abundant understory vegetation within MSO habitats would be improved or restored for both the short- and long-term around 28 springs, along 5 miles of ephemeral channels, in 3,870 acres of meadows, and 940 acres of aspen stands
- The development of 8,412 acres of restricted target and threshold habitats would be managed towards meeting a 110-150 BA for MSO nest and roost habitat as recommended in the draft MSO Recovery Plan (USDI FWS 2011)
- Total treatments in MSO habitat include 82,344 acres of mechanical thinning and 112,546 acres of low severity prescribed burning and would provide for understory grass/forb/shrub release to improve habitat components for MSO prey base; improvements would be maximized in the short-term and while improvements would decline, they would be maintained above existing conditions over the long-term; overall this represents the most acres of MSO habitat improved through treatment and hence the largest understory response of any action alternative
- Thinning and low severity prescribed fire on 67,378 acres of restricted “other” habitat would provide for “groupy” tree structure and canopy gaps resembling historical conditions at spatial scales capable of reestablishing understory regeneration and reducing risk of active crown fire over both the long- and short-term
- Implementing both mechanical and prescribed burn treatments would reduce hazardous fuel loads, reducing the potential for future stand replacing, high severity crown fire and also protecting soil resources by reducing severity of ground fires over both the long- and short-term; however, these benefits would decrease in the short-term without maintenance burning
- Alternative C would preserve current old growth habitat and develop old growth components in 100 percent of the stands within MSO protected, target, and threshold habitats (45,168 acres) and additional acreage in restricted other stands meeting specific criteria (see Silviculture report), sustaining key MSO habitat components over the long-term
- Forest conditions within the historical range of variability (FRCC 1) would be returned to 19 percent of the landscape by the year 2020, thus reducing the potential for large-scale MSO habitat loss from high-severity crown fire; while this benefit decreases in the long-term, the amount of area in FRCC 1 remains higher compared to existing conditions, providing both short- and long-term benefits
- Forest conditions moderately altered from the historical range of variability (FRCC 2) would be returned to 78 percent of the landscape by the year 2020, thus reducing the potential for large-scale MSO habitat loss from high-severity crown fire; while this benefit decreases in the long-term, the amount of area in FRCC 2 remains high in alternative C (similar to alternative B) compared to existing conditions or alternative D, providing both short- and long-term benefits
- Alternative C is the only alternative to reduce FRCC 3 to zero in the year 2020 and by 2050 about a third of the ponderosa pine forest (33 percent) would move into FRCC 3,

providing the best short- and long-term benefits relative to the historical range of variability

This is the only alternative to reduce fire severity within core areas. MSO stratified habitat will provide for a mosaic of desired stand structure conditions, improving habitat heterogeneity and vegetative diversity. This mosaic would allow for a diversity of future fire effects, thereby increasing opportunities for the maintenance of forest structure and function using planned and unplanned ignitions in the future (up to 30 years). Canopy characteristics and surface fuel loading combine to produce combinations of surface fire intensity and physical structure (the height, density, and horizontal and vertical continuity of canopy fuels) that can produce crown fire under a given set of conditions. The closer conditions are to this threshold, the faster it will deteriorate to a point where crown fire is possible. The changes in protected, target, and threshold habitats in alternative C would maximize future opportunities to manage fire and avoid stand replacing events.

Based on the above discussion, it is my determination that implementing alternative C would provide and sustain long-term nesting and roosting habitat while reducing potential risk of high severity wildland fire and other stochastic events. To mitigate adverse effects associated with treatments within protected habitat, no treatments would occur during the breeding season. Unintended smoke settling in PACs could adversely affect egg development by flushing the incubating female or affect nestling development. Overall, actions related to vegetation manipulation, burning, and noise disturbance while **implementing alternative C may affect, but are not likely to adversely affect the Mexican spotted owl.**

Alternative D

Under alternative D, mechanical treatments would occur in portions of all MSO habitats except for core areas (see protected habitat below). However, alternative D would treat the least amount of MSO habitat. Alternative D would treat almost 20,000 fewer acres of MSO habitat than alternative B and nearly 25,000 fewer acres than alternative C. Alternative D would prescribe burn only about four percent of treated MSO habitat (Table 76). The minimum post-treatment BA for nesting and roosting habitat would be 150 ft² per acre, in line with the current recovery plan (USDI 1995). No trees greater than 24 inches dbh would be removed and tree groups with diameters averaging 18 inches dbh or greater would not be cut for regeneration. A comparison of treatments in MSO habitat by alternative is displayed in Appendix 14. Alternative D would mechanically treat 84,178 acres and prescribe burn 3,543 acres of prescribed burning in protected and restricted habitat (Table 76).

Table 76. Alternative D Summary of Treatments in Ponderosa Pine MSO Habitat

Treatment Type*	MSO Habitat Type			
	Protected	Restricted	Target/ Threshold	Total Acres
Burn Only	889	2,354	301	3,543
MSO Restricted – Group Selection/Intermediate Thinning		65,024		65,024
MSO Target – Intermediate Thinning			6,518	6,518

Treatment Type*	MSO Habitat Type			
	Protected	Restricted	Target/ Threshold	Total Acres
MSO Threshold – Intermediate Thinning			1,894	1,894
PAC – Intermediate Thinning ≤16"	10,741			10,741
Total	11,630	67,378	8,713	87,721

An overview of immediate post-treatment results (year 2020) and long-term changes to habitat structure (year 2050) are displayed by RU Table 77. BA and percent maximum SDI would both remain high in target and threshold habitat and in protected habitat, reflecting the desired condition in nesting and roosting habitat and the light intensity of the proposed treatments. Increases in percent area for trees greater than 18 inches dbh, including trees greater than 24 inches dbh would occur. Trees 12 to 18 inches dbh would decrease in most RUs, but remain above 20 percent in target and threshold habitat and in protected habitat and above 15 percent in restricted “other” habitat. The number of average trees per acre 18 inches or greater increased across all habitats in all RUs. The percent of oak BA increased in protected habitat and typically decreased by a percentage point in restricted habitats as a result of prescribed fire. CWD increased across all RUs. Snags greater than 18 inches dbh increased in all habitats.

Table 77. Alternative D - 2020 and 2050 Mexican Spotted Owl Habitat Forest Structure and Habitat Components Based on Weighted Stand Averages

RU	Basal Area		% Max SDI		Avg. Percent of Total SDI by Size Class						Avg. TPA 18”+		Avg. Gambel Oak BA Percent of Total BA		Tons CWD >12”		Snags >18”	
					12.0 – 17.9”		18.0 – 23.9”		24.0” +									
	20	50	20	50	20	50	20	50	20	50	20	50	20	50	20	50	20	50
Restricted Target/ Threshold																		
RU 1	147	176	74%	82%	30%	24%	20%	24%	8%	11%	19.5	28.3	25%	24%	1.9	2.6	.5	1.4
RU 3	152	181	79%	86%	26%	21%	19%	21%	9%	12%	19.0	26.6	29%	27%	1.1	2.1	.7	1.6
All	149	179	76%	84%	28%	23%	19%	23%	9%	11%	19.3	27.6	26%	25%	1.5	2.4	.6	1.5
Restricted Other																		
RU 1	86	123	43%	56%	20%	18%	20%	16%	17%	17%	11.8	16.7	20%	19%	1.1	1.5	.4	.8
RU 3	94	130	48%	60%	20%	18%	20%	17%	16%	16%	12.0	17.4	25%	24%	1.1	1.6	.5	.9
RU 4	96	130	50%	61%	18%	16%	19%	16%	18%	17%	11.9	16.4	27%	26%	1.0	1.5	.5	1.0
RU 5	77	114	38%	51%	19%	20%	15%	13%	19%	16%	8.6	12.7	13%	16%	.6	.9	.4	.6
All	91	127	46%	58%	20%	18%	20%	17%	17%	16%	11.9	17.0	23%	22%	1.1	1.6	.5	.9

RU	Basal Area		% Max SDI		Avg. Percent of Total SDI by Size Class						Avg. TPA 18"+		Avg. Gambel Oak BA Percent of Total BA		Tons CWD >12"		Snags >18"	
					12.0 – 17.9"		18.0 – 23.9"		24.0" +									
	20	50	20	50	20	50	20	50	20	50	20	50	20	50	20	50	20	50
Protected																		
RU 1	158	177	74%	76%	32%	28%	17%	24%	9%	12%	17.7	27.8	13%	13%	1.0	2.2	.7	1.7
RU 3	172	191	81%	83%	31%	26%	18%	24%	9%	13%	20.9	30.8	12%	11%	1.5	2.8	.8	1.9
RU 4	109	131	51%	56%	35%	38%	14%	23%	5%	8%	10.8	19.8	7%	8%	.7	1.6	.4	1.3
RU 5	147	170	71%	75%	31%	26%	17%	22%	9%	13%	16.9	26.3	11%	11%	1.5	2.7	.7	1.7
All	159	178	74%	77%	32%	28%	17%	24%	9%	12%	18.0	28.0	13%	13%	1.1	2.3	.7	1.7

It is expected implementation of the entire project will require 10 or more years to complete. If work were completed in 10 years, an average of about 8,700 acres of MSO habitat would be mechanically treated and 30 acres prescribed burned each year under alternative D. No mechanical treatments would occur on slopes greater than 40 percent in MSO habitat.

Protected Habitat

Mechanical treatments in PACs would be the same as that described in alternative B. Similar to alternative B, optimal treatments were defined as those that met the basal area target and produced the best growth rates; stands with incomplete data were not proposed for thinning above the 9 inch dbh category (Table 78). Treatments would include:

- Fifteen PACs (Archies, Bar M, Bonita Tank, Foxhole, Frank, Holdup, Iris Tank, Knob, Lake No. 1/Seruchas, Lee Butte, Red Hill, Red Raspberry, Rock Top, Sawmill Springs, and T6 Tank) would require thinning up to 12 inch dbh on 1,423 acres
- Seventeen PACs (Archies, Bar M, Bonita Tank, Crowdad, Foxhole, Frank, Holdup, Iris Tank, Knob, Lake No. 1/Seruchas, Lee Butte, Mayflower Tank, Red Hill, Red Raspberry, Rock Top, Sawmill Springs, and T6 Tank) would require thinning up to 14 inch dbh on 4,331 acres, and
- Fifteen PACs (Bar M, Bear Seep, Bonita Tank, Crowdad, Foxhole, Frank, Holdup, Iris Tank, Knob, Lake No. 1/Seruchas, Lee Butte, Mayflower Tank, Red Hill, Red Raspberry, Rock Top, Sawmill Springs, and T6 Tank) would require thinning up to 16 inch dbh on 1,902 acres

Table 78. General Description and Acres of Mechanical Treatment in Alternative D by PAC (all mechanically treated PACs occur on the Coconino NF)

PAC Name	General Description	MSO PAC Mechanical Treatment and Prescribed Burning (dbh and acre)			
		Treat up to 9" dbh (Acres)	Treat up to 12" dbh (Acres)	Treat up to 14" dbh (Acres)	Treat up to 16" dbh (Acres)
Lake No. 1/Seruchos	Dense thickets of VSS3 pine, oak is competing with pine for nutrition, sunlight and moisture, need to grow larger trees over time, enhance oaks, create small openings	123	66	50	0
Archies	Pine-oak with strong oak component but few large oak – many pines < 9" dbh	444	41	11	0

PAC Name	General Description	MSO PAC Mechanical Treatment and Prescribed Burning (dbh and acre)			
		Treat up to 9" dbh (Acres)	Treat up to 12" dbh (Acres)	Treat up to 14" dbh (Acres)	Treat up to 16" dbh (Acres)
Red Hill	Scrappy habitat that has been treated with an overstory removal in the past, dense pockets of ponderosa pine with heavy mistletoe infection in areas, thin pine to grow larger trees and reduce fire threat, enhance oak where present, grow larger trees over time and reduce competition	170	207	486	0
Crawdad	Oak is suppressed by high densities of pine, need for creating gaps around oak and releasing individual oak trees	138	0	342	120
Holdup	Most of PAC is pure pine, thin around any existing oak and provide areas for oak to establish	57	197	264	18
Bonita Tank	Treatments to grow larger trees and release oaks are needed in southern portion of PAC outside of ridges and draws	37	203	429	127
Red Raspberry	Diverse topography, protect microclimates from fire, high percentage of VSS 3 and VSS 4, need for enhancing openings, create, retain, and enhance larger trees	426	30	249	61
Bear Seep	PAC is pure ponderosa or oak, high density of trees > 9 inch dbh	453	0	0	153
Mayflower Tank	PAC has steep slopes, heavy fuels, limited number of small trees	312	0	139	217
Knob	PAC has limited habitat, generally pure pine and open with some dense dog-hair thickets	273	26	252	114
T-Six Tank	PAC has dense regeneration, need for removing dense patches of ponderosa pine, maintaining Gambel oak, and thinning dense pine doghair thickets	126	116	279	160

PAC Name	General Description	MSO PAC Mechanical Treatment and Prescribed Burning (dbh and acre)			
		Treat up to 9" dbh (Acres)	Treat up to 12" dbh (Acres)	Treat up to 14" dbh (Acres)	Treat up to 16" dbh (Acres)
Iris Tank	PAC has dense pine with pockets of doghair thickets; oak is present in all size classes but is suppressed by pine, need to release oaks and thin dense pockets of pine and reduce fuels southwest of the nest core	172	13	261	150
Frank	PAC has areas of pure pine with dense pockets of VSS3 and VSS4, need to release any oaks present and encourage recruitment of oaks, reduce pine densities and increase diameters of both pine and oak	297	130	212	62
Rock Top	Treat in pure pine to increase the amount of oak and grow larger trees	118	57	506	90
Lee Butte	Treat in dense pine to increase the amount of oak, reduce tree density, and increase tree diameter on slopes to improve habitat and protect nest core	121	1	328	314
Foxhole	Dense thickets of pine with some oak, need for enhancing oak and thinning groups	41	124	136	178
Bar M	PAC is part of the mega-cluster of PACs within the Bar-M area, break up contiguous fuels in areas of pure pine, thin out dense clumps of pine and release oaks within clumps, release oaks, provide openings for forage and grow larger trees	119	149	199	66
Sawmill Springs	All size classes of pine and oak present, need for large dbh size classes to enhance and maintain habitat structure	192	63	190	71
Total Mechanical Treatment Acres		3,616	1,423	4,331	1,902

Mechanically treatments would take place within 18 of the 110 PACs occurring within a ¼ mile of the project area boundary (16 percent) under alternative D. This includes 11,272 acres out of 36,455 total PAC acres in the treatment area (31%). No PACs and no core areas would be burned under alternative D. Although the implementation schedule is not yet known, an average of 1.8

PACs would be treated per year if 4FRI implementation lasted 10 years. On average, this equals less than one percent of the PACs across the two forests getting treated in a given year.

Forest Structure and Density in MSO Habitat

Mechanical treatments in MSO habitat would be identical as those in alternative B. Modeling for both alternatives used a 16 inch dbh limit and the same targeted range for BA in mechanically treated PACs. Therefore, treatment results are similar to those described in alternative B. Differences in results are highlighted in this section rather than repeating the all the detailed discussion that is presented in alternative B. Values for individual habitat components specific to alternative D are presented in Tables 79 and 80 below.

Large Trees

Overall results for percent of tree size classes, including TPA 18 inches dbh and larger, would be the same for most variables as those discussed in alternative B. Alternative D would be one percent less for trees 18 to 23.9 inches dbh outside core areas and TPA 18 inches dbh and greater inside core areas. In both cases, this minor difference could be a result of the no burn design in PACs. Mechanical treatments are, by design, conservative in protected habitat and prescribed burning in other alternatives would be conducted to minimize loss of habitat components. Therefore, treatment results in alternatives B and D would be similar in PAC habitat. However, modeling does not reflect benefits to vegetation from the nutrient pulse after burning or the benefit of reducing litter and raising the crown base height in these dense stands. Treatment results would still benefit individual large trees by increasing growth rates and potentially increasing resiliency of individual large trees to stochastic events. This would improve MSO habitat by maintaining and developing roost and nest structure in pine and Gambel oak trees and mast production in oak trees. However, only 18 of 72 PACs would realize any habitat improvements. The remaining 54 PACs would be no different from the no-action alternative.

Basal Area

BA in alternative D would consistently be higher in individual mechanically treated PACs than in any other action alternative. Mechanical treatments would leave trees in each size class inside of PACs rather than cut everything below a specific dbh limit. Prescribed burning in alternative B would eliminate a proportion of the small trees left after thinning. Omitting this source of mortality would lead to higher levels of BA in 2050 (Table 79). Gambel oak BA would be about the same at the PAC and RU levels for all alternatives. No treatment would occur in the remaining 54 PACs so BA would be the same as the no action alternative. The relatively high, post-treatment BA would make PAC habitat the most at risk of all alternatives due to the least amount of reduction in within-stand competition. While individual large trees would benefit from this alternative, overall stand conditions for most PACs would be no different than the no-action alternative.

Canopy Cover

Post-treatment forests would remain dense in PACs. Any variability in overstory species diversity present before treatment would remain by design. Under alternative D there would be little to no improvements expected in the sub-canopy flight zone for foraging MSOs in most PACs.

Table 79. Changes in Forest Structure Attributes Within MSO PACs By Alternative. Values Shown Are Model Results For For The Year 2050

Forest Attribute	Alternative A ¹	Alternative D ²
PACs With Thinning Outside Core Areas (n = 18)		
12 – 18” dbh (%)	28	27
18 – 23.9” dbh (%)	22	25
≥ 24” dbh (%)	11	13
TPA ≥ 18” dbh	26	28
Ponderosa Pine BA	134	126
Gambel Oak BA	27	26
PACs Without Treatments (n = 54)		
12 – 18” dbh (%)	27	27
18 – 23.9” dbh (%)	22	22
≥ 24” dbh (%)	12	12
TPA ≥ 18” dbh	27	27
Ponderosa Pine BA	125	125
Gambel Oak BA	27	27

¹ = No Action Alternative

² = No Burning Within PAC Habitat

MSO Prey Habitat

Snags, Logs, and Coarse Woody Debris

Differences in prey habitat would be expected in alternative D. By not using prescribed fire in PAC habitat, snags, logs and CWD would be higher in this alternative than in any of the other alternatives (Table 80). Snags in mechanically treated PACs would be similar to alternative B, but snags would be higher in untreated PACs. Logs and CWD would be higher in all PACs. The changes in these attributes varied slightly by individual PAC (Appendix 15). The abundance in surface fuels could benefit prey species. However, the fire risk would remain high within protected habitat and increase through time.

Understory Index

The lack of fire-induced mortality in smaller leave trees would minimize the amount of light of reaching the forest floor. Understory production would remain very low post-treatment (Table 80). In addition, no nutrient pulses would occur and there would be no reduction in pine litter, limiting understory response beyond what the modeled response indicates. Benefits from additional logs and CWD would be limited by the lack of food production for most prey species.

Affects to forest structure and prey habitat are summarized by PAC in Appendix 15.

Table 80. Changes in Prey Habitat Attributes Within MSO PACs. Values Shown for Logs per Acre and Coarse Woody Debris (CWD) are for the Year 2050; Understory Index (pounds per acre) Results are for the Year 2020.

Forest Attribute	Alternative A ¹	Alternative D ²
PACs With Thinning Outside Core Areas (n = 18)		
Snags/ Ac ≥ 12" dbh	6.7	5.7
Logs/ Ac	5.8	5.4
CWD (tons/ac)	10.1	9.3
Understory Index	40	48
PACs Without Treatments (n = 54)		
Snags/ Ac ≥ 12" dbh	7.7	7.7
Logs/ Ac	8.2	8.2
CWD (tons/ac)	12.2	12.2
Understory Index	46	52

¹ = No Action Alternative

² = No Burning Within PAC Habitat

Fire Risk

Alternative D is the only action alternative to have a modeled decrease in FRCC 1 across the ponderosa pine landscape by the year 2020 (Table 81). Most (82 percent) of the ponderosa pine forest would occur as FRCC 2 in 2020. By 2050 most of the total acres would again be FRCC 3. Alternative D would do little to decrease the risk of high-severity crown fire moving into protected habitat in the long-term and only makes a limited contribution towards increasing the opportunity for managing future unplanned ignitions. The risk to nesting and roosting habitat would remain high given the limited changes in fire behavior within protected habitat and outside MSO habitat.

Table 81. Fire Regime Condition Class (FRCC) Ratings in Ponderosa Pine Forest Through Time Under Alternative D

Conditions	Year	Measure	FRCC1	FRCC2	FRCC3
Existing	2010	Acres	70,680	136,311	297,866
		%	14	27	59
Alt. D	2020	Acres	40,389	413,983	50,486
		%	8	82	10
	2050	Acres	25,243	227,186	252,428
		%	5	45	50

Changes in surface and crown fire would be minimal between alternative D in 2020 and existing conditions. This is a result of light mechanical treatments in 18 PACs and no prescribed fire in PAC habitat. Burn-only prescriptions in protected habitat outside of PACs (889 acres) would be designed to support MSO habitat objectives. These treatments would reduce surface fuels, primarily litter, and raise crown base height across minimal acreage. Predicted surface fire would increase in protected habitat by seven percent and active crown fire would decrease by seven percent, amounting to change in about 2,800 acres (Table 82). All crown fires are projected to burn as high-severity and would account for 42 percent of protected habitat under alternative D, the most crown fire under any action alternative. Therefore, minimizing treatments in protected habitat does not meet desired conditions. The lack of treatment leaves PACs, including core areas, vulnerable to the threat of future high-severity crown fire. Appendix 16 displays MSO habitat and fire behavior for each alternative.

Table 82. Predicted Fire Behavior in Protected Habitat Under Current Conditions and After Implementation of Alternative D in 2020

MSO Habitat	Total (Ac)	Surface Fire (Ac)	Passive Crown Fire (Ac)	Active Crown Fire (Ac)	Conditional Crown Fire (Ac)	Surface Fire (%)	Passive Crown Fire (%)	Active Crown Fire (%)	Conditional Crown Fire (%)
Existing Condition									
Ponderosa Pine	512,481	313,423	48,523	113,203	31,910	61	9	22	6
Protected	36,757	18,610	3,141	9,930	4,917	51	9	27	13
Alternative D									
Ponderosa Pine	512,481	472,220	17,874	10,841	6,124	92	3	2	1
Protected	36,757	21,399	3,366	7,180	4,652	58	9	20	13

Restricted Habitat

Mechanical treatments would occur on about 73,436 acres or 99 percent of total restricted acres in the treatment area (Appendix 14). This includes about 96 percent of the total target and threshold acres. Although the implementation schedule is not yet known, on average 7,344 acres would be mechanically treated per year if 4FRI implementation lasted 10 years. On average, this equals about 10 percent of the restricted getting treated in a given year. About 2,655 acres of restricted habitat (about 3.5%) would be prescribed burned.

Forest Structure and Density in MSO Habitat

Treatments in restricted habitat would be expected to maintain and create replacement nesting and roosting habitat while providing a diversity of stand conditions and stand sizes across the landscape. Treatments were designed to develop uneven-aged forest structure, irregular tree spacing, various group sizes, and reestablishing interspace adjacent to tree groups. Large trees and Gambel oak would be released from competition with unnaturally dense groups of young pine trees.

Large Trees

Mechanical treatments are, by design, conservative in target and threshold habitat and focus on increasing the percent of larger tree size-classes and increasing tree growth rates, in accordance with the Recovery Plan. Therefore treatment results would be of a lower intensity in these habitat classifications than they are in restricted “other” habitat. The metrics for trees greater than 18 inches dbh all improve relative to the no action (Table 83). Minor variability occurs at the subunit level (Appendix 14). Overall, there would be little change these percentages and in TPA greater than 18 inches dbh relative to alternative B.

Large tree results would also be consistent in restricted “other” habitat across RU: decreases (10 to 13 percent) occurred in BA for trees less than 18 inches dbh, although the distribution of this size-class remained at or above 15 percent (Table 84). Trees 18 to 23.9 inches dbh would decrease by 2 to 3 percent; and trees greater than 24 inches dbh would more than double compared to the no action alternative. TPA greater than 18 inches dbh would decrease by about half. Values for trees greater than 18 inches dbh in alternative D would be similar to, but consistently lower than other action alternatives as a result of not using prescribed fire after thinning treatments. The low severity thinning provided by fire would increase residual tree growth rates. Not using prescribed burning in in alternative D would lead to lower percentages of tree groups 18 to 23.9 inches dbh and trees 24 inches dbh and larger, although the percentages for each size class would be close to or slightly above 15 percent. Growing and maintaining trees greater than 18 inches dbh is a key habitat objective of the Recovery Plan. Alternative D would provide the lowest density of trees in these size classes.

Basal Area

BA would consistently decrease in target and threshold habitat, but would be higher in alternative D than the other action alternatives (Table 83). BA in restricted “other” would decrease by nearly 50 percent but would again be highest in alternative D (Table 84). Gambel oak BA would increase slightly in target and threshold habitat but decrease in restricted “other” habitat (Tables 83 and 84). The decreases in pine BA relates to the objective of improving growth rates of trees in the larger size classes and creating openings within the forest matrix. The consistently higher post-treatment BA in alternative D, relative to other action alternatives, would mean less light, moisture, and nutrients availability for understory herbaceous species.

Canopy Structure

Based on BA and percent maximum SDI, canopy cover would remain dense. Canopy cover would be 50 percent or greater at the stand level, based on BA, TPA, and tree dbh (see silviculture report for details). Therefore, canopy cover within tree groups alone would be higher. Existing variability in overstory species diversity would remain by design. Burning in PACs should improve sub-canopy flight space for MSOs by lifting crown base height. Combined, these factors should improve the elements of canopy structure such as cover, density, flight space, and species diversity.

Table 83. Changes in Forest Structure Attributes Within MSO Target and Threshold Habitat By Alternative. Values Shown Are Model Results for Subunits Averaged By Restoration Unit for The Year 2050

Forest Attribute	Alternative A	Alternative D
Restoration Unit 1		
12 – 18” dbh (%)	26	22
18 – 23.9” dbh (%)	25	27
≥ 24” dbh (%)	11	13
TPA ≥ 18” dbh	31	33
Ponderosa Pine BA	135	112
Gambel Oak BA	43	47
Restoration Unit 3		
12 – 18” dbh (%)	23	20
18 – 23.9” dbh (%)	23	24
≥ 24” dbh (%)	11	12
TPA ≥ 18” dbh	30	31
Ponderosa Pine BA	116	101
Gambel Oak BA	52	55

Table 84. Changes in Forest Structure Attributes Within MSO Restricted “Other” Habitat by Alternative. Values Shown are Model Results for Subunits Averaged by Restoration Unit for the Year 2050

Forest Attribute	Alternative A	Alternative D
Restoration Unit 1		
12 – 18” dbh (%)	29	16
18 – 23.9” dbh (%)	18	13
≥ 24” dbh (%)	9	17
TPA ≥ 18” dbh	20	10
Ponderosa Pine BA	121	61
Gambel Oak BA	30	20
Restoration Unit 3		
12 – 18” dbh (%)	27	16
18 – 23.9” dbh (%)	20	14
≥ 24” dbh (%)	9	16
TPA ≥ 18” dbh	23	11
Ponderosa Pine BA	114	60
Gambel Oak BA	39	25
Restoration Unit 4		
12 – 18” dbh (%)	25	15
18 – 23.9” dbh (%)	22	16
≥ 24” dbh (%)	12	21
TPA ≥ 18” dbh	23	13

Forest Attribute	Alternative A	Alternative D
Ponderosa Pine BA	109	63
Gambel Oak BA	33	21
Restoration Unit 5		
12 – 18” dbh (%)	29	16
18 – 23.9” dbh (%)	18	13
≥ 24” dbh (%)	12	20
TPA ≥ 18” dbh	20	11
Ponderosa Pine BA	114	62
Gambel Oak BA	22	14

MSO Prey Habitat

Snags, Logs and Coarse Woody Debris

Snags greater than 18 inches dbh would more than double in target and threshold habitat and nearly double in restricted “other” habitat as well (Table 77 above). Large snags are currently well below forest plan guidelines and would remain low. Snags greater than 12 inches dbh would also decrease, but would average about 5 per acre (Table 85). Average snags per acre were highest in this alternative relative to other action alternatives as a result of the limited acres burned. Snags are an important component of nesting, roosting, and foraging habitats.

Logs would decrease by less than 1 per acre in target and threshold habitat and increase by an average of more than ½ per acre in restricted “other” habitat (Table 86). There would be little variability by subunit (Appendix 14). CWD would consistently decrease by about 1 ton per acre across restricted habitats (Table 86). The small scale of change would primarily be a result of the limited prescribed burning in alternative D. Logs and CWD would be consistently higher in this alternative than in the other action alternatives and both remained above forest plan direction, providing the highest levels of this important prey habitat component.

Understory Index

The increase in understory response in target and threshold habitat would range from eleven to seventeen pounds per acre (Table 85). This would be the lowest of the action alternatives. Increases in understory response in restricted “other” habitat ranged from 188 to 267 pounds per acre above the no action response (Table 86). Although the increase was similar in scale to the other action alternatives, alternative D always had the lowest response, indicating that this alternative would provide the least amount of herbaceous food and cover for MSO prey species.

The biomass index only accounts for soil and overstory BA. Alternative D decreased competition for water, nutrients, and light, but does not reduce litter depth and would not result in a nutrient pulse, both of which affect understory production (Appendix 8). Increased biomass production represents grass and forb development during the growing season, providing food and cover for arthropods, small mammals and birds. In turn, this can increase prey availability, diversity, and biomass for MSOs. These potential increases would be minimized in alternative D relative to the other action alternatives.

Table 85. Changes in Prey Habitat Attributes Within MSO Target and Threshold Habitat by Alternative. Values Shown are Model Results for Subunits Averaged by Restoration Unit. Results for Logs Per Acre and Coarse Woody Debris (CWD) are for the Year 2050; Understory Index Results (lbs per acre) are for the Year 2020

Forest Attribute	Alternative A	Alternative D
Restoration Unit 1		
Snags/ Ac $\geq 12''$ dbh	6.5	4.9
Logs/ Ac	9.1	8.4
CWD (tons/ac)	12.3	11.2
Understory Index	36	53
Restoration Unit 3		
Snags/ Ac $\geq 12''$ dbh	6.7	5.3
Logs/ Ac	7.6	6.9
CWD (tons/ac)	11.5	10.3
Understory Index	32	43

Table 86. Changes in Prey Habitat Attributes Within MSO Restricted “Other” Habitat by Alternative. Values Shown are Model Results for Subunits Averaged by Restoration Unit. Results for Logs Per Acre And Coarse Woody Debris (CWD) are for the Year 2050; Understory Index Results (lbs per acre) are for the Year 2020.

Forest Attribute	Alternative A	Alternative D
Restoration Unit 1		
Snags/ Ac $\geq 12''$ dbh	5.1	1.4
Logs/ Ac	3.8	4.4

Forest Attribute	Alternative A	Alternative D
CWD (tons/ac)	8.0	7.5
Understory Index	77	344
Restoration Unit 3		
Snags/ Ac $\geq 12''$ dbh	5.6	1.7
Logs/ Ac	4.7	5.3
CWD (tons/ac)	8.7	7.9
Understory Index	53	288
Restoration Unit 4		
Snags/ Ac $\geq 12''$ dbh	5.1	1.8
Logs/ Ac	4.4	5.4
CWD (tons/ac)	7.7	7.1
Understory Index	61	249
Restoration Unit 5		
Snags/ Ac $\geq 12''$ dbh	4.1	1.3
Logs/ Ac	2.9	3.7
CWD (tons/ac)	6.5	6.3
Understory Index	65	267

Fire Risk

Prescribed burning would occur across 2,354 acres of restricted habitat, including 301 acres of burn-only prescriptions in target and threshold habitat (Table 76 above). The threat of crown fire in target and threshold habitat would be reduced by the year 2020, decreasing from 51 percent of the area to about 12 percent (Table 87). Surface fire would be expected in 94 percent of restricted “other” acres. These reductions would primarily be a result of mechanical treatments given the limited prescribed burning in MSO habitat in alternative D. While the thin-only treatments reduce

the threat of active crown fire, mechanical treatments increase total litter, adding to levels already outside the historical range of variation. In addition to decrease in risk associated with MSO treatments, treated areas outside of MSO habitat would be moved closer towards the historical range of variation, thereby decreasing the threat of high-severity crown fire reaching MSO habitat. Appendix 16 displays MSO habitat and fire behavior for each alternative.

Table 87. Predicted Fire Behavior in Restricted Habitat Under Current Conditions and After Implementation of Alternative D in 2020

MSO Habitat	Total (Ac)	Surface Fire (Ac)	Passive Crown Fire (Ac)	Active Crown Fire (Ac)	Conditional Crown Fire (Ac)	Surface Fire (%)	Passive Crown Fire (%)	Active Crown Fire (%)	Conditional Crown Fire (%)
Existing Condition									
Ponderosa Pine	512,481	313,423	48,523	113,203	31,910	61	9	22	6
Target/Threshold	8,713	4,292	926	2,854	625	49	11	33	7
Restricted	67,378	35,465	6,608	20,764	4,423	53	10	31	7
Alternative D									
Ponderosa Pine	512,481	472,220	17,874	10,841	6,124	92	3	2	1
Target/Threshold	8,713	7,734	419	321	223	89	5	4	3
Restricted	67,378	63,075	3,778	283	124	94	6	0	0

Other Habitat Changes

Meadows and Aspen

There would be no meadow and no aspen treatments in PAC habitat in Alternative D. While total acres of meadow and aspen treatments are limited in all action alternatives, none of these key prey habitats would be improved within this concentrated area of hunting for nesting MSOs.

About 3,735 acres of grassland and meadow burn treatments would occur in restricted habitat, with no mechanical removal of encroaching post-settlement trees (the same as alternative B).

Alternative D would include approximately 740 acres of mechanical removal of encroaching post-settlement pine trees in aspen habitat with no subsequent burning and about 17 acres of prescribed burn-only treatments. Removal of pine in aspen habitat would be expected to improve the health of aspen clones, providing habitat diversity that would benefit prey species within MSO habitat. Understory vegetation would also respond positively due to increased light, moisture, and nutrients. The response would not be maximized because there would be no changes to the litter layer and no nutrient pulse into the soil. Prescribed burning alone would provide limited benefits to MSO because of the patchy nature of burning in aspen and the limited

changes in overstory shading. Aspen treatments, particularly the removal of pine, would be expected to greatly improve understory conditions for MSO prey species.

At least 6,124 acres of grassland and meadow treatments would occur in restricted habitat. Alternative D would treat a total of 5,989 acres of grassland/meadow habitat. About 3,735 acres of grassland treatments would be operational burn only. Tree encroachment would not be expected to be addressed in grassland habitat. Nevertheless, benefits to meadows would occur by reducing surface fuels and creating a nutrient pulse into the mollisol soils. In addition, this would preclude the need to create firelines to prevent prescribed fire from neighboring ponderosa pine forest from entering into this entering non-ponderosa pine habitat. Meadow plus an unknown percentage of grassland treatments would be expected to improve understory conditions for MSO prey species. However, operational burning would only be expected to cause minimal tree mortality and would not change overstory canopy, limiting the potential vegetative response in meadows. An additional 2,254 acres of grassland/meadow habitat that currently functions as pine forest would be restored, including both mechanical removal of trees and prescribed burning. These acres would provide additional habitat where understory vegetation would be expected to respond strongly, providing food and cover for MSO prey species.

Similar to alternative B and C, aspen treatments in alternative D would include approximately 741 acres of aspen restoration but only about 17 acres of prescribed burn-only treatment. Prescribed burning would decrease litter and potentially kill young pine, helping to maintain or slow the decrease in aspen clone viability. Aspen restoration would be expected to improve the health of aspen clones. Prescribed burning would provide limited benefits to MSO because of the patchy nature of burning in aspen and the limited changes in overstory shading. Aspen restoration would be expected to greatly improve understory conditions for MSO prey species.

Disturbance

Disturbance could occur as a result of project-related activities including moving and operating harvest machinery, hauling forest materials, building fire line, managing prescribed burns, smoke, personnel in the field, and road maintenance and construction. Noise disturbance from project activities may disturb MSO. Alternative D would mechanically treat 84,177 acres of MSO habitat, creating as much disturbance from mechanical treatments as alternative B and more than C by the amount of mechanical disturbance associated with 1,833 additional acres of treatment.

Noise would not be expected to disturb nesting and roosting MSOs because of project planning intended to minimize disturbance in and near core areas. Haul routes either avoid PACs, occur more than a ¼ mile from core areas, or employ timing restrictions to avoid disturbance during the nesting season.

Alternative D would prescribe burn 3,543 acres of MSO habitat, a fraction of the acres proposed for burning in alternative B (107,696 acres) or C (112,546 acres). Burning around PACs would include incorporating fire lines around or near PAC boundaries. Roads, natural barriers, or new fireline would be built to prevent fire from entering PACs. Building line would occur outside the nesting season. Noise and smoke related to burning could disturb owls. Design features would include timing restrictions so that habitat in and around PACs would not be prescribed burned during the breeding season (March 1 to August 31). The area excluded from burning around PACs would be determined on a PAC by PAC basis. Roads, topography, and prevailing weather patterns would be identified so that an adequate buffer would be defined around PACs. Burning within the buffer would be conducted in association with PAC burning outside the breeding season. Site-

specific buffers would be designed so that noise and settling smoke from burning outside the buffer would not disturb resident owls in the PACs during the breeding season. Appropriate distances for individual PACs would be decided by biologists, fuels specialists, and the USFWS. As a result, smoke and noise are not expected to result in negative effects to MSO, particularly with the limited burning proposed under this alternative.

Direct and Indirect Effects

Treatment design, project design criteria, and mitigation would be implemented to be compliant with Recovery Plan guidelines and forest plans as amended. Management activities in PACs and protected habitat are designed to retain and improve nesting and roosting structure. Thinning treatments within PACs are designed to increase growth and retention of large pine and oak trees, benefiting PACs most threatened with loss of these habitat components. Treatments within PACs would occur outside of the breeding season. Mechanical thinning and prescribed burning activities would provide for long-term sustainability of MSO habitat components. Core areas would not be treated mechanically or with prescribed fire in alternative D. Therefore nesting and roosting habitat within PACs would continue to develop slower, relative to treated stands of similar habitat, and old trees would continue to be at risk due to forest health issues. Surface fuels would remain high in core areas, potentially creating higher severity fire effects if these stands were to burn. However, reduced threat of high severity crown fire from outside MSO habitat, combined with reductions in wildfire threat within MSO habitat, increases sustainability of these habitats. Vegetation associated with springs and ephemeral channels within PACs would be increased, providing food and cover for prey species. Meadows and aspen would be burned in protected habitat, potentially benefiting habitat for prey species. Short-term impacts may occur to individual MSO, e.g., owls foraging outside of PACs during crepuscular hours. Long-term benefits to MSO habitat and prey habitat would occur in terms of improved forest structure and reduced threats from stochastic events. Smoke from prescribed fire could potentially affect nesting owls and developing nestlings.

Restricted habitat would be managed for sustainable long-term forest stand structure by implementing combinations of group selection cuttings arranged to spatially distribute groups of trees and canopy openings, moving towards Recovery Plan and forest plan guidelines. The proposed changes to forest structure in restricted habitat are designed to retain or develop MSO nesting and roosting habitat in target and threshold stands while moving towards habitat sustainability, thereby decreasing the risk of large scale stochastic events. In restricted “other” habitat, MSO prey habitat would benefit from the creation of openings between tree groups, meadow improvement, and conducting aspen restoration in restricted habitat, all of which would increase understory food and cover.

The combination of mechanical treatments and low severity burning would lessen potential fire behavior after treatments are implemented. Post-treatment fires would be more likely to burn as surface fires rather than crown fires which more closely resemble the historical range of variation.

Road decommissioning would reduce disturbance to MSOs, improving owl habitat quality in the long-term. Work related to road maintenance, construction, and relocation inside of PACs would occur outside the nesting season, but could create noise, potentially disturbing roosting owls in the short-term. Haul routes for removing harvested materials would avoid areas within a quarter mile of core areas or implement timing restrictions. By phasing project activities, not all MSO habitats would be treated simultaneously, thus lessening the impacts.

Activities associated with spring, ephemeral channel restoration, and meadow and aspen treatments in PAC habitat would occur outside the nesting season, but could create noise that could potentially disturb roosting MSOs. Because project implementation will be phased, not all MSO habitats would be treated simultaneously, lessening disturbance to MSOs.

Mechanical thinning would result in little change to overall forest structure in protected habitat. However, thinning is designed to release large oak and pine and increase growth rates of trees greater than 18 inches dbh. Treatments would increase long-term development and retention of this limited component of MSO habitat. Combined, these changes should decrease future fire severity. Thinning would bring slight improvements to prey habitat in terms of understory vegetation in protected, target, and threshold habitats in the short-term. Understory biomass would increase by 100s of pounds of forage in restricted “other” habitat relative to the other MSO habitats and would persist longer due to creation of interspaces. Increasing growth rates of mature and old growth trees and retaining existing large trees will indirectly contribute to maintaining large snags, logs, and CWD across the landscape in the long-term.

The limited prescribed burning in all MSO habitats would limit the benefits of reducing fire threat (i.e., litter reduction and increasing crown base height) and stimulating understory biomass development. The relative biomass index values are based only on changes to overstory. Increased biomass development from litter reduction, increasing sunlight from raising crown base height, and the associated nutrient pulse would occur on the fewest acres under alternative D. Therefore, improvements to prey habitat would be the least under alternative D relative to the other action alternatives.

Proposed changes to forest structure in restricted habitat are designed to retain or enhance MSO nesting and roosting habitat in target and threshold stands while moving towards the ecological capacity in restricted “other” habitat. These changes will primarily result from reductions of mid-aged trees 12 to 18 inches dbh. Impacts to MSO from implementation would be reduced by phasing project activities across the treatment area.

Fire risk will decrease in PACs as a result of treatments, but the decrease will be much less than in other habitats because of the small scale of change in forest structure, particularly under alternative D. Thinning in the 18 selected PACs would go up to 16 inches dbh with a target BA of 150 square feet per acre, similar to alternative B, and no prescribed fire would be used in PACs. Reductions in the potential for canopy fire would be the least under this alternative, minimizing the ability to manage unplanned ignitions and minimizing the potential for fuels reduction in future maintenance burns.

Road closures, road relocations, and improvements and restoration of key habitats would also improve habitat for prey species by decreasing human disturbance and increasing habitat serving as food and cover. Large snag longevity would, on average, increase with decreased access by firewood cutters. Grasses, sedges, flowering forbs, and woody shrubs would benefit from spring and channel restoration and meadow/grassland and aspen treatments, all of which would benefit MSO prey. While small in scale and limited in scope, these actions target site-specific micro-habitats important to small mammals, birds, and arthropods and so increase total prey biomass. Improving connectivity of herbaceous undergrowth could improve arthropod populations. This in turn could indirectly benefit MSO prey species through increased food availability (i.e., arthropod availability) and improved habitat (from increased pollinator populations). Total treated acres in these prey habitats are nearly the same in alternatives B and C, only differing by 19 fewer acres

of aspen treatment. However, meadow and grassland treatment intensity is much lighter in alternative B, largely consisting of operational burns only. No tree mortality would be expected except perhaps in seedlings, so overstory shading and competition for nutrients and water would not change. Expected benefits to herbaceous vegetation would largely be limited to a short-term pulse of nutrients. Benefits to meadows and grasslands would be much less under this alternative than in alternative C. Understory response would be expected to be stronger in restricted habitat where, in general, greater reductions in canopy cover, and more openings would be created. Improvements in prey habitat should benefit prey species. Increases in prey populations should indirectly benefit MSOs.

Alternative D - Determination of Effects for MSO

Alternative D moves the 4FRI landscape towards the stated desired conditions. However, it accomplishes less than the other action alternative in terms of creating or moving towards a resilient, sustainable ecosystem. The determination of effects for Mexican spotted owls and their habitat is based on design criteria, mitigation, proposed forest plan amendments, the above effects discussion, and the following:

- By design, mechanical thinning and prescribed burning within MSO protected habitat would follow the intent of the MSO Recovery Plan and respective forest plan guidelines as amended
- By design, mechanical thinning and low severity prescribed burning within threshold, target, and other restricted habitat would follow MSO Recovery Plan and respective forest plan guidelines as amended
- Mechanical treatment activities in 18 PACs may cause short-term displacement to foraging and roosting MSOs outside the breeding season
- Improving stand structural and spatial conditions would meet short-term objectives of improving overall forest health and long-term objectives of increased forest resiliency
- Fire behavior in protected habitat would be changed in this alternative, with 58 percent of the area supporting surface fire in 2020 and 20 percent of the area at risk from active crown fire; alternative D provides the least protection from high-severity crown fire in protected habitat
- About 20 percent of the total road miles in 58 PACs would be decommissioned after treatment activities, lessening the amount of long-term disturbance to MSOs and their prey that is associated with access; road segments in three PACs, including core habitat in one PAC, and in restricted habitats would be relocated to provide long-term protection for ephemeral stream channels and the habitat they support
- Fire and smoke effects from prescribed burning may disturb individual birds in and adjacent to the treatment area, but timing restrictions and low severity burn prescriptions would reduce impacts and largely lead to no or only short-term effects; the amount of burning across the landscape under this alternative minimizes the potential of smoke settling into PACs relative to the other action alternatives
- Post-treatment growth rates of trees would increase, tree resiliency to drought and insects would improve, and more of the total BA would be occurring in larger size classes, improving MSO habitat components in both the long and short-term, however, the lack of prescribed burning in acres treated mechanically would minimize these benefits relative to the other action alternatives

- Large snags (greater than 18 inches dbh) are currently below forest plan guidelines; future snag recruitment is expected through existing insect and disease activities and impacts of low severity prescribed burning. Snag development is expected to occur as more trees attain larger size-classes and meet the size-class distribution recommended in the Recovery Plan; snag retention would improve through road decommissioning; because of the limited use of prescribed burning, snag development would be minimal and snag retention is expected to be maximized in alternative D, relative to the other action alternatives
- Key sites that can support diverse and abundant understory vegetation within MSO habitats would be improved or restored for both the short- and long-term around 28 springs, along 5 miles of ephemeral channels, in 3,870 acres of meadows, and 940 acres of aspen stands
- The development of 8,412 acres of restricted target and threshold habitats would be managed towards meeting a 150-170 BA for long-term MSO nest and roost habitat as recommended in the existing Recovery Plan (USDI FWS 1995)
- Total treatments in MSO habitat include 84,178 acres of mechanical thinning and 3,543 acres of low severity prescribed burning and would provide for understory grass/forb/shrub release to improve habitat components for MSO prey species; improvements would be maximized in the short-term and while improvements would decline, they would be maintained above existing conditions over the long-term; combined, this represents the least amount of acres of MSO habitat improved relative to the other action alternatives, hence the least of amount of understory response
- Thinning on 67,378 acres of restricted “other” habitat would provide for “groupy” tree structure and canopy gaps resembling historical conditions at spatial scales capable of reestablishing understory regeneration and reducing risk of active crown fire over both the long- and short-term
- Implementing both mechanical and prescribed burn treatments would reduce hazardous fuel loads, reducing the potential for future stand replacing, high-severity, crown fire and also protecting soil resources by reducing severity of ground fires over both the long- and short-term; these benefits would decrease in the short-term without maintenance burning; alternative D leaves the lowest crown base height, largest crown bulk density, and highest surface fuel loading, resulting in the highest residual threat of high-severity crown fire in the future
- Alternative D would preserve current old growth habitat and develop old growth components in 100 percent of the stands within MSO protected, target, and threshold habitats (45,168 acres) and additional acreage in restricted other stands meeting specific criteria (see Silviculture report), sustaining key MSO habitat components over the long-term
- Forest conditions within the historical range of variability (FRCC 1) would be returned to eight percent of the landscape by the year 2020. This is the smallest percentage of the landscape within the historical range of variability compared to the other action alternatives and would make limited contributions to reducing the potential for large-scale MSO habitat loss from high-severity crown fire;
- Forest conditions moderately altered from the historical range of variability (FRCC 2) would be returned to 82 percent of the landscape by the year 2020, thus reducing the potential for large-scale MSO habitat loss from high-severity crown fire in the short-term

- Alternative D reduces the FRCC 3 to 10 percent in the year 2020 and by 2050 about half of the ponderosa pine forest (50 percent) would move into FRCC 3, providing the least short- and long-term benefits relative to the historical range of variability of any of the action alternatives

MSO stratified habitat will provide for a mosaic of desired stand structure conditions, allowing for wildlife habitat and vegetative diversity. This mosaic would allow for a diversity of fire effects thereby increasing opportunities for the maintenance of forest structure and function using planned and unplanned fire in the future (up to 30 years). Canopy characteristics and surface fuel loading combine to produce combinations of surface fire intensity and physical structure (the height, density, and horizontal and vertical continuity of canopy fuels) that can produce crown fire under a given set of conditions. The closer conditions are to this threshold, the faster it will deteriorate to a point where crown fire is possible. The limited changes in protected, target, and threshold habitats in alternative D would limit future opportunities to manage fire and avoid stand replacing events.

Based on the above discussion, it is my determination that implementing alternative D would provide and sustain long-term nesting and roosting habitat while reducing potential risk of high severity wildland fire and other stochastic events. To mitigate adverse effects associated with treatments within protected habitat, no mechanical treatments would occur during the breeding season and no activities would occur within the core area. Unintended smoke settling in PACs could adversely affect egg development by flushing the incubating female or affect nestling development. Overall, actions related to vegetation manipulation, burning, and noise disturbance while **implementing alternative D may affect, but are not likely to adversely affect the Mexican spotted owl.**

Critical Habitat (All Action Alternatives)

Six CHUs occur within or overlap the 4FRI analysis area, encompassing about 488,974 total acres. This represents a subset of the protected and restricted habitat within the 4FRI treatment area. Approximately 93,739 acres of protected and restricted habitat within the 4FRI treatment area occurs within designated CHUs. Overall, proposed treatment acres are similar between alternatives, but vary in some categories (Table 88). Effects to Critical Habitat are averaged across habitats (see discussion of effects to protected and restricted habitat by alternative above). Many of the differences between alternatives are limited at the scale of Critical Habitat and are therefore presented here in a single analysis.

Table 88. Treatments in Critical Habitat by Alternative

Alternative	Acres Thinned	% Thin	Acres Burned	% Burn
B	63,725	68	86,419	92
C	64,903	69	93,739	100
D	63,725	68	3,063	3

Comparisons of most attributes are done for the year 2050 to allow for changes in forest development to become more readily apparent. The main exception is the relative index value for

understory development which is compared for the year 2020 when herbaceous response is most apparent. After that, tree growth increases and the canopy develops causing a continual decrease in understory response through 2050. Individual values for the primary constituent elements are presented by CHU by alternative in Appendix 18.

Forest Structure

Distribution of Large Trees

The distribution of size classes would be similar between alternatives, with B and C nearly identical and D frequently a percentage below them for trees greater than 18 inches dbh. However, TPA greater than 18 inches dbh would be about the same across alternatives. Forest densities would remain high, limiting the benefits of MSO treatments in terms of forest health and resiliency, but treatments would target the release of large trees from competition and increasing growth rates of large trees. Overall, all alternatives would move the distribution of large trees towards desired conditions for MSO habitat.

Basal Area

Pine BA would be reduced by all the action alternatives. Post-treatment BA is nearly identical between alternatives B and C. When differences occur they would typically only be a percentage apart. BA for alternative D would consistently be 3 to 6 feet² higher per acre. BA for Gambel oak would be even more similar, with alternative D the same in some CHUs (UGM-14 and 15) and 2 to 3 feet² higher per acre higher in others (UGM-11, 12, and 13). The slightly higher values in alternative D are a result of the limited acres of prescribed burning. Overall, BA would typically meet the values identified in the Recovery Plan.

Canopy Structure

The BA, TPA, and SDI values post-treatment would provide for canopy cover (see discussions by alternative above). No species other than ponderosa pine would be targeted for selection, unless small trees of other species are within a crown diameter of old tree ponderosa pine or large Gambel oak (see design features), ensuring species diversity and structural heterogeneity would remain in the canopy. Some oak would be lost to fire, particularly in alternatives B and C. Design features would be in place to minimize loss of larger oak. Fire would also be expected to stimulate oak sprouting. Canopy continuity would be maintained in protected and target and threshold habitats, but some defined tree groups and canopy openings would be created in restricted “other” habitat. Combined, this would retain MSO habitat in protected and target and threshold habitats and move restricted “other” habitat towards a blend of denser forest with an interspersed of increased foraging opportunities.

MSO Prey Species

Snags, Logs, and Coarse Woody Debris

Numbers of snags greater than 12 inches dbh would be similar across alternatives. Values would varied by only a fraction of a percent among alternatives. However, a consistent pattern indicates that alternative C would typically have the lowest value and alternative D the highest value. Snags greater than 12 inches dbh would vary from about 2 per acre in UGM-12 and 13 to 4 to 6 per acre in UGM-11, 14, and 15. Snag habitat would be closer to historical conditions than forest plan guidance, but would be expected to meet habitat needs for MSO and their prey (Appendix

7). Snag habitat would be expected to be accounted for in MSO habitat because of more large trees and improved growth rates for large trees to help ensure future snag recruitment as described in the Recovery Plan.

Logs per acre would be maintained across Critical Habitat. Values for logs per acre would be similar among alternatives, with values for B and C about the same and alternative D consistently having higher values. The number of logs per acre would range from over 4 to over 6 per acre, depending on the CHU, with all values above forest plan guidance. Values for CWD would be similar between alternatives B and C, but typically several tons per acre higher in alternative D. This is directly correlated with the reduced acres of prescribed burning in alternative D. It is expected that low severity prescribed burning would leave a patchy mosaic in alternatives B and C, including unburned areas. Small mammals, including key MSO prey species, tend to respond positively to restoration-based treatments (Appendix 7). Levels of CWD exceed forest plan guidance in all alternatives. Prey populations would be expected to benefit from retaining these structural elements after treatments.

Species Richness and Abundance in the Herbaceous Layer

Understory response would be limited where change in overstory characteristics would be limited. Increases in the relative index for understory response relate to biomass quantity. An assumption can be made that large increases in understory yield, combined with low severity burning, would also increase understory species richness. Similarly, increases in arthropod abundance and richness could be assumed as well (Appendix 8). The pattern in understory response would be different from other habitat components in that alternatives B and D were similar, with alternative B consistently higher. Overall, a much greater response would occur in alternative C as a result of higher treatment intensity. In addition to the overstory/understory relationship, prescribed burning, which is also highest in alternative C, would contribute to the understory response. Prey species response would be expected to be greatest in alternative C and least in alternative D.

Cumulative Effects

Past projects (since 1996) and current projects identified in MSO habitat within the 4FRI area have or will treat a total of 9,765 acres (Appendix 12). Cumulatively, this amounts to 3,190 acres of protected habitat and 6,575 acres of restricted habitat. Most acres treated from these projects involve mechanical harvest or burning treatments, but also include slash disposal, invasive weed treatments, and limited acres of animal damage control, erosions control, and disease tree harvest (details can be found in Appendix 12). Effects to MSO habitat are broken down into two broad categories: Forest structure and prey habitat.

Projects before 1996 are incorporated into existing conditions. Aspects of existing conditions that are a result of these early projects include a deficit in large trees and snags and even-aged conditions. Pre-1996 projects also had heavy selection pressure for preferred tree genetics to provide healthy trees with good form. This latter effect resulted from harvested areas being regenerated from planting stock or from the selected reserve trees left in seed tree harvest units (Bruce Higgins, *pers comm.*). Wildlife habitat in the form of nesting, feeding, and loafing sites was reduced by selecting for disease-free trees with symmetric shapes, eliminating fork-top trees, trees with unusual branching patterns, and replanting with selected genetic stock from nurseries.

Forest Structure

Past and ongoing precommercial thinning, commercial thinning, thinning to reduce hazard fuels, and disease control harvest (4,204 acres) all decrease tree competition and improve tree growth rates. These projects were not likely to move towards desired forest structure conditions in terms of uneven-aged stands with canopy gaps, but did improve forest health by decreasing tree densities. Overly dense forests (zones 3 and 4) are vulnerable to stochastic events such as insects, disease, and high-severity crown fire. Thinning treatments resulted in forest density within the low to moderate density zones and improved forest health by decreasing competition between trees and reducing the risk of habitat loss from stochastic events, even if they narrow the range of age-classes and do not create openings. These benefits will also help general forest health under drier and warmer conditions.

Precommercial thinning, commercial thinning, and thinning to reduce hazard fuels (4,181 acres) all have diameter limits for which trees are removed. The focus is on removing small to medium-sized trees. Pre-settlement and large post-settlement trees are retained, increasing the ratio of large trees and likely increasing recruitment of trees into larger size-classes by 2050. Combined, these actions should contribute to increasing trees per acre larger than 18 inches in the long-term. However, eventually recruitment will be limited in areas where multiple size-classes were removed by thinning treatments, i.e., when all trees below a certain diameter are removed, there will be a gap in time after residual trees attaining larger diameters and before trees that established post-treatment are recruited into large size-classes.

Thinning projects (including precommercial thinning, commercial thinning, and thinning to reduce hazard fuels) completed in protected habitat (1,681 acres) followed Recovery Plan direction. This includes only removing trees 9 inches dbh and smaller. Removing only small trees reduces ladder fuels, thereby decreasing the risk of surface fire becoming crown fire. However, this does little to improve the quality of MSO habitat. These projects should result in post-treatment BA and canopy cover values meeting or moving towards Recovery Plan direction.

Group selection harvest (67 acres of restricted only) with a restoration emphasis was designed to reestablish forest openings and attain a mosaic of interspaces and tree groups of varying sizes and shapes. This treatment would decrease tree density while moving towards desired stand structure conditions.

Snags would be decreased from many activities due to human health and safety concerns during operations, but snags are also created from mechanical damage and fire. The cumulative effect to snags is difficult to summarize because of the lack of detail on snag structure, i.e., in addition to overall numbers, diameter, height, age, presence of bark, and spatial distribution all affect the wildlife value of snags.

Removing conifer competition with mid and understory oak as part of the thinning contributed to maintaining and improving oak growth and vigor.

Prescribed burning (1972 acres) and managed wildfire (11 acres) produced low severity burns that reduced surface fuels and caused periodic tree mortality of susceptible pre-settlement trees, typically improving forest structure.

Mixed and high severity wildfire killed a larger proportion of old forest structure or eliminated existing forest altogether. Mixed and high severity wildfire also killed large oaks that were

replaced by oak sprouts, thereby changing oak structure from old (potential nest and roost structure for MSO and mast for prey species) to young (potential cover for prey species but reduced mast production).

Prey Habitat

Thinning treatments open the overstory canopy and remove subcanopy structure, allowing more light to reach the forest floor and increasing moisture availability. The open spacing in canopies tends to be a short-term event as increased growth rates in residual trees reestablishes continuous canopy cover. This allows for a short-term increase in understory production, improving prey food and cover resources. However, the relatively regular spacing of post-thinning residual trees does not allow for support of long-term understory benefits.

Piling of fuels (1,593 acres) creates prey habitat, but typically piles are eventually burned. Piling of fuels provides nesting and hiding cover for prey species. Pile burning (1,104 acres) can cause mortality to individual animals. Invasive weed treatments (711 acres) improves prey habitat by releasing native species. This prevented one or two species of invasive weeds dominating areas. Invasive weeds may provide cover, but typically do not produce forage and can increase fire risk. Erosion control (33 acres) would move prey habitat towards desired conditions. Animal damage control (18 acres of restricted habitat) would consist of direct removal of prey species, causing a short-term, localized decrease in prey numbers.

Group selection harvest (67 acres of restricted only) with a restoration emphasis was designed to reestablish forest openings and attain a mosaic of interspaces and tree groups. This treatment created patches of openings where understory development could persist in the long-term.

Broadcast burning would increase understory production. The scale of this increase would largely depend on site-specific forest structure, but in general would increase food and cover for prey species.

The affected environment for the range analysis is the 4FRI project area. Only allotments within the project area have been considered. Of the 988,764 acres of this project area, 790,985 are within grazing allotments and 197,779 acres are not grazed by livestock (Appendix 12). Within the project area there are 49 livestock grazing allotments, 47 are active allotments and two are vacant. Of these 49 allotments, 40 permit cattle grazing and nine permit sheep grazing. The amount of each allotment lying within the project area averages 65 percent, and varies from less than one percent to 100 percent. There are 229 main pastures located within the project area. Main pastures are the large pastures that are used more than 30 days per year by livestock. About 80 percent of the total project is grazed and that includes most MSO habitat. Plant species composition and diversity is expected to be maintained in the long-term by ongoing and future grazing. Small mammal populations in pastures with early summer grazing are likely negatively affected by the loss of cover when animals are nesting or young are dispersing. The number of pastures with early summer grazing is limited and season use is rotated so that the same pastures are not grazed in spring/early summer in successive years. Allotments are managed to provide 60 percent or more of the understory biomass for wildlife. Grazing pressure is uneven across the landscape and some areas have much higher impacts (e.g., near water) and some areas have less pressure (steeper slopes). Overall, forest plan guidance directs the range program to maintain adequate understory conditions.

Reasonably Foreseeable Actions

Appendix 12 lists known future projects expected to overlap protected (Table 4a) and restricted habitat (Table 4b). Most projects include habitat restoration objectives in MSO habitat (e.g., McCracken, Marshall, Elk Park, Turkey/Barney, Upper Beaver Creek, Aspen Restoration). Some projects will likely have negative impacts to MSOs and their habitat (powerline ROW maintenance, reopening rock pits). With limited detail on most of the foreseeable actions, including specific boundaries for where the actions will take place, it is difficult to assess impacts to MSO habitat. Most projects are expected to move habitat towards desired conditions. The Elk Park project will cut trees up to 16 inches dbh across 390 acres in the Clark PAC. The project has a restoration design and will only cut ponderosa pine trees. This project is designed to decrease fire risk and improve MSO habitat. Substantial improvements to restricted habitat is expected from what may result in over 20,000 acres of long-term improvements to both forest structure and prey habitat from projects intended to improve forest health, resiliency, and create tree groups and canopy gaps within the MSO Recovery Plan guidelines (e.g., Elk Park, Marshall, McCracken, Turkey/Barney).

Summary of Cumulative Effects

Overall, there are 399,633 acres of MSO habitat within the 4FRI project boundary. Six CHUs occur within or overlap the 4FRI analysis area, encompassing about 488,974 total acres. Almost 160,000 acres of Critical Habitat occur within the project area, including mixed-conifer habitat. About 112,546 acres of pine-oak Critical Habitat occur within the 4FRI treatment area. Past and ongoing projects have or will treat 9,765 acres of MSO habitat, including 3,190 acres of protected and 6,575 acres of restricted habitat. Tree harvest and prescribed burning treatments (6,996 acres) improved forest health, but only 2,783 of these acres actually improved forest structure and prey habitat in terms of MSO habitat. Pile burning and site preparation (1,156 acres) had negligible effects to either forest structure or prey habitat. Piling of slash fuels (1,593 acres) benefited prey habitat and animal damage control had negative effects to prey species. Reasonably foreseeable actions should largely benefit both forest structure and prey habitat in MSO habitat.

Cumulative Effects Alternative A

Alternative A would not contribute to the improvement of either forest structure or prey habitat within MSO habitat. The contributions of past, ongoing, and reasonably foreseeable actions both spatially and temporally are not expected to alter these effects.

Maintaining existing conditions would maintain the current deficit of trees greater than 24 inches dbh. Current levels of TPA greater than or equal to 18 inches dbh, already below forest plan and Recovery Plan direction, would likely be maintained due to increases in mortality rates resulting from competition. Slow to stagnating tree growth rates prolongs the time required for mid-aged trees to grow into mature trees. Replacement of mid-aged trees by younger trees would occur at low rates because of current deficits in small size-classes, delaying or limiting long-term attainment of desired conditions for mature and old-growth forest. In the long-term, consistently high canopy cover would delay or prevent development of multi-storied and uneven-aged forest structure. Growth could be further suppressed and mortality rates increased if long-term climate patterns continue towards hotter and drier growing conditions. Within-stand mortality resulting from competition for rooting space, water, and nutrient availability could lead to patches of more open conditions. This could reduce potential nesting and roosting habitat even in locations where individual trees might eventually grow into larger size-classes.

Pine-oak habitat would remain outside the historical range of variability in terms of tree densities and age-class distribution under alternative A. Loss of large diameter oak would continue, as would the suppression of young oak by competing pine trees. Total BA in oak may decline over time and would likely remain below desired conditions. Dense forest structure also increases the risk of insect and disease outbreaks occurring at scales outside the historical range of variability. Large-scale stochastic events could continue to slow or prevent development of new MSO nesting and roosting habitat.

The lack of road closures, with continued access to the existing roads footprint, would maintain the same threat to large snag persistence. Ecosystem function will continue to decline with continued tree encroachment into spring, channel, meadow, and aspen habitats.

The ability to retain sustainable and resilient ecosystems would be further compromised by vulnerability to high-severity crown fires. The overt threat of high-severity crown fire could limit options for treating uncharacteristic fuel loads through the use of unplanned ignitions, compounding the fire risk through time. By not treating outside MSO habitat, the risk of high-severity crown fire remains high from ignitions starting outside of pine-oak habitats as well as fire igniting within MSO habitat.

Cumulative Effects for Alternatives B - D

Alternative B, C, and D restoration treatments would contribute towards improving MSO forest health and vegetation diversity and composition, sustaining old forest structure over time, and moving forest structure toward the desired conditions.

Cumulative effects were evaluated across the 4FRI analysis area plus a ½ mile buffer beyond the 4FRI boundary. The cumulative effects area includes 110 PACs. Most of the projects identified as part of the cumulative effects analysis occur outside of MSO habitat. However, six projects are specifically designed to treat MSO habitat: Bill Williams Mountain Restoration (still in planning), Marshall Fuels Reduction (900 acres), Rocky Park Fuels Reduction (555 acres), Turkey/Barney Pasture Forest Health Restoration (still in planning), Wing Mountain Fuels Reduction and Forest Health (542 acres), and Woody Ridge Forest Restoration Project (323 acres). These projects apply mechanical thinning and prescribed burning treatments to reduce fuels and fire threat. Total acres of MSO habitat treatment is not yet known because some projects are still in the planning and analysis stages. About 2,320 acres of protected (at least 1,006 acres) and restricted habitat (at least 782 acres) are identified for treatment. The projects commonly use nine inch dbh limits in protected habitat and 12 inch dbh limits in restricted habitat.

Changes to MSO habitat structure as a result of these actions are expected to be minimal. None of the treatments are expected to measurably decrease the number of trees greater than 12 inches dbh. The ratio of trees greater than 12 inches dbh is likely to increase as a result of smaller trees. Trees 18 inches dbh or greater would be unaffected by the fuel reduction/restoration treatments. Total BA of pine would decrease, but given the focus on small trees, their removal may not substantially alter total stand BA. Gambel oak is not targeted for removal, but small diameter oak will likely burn, decreasing oak BA in the short term. However, shrubby oak commonly sprout vigorously after fire. The total BA of Gambel oak is not expected to change substantially in the long-term. The reduction in small trees should open the space between ground level and crown base height, improving MSO flight paths for foraging. However, dbh limits commonly result in loss of forest structure and decrease inherent heterogeneity in tree spacing. Reduced crown fire risk and increased understory production that result from these treatments tend to be short-term

because creation of interspace and irregular tree spacing typically cannot be attained diameter caps.

Changes are expected in MSO prey habitat. Decreases would occur in coarse woody debris, logs, and snags. Burn prescriptions and ignition techniques should limit overall losses of logs and snags. Burned snags will fall and provide logs and trees killed by fire will become snags. The longevity of fire-killed snags is less than that of snags formed from other processes. However, maintenance burning should provide pulses of snags and logs through time. Less coarse woody debris is expected to be present as a result of prescribed burning. Thinning and burning should increase tree growth rates and self-pruning of the lower tree branches through time should gradually replenish CWD. Improving growing conditions should decrease density-related mortality of larger and older trees. Improving recruitment into the larger size classes will improve MSO habitat and the ability to provide large snags that remain on the landscape longer than smaller diameter or fire-created snags. The combination of thinning and burning should improve species richness in the herbaceous understory, increase plant abundance, and improve fruit and seed production.

These projects represent polygons omitted from the 4FRI planning effort because planning were already in progress. Treating within these polygons will reduce fire threat for MSO habitat within the respective project polygon as well as reducing the threat of high severity crown fire starting in these polygons and burning habitat outside the polygons. Given the dbh limits employed and the generally low intensity of the treatments, decreases in the risk of high severity crown fire and improvements to understory vegetation/prey habitat are expected to be short term only.

Cumulative effects will include local disturbance from noise and potentially additional disturbance from smoke. The individual projects include the Williams Ranger District (Bill Williams Mountain) and projects distributed across the Flagstaff District from the San Francisco Peaks to the edge of the Mogollon Rim. Given the various stages of planning or implementation, project effects are dispersed both spatially and temporally. Given the scale of the 4FRI analysis area (593,211 acres), the amount of MSO habitat within the analysis area (399,633 acres), and the period of time over which treatments will be implemented (10 or more years), the cumulative effects are expected to be negligible relative to the scale of both time and space within which potential effects would occur.

Black-footed Ferret

Alternative A No Action

Direct/Indirect Effects

Habitat conditions for black-footed ferret would remain in their current condition, not withstanding natural processes. Because there are no known black-footed ferrets on the project area, the probability of direct effects to black-footed ferrets from the current condition are low.

Because prairie dogs often occur in open areas such as grasslands and meadows their habitat and colonies have a greater chance of being impacted by increased tree densities and encroachment of these habitats. Denser forest conditions produce lower values in understory biomass (lbs/acre). Under the No Action understory biomass would continue to decline over the next 40 years (Appendix 8). This in turn leads to less available habitat for species such as the ferret that rely on prairie dogs for food.

Fire intensity would continue to increase overtime as vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects to prairie dog habitat and consequently potential habitat for black-footed ferret. Eight percent of the grassland habitat has the potential for crown fire (Fire Ecology report). Stability of key ecosystem components such as, species composition, forest structure, soil characteristics and hydrologic function are at moderate to high risk of loss in the event of high severity disturbance, such as high severity wildfire on 76 percent of grasslands (Fire Ecology report). This alternative would result in the most stress on meadow and grassland habitats and thus would have the greatest negative contribution to potential black-footed ferret habitat.

Cumulative Effects

The area analyzed for cumulative effects to black-footed ferret encompasses the grasslands within the project area and the associated prairie dog complexes. Direct and indirect effects are unlikely to occur since there are no known locations of black-footed ferrets on the project area and potential habitat will be surveyed prior to implementation. There are no effects to black-footed ferret therefore, no cumulative effects.

Determination of Effect

Alternative A would have no effect to the black-footed ferret.

Alternative B Proposed Action

Direct/Indirect Effects

Direct effects are unlikely to occur since there are no known locations of black-footed ferrets on the project area and potential habitat will be surveyed prior to implementation. Short-term and localized effects from mechanical thinning and prescribed burning would result in the potential collapsing of burrows and displacement of prairie dogs in active prairie dog towns. No temporary road construction would occur within grasslands. Alternative B would restore 11,222 acres of grassland habitat in potential habitat for black-footed ferrets and their prey. The potential for crown fire within grasslands would be slightly (1%) reduced (Fire Ecology report). Prescribed fire treatments would improve the stability of key ecosystem elements such as species composition, soils and hydrologic function within grasslands by shifting 4,500 acres from Fire Regime Condition Class (FRCC) 3 to FRCC 2, and increasing FRCC 1 by 1,683 acres (Fire Ecology report). Treatments within the open linkages are designed to provide more contiguous open conditions, improving connectivity between grasslands and allow more opportunities for prairie dogs to colonize new areas and adapt to disturbances over time. The overall increase in grassland treatments and restored connectivity of grasslands would have a beneficial impact on prairie dog populations contributing to potential black-footed ferret habitat.

Determination of Effect

Implementation of Alternative B would have no effect to the black-footed ferret.

Alternative C

Direct/Indirect Effects

This alternative has similar effects as Alternative B; however, Alternative C adds 48,206 acres of grassland restoration treatments. These treatments would occur within open linkages providing additional opportunities for prairie dogs to colonize new areas and re-colonize areas where trees

have encroached previously occupied habitat in Government and Garland Prairie, Kendrick Park and other grasslands. Alternative C treats the most acres and elicits the greatest response in understory (Appendix 8). Potential for crown fire in grasslands would be eliminated and prescribed fire and mechanical treatments in grasslands would improve the stability of the key ecosystem elements by almost doubling acres in FRCC1 and reducing FRCC3 by half (Fire Ecology report). Alternative C would provide the greatest improvement to meadow and grassland habitats thereby improving habitat for prairie dogs and potential habitat for ferrets.

Determination of Effect

Implementation of Alternative C would have no effect to the black-footed ferret.

Alternative D

Direct/Indirect Effects

This alternative has similar effects as Alternative B however; Alternative D produces the lowest response of understory biomass of all the action alternatives (Appendix 8). Alternative D does not include prescribed burning across the mechanical treatments as Alternative B does and there are about 20,645 fewer acres of prescribed burn only. There would be little change in crown fire potential and the lack of prescribed fire in grasslands reduces the acres in FRCC1 by 3 percent and increases the acres in FRCC3 reducing the stability of key ecosystem elements (Fire Ecology report). The lack of burning means no nutrient pulse into the system, further limiting understory response. This alternative provides the least amount and lowest quality of habitat for prairie dogs hence less habitat for black-footed ferrets.

Determination of Effect

Implementation of Alternative D would have no effect to the black-footed ferret.

Cumulative Effects for all Action Alternatives

The area analyzed for cumulative effects to black-footed ferret encompasses the grasslands within the project area and the associated prairie dog complexes. Direct and indirect effects are unlikely to occur since there are no known locations of black-footed ferrets on the project area and potential habitat will be surveyed prior to implementation. There are no effects to black-footed ferret therefore, no cumulative effects.

Forest Service Sensitive Species

The most recent Regional Forester's Sensitive Species list was transmitted to Forest Supervisor's on October 1, 2007 and is the basis for the species used for this analysis.

Effects Common to All Action Alternatives

Constructing and reconstructing 272 miles of roads along their original alignments would not have noticeable impacts to the physical habitat features along the roads. Increased disturbance associated with the increased activity on the improved road conditions may decrease the habitat quality along the improved roads and increase the potential for vehicles to collide with wildlife. If each mile impacts approximately 3 acres of habitat, then about 81 acres of habitat would be impacted by road reconstruction.

Research proposals in Alternative C, the impacts of the silvicultural prescriptions have been reflected in the vegetation data already analyzed. Constructing 15 weirs that would impact 3 acres would not have a discernible impact to habitat at the project level.

Improving springs and seeps and restoring riparian habitat and ephemeral streams in the action alternatives would improve habitat. There would be short term disturbance to vegetation during implementation of restoration projects. However, restored vegetation would be expected within a one to three year period (Water Quality and Riparian report). Springs and seeps will be surveyed prior to implementation and appropriate timing restrictions would apply reducing direct impacts to wildlife.

Decommissioning 904 miles of roads would temporarily improve the quality of the habitat in those areas where the roads are decommissioned. While the physical structure and features of the habitat may not measurably change along the former road alignment, eliminating disturbance along the roadway would be expected to improve the quality of habitat beyond the immediate area of the road. With each mile of road impacting approximately 3 acres of habitat, about 3,333 acres of forested habitat may be impacted. This would not have a discernible impact to habitat across the landscape.

Constructing 245 miles of temporary roads would temporarily disturb vegetation and reduce available habitat for wildlife. Use of these roads by machinery and equipment could crush animals moving across the terrain. These effects may impact individuals but are expected to be short-term occurring only during project implementation. Temporary roads would be obliterated to eliminate use and vegetation would be restored over the long-term.

Northern Goshawk

Alternative A

The No Action alternative, Alternative A, would shift the VSS distribution towards more VSS 5 and 6 as trees develop and mature (Figure 37). Overall, there would be no groups of VSS 1 or 2 by 2050, limiting regeneration to individual trees scattered under existing canopies. With few openings and a relatively continuous canopy, the “volunteer” regeneration would not be likely to support a continuous flow of trees into larger size-classes. This would not promote a sustainable distribution of age-classes, would not provide the variety of habitats used by key goshawk prey species, and so would not meet the desired conditions.

In Alternative A, the continued density of live trees would create conditions conducive to self-pruning, a natural process for ponderosa pine as lower branches are shaded out by the canopy overhead. However, in Alternative A the self-pruning would be more extensive than in the action alternatives due to the higher density of trees and lack of openings in the canopy. As trees self-prune and more of the live crown ratio for each tree is reduced, less effective habitat is available for nest sites for goshawks.

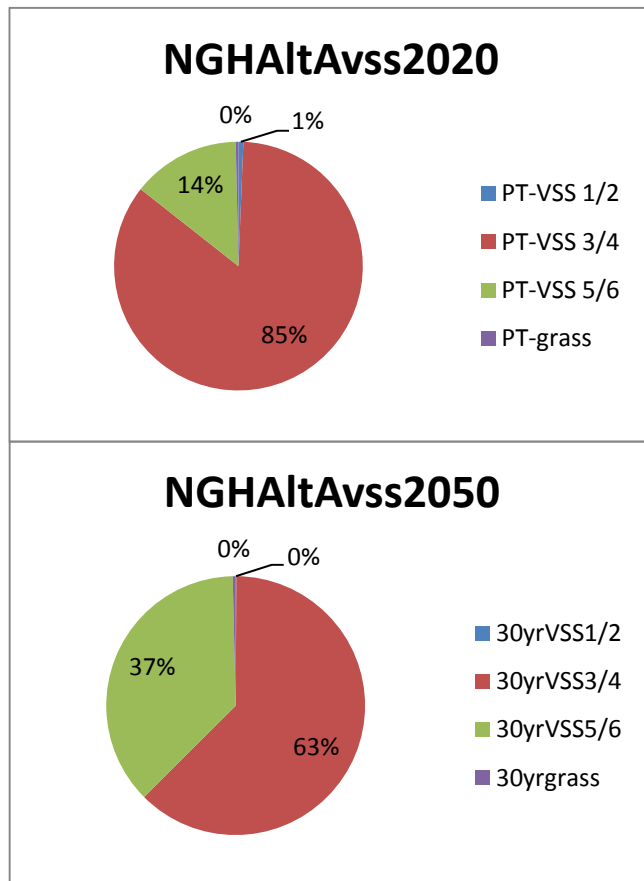


Figure 37. Projected changes to NGH habitat post-treatment (2020) and 30 years post-treatment (2050) in Alternative A

Action Alternatives

Action Alternatives B and C would move the VSS balance toward desired conditions through a combination of silvicultural treatments and prescribed burns designed to create the specific habitat features and characteristics put forth in the forest plan for northern goshawks. The Large Tree Retention Strategy included in the prescriptions and design features for Alternative C but not in Alternative B does not have a discernible impact on the distribution or amount of large trees as evidenced by the comparable acres of VSS across the area in both Alternatives B and C (Figure 38).

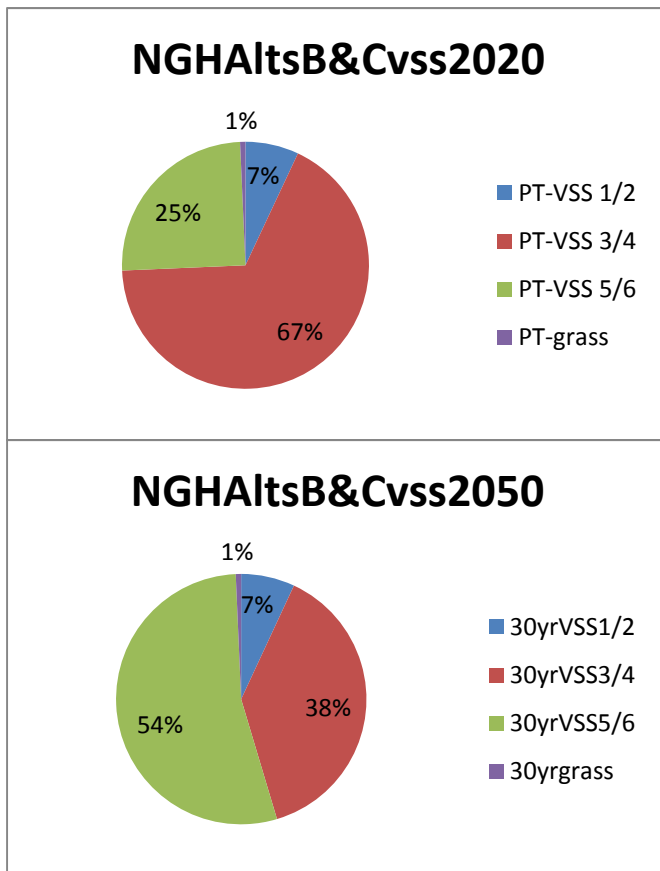


Figure 38. Projected changes to NGH habitat post-treatment (2020) and 30 years post-treatment (2050) in Alternatives B and C

While Alternative D does not include the LTRS, the changes in VSS 5 and 6 would be slightly less in Alternative D due to the considerably fewer acres of prescribed burning rather than the silvicultural prescriptions (Figure 38).

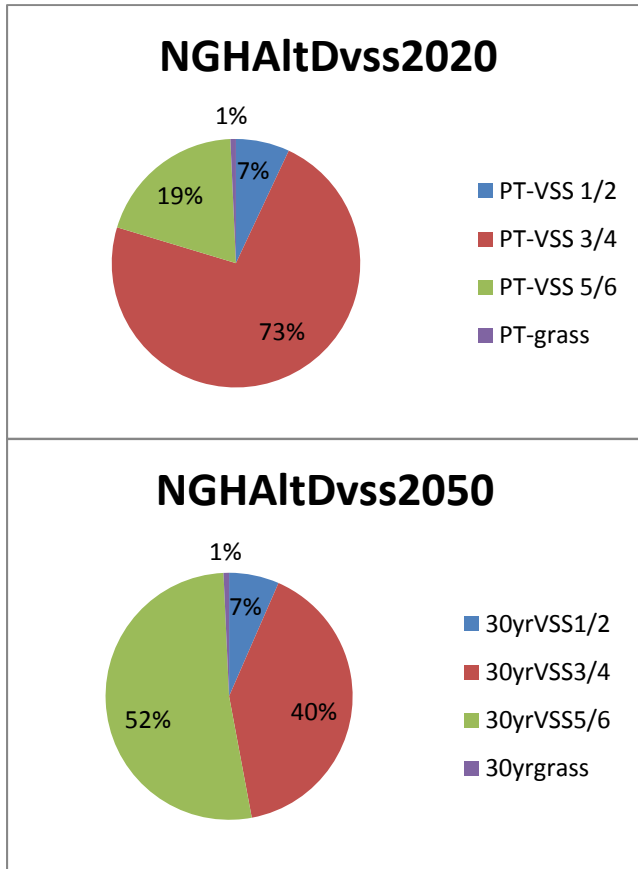


Figure 39. Projected changes to NGH habitat post-treatment (2020) and 30 years post-treatment (2050) in Alternative D

For northern goshawk LOPFA (a.k.a. foraging habitat), the acres were analyzed in two parts based on the dissimilar stand structure between even-aged and uneven-aged portions of the landscape (Table 40). For the LOPFA, 44% is even-aged and 56% is uneven-aged. The treatments in the action alternatives will not appreciably change the stand structure of the even-aged stands enough to shift them from even-aged to uneven-aged. Therefore, that particular ratio will not change. However, post-treatment conditions will change the VSS distribution and promote regeneration within the interspersed of resulting stands, and leading to future uneven-aged development within the existing forest. The existing conditions in the LOPFA are as follows:

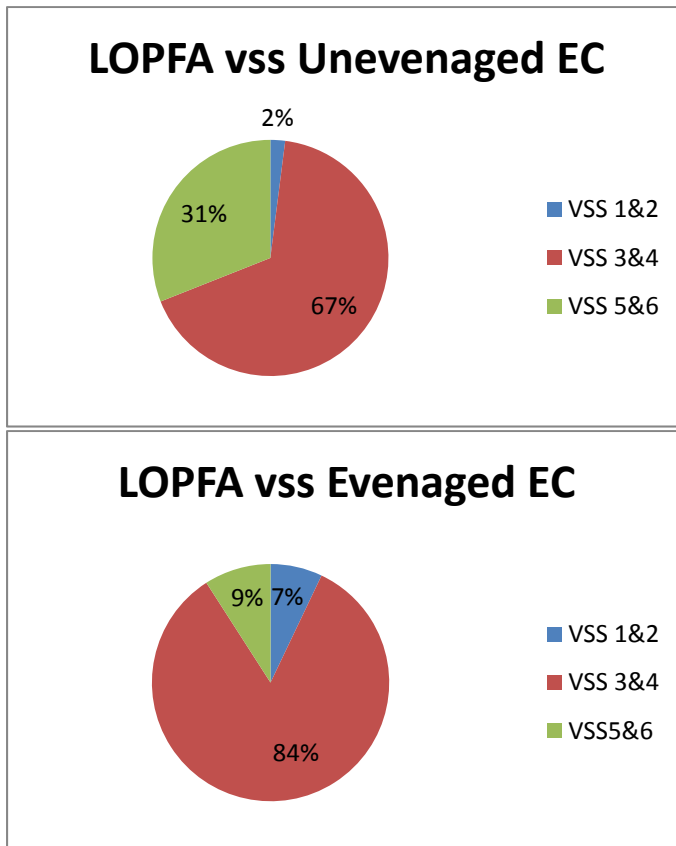


Figure 40. Existing VSS distribution for LOPFA in even-aged vs. uneven-aged stands

The no action alternative, Alternative A, would change the VSS distribution through forest succession modified by the mortality associated with extremely high trees densities as trees compete for limited space and nutrients and water as well as the increased potential for insect and disease outbreaks and mortality (Figure 41).

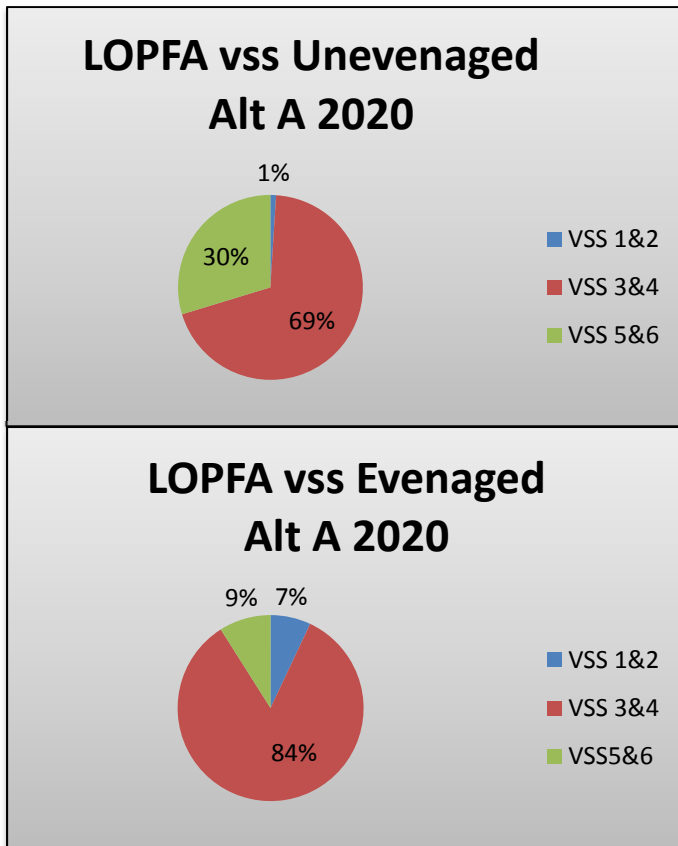


Figure 41. Projected changes to LOPFA habitat post-treatment (2020) in Alternative A

By 2050, Alternative A would move towards the desired ratios of VSS 5 and 6, again, through density induced mortality in the VSS 3 and 4 size trees (Figure 42).

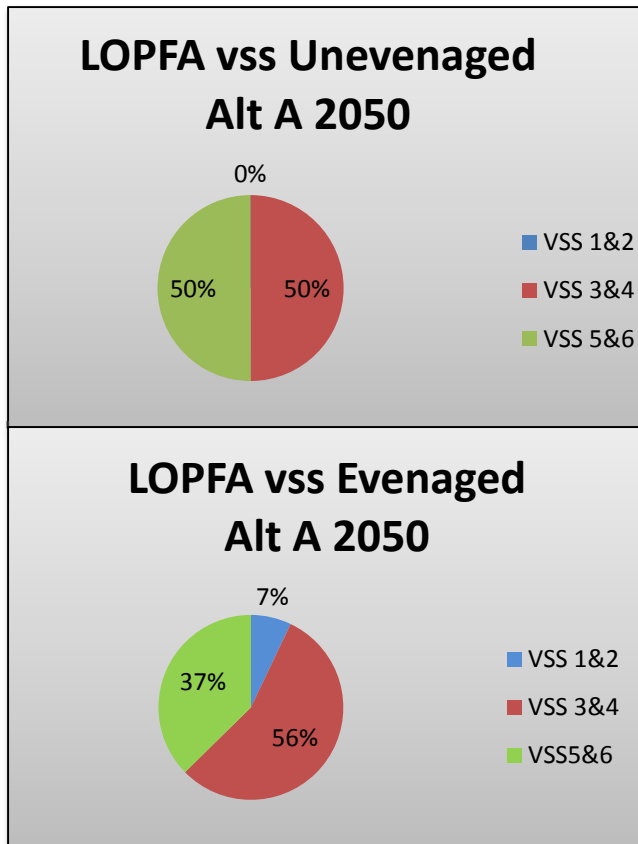


Figure 42. Projected changes to LOPFA habitat 30 years post-treatment in Alternative A.

Immediately post treatment (2020), the Action Alternatives B, C, and D would have similar results in moving the LOPFA toward balancing VSS ratios by increasing the amounts of VSS 5 and 6 primarily through treating the abundant VSS 3 and 4 size trees (Figure 43). Alternatives B and C move more acres into VSS 5 and 6 through the effects of prescribed burning removing VSS 3 and 4 trees.

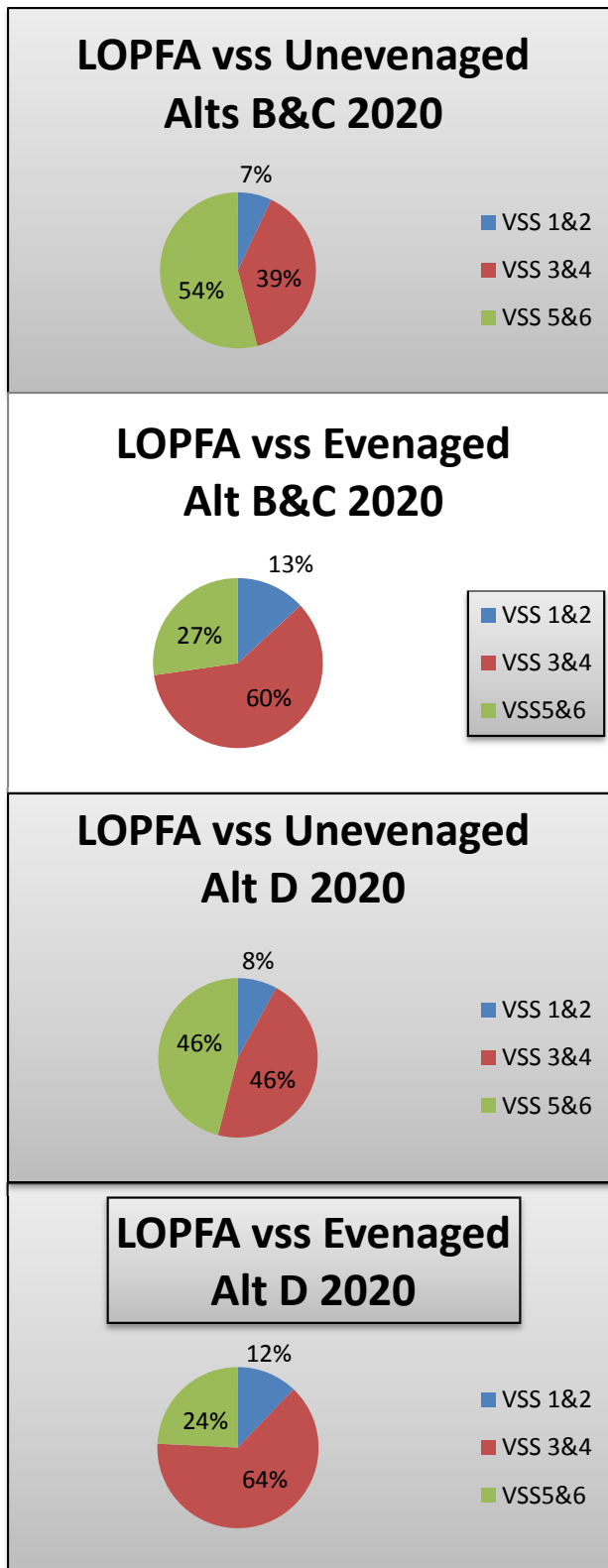


Figure 43. Projected changes to LOPFA habitat post-treatment (2020) in Alternatives B, C, and D

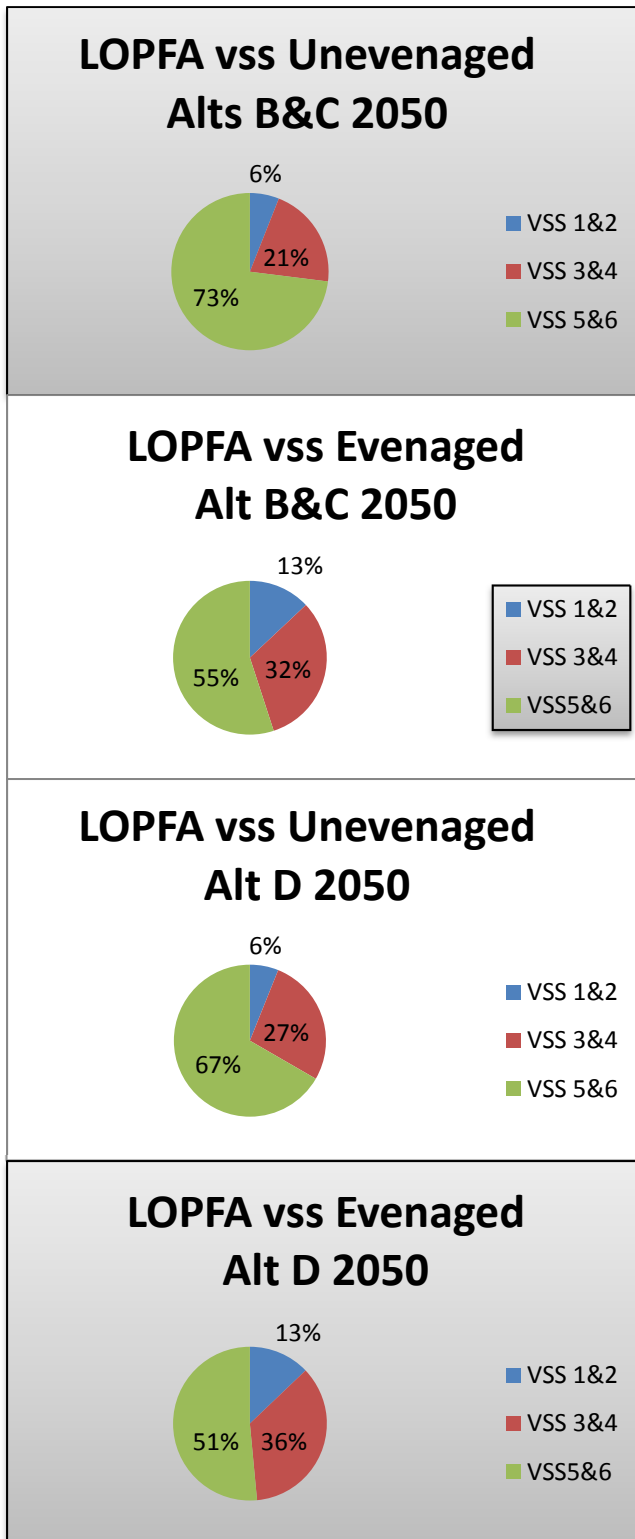


Figure 44. Projected changes to LOPFA habitat 30 years post-treatment in Alternatives B, C, and D

Thirty years after treatments, even more acres have moved into VSS 5 and 6 for the action alternatives with Alternatives B and C producing more acres of large trees than Alternative D due to more acres of prescribed burning removing more VSS 3 and 4 size trees in Alternatives B and C than Alternative D (Figure 44).

Restoration Unit (RU) NGH:

See Appendix 9 for pie charts displaying the relative percent of VSS by RU by alternative from the existing condition, to the year 2020 immediately post-treatment, and the year 2050, thirty years post-treatment. These provide a visual picture of the relative changes to goshawk nesting habitat among the RUs. The trends in changes are similar at all scales of analysis as are the reasoning for the resultant cause and effect. The VSS distribution for the Restoration Unit level is thoroughly analyzed in detail in the silvicultural report.

Restoration Subunit (SU) NGH:

The analysis of VSS changes among the SUs is discussed in the Silviculture report for this project. The existing conditions of VSS are listed in tables by SU and RU in Appendix 10.

Landscape PIPO:

For the landscape perspective, the ponderosa pine vegetation across the treatment area where changes would be expected to occur is addressed.

The existing condition is not that different from the other goshawk strata analyzed above (Table 45). The changes to the %VSS distribution for the ponderosa pine vegetation in the treatment areas without consideration of special species status are similar to those seen at the various scales discussed above. The first box within the following image shows exiting VSS for all ponderosa pine across the landscape.

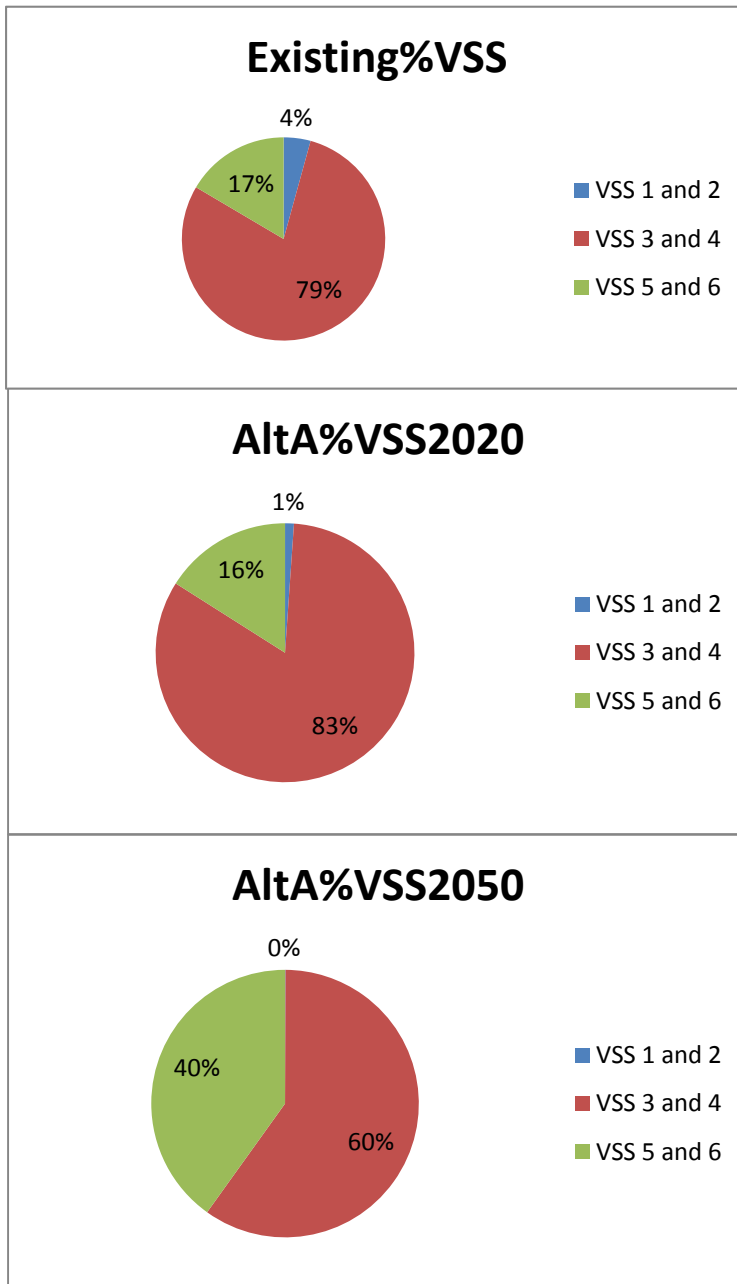


Figure 45. Projected changes to VSS across landscape in Alternative A post-treatment (2020) and 30 years post-treatment (2050)

Increases in VSS 5 and 6 for Alternative A are caused by density induced mortality among the VSS 3 and 4 size trees. As the numbers and associated BA of smaller trees decrease, stands can become dominated by larger trees and hence reclassified from a mid-aged stand to a mature stand.

Alternatives B and C show essentially identical changes at this scale. The changes in percent VSS are attributed to removing the VSS 3 and 4 size trees through mechanical harvest and prescribed burning and leaving the large trees that comprise VSS 5 and 6 (Figure 46).

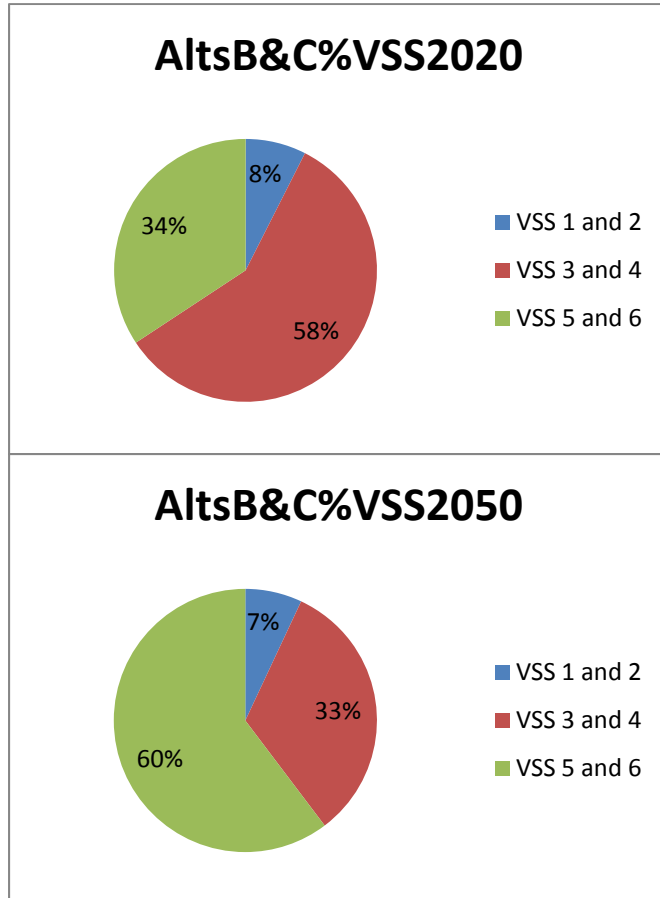


Figure 46. Projected changes to VSS across landscape in Alternatives B and C post-treatment (2020) and 30 years post-treatment (2050)

Again, Alternative D shows slightly less increase in VSS 5 and 6, or acres of large trees, due to the continued dense conditions of VSS 3 and 4 size trees occupying the majority of the area due to the lack of prescribed burning in Alternative D (Figure 47).

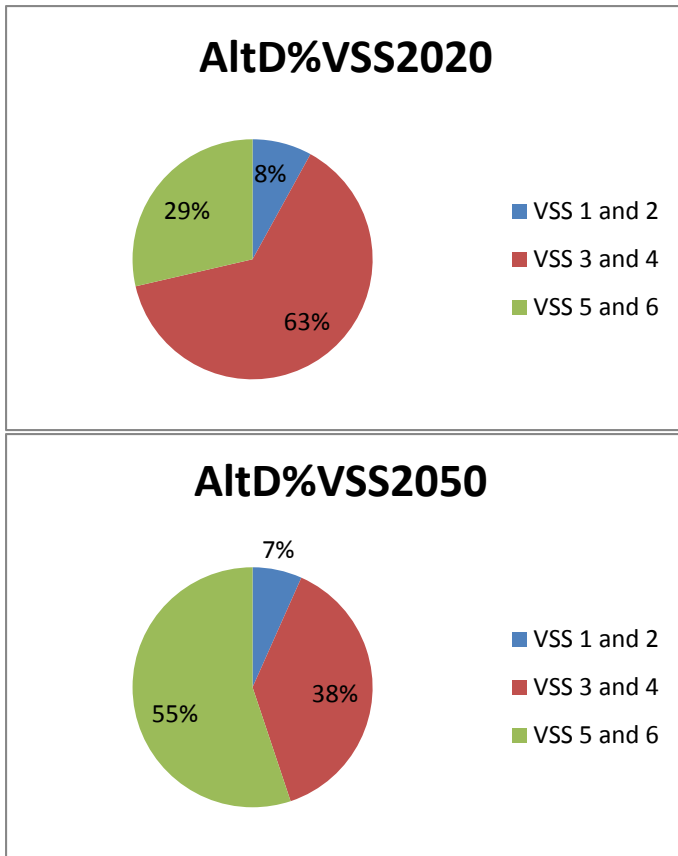


Figure 47. Projected changes to VSS across landscape in Alternative D post-treatment (2020) and 30 years post-treatment (2050)

Following are discussions on additional physical features associated with prey species' habitat in ponderosa pine forest (Figures 48 to 50). All of the alternatives ultimately increase the amount of down woody debris which is considered to be very important for prey species' habitat needs for foraging and cover. Although Alternatives B and C show a slight initial decrease in down woody debris before it increases, all alternatives are within the range of 5-7 tons/ac of the desired condition for this habitat parameter by the year 2050.

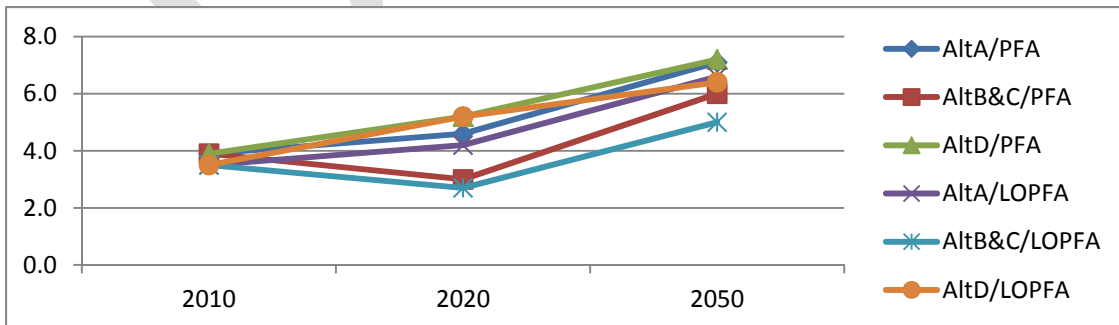


Figure 48. Down woody debris (tons/ac) PFA/LOPFA by Alternative

Coarse woody debris is considered an important habitat feature for prey species as not only living habitat for dens and cover but also as foraging habitat. Coarse woody debris differs from down

woody in that it is larger material greater than 12" dbh at the mid-section providing down log habitat for mammals and sources of food for various other prey species. All of the alternatives increase the amount of coarse woody debris, with the most coarse woody debris being produced within PFA habitat by the action alternatives.

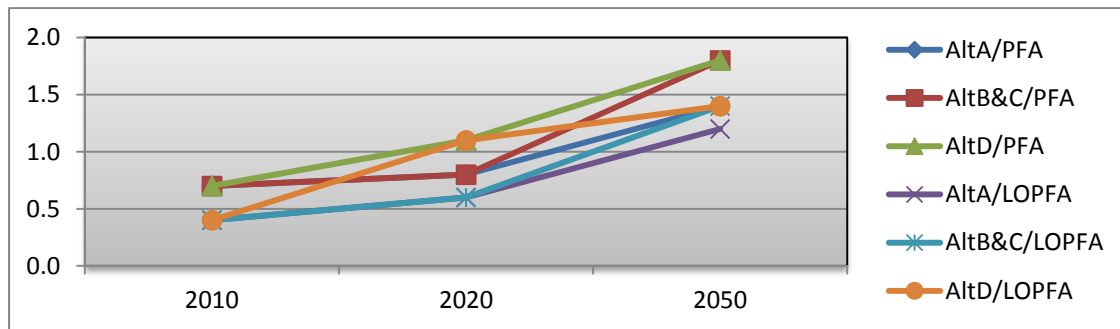


Figure 49. Coarse woody debris (CWD)>12" PFA/LOPFA by Alternative

Snags are considered to be a valuable habitat component in any landscape. They provide living space for dens and roosts as well as foraging habitat for many bird and mammal species. Alternative A shows an increase in the amount of snags both in the PFA as well as in the LOPFA. These snags would be created by density induced mortality among the existing trees on the landscape, primarily among the smaller VSS 3 and 4 trees, which are 12-17.9" dbh. Alternatives B and C would initially decrease the amount of snags in the LOPFA. This is contrasted by the initial increase in snags within the PFAs. Considering that the PFA is the primary foraging area immediately surrounding the nest area, this increase in snags closer to the nest may provide additional habitat for those prey species associated with snags. The snags created in the action alternatives would predominantly be created through the mortality associated with prescribed burning. All of the alternatives ultimately increase the amount of snags in PFAs and LOPFAs similarly by 2050.

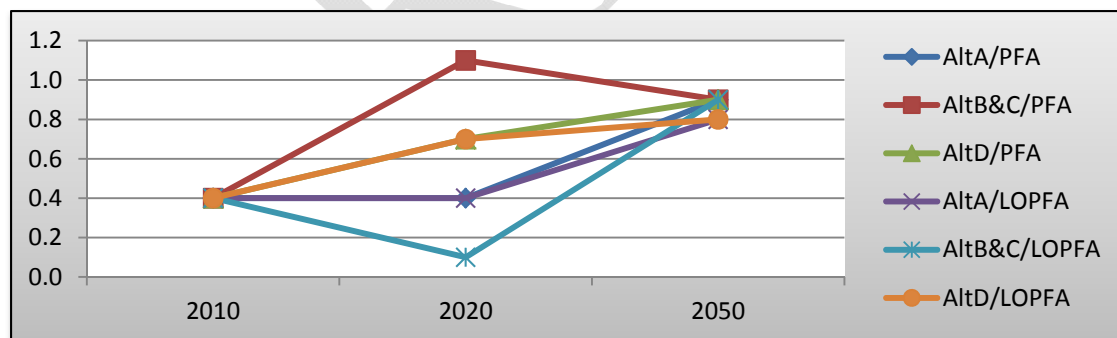


Figure 50. Snags >18"/ac PFA/LOPFA by Alternative

Overall summaries of effects to late seral pine habitat, and changes to prey species habitat by alternative is presented in Tables 89, 90, and 91.

Table 89. Summary of Alternative effects relative to Late Seral Ponderosa Pine

Proposed Activity	Alternative A – No Action	Alternative B – Proposed Action	Alternative C	Alternative D
Silviculture Treatments (UEA, IT, SI, savanna)	Net increase in quantity of late seral stage ponderosa pine Habitat quality deteriorates in late seral stage ponderosa pine due to dense conditions	Net increase in quantity of late seral stage ponderosa pine Habitat quality improves in late seral stage ponderosa pine due to less dense stand conditions		
Prescribed Burning	No change in quantity Habitat quality deteriorates w/ lack of Rx fire due to continued dense conditions	Increased acres of late seral ponderosa pine from expected fire associated mortality of young trees in those stands Rx fire would increase habitat quality on those acres where it occurs by opening stand structure which favors goshawk foraging methods	Less acres of Rx fire has effect of changing fewer acres to late seral than Alts B&C Less acres of Rx fire would have effect of lower habitat quality than Alts B&C	
Research	NA	NA	No discernible impact to late seral stage ponderosa pine in project area from this particular aspect of the project	NA
MSO PACs	No change in quantity or quality of habitat	Net increase in late seral ponderosa pine	Net increase in late seral ponderosa pine	Less increase in late seral ponderosa pine than Alts B&C due to less effects from Rx fire
Spring, seep, channel restoration	No change in quantity or quality of habitat	No change in late seral stage ponderosa pine quantity – Localized improvement to goshawk foraging (prey species) habitat		
Road Decommission	No change in quantity or quality of habitat	No change in late seral stage ponderosa pine quantity – Localized slight improvement in quality of habitat due to eliminated disturbance from discontinued use of road in habitat no real change to physical habitat features		
Temporary Road Construction	No change in quantity or quality of habitat	No change in late seral stage ponderosa pine quantity – Localized decrease in habitat quality in immediate vicinity of road alignments with creation of linear vegetative disturbance and subsequent disturbance from new road use.		

Proposed Activity	Alternative A – No Action	Alternative B – Proposed Action	Alternative C	Alternative D
Road Reconstruction	No change in quantity or quality of habitat	No change in late seral stage ponderosa pine quantity – No discernible changes to goshawk or prey species' habitat structure – Localized decrease in habitat quality as road use changes and increases potential for disturbance from use		
Mechanically treat and burn Aspen	No change in quantity or quality of habitat	No change in late seral stage ponderosa pine quantity or quality. Improved habitat quality for red-naped sapsucker	No change in late seral stage ponderosa pine quantity or quality. Less improvement in aspen habitat quality due to less Rx fire	

Table 90. Summary of changes to northern goshawk prey species' habitat features by Alternative in 2050

Prey Species Habitat Component	Measure	Existing Condition	Alternative A	Alternative B	Alternative C	Alternative D
Snags >18" dbh	Snags/ac	0.4/ac – pfa/outpfa	0.9/ac – pfa 0.8/ac - outpfa	0.9/ac – pfa/outpfa		0.9/ac – pfa 0.8/ac - outpfa
Downed Logs	CWD #/ac >12" diameter	0.7/ac – pfa 0.4/ac - outpfa	1.4/ac – pfa 1.2/ac - outpfa	1.8/ac pfa 1.4/ac - outpfa		
Woody Debris	Tons/ac	3.9/ac – pfa 3.5/ac - outpfa	7.1/ac – pfa 6.6/ac outpfa	6.0/ac – pfa 5.0/ac - outpfa		7.2/ac – pfa 6.4/ac - outpfa
Openings	Relevant to %SDI	45% - pfa 40% - outpfa	50% - pfa 46% - outpfa	33% - pfa 27% - outpfa		36% - pfa 29% - outpfa
Large trees	% VSS 5 & 6	17% VSS 5&6	40% VSS 5 & 6	60% VSS 5 & 6		55% VSS 5 & 6
Herb, Shrub, Understory	lbs/ac biomass production	@ 100 lbs/ac	Decrease to @ 50 lbs/ac	Over 250 lbs/ac then back to 150 lbs/ac		@ 250 lbs/ac then <150 lbs/ac
Interspersion of VSS	% age structure condition	43% - Even-aged 55% - Uneven-aged	No change in ratio	For all of the even-aged treatment areas, the general conditions will continue with possibly one additional VSS within the stands. Essentially, not much change in this particular habitat feature.		

Green indicates movement toward desired condition and red indicates movement away from desired condition. Brighter green indicates more of a move toward desired conditions.

Table 91. Summary of Alternative effects relative to MRNG prey species' habitat features

Proposed Activity	Alternative A – No Action	Alternative B – Proposed Action	Alternative C	Alternative D
Silviculture Treatments (UEA, IT, SI, savanna)	Overall decline in habitat quality as stand conditions deteriorate with continued dense conditions across the landscape Net increase of acres of large trees, snags, logs, woody debris Net decrease in herb, understory production and openings	Overall increase in habitat quantity and quality as stand conditions improve with less dense stand conditions across the landscape Net increase in snags/ac, downed logs, and woody debris Net increase in large tree component with increased acres of VSS 5&6 Net increase in herb/shrub/understory component with reduced tree density (TPA) and SDI (%SDI) as measured by biomass production Net increase of openings with reduced SDI (%SDI)		
Prescribed Burning	No change in habitat quantity Decreased biomass production due to continued dense conditions	Increased acres of large tree component from expected fire associated mortality of young trees in those stands Rx fire would increase biomass production on those acres where it reduces tree densities allowing increased herb, shrub and understory quantity and thus improving prey species' habitat quality		Less acres of Rx fire has effect of changing fewer acres to large tree than Alts B&C Less acres of Rx fire would have effect of slightly less biomass production than Alts B&C due to tree densities
Research	NA	NA	No discernible impact to prey species' habitat in project area from this particular aspect of the project	NA
MSO PACs	No change in quantity or quality of habitat	Net improved habitat with silvicultural treatments and Rx fire	Net improved habitat with silvicultural treatments and Rx fire	Less improved habitat with less Rx fire.
Spring, seep, channel restoration	No change in quantity or quality of habitat	Localized improvement to prey species' habitat by improving available water within habitat		

Proposed Activity	Alternative A – No Action	Alternative B – Proposed Action	Alternative C	Alternative D
Road Decommission	No change in quantity or quality of habitat	Localized slight improvement in quality of habitat due to eliminated disturbance from discontinued use of road in habitat no real change to physical habitat features		
Temporary Road Construction	No change in quantity or quality of habitat	Localized decrease in habitat quality in immediate vicinity of road alignments with creation of linear vegetative disturbance and subsequent road use.		
Road Reconstruction	No change in quantity or quality of habitat	No discernible changes to prey species' habitat structure – Minor limited decrease in habitat quality as road use changes and increases		
Mechanically treat and burn Aspen	No change in quantity or quality of habitat	Improved habitat quality for red-naped sapsucker	Improved habitat quality for red-naped sapsucker	Less improvement of habitat with less Rx fire

Direct effects to goshawks would be those actions that physically come in contact with goshawks. For Alternative A, with no actions occurring, there would not be any direct effects from that alternative. For the Action Alternatives, implementing a breeding season timing restriction (BSTR) for activities occurring within the goshawk PFAs would eliminate most of the potential for direct effects to goshawks from all of the proposed activities. The breeding season timing restriction is taken directly from the Forest Plan and limits human activity within the PFA from March 1 through September 30 each year. If territories are monitored and found to be unoccupied, the breeding season timing restriction may be suspended for that particular season.

The forest plans do allow some **prescribed burning** to occur within PFAs during the breeding season. The direct effect of this would be smoke inhalation by incubating adults or nest-bound chicks. For a species that evolved with and is closely associated with a fire adapted ecosystem, these impacts would be considered normal experiences and impacts for northern goshawks.

While only 59 PFAs are identified for treatments, 74 PFAs would have some sort of **hauling** occurring through the PFA (Table 92). The BSTR would eliminate disturbance during the breeding season in most of the PFAs.

Table 92. Miles of roads in PFAs

Miles of haul roads in PFA	Number of PFAs
0-1 mile of haul road	15
1.9 miles of haul roads	16
2.0 – 2.9 miles of haul roads	26
3.0 – 3.9 miles of haul roads	9

Miles of haul roads in PFA	Number of PFAs
4.0 – 4.9 miles of haul roads	4
5.0 – 5.9 miles of haul roads	4

Thirty one of the PFAs would have less than 2 miles of haul route through the PFA. Eight PFAs would have over 4 miles of haul route through their PFAs. With the BSTR on the haul routes through all but three of the PFAs, the impact from hauling through the PFAs would be limited to occurring outside of the breeding season when most goshawks are not in their territories. For the majority of the PFAs, a BSTR would alleviate both disturbance impacts to nesting and breeding behavior as well as the potential for goshawk collision with equipment implementing commercial mechanical treatments. There are three PFAs located on the Kaibab NF (MAP?) that are located on Level 3 roads that are not conducive to BSTR. Also, these three PFAs have the highest projected amount of project activity traffic to be coming through their territories. There is a high potential for goshawk collision with vehicles in these three PFAs if a BSTR is not implemented on the hauling activities through these territories. It has been estimated that the ratio of logging trucks to acres would be 1:1. That means there would be one logging truck travelling in and out of a given area for every acre proposed for mechanical treatment. These three PFAs would experience about 7600 loads, multiplied by two (one trip in empty and one trip out loaded) for a total of 15,200 passes in logging trucks. That does not include the support vehicles with personnel and supplies. These three PFAs may experience considerable negative impacts from mechanical treatments in adjacent areas as traffic passes through the PFAs.

Indirect effects are those changes that occur which may impact the goshawk's environment to such a degree that the changes impact the animals or their use of the habitat. The physical changes to the quantity and quality of the goshawk's habitat and that of its prey species have been thoroughly addressed in the preceding analyses of the significant issues and the MIS analysis.

Following are some more site specific details regarding the effects of the various proposed activities. Alternative B proposes the most **acres of treatment** within goshawk PFAs. The combined total amount of acres treated within PFAs is listed in Table 93. The amount of acres proposed for treatment in Alternative C is very comparable. The most notable difference among the action alternatives with regard to treating acres in goshawk PFAs, is the considerably reduced number of acres proposed for prescribed burning in Alternative D. The physical effects of this to the goshawk habitat stand structure and quality have been discussed. With BSTR on all mechanical treatments, the main difference among the action alternatives for this particular action will be the considerably less indirect effects of smoke from prescribed burning in Alternative D as compared with Alternatives B and C. Alternative A would not have any impacts from prescribed burning. However, the risk of landscape scale wildfire with the potential to completely eliminate large stands of forested habitat is considerably increased with the lack of treatments in Alternative A.

Table 93. Percent of Acres treated for Alternative B (Most acres treated for any alternative)

PFA Name	Acres treated	PFA Total Acres	% treated
PFA_Kaufman_030702017	106	617	17%
PFA_Trail_030704005	135	677	20%
PFA_Jackass_North_030701009	145	652	22%
PFA_Wing_West_#####	201	623	32%
PFA_Pumpkin_030702030	227	671	34%
PFA_Pumphouse_030405007	239	643	37%
PFA_Mars_030402022	227	558	41%
PFA_Three_Sisters_030701014	314	733	43%
PFA_Hammer_030704002	393	862	46%
PFA_Orion_030402025	386	777	50%
PFA_Casner_Cabin_030402003	335	652	51%
PFA_Phillips_110_030701004	354	637	56%
PFA_White_Horse_030402007	462	804	58%
PFA_Schultz_Pass_030402006	394	641	62%
PFA_Fort_Valley_030402012	602	903	67%
PFA_Devil_Dog_030701015	410	602	68%
PFA_Racetrack_030405013	493	679	73%
PFA_Reese_030402008	437	573	76%
PFA_Sheep_Spring_030405024	470	604	78%
PFA_Crater_030402014	566	691	82%
PFA_Thicket_030405006	536	650	83%
PFA_T_Six_030405001	526	631	83%
PFA_Alto_030402009	494	588	84%
PFA_Coyote_Basin_030405014	516	612	84%
PFA_Blackjack_030405004	526	617	85%
PFA_Mud_030405010	661	775	85%
PFA_Corner_030402017	637	726	88%
PFA_Tree_Spring_030405019	565	642	88%
PFA_Cherry_Canyon_030405020	588	632	93%
PFA_Stage_Station_030701010	501	530	95%

PFA Name	Acres treated	PFA Total Acres	% treated
PFA_Kennedy_Dam_030701008	642	649	99%
PFA_Grandview_030704007	157	157	100%
PFA_Porkchops_030402024	718	718	100%
PFA_Newman_030405016	642	642	100%
PFA_Volunteer_030702025	360	360	100%
PFA_Marteen_030702004	751	751	100%
PFA_Badger_030402016	630	630	100%
PFA_Kaibab_Lake_West_030701001	655	655	100%
PFA_Ashurst_030405018	682	682	100%
PFA_Juniper_Ridge_030702005	591	591	100%
PFA_Kaibab_Lake_East_030702016	620	620	100%
PFA_Coxcombs_030702028	624	624	100%
PFA_Lost_Spring_Tank_030702007	648	648	100%
PFA_Mason_030405011	626	626	100%
PFA_Horseshoe_030402023	745	745	100%
PFA_Squaw_030702029	612	612	100%
PFA_Bear_030405012	642	642	100%
PFA_Walker_Hill_030402002	612	612	100%
PFA_Camp_36_030704001	649	649	100%
PFA_Tule_Tank_Wash_030701012	635	635	100%
PFA_Cowhill_030407002	632	632	100%
PFA_Boulin_Tank_030702014	596	596	100%
PFA_Long_Jim_030704010	753	753	100%
PFA_Big_Spring_030702022	604	604	100%
PFA_Path_030402026	610	610	100%
PFA_Sitgreaves_030702006	667	667	100%
PFA_Beale_030702009	635	635	100%
PFA_El_Paso_030702002	596	596	100%
PFA_Roadside_030405009	762	762	100%

Of the 59 PFAs being treated within the project area, half of them will have their entire territories treated by mechanical or prescribed burning in Alternatives B and C. Nine PFAs would have less than half of their territories treated. Seventeen PFAs would have less than three quarters of their territories treated. As the percent of the PFA that is treated increases, the relative portion of the PFA that would move towards desired conditions for goshawk habitat would increase.

Alternatives B and C would move the most acres of PFA habitat towards desired conditions with the combination of mechanical and prescribed fire treatments. Alternative D would move slightly fewer acres towards desired conditions. Alternative A would change some physical features of habitat as discussed earlier, but would not improve the quality of the habitat.

An impact associated with the mechanical treatments is the **construction of temporary roads** to provide access for vehicles and equipment (Table 94). A total of 40.36 miles of temporary roads inside PFAs are proposed for the action alternatives.

Table 94. Temporary road construction in PFAs

Miles of temporary Road Construction	Number of PFAs impacted
0 miles of temporary road construction	41
<1 miles of temporary road construction	19
miles of temporary road construction	11
>2 miles of temporary road construction	3

The majority of the PFAs in the project area would not have any temporary road construction. About ¼ of the PFAs would have less than 1 mile of temporary road construction. 15% of the PFAs would have 1-2 miles of temporary road construction. Only 3 PFAs would have more than 2 miles of temporary road construction. One fifth of the temporary roads constructed would be within nest stands in PFAs. Two PFAs have more than 1 mile of temporary road construction within nest stands. Four different PFAs have the most amount of disturbance within their respective PFAs and nest stands. The effects of temporary road construction to goshawk PFA and nest habitat include removal of trees and understory vegetation along the road alignment. During the use of the temporary road, the habitat quality of the narrow linear configuration of the road is not good for goshawks or prey species. After the road is closed and obliterated, the disturbed area would provide habitat in the created opening for early seral stage prey species discussed earlier.

Another associated activity with the mechanical treatments would be **relocating roads** from their current location to a new location that would have less impact to resources than the existing location. For the action alternatives, the total miles of relocated roads within PFAs is about 0.7 miles and would impact 10 PFAs in the project area. Four nest stands would be impacted by about 0.2 miles of relocated road. The impacts from relocated roads are similar to those associated with temporary roads. The new road alignments would move the disturbance associated with the road use from the original location to the new location. Given the probable close proximity of the old and new alignments, the degree of disturbance between the two locations would probably not be discernible. With each mile of road impacting approximately 3 acres, about 2 acres of habitat would be impacted by relocating roads. No acres would be impacted in Alternative A. However, the reason for moving the roads to the new locations would not be addressed and undesirable resource impacts would be expected to continue.

Reconstructing 27 miles of **roads** along their original alignments would not have noticeable impacts to the physical habitat features along the roads. Increased disturbance associated with the increased activity on the improved road conditions may decrease the habitat quality along the improved roads. If each mile impacts approximately 3 acres of habitat, then about 81 acres of habitat would be impacted by road reconstruction. Implementing BSTR would eliminate disturbance impacts from activities to nesting goshawks.

For the **Research** proposals in Alternative C, the impacts of the silvicultural prescriptions have been reflected in the vegetation data already analyzed. Constructing 15 weirs that would impact 3 acres would not have a discernible impact to goshawk habitat at the project level. Impacts to goshawks or their prey species habitat would be limited to the immediate vicinity of the locations of the individual projects. Alternatives A, B and D would not have any impacts to changing the physical structure or quality of the goshawk habitat from this facet of the project as it is not included in these alternatives.

The effects of the **MSO prescriptions** on goshawk habitat in the action alternatives are reflected in the vegetation data already analyzed. MSO prescriptions would impact approximately 25% of the goshawk habitat across the landscape. MSO prescriptions would be considered to be coinciding with desired conditions for goshawk nesting habitat and therefore not in conflict with goshawk habitat needs.

Improving **springs and seeps and restoring ephemeral channels** in the action alternatives would improve prey species habitat in those areas where the treatments occur. Implementing the BSTR would alleviate disturbance to goshawks during the nesting season during activities. Alternative A would not improve prey species habitats at the springs or along the ephemeral channels.

Decommissioning 904 miles of **roads** in all of the action alternatives would improve the quality of the habitat in those areas where the roads are decommissioned. While the physical structure and features of the habitat for goshawks and their prey may not measurably change along the former road alignment, eliminating disturbance along the roadway would be expected to improve the quality of habitat beyond the immediate area of the road for the goshawk and its prey species. With each miles of road impacting approximately 3 acres of habitat, about 3,333 acres of forested habitat may be impacted. This would not have a discernible impact to goshawk habitat cross the landscape. Implementing these activities under the BSTR would eliminate disturbance to nesting goshawks. In Alternative A, use of any open roads would continue the current level of disturbance occurring within PFAs and would not improve the quality of the adjacent habitat.

Mechanical treatments in aspen stands in the action alternatives would improve the quality of the aspen habitat for goshawk prey species including the red-naped sapsucker. There would be greater improvement in Alternatives B and C implementing prescribed burning with the mechanical treatments than in Alternative D with just mechanical treatments. Alternative A would not improve any acres of aspen habitat. Implementing the BSTR for any activities within PFAs would eliminate disturbance to nesting goshawks.

Cumulative Effects:

Most past vegetation treatment projects after 1996 have been designed to move the landscape towards the desired conditions for northern goshawks. Those same projects have also included

BSTR for activities within goshawk PFAs. This project would contribute to the cumulative effects of moving the landscape towards desired conditions for the northern goshawk.

Alternatives B and C contribute most to moving the landscape towards desired conditions. Alternative D does slightly less to move towards desired conditions. While some desired physical features may be achieved in Alternative A, it does not contribute to the cumulative effects of moving the landscape towards desired conditions.

Northern Leopard Frog

Alternative A No Action

Direct/Indirect Effects

Under the No Action Alternative, habitat conditions for wildlife would remain in their current condition, notwithstanding natural processes. The No Action Alternative would have no direct effect on northern leopard frog. However, dense forest conditions would still occur and the high fire hazard potential would persist. 30 percent of the ponderosa pine habitat in Restoration Unit 1 would remain at high risk. Large crown-wildfires could adversely affect potential habitat by destroying understory and overstory vegetation. As a result overland flow would increase, and soil erosion would increase with potentially high sediment loads. Water quality and riparian conditions would be adversely affected on a wide-scale basis (Water Quality and Riparian report), resulting in indirect adverse effects.

Under the No Action Alternative, there would be no restoration of springs and no restoration of ephemeral channels. These areas would continue to exhibit downward trends in functional condition or remain in static condition for the foreseeable future (Water Quality and Riparian report) resulting in degradation of potential habitat for frogs.

Denser forest conditions produce lower values in understory biomass (lbs/acre). Under the No Action alternative understory biomass would continue to decline over the next 40 years (Appendix 8). Limited cover around tanks and the limited herbaceous understory across the project area would continue to reduce the likelihood that frogs would successfully forage around and migrate between livestock tanks due to increased risk of predation.

Cumulative Effects

The area analyzed for cumulative effects for northern leopard frog is the project area and the adjoining critical and potential breeding sites. This alternative would continue to result in indirect impacts to northern leopard frogs, which may combine with ongoing activities that have similar effects. Degradation of habitat facilitated by this alternative would cumulatively combine with other Forest activities, high-impact recreational use, livestock grazing, habitat loss and degradation on private lands and climate change and would continue to fragment key aquatic and dispersal habitat.

Determination of Effect

Alternative A may impact northern leopard frogs, but is not likely to cause a trend to federal listing or loss of viability.

Alternative B Proposed Action

Direct/Indirect Effects

Dispersing leopard frogs could be directly impacted if they collide with mechanical equipment or are overtaken by fire during prescribed fire activities. All springs and seeps will be surveyed prior to restoration activities. Mitigation measures would reduce the likelihood of direct impacts to frogs from mechanical thinning, temporary road construction, spring, seep and ephemeral drainage restoration, road decommissioning and prescribed fire.

Under the Proposed Action dense forest conditions and surface fuel loading in Restoration Unit 1 would be reduced. The likelihood of large crown wildfires adversely affecting potential habitat by destroying understory and overstory vegetation would be reduced by 37 percent in the ponderosa pine and five percent in grasslands within this Restoration Unit. As a result overland flow would be stable, and soil erosion would not have the high sediment loading potential. Water quality would be not adversely affected on a wide-scale basis, resulting in indirect beneficial effects.

Under Alternative B, 78 springs/seeps would be restored with 32 of those in Restoration Unit 1, which contains all critical and potential breeding sites and the northern leopard frog corridor. Additionally, 24 miles of ephemeral streams would be restored in this Restoration unit. There would be short term disturbance to vegetation during implementation of stream and spring restoration projects however restored vegetation would be expected to recover within a 1 to 3 year period (Soil Resources report). An important consideration for restoration of springs is to restore discharge from the spring source except where prescribed by existing water rights adjudicated. All action alternatives would allow discharge from springs to resume flow through their historic spheres of discharge as described by Springer and Stevens (2008) (Water Quality and Riparian report). Spring and seep restoration would increase riparian vegetation increasing availability of food and reproductive sites for this species over the long-term, resulting in direct beneficial effects to habitat. Restoration of ephemeral channels would improve cover and water flow that provides escape from predators and prevents water loss for migrating leopard frogs.

Constructing and reconstructing 42 miles of roads along their original alignments would not have noticeable impacts to the physical habitat features along the roads. Increased disturbance associated with the increased activity on the improved road conditions may decrease the habitat quality along the improved roads. If each mile impacts approximately 3 acres of habitat, then about 127 acres of breeding and dispersal habitat would be impacted by road construction and reconstruction.

Decommissioning 205 miles of roads in Restoration Unit 1 would improve the quality of the habitat in those areas where the roads are decommissioned. While the physical structure and features of the habitat may not measurably change along the former road alignment, eliminating disturbance along the roadway would be expected to improve the quality of habitat and reduce the potential for frogs to be crushed by vehicles using these roads. With each mile of road impacting approximately 3 acres of habitat, about 615 acres of forested habitat may be improved within northern leopard frog breeding and dispersal habitat.

Constructing 71 miles of temporary roads would temporarily disturb vegetation and reduce habitat quality for leopard frogs. Use of these roads by machinery and equipment could crush animals moving across the road. These effects may impact individuals but are expected to be

short-term occurring only during project implementation. Temporary roads would be obliterated to eliminate use and vegetation would be restored over the long-term.

Implementation of the proposed action could increase the risk of spread of Chytrid fungus across the project area. Machinery and equipment used during implementation could transfer Chytrid fungus between water bodies, increasing the occurrence of the pathogen in leopard frog habitats across the project area. Potential impacts from chytrid fungus that is spread by machinery and equipment would be minimized by requiring decontamination procedures to be followed when activities take place within wetted areas or moist perimeter of a tank or ephemeral stream. Therefore, minimal potential for spread would exist.

Under the proposed action surface disturbance within proximity of suitable habitats would increase. Direct impacts could result from crushing and trampling of migrating and/or basking individuals. The use of heavy machinery and increased levels of human activity and traffic are likely to increase sedimentation in the earthen livestock tanks in the vicinity, especially in those located downslope from treatment areas. Effects of sedimentation on leopard frog habitats are extensive and varied. They include alterations in water quality and vegetation structure that ultimately have detrimental impacts on leopard frogs by decreasing rate of development, increasing vulnerability to predators, and reducing food availability.

Prescribed burning may result in mortality of leopard frogs. Early fall prescribed fire has the highest likelihood of impacting leopard frogs, as this is a time of year when they are migrating between suitable habitats. Leopard frogs may migrate en masse, and large numbers may therefore be susceptible to fire at one time. Prescribed burns within Subunits 1-5 and 1-6, where the majority of critical breeding sites occur, would be coordinated with a wildlife biologist to insure protections for migrating frogs. In coordination with AGFD occupied, critical breeding sites and potential breeding sites have been identified and mapped and will be included in the individual task order map with a protected water designation. Project design features have been developed to reduce the potential impact to these important breeding sites and frogs using and moving between these sites. Implementation of best management practices would curtail soil erosion and minimize potential for inflow into potential northern leopard frog habitat.

Determination of Effect

Implementation of Alternative B may impact individuals, but is not likely to cause a trend to federal listing or loss of viability.

Alternative C

Direct/Indirect Effects

The direct/indirect effects are similar to Alternative B. Alternative C includes six watershed research areas with construction of fifteen stream flow-watershed structures (weirs). The installation of 15 weirs in drainages within restoration units 1, 3, and 5 could potentially act as barriers to leopard frog movement limiting their ability to occupy additional areas. Weirs could force leopard frogs to move over land making them more vulnerable to predation. Weirs can also alter the hydrology and potentially create pools with slow moving water creating habitat. Northern leopard frog surveys have documented frogs using pools created by weirs. The design of weirs will be important to ensure ample amphibian passage. The research areas and weirs would not be within the amphibian linkage or the subunits that contain breeding and potential

breeding sites and would not restrict expansion into other habitat. Potential impacts from chytrid fungus that is spread by machinery and equipment would be minimized by requiring decontamination procedures to be followed when activities take place within wetted areas or moist perimeter of a tank or ephemeral stream. Therefore, minimal potential for spread would exist.

Alternative C treats the most acres and elicits the greatest response in understory (Appendix 8). Additional meadow and grassland treatments are scattered throughout the project area and would occur in most subunits increasing the likelihood that frogs would successfully forage around and migrate between livestock tanks due to decreased risk of predation. Project design features have been developed to reduce the potential of impact to important breeding sites and the frogs using and moving between these sites.

Determination of Effect

Implementation of Alternative C may impact individuals, but is not likely to cause a trend to federal listing or loss of viability.

Alternative D

Direct/Indirect Effects

This alternative has similar effects as Alternative B however; Alternative D produces the lowest response of understory biomass of all the action alternatives. The reduced understory biomass would result in less cover reducing the likelihood that frogs will successfully forage around and migrate between livestock tanks due to increased risk of predation. Alternative D does not include prescribed burning across the mechanical treatments as Alternative B does resulting in fewer acres of prescribed burn only. The lack of burning means no nutrient pulse into the system, further limiting understory response, however, this reduction of prescribed fire could reduce direct impacts to frogs migrating overland between stock tanks.

Determination of Effect

Implementation of Alternative D may impact individuals, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects for all Action Alternatives

The area analyzed for cumulative effects for northern leopard frog is the project area and the adjoining critical and potential breeding sites within ½ mile. Direct impacts from mechanical thinning, temporary road construction, prescribed fire and other restoration activities would combine with ongoing activities that have similar effects. Current, ongoing and reasonably foreseeable projects are listed in Appendix 12 and include fuels reduction, forest health, aspen regeneration, tornado rehabilitation and powerline development and maintenance. These activities could result in short-term direct impacts to frogs however they are not expected to result in long-term cumulative effects and are expected to be localized in nature. Mitigation measures to limit direct impacts have been developed in this project as well as ongoing and reasonably foreseeable projects (i.e. Upper Beaver Creek within ½ mile of project) within critical breeding and dispersal habitats.

Implementation of current, ongoing and reasonably foreseeable projects could occur simultaneously; however it is not anticipated to combine to cause a negative indirect effect. Best

Management Practices (BMPs) are implemented for all projects and would curtail soil erosion and minimize potential for inflow into potential northern leopard frog habitat. Other activities that occur within the action area and may have impacts to leopard frogs and their habitats include livestock grazing, and recreation activities such as off road vehicle use and camping. Travel Management Rule decision reduces off road motorized travel in leopard frog habitats reducing impacts to waters and travel corridors. Range management is designed to rotate cattle to limit impacts to any one area allowing time for habitat recovery however; wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows, drainages and around waters.

Alternative C could alter amphibian movement in drainages within Restoration Units 1, 3 and 4. Other projects that may combine to alter amphibian movement include the Beaver Creek Experimental Watershed, road construction, off highway vehicle use, grazing, wildfire and fire suppression activities and the lack of vegetation management to reduce tree densities and increase vegetative ground cover. These activities are not expected to result in long-term cumulative effects and are expected to be localized in nature.

Bald Eagle

Alternative A No Action

Direct/Indirect Effects

No direct effect is expected because there are no activities or disturbance associated with project implementation. Thirty-nine percent of the ponderosa pine has the potential for crown fire (Fire Ecology report). Habitat conditions would remain in their current condition, notwithstanding natural processes. Dense forest conditions would still occur and the high fire hazard potential would continue to place potential bald eagle nesting, roosting and foraging habitat at risk with respect to stand-replacing fire.

Tree densities would continue to be high slowing their growth into larger diameter classes and thereby limiting the development of larger diameter (≥ 18 -inch) trees, and consequently larger diameter snags, important for roosting and perching. However, smaller diameter trees (VSS 3 and 4) would be lost to mortality, due to high tree densities, and in 30 years post treatment the percentage of larger trees would increase.

Cumulative Effects

The area analyzed for cumulative effects for bald eagle is the ponderosa pine within the project and $\frac{1}{2}$ -mile of the project boundary. Cumulative impacts from this alternative would be the greatest to wintering bald eagles. Continued dense forest conditions would limit the growth and sustainability of large trees slowing development of potential roost areas. Other activities including utility line and road construction and maintenance, high-impact recreation, and climate change would combine to result in degradation of nesting and roosting habitat.

Alternative B Proposed Action

Direct/Indirect Effects

Direct effects would be from activities that cause disturbances (smoke, auditory or visual) to golden eagles nesting or foraging within or adjacent to the project. Under the Proposed Action,

there would be no direct adverse effects to nesting eagles as project design features would eliminate disturbance near known nesting sites. No vegetation treatments would occur within ½ mile (2,500 feet), unless mitigated by topography, of an occupied golden eagle nest between March 1 and August 31. Drift smoke from prescribed fire is expected in most places; however, concentrations of smoke that might settle in an area for more than one or two nights when a female is on the nest could have adverse effects to individuals. Prevailing southwest winds and the topography of the area typically act to lift smoke, carrying it away from ignition sites. Nests on cinder cones and other raised topographic features and in Sycamore and Oak Creek Canyons or in canyons immediately adjacent to Sycamore and Oak Creek Canyons or the Mogollon Rim are not expected to have smoke settle in them long enough to cause measurable effects to eagles because of the air movement in these landscape-scaled features. Conversely, nests in areas occurring in small canyons or valleys may have dense smoke settle in nesting locations.

When smoke settles into low-lying areas it typically does not last more than 1 or 2 nights. Limited smoke at nest locations would be expected to expose adult eagles to negligible effects as this would repeat an aspect of their evolutionary environment. However, on occasion dense smoke may settle into specific nest locations. Dense smoke settling into nest areas early in the season (March through June) could disturb brooding females. If the female flushed long enough to affect incubation this could result in loss of viability of the eggs. Dense smoke settling for multiple consecutive nights could affect developing lungs of nestlings. Unlike mammals, damaged avian lungs do not repair themselves through time (Hedwall pers. comm. 2012). Causing the female to discontinue incubating eggs or affecting lung development of nestlings would cause long-term adverse effects. Outside of these examples, smoke settling in nest locations would typically be short-term and not likely to cause adverse effects.

The project area was divided into subunits that were designed using 6th code watersheds as boundaries. FWS and fire specialists determined subunits were an appropriate boundary for analyzing smoke impacts to nests and that burning within a given subunit could impact nests within that subunit if nests are located where smoke settles. Fire specialists and biologists reviewed the 3 bald eagle nest locations within the project area to determine if smoke would be expected to settle for more than one or two nights. Of the 3 nests, two at Upper Lake Mary were identified as areas where smoke would settle if conditions are not optimal and fuels loads are heavy. In consultation with FWS, the Forest Service designed mitigation for those specific nest locations to include monitoring to determine if the nest is occupied/active and if so, a timing restriction would be placed on initial entry burning within the subunit where the nest was located until young had fledged. At present, the subunit that could have a restricted burning period is 1-3. Alternative B would defer all confirmed roost sites and nest sites with a 300-foot no cut zone from mechanical thinning treatments. Additionally, timing restrictions during the winter roosting season would provide protection from disturbance to roosting eagles. Potential roost treatments would be designed to maintain and develop roost characteristics such as, large trees and snags, while reducing surface fuel loading and crown fire potential within the roost increasing roosting habitat for eagles in the project.

There is no effect to nesting or roosting eagles, however, short-term disturbance to foraging bald eagles would occur during mechanical treatments, prescribed burning, hauling of timber and other project activities may cause visual or auditory disturbance to foraging bald eagles. Approximately 10,000 acres of prescribed burning and 30,000 acres of mechanical treatment would occur annually; however, these are short-term effects and would be minimized due to activities being temporally and spatially separated. This disturbance would be localized and of short duration and

may affect individual birds but would not affect the overall distribution or reproduction of the species.

Indirect effects to the bald eagle include effects to eagle habitat, eagle prey species, or prey species habitat. There are no anticipated adverse effects to prey species or prey species habitat. Indirect effects to habitat would occur from treatments that modify the number of trees in a group of suitable roost trees, as eagles prefer to roost in large trees within close proximity to other large trees. However, thinning would improve old tree longevity, resulting in beneficial effects. In restoration units with documented bald eagle use snags would slightly increase post treatment (2020) and continue to increase in the long term. Ignition techniques and site preparation would reduce potential mortality to these components from burning activities. In addition, the Proposed Action would include developing old-growth stands in 34% of the area post treatment and 60% of the area 30 years later that may be used as future winter roost sites for bald eagles. Alternative B would develop more old growth in both the short-term (post treatment) and in the long term (30 years post treatment) than Alternative A or D and the same as Alternative C.

Alternative C

Direct/Indirect Effects

The effects are similar as Alternative B. One documented roost is located within an Arizona Game and Fish Research site however these treatments are designed to provide group sizes up to 15 acres in size and will be tailored to meet Forest Plan guidelines. All alternatives are designed to eliminate disturbance to and provide habitat for nesting and roosting bald eagles.

Determination of Effect

Alternative C may impact individuals, but is not likely to cause a trend to federal listing or loss of viability.

Alternative D

Direct/Indirect Effects

The effects are similar as Alternative B. Alternative D would provide 5% less developing old growth in the short-term (post treatment) and 5% less long term (30 years post treatment) compared to alternative B and C. All alternatives are designed to eliminate disturbance and provide habitat to nesting and roosting bald eagles.

Determination of Effect

Alternative D may impact individuals, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects for all Action Alternatives

The area analyzed for cumulative effects for bald eagle is the ponderosa pine within the project and ½ -mile of the project boundary. Current, ongoing and reasonably foreseeable projects are listed in Appendix 12 and include fuels reduction, forest health, aspen regeneration, tornado rehabilitation and powerline development and maintenance. Short-term impacts added to similar impacts from nearby projects were considered. Implementation of other project activities could occur simultaneously however, it is not anticipated to combine to cause a negative effect. All alternatives would improve and develop quality potential nesting and roosting habitat by

developing groups of large trees and snags that are more fire resilient. This positive effect would be combined with similar effects from activities such as the Travel Management rule efforts that may decrease the frequency of disturbance on the majority of potential roost sites, slightly counteracting the effects of utility line and road construction and maintenance and short-term disturbances from vegetation management and prescribed fire.

American Peregrine Falcon

Alternative A No Action

Direct/Indirect Effects

Under the No Action Alternative, there would be no direct effects to peregrines. Fire intensity in grassland habitats would continue to increase overtime as vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects to meadow habitat and consequently potential habitat for peregrine prey. Stability of key ecosystem components such as, species composition, forest structure, soil characteristics and hydrologic function are at moderately to high risk of loss in the event of high severity disturbance, such as high severity wildfire on 76 percent of grasslands (Fire Ecology report). This alternative would result in the most stress on meadow and grassland habitats and thus would have the greatest negative contribution to potential grassland habitat.

Cumulative Effects

The area analyzed for cumulative effects for peregrine falcon is grassland, savanna and riparian habitat within the project area and within ½ mile of the project boundary. This alternative would result in cumulative impacts to peregrine falcons by continuing to reduce the quality of foraging habitat by reducing meadow, grassland and savannas and reducing water yield in marsh, pond or lake habitats.

Determination of Effect

Alternative A may impact peregrine falcon, but is not likely to cause a trend to federal listing or loss of viability.

Effects Common to All Action Alternatives

Constructing and reconstructing 272 miles of roads along their original alignments would not have noticeable impacts to the physical habitat features along the roads. Increased disturbance associated with the increased activity on the improved road conditions may decrease the habitat quality along the improved roads. If each mile impacts approximately 3 acres of habitat, then about 816 acres of habitat would be impacted by road reconstruction.

Improving springs and seeps and restoring riparian habitat and ephemeral streams in the action alternatives would improve habitat. There would be short term disturbance to vegetation during implementation of restoration projects. However, restored vegetation would be expected within a one year period (i.e. Hoxworth Spring Restoration).

Decommissioning 905 miles of roads in all of the action alternatives would improve the quality of the habitat in those areas where the roads are decommissioned. While the physical structure and features of the habitat may not measurably change along the former road alignment, eliminating disturbance along the roadway would be expected to improve the quality of habitat in the long

term. With each mile of road impacting approximately 3 acres of habitat, about 2,715 acres of forested habitat may be impacted.

Constructing 251 miles of temporary roads would temporarily disturb vegetation and reduce available habitat for peregrine prey. Use of these roads by machinery and equipment could crush animals moving across the road. These effects may impact individuals but are expected to be short-term occurring only during project implementation. Temporary roads would be obliterated to eliminate use and vegetation would be restored over the long-term.

Alternative B Proposed Action

Direct/Indirect Effects

Under the proposed action, no direct effects from mechanical treatments, temporary road construction, prescribed burning or spring and riparian habitat and ephemeral streams restoration is expected. There are four peregrine eyries (nest locations) within the treatment area. All four are associated with one pair of peregrines. These eyries are located on cliff ledges in a rugged canyon. No thinning treatments are proposed in this area with a burn only treatment designated. Smoke from burning operations is expected to drain away from the nest location reducing the potential for birds to be exposed to heavy concentrations of smoke. This area is also designated as Mexican spotted owl protected activity center and protection measures developed for the owl would also protect peregrines breeding in this area as their breeding season overlaps with the owl.

Mechanical treatments prescribed burning, hauling of timber and other project activities may cause visual or auditory disturbance to foraging peregrine falcons. Approximately 10,000 acres of prescribed burning and 30,000 acres of mechanical treatment would occur annually; however, these are short-term effects and would be minimized due to activities being temporally and spatially separated. This disturbance would be localized, of short duration and low intensity and may affect individual birds but would not affect the overall distribution or reproduction of the species.

While peregrines do not nest or forage in ponderosa pine forest, active management in portions of the pine forest could potentially affect prey base habitat, e.g., meadows, grasslands, and savannas are commonly encroached by pine trees as a result of fire exclusion; restoring these habitats towards historic conditions and increasing water yield across the forest to improve marsh, pond, or lake habitat can increase prey base for peregrine falcons, resulting in an indirect beneficial effect.

Determination of Effect

Alternative B may impact individuals, but is not likely to cause a trend to federal listing or loss of viability.

Alternative C

Direct/Indirect Effects

Alternative C has similar effects as Alternative B and D. Alternative C provides for more grassland restoration which would have a greater beneficial effect to peregrine prey.

Impacts of the silvicultural prescriptions for research proposals have been reflected in the vegetation data already analyzed. Constructing 15 weirs that would impact 3 acres would not have a discernible impact to habitat at the project level.

Determination of Effect

Alternative C may impact individuals, but is not likely to cause a trend to federal listing or loss of viability.

Alternative D

Direct/Indirect Effects

This alternative has similar effects as Alternative B; however, Alternative D produces the lowest response of understory biomass of all the action alternatives. Alternative D does not include prescribed burning across the mechanical treatments as Alternative B does resulting in fewer acres of prescribed burn only. The lack of burning means no nutrient pulse into the system, further limiting understory response. The reduced understory biomass would result in fewer habitats for peregrine prey.

Determination of Effect

Alternative D may impact individuals, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects for all Alternatives

The area analyzed for cumulative effects for peregrine falcon is grassland, savanna and riparian habitat within the project area and within ½ mile of the project boundary. Under all alternatives, there would be an additive indirect effect from activities that modify vegetation. Other, present and reasonably foreseeable projects are listed in Appendix 12. Those projects where thinning and burning occurs could affect the prey base on a short-term basis by impacting individuals of prey species due to disturbance of prey species' habitat and harm from fire. However, projects would be implemented at different times and/or different locations, thus disturbances to the prey base would be minimized.

Other past, present and ongoing projects have implemented thinning (2,304 acres) and prescribed burning (8,951 acres) in grasslands and prescribed burning (11 springs) and mechanical treatment (6 springs) improving habitats for peregrine prey species in the long-term.

Clark's Grebe

Alternative A No Action

Direct/Indirect Effects

Under the No Action Alternative, habitat conditions for wildlife would remain in their current condition, notwithstanding natural processes. The No Action Alternative would have no direct effect on Clark's Grebe. However, dense forest conditions would still occur and the high fire hazard potential would persist. Large crown-wildfires could adversely affect potential habitat by destroying understory and overstory vegetation. As a result overland flow would increase, and soil erosion would increase with potentially high sediment loads. Water quality and riparian

conditions would be adversely affected on a wide-scale basis (Water Quality and Riparian report), resulting in indirect adverse effects.

Cumulative Effects

The area analyzed for cumulative effects for Clark's grebe is the marshes and lakes within the CNF in the project area. This alternative would result in continued high crown fire potential putting grebe habitat at risk of overland flow, increased soil erosion with potentially high sediment loads reducing water quality. This could combine with impacts from livestock grazing, recreational uses within wetlands and increased drought from climate change.

Determination of Effect

Alternative A would have no impact to the Clark's grebe.

Alternative B Proposed Action

Direct/Indirect Effects

Under the Proposed Action, there would be no direct effects to Clark's Grebe eggs, young, or adults from mechanical treatment and/or prescribed burning. The project would not treat in Clark's grebe habitat. Under the Proposed Action management in adjacent ponderosa pine, grasslands and ephemeral drainages could indirectly affect their habitat by increasing water yield and improving marsh, pond, and lake habitats increasing availability of food and reproductive sites for these species over the long-term, resulting in direct beneficial effects to habitat.

Determination of Effect

Alternative B would have no impact to the Clark's grebe.

Alternative C

Direct/Indirect Effects

The effects are similar as Alternative B and D. The research areas are not located within subunits where grebe habitat exists. The majority of the additional grassland treatments will occur on the Kaibab NF where grebes are not present.

Determination of Effect

Alternative C would have no impact to the Clark's grebe.

Alternative D

Direct/Indirect Effects

The effects are the same as Alternative B and C.

Determination of Effect

Alternative D would have no impact to the Clark's grebe.

Cumulative Effects for all Action Alternatives

The area analyzed for cumulative effects for Clark's grebe is the marshes and lakes within the CNF in the project area. Past, present and reasonably foreseeable projects are listed in Appendix

12. Activities within Clarks Grebe habitat were designed to improve habitat conditions for the grebe and include Antelope Tank, Post Lake, and Long Lake habitat restoration projects. Thinning and prescribed fire have occurred in both the ponderosa pine and juniper with projects such as; Anderson Mesa Prescribed Burn, Lake Mary, Elk Park and Mormon Lake Basin Fuels Reduction and Forest Health projects and Picket Agra Ax reducing tree densities potentially increasing water yield into grebe's habitat. Implementation of BMPs would curtail soil erosion and minimize potential for inflow into potential Clark's grebe habitat. Impacts from livestock grazing and increased drought from climate change are expected to be somewhat decreased by a reduction of tree densities increasing water yield into grebe's habitat.

Western Burrowing Owl

Alternative A No Action

Direct/Indirect Effects

There are no documented nesting burrowing owls on the project area, however potential nesting habitat does exist. Burrowing owls are closely associated with prairie dogs. Prairie dogs often occur in grassland habitats and colonies have a greater chance of being impacted under this alternative due to the continued encroachment of trees. Denser forest conditions produce lower values in understory biomass (lbs/acre). Under the No Action understory biomass would continue to decline over the next 40 years (Appendix 8). This in turn leads to less available habitat for prairie dogs and consequently burrowing owls. Fire intensity would continue to increase overtime as vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects to prairie dog habitat and consequently potential habitat for western burrowing owl. Eight percent of the grassland habitat has the potential for crown fire (Fire Ecology report). Stability of key ecosystem components such as, species composition, forest structure, soil characteristics and hydrologic function are at moderately to high risk of loss in the event of high severity disturbance, such as high severity wildfire on 76 percent of grasslands (Fire Ecology report). This alternative would result in the most stress on meadow and grassland habitats and thus would have the greatest negative contribution to potential western burrowing owl habitat.

Determination of Effect

Alternative A would have no impact to burrowing owls.

Cumulative Effects

The area analyzed for cumulative effects to burrowing owls encompasses the project area and the associated prairie dog complexes. The No Action Alternative would maintain the current risk to burrowing owl habitat and adjacent forest lands. The No Action Alternative has a cumulative effect of reducing the number of grassland acres within the project area, as dense forest conditions would continue to place burrowing owl habitat and adjacent habitat at risk of tree encroachment. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects to burrowing owl habitat.

Alternative B Proposed Action

Direct/Indirect Effects

Direct effects could occur if motorized equipment runs over above ground nests or burrows. There are no documented nesting burrowing owls on the project area, however potential nesting habitat does exist. While 10-15% of the immediate area in grasslands may be disturbed in the short term, the area is expected to quickly be covered with new needle duff and improved herbaceous vegetative cover, improving soil nutrient cycling function and stabilizing soil and maintaining and improving soil productivity in the longer term (more than 2 years) (Soil Resources report). Indirect effects to burrowing owls include effects to owl habitat, owl prey species, or prey species habitat. However, active management in some areas of ponderosa pine forest could potentially affect their habitat, e.g., meadows and grasslands are commonly encroached by pine trees as a result of fire exclusion; restoring these habitats towards historic conditions can increase potential nesting and foraging habitat for western burrowing owls. Meadow restoration treatments would improve and increase available habitat for prairie dogs, which would subsequently provide nesting habitat for burrowing owls. The Proposed Action would increase available habitat for prairie dogs with 11,222 acres of grassland restoration treatments. Prescribed burning would result in the removal of cover and food however it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats for insects and small mammals increasing food sources and resulting in an indirect beneficial effect for burrowing owls.

Determination of Effect

Alternative B would have no impact to burrowing owls.

Alternative C

Direct/Indirect Effects

Alternative 3 would have a more pronounced impact of decreasing pine tree encroachment in grasslands by 48,206 thus decreasing impacts to the larger prairie dog population. These treatments would occur within open linkages providing additional opportunities for Gunnison's prairie dogs to colonize new areas and re-colonize areas where trees have encroached previously occupied habitat in Government and Garland Prairie, Kendrick Park and other grasslands. Alternative C treats the most acres and elicits the greatest response in understory (Appendix 8). As a result the habitat as a whole would be more likely to support a greater prairie dog population in grassland systems in the project area thus supporting more potential burrowing owl habitat.

Determination of Effect

Alternative C would have no impact to burrowing owls.

Alternative D

Direct/Indirect Effects

This alternative has similar effects as Alternative B however; Alternative D produces the lowest response of understory biomass of all the action alternatives. Alternative D does not include prescribed burning across the mechanical treatments as Alternative B does and there are about 20,645 fewer acres of prescribed burn only. The lack of burning means no nutrient pulse into the

system, further limiting understory response. This Alternative provides the least amount and lowest quality of habitat for prairie dogs hence less habitat for burrowing owls.

Determination of Effect

Alternative D would have no impact to burrowing owls.

Cumulative Effects for all Action Alternatives

The area analyzed for cumulative effects to burrowing owls encompasses the project area and the associated prairie dog complexes. Cumulative activities such as the Travel Management Rule are likely to decrease motorized use in grasslands thus decreasing impacts to prairie dog populations. This combined with forest restoration activities could open up more habitats or provide more contiguous swaths of grassland habitat key to supporting thriving prairie dog colonies. Past, present and reasonably foreseeable projects are listed in Appendix 12 and past projects have implemented thinning on 2,304 acres and prescribed burning on 8,951 acres in grasslands. Short term and localized effects from mechanical thinning and prescribed burning would result in the potential collapsing of burrows and displacement of prairie dogs. This impact may combine with short-term cumulative impacts from localized dispersed camping, wildfire and wildfire suppression activities to temporarily displace prairie dog populations (and thus burrowing owls) in a limited area.

The thinning of 2,340 acres and prescribed fire on 8,951 acres in grasslands will add to the acres of treatments in this project to reduce tree densities in grasslands and connect open corridors across the analysis area providing additional potential habitat for burrowing owls.

Ferruginous Hawk

Alternative A No Action

Direct/Indirect Effects

Because ferruginous hawks are not known to nest in the project area the probability of direct effects from the current condition are low. The No Action Alternative would not treat meadows and grassland within the project area and trees would continue to encroach on these habitats. Denser forest conditions produce lower values in understory biomass (lbs/acre). Under the No Action understory biomass would continue to decline over the next 40 years (Appendix 8). This in turn leads to less available habitat for prairie dogs and consequently ferruginous hawks. Fire intensity would continue to increase overtime as vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects to prairie dog habitat and consequently potential habitat for ferruginous hawk. Eight percent of the grassland habitat has the potential for crown fire (Fire Ecology report). Stability of key ecosystem components such as, species composition, forest structure, soil characteristics and hydrologic function are at moderately to high risk of loss in the event of high severity disturbance, such as high severity wildfire on 76 percent of grasslands (Fire Ecology report). This alternative would result in the most stress on meadow and grassland habitats and thus would have the greatest negative contribution to potential ferruginous hawk habitat.

Cumulative Effects

The area analyzed for cumulative effects to burrowing owls encompasses the project area and the associated prairie dog complexes. The No Action Alternative would maintain the current risk to

ferruginous hawk habitat and adjacent forest lands. The No Action Alternative has a cumulative effect of reducing the number of grassland acres within the project area, as dense forest conditions would continue to place ferruginous hawk habitat and adjacent habitat at risk of tree encroachment. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects to ferruginous hawks. This alternative would result in the most stress on grassland habitats and thus would have the greatest negative contribution to potential ferruginous hawk habitat.

Determination of Effect

Alternative A would have no impact to ferruginous hawks.

Alternative B Proposed Action

Direct/Indirect Effects

There are no direct effects to ferruginous hawks as none are known to nest in the project area. Indirect effects to the ferruginous hawk include effects to ferruginous hawk prey species or prey species habitat. Forest treatments can indirectly beneficially affect potential habitat by restoring meadows, grasslands, and savannas encroached by pine trees resulting from fire exclusion. Moving these habitats towards historic conditions could increase potential nesting and foraging habitat for ferruginous hawks.

There are no anticipated adverse effects to prey species or prey species habitat. Meadow and savanna restoration treatments may have a short-term impact of disturbing prey during implementation however over the long-term habitat would improve and increase available habitat for prairie dogs, a primary prey species. While 10-15% of the immediate area in grasslands and 10-20% in savanna may be disturbed in the short term, grasslands are expected to quickly be covered with new needle duff and improved herbaceous vegetative cover, improving soil nutrient cycling function and stabilizing soil and maintaining and improving soil productivity in the longer term (more than 2 years) while soil disturbance in savanna restoration would not pose a risk to long term soil productivity (Soil Resources report). The Proposed Action would increase available habitat for prairie dogs with 11,185 acres of meadow enhancement treatments and 45,469 acres of savannah treatments, resulting in an indirect beneficial effect.

Mechanical treatments prescribed and pile burning and hauling of timber and other project activities may cause visual or auditory disturbance to foraging ferruginous hawks. Approximately 10,000 acres of prescribed burning and 30,000 acres of mechanical treatment would occur annually; however, these are short-term effects and would be minimized due to activities being temporally and spatially separated. This disturbance would be localized, of short duration and low intensity and may affect individual birds but would not affect the overall distribution or reproduction of the species.

Determination of Effect

Alternative B would have no impact to ferruginous hawks.

Alternative C

Direct/Indirect Effects

Alternative 3 would have a more pronounced impact of decreasing pine tree encroachment in grasslands by 48,196 acres thus decreasing impacts to the larger prairie dog population. These treatments would occur within open linkages providing additional opportunities for Gunnison's prairie dogs to colonize new areas and re-colonize areas where trees have encroached previously occupied habitat in Government and Garland Prairie, Kendrick Park and other grasslands.

Alternative C treats the most acres and elicits the greatest response in understory. As a result the habitat as a whole would be more likely to support a greater prairie dog population in grassland systems in the project area thus supporting more potential ferruginous hawk foraging habitat.

Determination of Effect

Alternative C would have no impact to ferruginous hawks.

Alternative D

Direct/Indirect Effects

This alternative has similar effects as Alternative B however; Alternative D produces the lowest response of understory biomass of all the action alternatives. Alternative D does not include prescribed burning across the mechanical treatments as Alternative B does and there are about 20,645 fewer acres of prescribed burn only. The lack of burning means no nutrient pulse into the system, further limiting understory response. This Alternative provides the least amount and lowest quality of habitat for prairie dogs hence less habitat for ferruginous hawks.

Cumulative Effects for all Action Alternatives

The area analyzed for cumulative effects to ferruginous hawks encompasses the project area and the associated prairie dog complexes. Cumulative activities such as the Travel Management Rule are likely to decrease motorized use in grasslands thus decreasing impacts to prairie dog populations. This combined with forest restoration activities could open up more habitats or provide more contiguous swaths of grassland habitat key to supporting thriving prairie dog colonies. Past, present and reasonably foreseeable projects are listed in Appendix 12 and past project have implemented thinning on 2,304 acres and prescribed burning 8,951 acres in grasslands. Short term and localized effects from mechanical thinning and prescribed burning would result in the potential collapsing of burrows and displacement of prairie dogs. This impact may combine with short-term cumulative impacts from localized dispersed camping, wildfire and wildfire suppression activities to temporarily displace prairie dog populations (and thus ferruginous hawks) in a limited area.

The thinning of 2,340 acres and prescribed fire on 8,951 acres in grasslands will add to the acres of treatments in this project to reduce tree densities in grasslands and connect open corridors across the analysis area providing additional potential habitat for ferruginous hawks.

Determination of Effect

Alternative D would have no impact to ferruginous hawks.

Four Spotted Skipperling

Alternative A No Action

Direct/Indirect Effects

Under the No Action Alternative, there would be no direct effect to this species. Meadows would not be rehabilitated, thus there would no benefits to these species. Favorable habitat would decrease over the next 40 years as conifers encroach into meadows and canopy closure increases and understory productivity and diversity decreases, resulting in reduced availability of food and reproductive sites for this species. Uncharacteristic tree densities and patterns in ponderosa pine forest would potentially decrease water yield in canyons and riparian habitat and decrease resilience of the habitat by increasing the threat of stand replacing high severity fire. Fire intensity would continue to increase overtime as vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects to grasslands. Eight percent of the grassland habitat has the potential for crown fire (Fire Ecology report). Stability of key ecosystem components such as, species composition, forest structure, soil characteristics and hydrologic function are at moderate to high risk of loss in the event of high severity disturbance, such as high severity wildfire, on 76 percent of grasslands (Fire Ecology report).

Under the No Action Alternative, there would no restoration of springs. These areas would continue to exhibit downward trends in functional condition or remain in static condition for the foreseeable future (Water Quality and Riparian report) resulting in degradation of habitat.

Not moving these grassland and spring habitats towards historic conditions could result in reduced food and reproductive sites and reduced habitat connectivity for four-spotted skipperling.

Cumulative Effects

The area analyzed for cumulative effects for the four-spotted skipperling is the project area. Continued pine tree encroachment into grasslands and private development in grasslands would result in a cumulative impact along with such activities as grazing and high impact recreational use to limit meadow, grassland, and seep and spring habitat. This alternative would result in the most stress on meadow, grassland, and seep and spring habitats and thus would have the greatest negative contribution to potential four-spotted skipperling habitat.

Determination of Effect

Alternative A may impact four-spotted skipperling, but is not likely to cause a trend to federal listing or loss of viability.

Alternative B Proposed Action

Direct/Indirect Effects

Under the Proposed Action, spring and seep restoration would occur within or near wet meadows.

Under Alternative B, 93 springs/seeps would be restored on potential habitat for four-spotted skipperling. There would be short term disturbance to vegetation during implementation of stream and spring restoration projects however restored vegetation would be expected to recover within a 1 to 3 year period (Soil Resources report). An important consideration for restoration of springs is to restore discharge from the spring source except where prescribed by existing water rights adjudicated. All action alternatives would allow discharge from springs to resume flow

through their historic spheres of discharge as described by Springer and Stevens (2008) (Water Quality and Riparian report). Spring and seep restoration would increase riparian vegetation increasing availability of food and reproductive sites for this species over the long-term, resulting in direct beneficial effects to habitat.

Individuals may be impacted by mechanical activities, such as contact with machinery and tools. These activities would be minimal and short term. Spring and seep restoration would increase riparian vegetation increasing availability of food and reproductive sites for four-spotted skipperling over the long-term.

Indirect effects would result from vegetation modification activities such as mechanical treatments, temporary road construction and prescribed burning. These activities would disturb or remove understory vegetation, in effect reducing availability to adult butterflies and/or caterpillars. However, these would be short-term effects and would be minimized due to activities being temporally and spatially separated. In contrast, reducing canopy closure, removing trees in meadows, restoring openings throughout the ponderosa pine and prescribed burning would encourage the development of understory vegetation, increasing availability of food and reproductive sites and providing habitat connectivity for these species over the long-term, resulting in indirect beneficial effects. Meadow restoration treatments may have a short-term impact of disturbing four-spotted skipperling during implementation however over the long-term habitat would improve and increase available habitat for butterflies. While 10-15% of the immediate area in grasslands and 10-20% in savanna may be disturbed in the short term, grasslands are expected to quickly be covered with new needle duff and improved herbaceous vegetative cover, improving soil nutrient cycling function and stabilizing soil and maintaining and improving soil productivity in the longer term (more than 2 years) (Soil Resources report). Reducing uncharacteristic tree densities and patterns in ponderosa pine forest could potentially increase water yield in canyons and riparian habitat and increase resilience of the habitat by reducing the threat of stand replacing high severity fire. Moving these habitats towards historic conditions could increase heterogeneity providing both direct habitat connectivity and habitat stepping stones facilitating landscape movement.

Determination of Effect

Alternative B may impact the four-spotted skipperling, but is not likely to cause a trend to federal listing or loss of viability.

Alternative C

Direct/Indirect Effects

Alternative C would have similar effects as Alternative B. This alternative would improve the most habitats for butterflies than the other two alternatives. Alternative C would add 48,196 additional acres of grassland restoration treatments. These treatments would occur within open linkages providing additional opportunities for butterflies to disperse and access adequate reproductive sites. Areas where trees have encroached grassland habitat in Government and Garland Prairie and Kendrick Park would provide larger patches of higher quality habitat while additional grassland treatments in other areas would provide habitat stepping stones facilitating landscape movement. The overall increase in grassland treatments would have a greater beneficial impact on the development of understory vegetation, increasing availability of food and reproductive sites and improving habitat connectivity resulting in indirect beneficial effects.

Determination of Effect

Alternative C may impact the four-spotted skipperling, but is not likely to cause a trend to federal listing or loss of viability.

Alternative D

Direct/Indirect Effects

Alternative D would have similar effects as Alternative B however the understory response is not anticipated to be as robust due to the lack of prescribed burning after mechanical treatments. The lack of burning means no nutrient pulse into the system, further limiting understory response. Based on a literature review of studies within the project area, litter depth appears to exert a strong negative influence on understory productions in several, but not all studies (Appendix 8).

Determination of Effect

Alternative D may impact the four-spotted skipperling, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects for all Action Alternatives

The area analyzed for cumulative effects for four-spotted skipperling is the project area. Cumulative activities such as the Travel Management Rule are likely to decrease motorized use in grasslands and meadows thus decreasing impacts to butterfly habitat. This combined with forest restoration activities could open up more habitats or provide more contiguous swaths of grassland habitat key to supporting thriving butterfly populations. Short-term and localized effects from mechanical thinning, temporary road construction and prescribed burning would result in the temporary reduction of understory vegetation reducing plant availability to adult insects, a primary food source. This impact may combine with short-term cumulative impacts from localized dispersed camping, wildfire and wildfire suppression activities, ungulate grazing, and drought from climate change to temporarily displace butterflies in a limited area.

Those projects where thinning and burning occurs in grassland and spring habitats could add to direct impacts from project activities by harm from fire and mechanical activities. However, projects would be implemented at different times and/or different locations, thus disturbances to individuals would be minimized.

Other past, present and ongoing projects have implemented thinning (2,304 acres) and prescribed burning (8,951 acres) in grasslands and prescribed burning (11 springs) and mechanical treatment (6 springs) improving habitats for four-spotted skipperling in the long-term.

Nitocris Fritillary

Alternative A No Action

Direct/Indirect Effects

Under the No Action Alternative, there would be no direct effect to these species. Meadows, seeps and springs would not be rehabilitated, thus there would no benefits to these species. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure increases and understory productivity and diversity decreases, resulting in an indirect adverse effect. Uncharacteristic tree densities and patterns in ponderosa pine forest would

potentially decrease water yield in canyons and riparian habitat and decrease resilience of the habitat by increasing the threat of stand replacing high severity fire. High fire hazard potential in the project area would persist.

Under the No Action Alternative, there would be no restoration of springs and no restoration of ephemeral channels. These areas would continue to exhibit downward trends in functional condition or remain in static condition for the foreseeable future (Water Quality and Riparian report) resulting in degradation of habitat. Not moving these habitats towards historic conditions could result in reduced food and reproductive sites and reduced habitat connectivity for nitocris fritillary.

Cumulative Effects

The area analyzed for cumulative effects for nitocris fritillary is the Coconino Forest within the project area. This alternative would continue to result in indirect impacts to nitocris fritillary, which may combine with ongoing activities that have similar effects. Cumulative effects from indirect impacts to nitocris fritillary would be limited to increased tree densities resulting in limited herbaceous understory impacting the ability of butterflies to successfully forage around and migrate between habitats. Degradation and fragmentation of habitat facilitated by this alternative would cumulatively combine with other Forest activities, high-impact recreational use, livestock grazing, use of non-jurisdictional roads, and habitat loss and degradation on private lands and climate change would continue to fragment key reproductive and foraging habitat. This alternative would result in the most stress on meadow, grassland, ponderosa pine and seep and spring habitats and thus would have the greatest negative contribution to potential nitocris fritillary habitat.

Determination of Effect

Alternative A may impact nitocris fritillary, but is not likely to cause a trend to federal listing or loss of viability.

Alternative B Proposed Action

Direct/Indirect Effects

Under the Proposed Action, spring and seep restoration would occur within or near wet meadows.

Under Alternative B, 51 springs/seeps and 85 miles of ephemeral streams would be restored on potential habitat for nitocris fritillary. There would be short term disturbance to vegetation during implementation of stream and spring restoration projects however restored vegetation would be expected to recover within a 1 to 3 year period (Soil Resources report). An important consideration for restoration of springs is to restore discharge from the spring source except where prescribed by existing water rights adjudicated. All action alternatives would allow discharge from springs to resume flow through their historic spheres of discharge as described by Springer and Stevens (2008) (Water Quality and Riparian report). Spring and seep restoration would increase riparian vegetation increasing availability of food and reproductive sites for this species over the long-term, resulting in direct beneficial effects to habitat. Individuals may be impacted by mechanical activities, such as contact with machinery and tools. These activities would be minimal and short term. Spring and seep restoration would increase riparian vegetation increasing availability of food and reproductive sites for nitocris fritillary over the long-term.

Indirect effects would result from vegetation modification activities such as mechanical thinning, temporary road construction and prescribed burning. These activities would disturb or remove understory vegetation, in effect reducing availability to adult butterflies and/or caterpillars. However, these would be short-term effects and would be minimized due to activities being temporally and spatially separated. In contrast, reducing canopy closure, removing trees in meadows, restoring meadows and prescribed burning would encourage the development of understory vegetation, increasing availability of food and reproductive sites and providing habitat connectivity for these species over the long-term, resulting in indirect beneficial effects. Reducing uncharacteristic tree densities and patterns in ponderosa pine forest could potentially increase water yield in canyons and riparian habitat and increase resilience of the habitat by reducing the threat of stand replacing high severity fire. Moving these habitats towards historic conditions could increase heterogeneity providing both direct habitat connectivity and habitat stepping stones facilitating landscape movement.

Determination of Effect

Alternative B may impact the nitocris fritillary, but is not likely to cause a trend to federal listing or loss of viability.

Alternative C

Direct/Indirect Effects

This alternative would improve the most habitats for butterflies than the other two alternatives. Alternative C adds 48,206 additional acres of grassland restoration. These treatments would occur within open linkages providing additional opportunities for butterflies to disperse and access adequate nesting sites. Areas where trees have encroached grassland habitat would provide larger patches of higher quality habitat while additional grassland treatments in other areas would provide habitat stepping stones facilitating landscape movement. The overall increase in grassland treatments would have a greater beneficial impact on the development of understory vegetation, increasing availability of food and reproductive sites and habitat connectivity resulting in indirect beneficial effects.

Determination of Effect

Alternative C may impact the nitocris fritillary, but is not likely to cause a trend to federal listing or loss of viability.

Alternative D

Direct/Indirect Effects

Alternative D would have similar effects as Alternative B however the understory response is not anticipated to be as robust due to the lack of prescribed burning after mechanical treatments. The lack of burning means no nutrient pulse into the system, further limiting understory response. Based on a literature review of studies within the project area, litter depth appears to exert a strong negative influence on understory productions in several, but not all studies (Appendix 8).

Determination of Effect

Alternative D may impact the nitocris fritillary, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects for all Alternatives

The area analyzed for cumulative effects for nitocris fritillary is the Coconino Forest within the project area. Past, present and reasonably foreseeable projects are listed in Appendix 12 and include projects within wet areas within the ponderosa pine, springs and wet meadows. Past activities within springs and wet meadows and riparian streams have been limited with mechanical treatments implemented on 3 springs and 1.3 miles of riparian and prescribed burning on 8 springs and 2.8 miles of riparian habitats. There are 44 springs within ½ mile of the project boundary that may be improved through current and reasonably foreseeable projects that reduced tree densities and increased understory vegetation improving functional condition. These projects will combine with this forest restoration project to improve habitat for nitocris fritillary.

Cumulative activities such as the Travel Management Rule are likely to decrease motorized use in grasslands and meadows thus decreasing impacts to butterfly habitat. This combined with forest restoration activities could open up more habitats or provide more contiguous swaths of grassland habitat key to supporting thriving butterfly populations. Short term and localized effects from mechanical thinning, temporary road construction and prescribed burning would result in the temporary reduction of understory vegetation. This impact may combine with short-term cumulative impacts from localized dispersed camping, wildfire and wildfire suppression activities, ungulate grazing, and drought from climate change to temporarily displace butterflies in a limited area.

Nokomis Fritillary

Alternative A No Action

Direct/Indirect Effects

Under the No Action Alternative, there would be no direct effect to these species. Meadows, seeps and springs would not be rehabilitated, thus there would no benefits to this species. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure and litter depth increases and understory productivity and diversity decreases, resulting in an indirect adverse effect. Uncharacteristic tree densities and patterns in ponderosa pine forest would potentially decrease water yield in canyons and riparian habitat and decrease resilience of the habitat by increasing the threat of stand replacing high severity fire. High fire hazard potential in the project area would persist.

Under the No Action Alternative, there would no restoration of springs and no restoration of ephemeral channels. These areas would continue to exhibit downward trends in functional condition or remain in static condition for the foreseeable future (Water Quality and Riparian report) resulting in degradation of potential habitat. Not moving these habitats towards historic conditions could result in reduced food and reproductive sites and reduced habitat connectivity for nokomis fritillary.

Cumulative Effects

The area analyzed for cumulative effects for nokomis fritillary is the Coconino Forest within the project area. Continued pine tree encroachment into grasslands and private development in grasslands would result in a cumulative impact along with such activities as grazing and high impact recreational use to limit meadow, grassland and seep and spring habitats. This alternative

would result in the most stress on meadow, grassland, seep and spring habitats and thus would have the greatest negative contribution to potential nokomis fritillary habitat.

Determination of Effect

Alternative A may impact nokomis fritillary, but is not likely to cause a trend to federal listing or loss of viability.

Alternative B Proposed Action

Direct/Indirect Effects

Under the Proposed Action, spring and seep restoration would occur within or near wet meadows.

Under Alternative B, 51 springs/seeps and 85 miles of ephemeral streams would be restored on potential habitat for nokomis fritillary. There would be short term disturbance to vegetation during implementation of stream and spring restoration projects however restored vegetation would be expected to recover within a 1 to 3 year period (Soil Resources report). An important consideration for restoration of springs is to restore discharge from the spring source except where prescribed by existing water rights adjudicated. All action alternatives would allow discharge from springs to resume flow through their historic spheres of discharge as described by Springer and Stevens (2008) (Water Quality and Riparian report). Spring and seep restoration would increase riparian vegetation increasing availability of food and reproductive sites for this species over the long-term, resulting in direct beneficial effects to habitat. Individuals may be impacted by mechanical activities, such as contact with machinery and tools. These activities would be minimal and short term. Spring and seep restoration would increase riparian vegetation increasing availability of food and reproductive sites for nokomis fritillary over the long-term.

Indirect effects would result from vegetation modification activities such as mechanical thinning, temporary road construction and prescribed burning. These activities would disturb or remove understory vegetation, in effect reducing availability to adult butterflies and/or caterpillars. However, these would be short-term effects and would be minimized due to activities being temporally and spatially separated. In contrast, reducing canopy closure, removing trees in meadows, restoring meadows and prescribed burning would encourage the development of understory vegetation, increasing availability of food and reproductive sites for these species over the long-term, resulting in indirect beneficial effects. Reducing uncharacteristic tree densities and patterns in ponderosa pine forest could potentially increase water yield in canyons and riparian habitat and increase resilience of the habitat by reducing the threat of stand replacing high severity fire. Moving these habitats towards historic conditions could increase heterogeneity providing both direct habitat connectivity and habitat stepping stones facilitating landscape movement and improving reproductive and feeding sites for nokomis fritillary.

Determination of Effect

Alternative B may impact the nokomis fritillary, but is not likely to cause a trend to federal listing or loss of viability.

Alternative C

Direct/Indirect Effects

Alternative C would have similar effects as Alternative B and D. This alternative would improve the most habitats for this butterfly than the other two alternatives. Alternative C adds 48,206 additional acres of grassland restoration. The overall increase in grassland treatments would have a greater beneficial impact on *nokomis fritillary* resulting in indirect beneficial effects.

Determination of Effect

Alternative C may impact the *nokomis fritillary*, but is not likely to cause a trend to federal listing or loss of viability.

Alternative D

Direct/Indirect Effects

Alternative D would have similar effects as Alternative B however the understory response is not anticipated to be as robust and litter depth is expected to remain at current levels due to the lack of prescribed burning after mechanical treatments. The lack of burning means no nutrient pulse into the system, further limiting understory response. Work with the *nokomis fritillary* determined probability of occupancy increased with increasing larval host-plant abundance and percent cover of adult nectar sources, but decreased as litter reached heavy levels, perhaps as a result of impeded oviposition (Appendix 8). Spring enhancement would encourage larval host-plant abundance but continued high litter depth may limit occupancy.

Determination of Effect

Alternative D may impact the *nokomis fritillary*, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects for all Action Alternatives

The area analyzed for cumulative effects for *nokomis fritillary* is the Coconino Forest within the project area. Past, present and reasonably foreseeable projects considered are listed in Appendix 12 and include projects within springs, seeps, and riparian areas and streams. Past activities within springs and riparian areas and streams have been limited with mechanical treatments implemented on 3 springs and 1.3 miles riparian streams and prescribed burning on 8 springs and 2.8 miles riparian streams. There are 44 springs within ½ mile of the project boundary that may be improved through current and reasonably foreseeable projects that reduced tree densities and increased understory vegetation improving functional condition. These projects will combine with this forest restoration project to improve habitat for *nokomis fritillary*.

Cumulative activities such as the Travel Management Rule are likely to decrease motorized use in grasslands and meadows thus decreasing impacts to butterfly habitat. This combined with forest restoration activities could open up more habitats or provide more contiguous swaths of grassland habitat key to supporting thriving butterfly populations. Short term and localized effects from mechanical thinning, temporary road construction and prescribed burning would result in the temporary reduction of understory vegetation. This impact may combine with short-term cumulative impacts from localized dispersed camping, wildfire and wildfire suppression

activities, ungulate grazing, and drought from climate change to temporarily displace butterflies in a limited area.

Navajo Mogollon Vole

Alternative A No Action

Direct/Indirect Effects

Under the No Action Alternative, there would be no disturbance and no direct effects. Although habitat would be provided for this species, most of the forested area within the project is currently is moderately closed to closed condition (Silviculture report), which provides low quality habitat for the Mogollon vole. Under the No Action Alternative, meadows would not be rehabilitated, thus there would no benefits to the vole. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure increases, resulting in an indirect adverse effect. Seventy percent of the ponderosa pine and 12 percent of grassland habitat is at high risk of losing key ecosystem components such as, species composition, forest structure, soil characteristics and hydrologic function, in the event of high severity fire. High fire severity potential would persist, and a large crown wildfire event would have the potential to affect many individuals. Thirty-nine percent of the ponderosa pine and 8 percent of grassland habitat would support a crown fire. Fire intensity would continue to increase overtime as vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects to vole habitat.

Cumulative Effects

The area analyzed for cumulative effects for Navajo Mogollon vole is the project area. This alternative would continue to result in indirect impacts to Navajo Mogollon vole habitat, which may combine with ongoing activities that have similar effects. Cumulative effects from indirect impacts to voles would be limited to increased tree densities resulting in limited herbaceous understory impacting the ability of voles to successfully forage around and migrate between habitats. Degradation and fragmentation of habitat facilitated by this alternative would cumulatively combine with other Forest activities, high-impact recreational use, livestock grazing, use of non-jurisdictional roads, and habitat loss and degradation on private lands and climate change would continue to fragment key nesting and foraging habitat. Grazing may result in short-term impacts to habitat, is not expected to result in long-term cumulative impacts and is expected to be localized in nature. This alternative would result in the most stress on meadow, grassland and ponderosa pine habitats and thus would have the greatest negative contribution to potential Mogollon vole habitat.

Determination of Effect

Alternative A may impact Navajo Mogollon vole, but is not likely to cause a trend to federal listing or loss of viability.

Alternative B Proposed Action

Direct/Indirect Effects

Under the Proposed Action, thinning and prescribed burning activities may disturb individual voles, resulting in direct adverse effects. Approximately 10,000 acres of prescribed burning and 30,000 acres of mechanical treatment would occur annually. Prescribed burning would result in the removal of cover and food; however it is anticipated that meadows and open areas would

rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Such activities would occur across the project area at different times; thereby reducing impacts to this species. In addition, the effect would be short-term and would have no impact the to population viability of voles. However, fire exclusion has resulted in uncharacteristically dense forests and meadow and grassland encroachment. Forest treatments can indirectly affect potential vole habitat by restoring meadows and reducing uncharacteristic tree densities and patterns in ponderosa pine forest. Restoring meadows and creating openings in the forest would increase potential understory development, including bunch grasses and other C-3 plants providing preferred food sources. In addition to grassland restoration treatments, Alternative B calls for a diverse range of mechanical treatments that would vary from 10-90% open depending on localized site conditions providing both habitat connectivity and habitat stepping stones facilitating landscape movement. Reduction in stand density could potentially reverse the declining trend in C3 plants increasing habitat quality for Mogollon vole. Prescribed fire and mechanical treatments would improve the stability of key ecosystem elements such as species composition, forest structure, soils and hydrologic function by shifting 66 percent of the ponderosa pine to Fire Regime Condition Class (FRCC) 3 to 2 and increasing FRCC3 by 7 percent and shifting 4,500 acres of grassland from Fire Regime Condition Class (FRCC) 3 to FRCC 2, and increasing FRCC 1 by 1,683 acres (Fire Ecology report). The potential for crown fire within grasslands would be slightly (1%) reduced with a greater reduction in ponderosa (34%) (Fire Ecology report). Moving these habitats towards historic conditions could increase potential habitat quality and quantity and reduce the risk of uncharacteristic, high-severity wildfire. The reduction of ponderosa pine basal area, increased growth in the understory vegetation on the forest floor and increases in snags would result in indirect beneficial impacts to the vole.

Under Alternative B there are over 1,100 miles of closed roads that would be decommissioned. Roads often encourage removal of snags as hazard trees and provide easy access for fuelwood cutting potentially reducing snags along roadways. Ganey found an inverse relationship between snags and roads (pers. comm, 2012), so the proposed decommissioning of roads means more snags will be available in the future within vole habitat.

Under Alternative B, spring and seep restoration would have short-term disturbance to vegetation limiting habitat in for the vole however vegetation would be expected to recovery within a year and would improve riparian vegetation, increasing availability of food for small mammals over the long-term, resulting in indirect beneficial impacts. Fence design would allow access to small mammals.

Determination of Effect

Alternative B may impact the Navajo Mogollon vole, but is not likely to cause a trend to federal listing or loss of viability.

Alternative C

Direct/Indirect Effects

This alternative has similar effects as Alternative B. This alternative would improve the most habitats for the Navajo Mogollon vole than the other two alternatives. Alternative C adds 48,196 acres of grassland restoration treatments and restores larger grasslands such as Garland and Government Prairie where voles are known to occur. The overall increase in grassland treatments

would have a beneficial impact on this vole resulting in indirect beneficial effects. Research is proposed within vole habitat however the research treatments would provide additional heterogeneity across the landscape improving opportunities for voles.

Determination of Effect

Alternative C may impact the Navajo Mogollon vole, but is not likely to cause a trend to federal listing or loss of viability.

Alternative D

Direct/Indirect Effects

This alternative has the same effects as Alternative B however; the lack of prescribed burning after thinning treatments would deteriorate patterns of surface vegetation, as shrubs and other species adapted to fire decline (Huffman and Moore 2004, Moir 1988). Landscape patterns and mosaics that would have been created or maintained with fire would have to be maintained mechanically. The lack of burning means no nutrient pulse into the system, further limiting understory response.

Determination of Effect

Alternative D may impact the Navajo Mogollon vole, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects for all Action Alternatives

The area analyzed for cumulative effects for Navajo Mogollon vole is the project area. Current, ongoing and reasonably foreseeable projects are listed in Appendix 12 and include fuels reduction, forest health, aspen regeneration, tornado rehabilitation and powerline development and maintenance. Past and ongoing grassland activities include 8,951 acres of prescribed burning and 2,034 acres of mechanical treatments. Short-term impacts added to similar impacts from nearby projects were considered. Implementation of other project activities could occur simultaneously however, it is not anticipated to combine to cause a negative effect. All alternatives move these habitats towards historic conditions could increase potential habitat quality and quantity and reduce risk of uncharacteristic, high severity wildfire. This positive effect would be combined with similar effects from activities such as the Travel Management rule efforts that may decrease the frequency of disturbance on the majority of potential roost sites, slightly counteracting the effects of utility line and road construction and maintenance and short-term disturbances from vegetation management and prescribed fire.

Short term and localized effects from mechanical thinning, temporary road construction and prescribed burning would result in the temporary reduction of understory vegetation and soil compaction. This impact may combine with short-term cumulative impacts from localized dispersed camping, wildfire and wildfire suppression activities, ungulate grazing, and drought from climate change to alter availability of both food and cover for voles and temporarily displace voles in a limited area. Livestock are managed in systems designed to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative effects. However wild ungulates would continue to reduce vegetative understory and affect plant composition. Cumulative activities such as the Travel Management Rule are likely to decrease motorized use in grasslands and meadows thus decreasing impacts to vole habitat. This combined with forest

restoration activities could open up more habitats or provide more contiguous swaths of grassland habitat key to supporting thriving vole populations.

Long-tailed vole

Alternative A No Action

Direct/Indirect Effects

Under the No Action Alternative, there would be no disturbance and no direct effects. Although habitat would be provided for this species, most of the forested area within the project is currently is moderately closed to closed condition, which provides low quality habitat for the long-tailed vole. Under the No Action Alternative, meadows would not be rehabilitated, thus there would no benefits to the vole. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure increases, resulting in an indirect adverse effect. In addition, high fire hazard potential would persist, and a large crown wildfire event would have the potential to affect many individuals. Fire intensity would continue to increase overtime as vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects to long-tailed vole habitat. Eight percent of the grassland habitat has the potential for crown fire (Fire Ecology report). Stability of key ecosystem components such as, species composition, soil characteristics and hydrologic function are at moderately to high risk of loss in the event of high severity disturbance, such as high severity wildfire on 76 percent of grasslands (Fire Ecology report).

Water quality and riparian conditions would be adversely affected on a wide-scale basis (Water Quality and Riparian report), resulting in indirect adverse effects. Under the No Action Alternative, there would no restoration of springs and no restoration of ephemeral channels. These areas would continue to exhibit downward trends in functional condition or remain in static condition for the foreseeable future (Water Quality and Riparian report) resulting in degradation of potential habitat for long-tailed vole.

Cumulative Effects

The area analyzed for cumulative effects for long-tailed vole is the project area. Continued pine tree encroachment into grasslands and private development in grasslands would result in a cumulative impact along with such activities as grazing and high impact recreational use to limit meadow, grassland, and seep and spring habitats. Prescribed burning treatments and grazing may result in short-term impacts to habitat, but these are not expected to result in long-term cumulative impacts and are expected to be localized in nature. This alternative would result in the most stress on meadow, grassland, seep and spring habitats and thus would have the greatest negative contribution to potential long-tailed vole habitat.

Determination of Effect

Alternative A may impact long-tailed vole, but is not likely to cause a trend to federal listing or loss of viability.

Alternative B Proposed Action

Direct/Indirect Effects

Under the Proposed Action, thinning and prescribed burning activities may disturb individual voles, resulting in direct adverse effects. Approximately 10,000 acres of prescribed burning and 30,000 acres of mechanical treatment would occur annually. Prescribed burning would result in the removal of cover and food; however it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. While 10-15% of the immediate area in grasslands may be disturbed in the short term, the area is expected to quickly be covered with new needle duff and improved herbaceous vegetative cover, improving soil nutrient cycling function and stabilizing soil and maintaining and improving soil productivity in the longer term (more than 2 years) (Soil Resources report). Such activities would occur across the project area at different times; thereby reducing impacts to this species. In addition, the effect would be short-term. There would be no effects to population viability of voles. However, fire exclusion has resulted in uncharacteristically dense forests and meadow and grassland encroachment. Forest treatments can indirectly affect potential vole habitat by restoring meadows and reducing uncharacteristic tree densities and patterns in ponderosa pine forest. Restoring meadows and creating openings in the forest would increase potential understory development, including bunch grasses and other C-3 plants providing preferred food sources. In addition to grassland restoration treatments, Alternative B calls for a diverse range of mechanical treatments that would vary from 10-90% open depending on localized site conditions providing both habitat connectivity and habitat stepping stones facilitating landscape movement. Moving these habitats towards historic conditions could increase potential habitat and reduce the risk of uncharacteristic, high-severity wildfire. The reduction of ponderosa pine basal area, and increased growth in the understory vegetation on the forest floor would result in indirect beneficial impacts to the vole.

Under the Proposed Action, spring and seep restoration would occur within or near wet meadows.

Under Alternative B, 51 springs/seeps and 85 miles of ephemeral streams would be restored on potential vole habitat. Spring, seep and channel restoration would improve riparian vegetation, increasing availability of food for small mammals over the long-term, resulting in indirect beneficial impacts. Fence design would allow access to small mammals.

There would be short-term effects from riparian habitat and ephemeral stream restoration and spring restoration activities. Project implementation would disturb vegetation over the short-term. Past spring restoration projects have shown recovery of vegetation within one to three years after implementation (i.e. Hoxworth Spring). There will be no temporary roads, road construction or reconstruction within riparian habitat, ephemeral streams, seeps or springs.

Determination of Effect

Alternative B may impact the long-tailed vole, but is not likely to cause a trend to federal listing or loss of viability.

Alternative C

Direct/Indirect Effects

This alternative has similar effects as Alternative B; however, this alternative would improve the most habitats for the long-tailed vole than the other two alternatives. Alternative C adds 48,206 acres of grassland restoration treatments and restores larger grasslands such as Garland and Government Prairie where voles are known to occur. The overall increase in grassland treatments would have a beneficial impact on this vole resulting in indirect beneficial effects. Research is proposed within vole habitat however the research treatments would provide additional heterogeneity across the landscape improving opportunities for voles.

Determination of Effect

Alternative C may impact the long-tailed vole, but is not likely to cause a trend to federal listing or loss of viability.

Alternative D

Direct/Indirect Effects

This alternative has the same effects as Alternative B however; the lack of prescribed burning after thinning treatments would deteriorate patterns of surface vegetation, as shrubs and other species adapted to fire decline (Huffman and Moore 2004, Moir 1988). Landscape patterns and mosaics that would have been created or maintained with fire would have to be maintained mechanically. The lack of burning means no nutrient pulse into the system, further limiting understory response.

Determination of Effect

Alternative D may impact the long-tailed vole, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects for all Action Alternatives

The area analyzed for cumulative effects for long-tailed vole is the project area. Past, present and reasonably foreseeable projects considered are listed in Appendix 12 and include projects within springs, seeps, and riparian areas and streams. Past activities within springs and riparian areas and streams have been limited with mechanical treatments implemented on 11 springs, 50 acres of riparian areas and 1.3 miles riparian streams and prescribed burning on 6 springs, 17 acres riparian areas and 2.8 miles riparian streams. There are 44 springs within ½ mile of the project boundary that may be improved through current and reasonably foreseeable projects that reduced tree densities and increased understory vegetation improving functional condition. These projects will combine with this forest restoration project to improve habitat for long-tailed vole. Other past, present and ongoing projects have implemented thinning on 2,304 acre and prescribed burning on 8,951 acres in grasslands improving habitats for long-tailed vole in the long-term.

The action alternatives results in impacts that may combine cumulatively with other Forest and non-Forest activities including wildfire and wildfire suppression activities, livestock grazing, recreation and increased temperatures and predicted vegetation shifts at higher elevations from climate change. All these activities result in impacts by affecting vole habitat and potentially directly affecting vole burrows. The action alternatives would have a much larger beneficial

cumulative effect from meadow, grassland and ponderosa pine restoration treatments. This change combined with reduced motorized use within these areas would result in less disturbance and fragmentation to vole habitat.

Dwarf Shrew

Alternative A No Action

Direct/Indirect Effects

Under the No Action Alternative, there would be no disturbance and no direct effects. Although habitat would be provided for this species, most of the forested area within the project is currently is moderately closed to closed condition, which provides low quality habitat for the shrew. Under the No Action Alternative, meadows would not be rehabilitated, thus there would no benefits to the shrew. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure increases, resulting in an indirect adverse effect. In addition, high fire hazard potential would persist, and a large crown wildfire event would have the potential to affect many individuals.

Cumulative Effects

The area analyzed for cumulative effects for dwarf shrew is the project area. This alternative would continue to result in indirect impacts to dwarf shrew, which may combine with ongoing activities that have similar effects. Cumulative effects from indirect impacts to dwarf shrew would be limited to increased tree densities resulting in limited herbaceous understory impacting the ability of shrews to successfully forage around and migrate between habitats. Degradation and fragmentation of habitat facilitated by this alternative would cumulatively combine with other Forest activities, high-impact recreational use, livestock grazing, use of non-jurisdictional roads, and habitat loss and degradation on private lands and climate change would continue to fragment key nesting and foraging habitat. Prescribed burning treatments and grazing may result in short-term impacts to habitat, but these are not expected to result in long-term cumulative impacts and are expected to be localized in nature. This alternative would result in the most stress on meadow, grassland and ponderosa pine habitats and thus would have the greatest negative contribution to potential dwarf shrew habitat.

Determination of Effect

Alternative A may impact dwarf shrew, but is not likely to cause a trend to federal listing or loss of viability.

Alternative B Proposed Action

Direct/Indirect Effects

Under the Proposed Action, thinning and prescribed burning activities may disturb individual shrews, resulting in direct adverse effects. Approximately 10,000 acres of prescribed burning and 30,000 acres of mechanical treatment would occur annually. Prescribed burning would result in the removal of cover and food; however it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Such activities would occur across the project area at different times; thereby reducing impacts to this species. In addition, the effect would be short-term. There would be no effects to population viability of shrews. Increasing understory vegetation and associated litter provides cover and can

enhance prey populations. Many invertebrates, such as beetles, bugs, spiders, etc., are tied to specific understory plant species (Capinera 2010). Indirect benefits could potentially result from restoring meadows encroached by pine trees and reducing uncharacteristic tree densities and patterns in the ponderosa pine forest resulting from fire exclusion. These efforts would aid in restoring understory vegetation that would benefit dwarf shrews and their prey. Coarse woody debris would increase slightly in the short term and would continue to increase over the long term. Moving these habitats towards historic conditions would also improve the resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire. The reduction of dense forest canopy and increased growth in the herbaceous vegetation on the forest floor would result in indirect beneficial impacts to the vole. Forest conditions after treatment would improve shrew habitat within the project area.

Under the Proposed Action, spring, seep and channel restoration would improve riparian vegetation, increasing availability of food for small mammals over the long-term, resulting in indirect beneficial impacts. Fence design for exclosures would allow access to small mammals.

Determination of Effect

Alternative B may impact the dwarf shrew, but is not likely to cause a trend to federal listing or loss of viability.

Alternative C

Direct/Indirect Effects

This alternative would improve the most habitats for the dwarf shrew than the other two alternatives. Alternative C adds 48,206 acres of grassland restoration and 45,462 acres of savanna treatments. The overall increase in grassland, savanna and forest area treatments would have a beneficial impact on this vole resulting in indirect beneficial effects.

Determination of Effect

Alternative C may impact the dwarf shrew, but is not likely to cause a trend to federal listing or loss of viability.

Alternative D

Direct/Indirect Effects

This alternative has the same effects as Alternative B however the lack of prescribed burning after thinning treatments would deteriorate patterns of surface vegetation, as shrubs and other species adapted to fire decline (Huffman and Moore 2004, Moir 1988) limiting prey and resulting in indirect adverse affects to dwarf shrew. The lack of burning means no nutrient pulse into the system, further limiting understory response.

Determination of Effect

Alternative D may impact the dwarf shrew, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects for All Action Alternatives

The area analyzed for cumulative effects for dwarf shrew is the project area. Cumulative activities such as the Travel Management Rule are likely to decrease motorized use in grasslands and meadows thus decreasing impacts to shrew habitat. This combined with forest restoration activities could open up more habitats or provide more contiguous swaths of grassland habitat key to supporting thriving small mammal populations. Short-term and localized effects from mechanical thinning, temporary road construction and prescribed burning would result in the temporary reduction of understory vegetation. This impact may combine with short-term cumulative impacts from localized dispersed camping, wildfire and wildfire suppression activities, ungulate grazing, and drought from climate change to temporarily displace shrews in a limited area. Climate change is also expected to result in a higher frequency of high-severity wildfires (Marlon et al. 2009) and prolonged periods of drought (Furniss et al. 2010), which would also cumulatively contribute to decreases in vegetative ground cover.

Merriam's Shrew

Alternative A No Action

Direct/Indirect Effects

Under the No Action Alternative, there would be no disturbance and no direct effects. Although habitat would be provided for this species, most of the forested area within the project is currently is moderately closed to closed condition, which provides low quality habitat for the shrew. Under the No Action Alternative, meadows would not be rehabilitated, thus there would be no benefits to the shrew. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure increases, resulting in an indirect adverse effect. In addition, high fire hazard potential would persist, and a large crown wildfire event would have the potential to affect many individuals.

Cumulative Effects

The area analyzed for cumulative effects for Merriam's shrew is the project area. This alternative would continue to result in indirect impacts to Merriam's shrew, which may combine with ongoing activities that have similar effects. Cumulative effects from indirect impacts to Merriam's shrew would be limited to increased tree densities resulting in limited herbaceous understory impacting the ability of shrews to successfully forage around and migrate between habitats. Degradation and fragmentation of habitat facilitated by this alternative would cumulatively combine with other Forest activities, high-impact recreational use, livestock grazing, use of non-jurisdictional roads, and habitat loss and degradation on private lands and climate change would continue to fragment key nesting and foraging habitat. Prescribed burning treatments and grazing may result in short-term impacts to habitat, but these are not expected to result in long-term cumulative impacts and are expected to be localized in nature. This alternative would result in the most stress on meadow, grassland and ponderosa pine habitats and thus would have the greatest negative contribution to potential Merriam's shrew habitat.

Determination of Effect

Alternative A may impact Merriam's shrew, but is not likely to cause a trend to federal listing or loss of viability.

Alternative B Proposed Action

Direct/Indirect Effects

Under the Proposed Action, thinning and prescribed burning activities may disturb individual shrews, resulting in direct adverse effects. Approximately 10,000 acres of prescribed burning and 30,000 acres of mechanical treatment would occur annually. Prescribed burning would result in the removal of cover and food; however it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Such activities would occur across the ponderosa pine treatment area at different times; thereby reducing impacts to this species. In addition, the effect would be short-term. There would be no effects to population viability of shrews. Increasing diversity and density of understory vegetation provides habitat for prey populations. Many invertebrates are tied to specific understory plant species. Indirect benefits could potentially result from restoring meadows encroached by pine trees and reducing uncharacteristic tree densities and patterns in the ponderosa pine forest resulting from fire exclusion. These efforts would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit Merriam's shrew and their prey. Coarse woody debris would increase slightly in the short term and would continue to increase over the long term. Moving these habitats towards historic conditions would also increase resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire. The reduction of dense forest canopy and increased growth in the herbaceous vegetation on the forest floor would result in indirect beneficial impacts to the vole. Forest conditions after treatment would improve shrew habitat within the ponderosa pine treatment area.

Under the Proposed Action, spring and water tank exclosures would improve riparian vegetation, increasing availability of food for small mammals over the long-term, resulting in indirect beneficial impacts. Fence design would allow access to small mammals.

Determination of Effect

Alternative B may impact the Merriam's shrew, but is not likely to cause a trend to federal listing or loss of viability.

Alternative C

Direct/Indirect Effects

This alternative has the same effects as Alternative B; however, this alternative would improve the most habitats for Merriam's shrew than the other two alternatives. Alternative C adds 48,206 acres of grassland restoration and 45,462 acres of savanna treatments. The overall increase in grassland, savanna and forest area treatments would have a beneficial impact on this shrew resulting in indirect beneficial effects.

Determination of Effect

Alternative C may impact the Merriam's shrew, but is not likely to cause a trend to federal listing or loss of viability.

Alternative D

Direct/Indirect Effects

This alternative has similar effects as Alternative B however the lack of prescribed burning after thinning treatments would deteriorate patterns of surface vegetation, as shrubs and other species adapted to fire decline (Huffman and Moore 2004, Moir 1988). The lack of burning means no nutrient pulse into the system, further limiting understory response. Alternative D produces the lowest response of understory biomass of all the action alternatives limiting prey and resulting in indirect adverse affects to Merriam's shrew.

Determination of Effect

Alternative D may impact the Merriam's shrew, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects for all Action Alternatives

The area analyzed for cumulative effects for Merriam's shrew is the project area. Current, ongoing and reasonably foreseeable projects are listed in Appendix 12 and include fuels reduction, forest health, aspen regeneration, tornado rehabilitation and powerline development and maintenance. Cumulative activities such as the Travel Management Rule are likely to decrease motorized use in grasslands and meadows thus decreasing impacts to shrew habitat. This combined with forest restoration activities could open up more habitats or provide more contiguous swaths of grassland habitat key to supporting thriving small mammal populations. Short-term and localized effects from mechanical thinning, temporary road construction and prescribed burning would result in the temporary reduction of understory vegetation. This impact may combine with short-term cumulative impacts from localized dispersed camping, wildfire and wildfire suppression activities, ungulate grazing, and drought from climate change to temporarily displace shrews in a limited area. Development of private and state land has the greatest potential impact to shrew habitat.

Western Red Bat

Alternative A No Action

Direct/Indirect Effects

Under the No Action Alternative, there would be no disturbance and no direct effects to western red bats. Habitat would still exist for this species, however, the high fire hazard potential would persist, and a large crown wildfire event could have the potential to affect individuals. Seventy percent of the ponderosa pine and 12 percent of grassland habitat is at high risk of losing key ecosystem components such as, species composition, forest structure, soil characteristics and hydrologic function, in the event of high severity fire. Thirty-nine percent of the ponderosa pine and 8 percent of grassland habitat would support a crown fire. Fire intensity would continue to increase overtime as vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects to vole habitat. Although habitat would be provided for this species, most of the forested area within the project area is in a moderately closed or closed canopy condition (Silviculture report). Under the No Action alternative grasslands and forest openings would not be restored, thus there would be no benefits to bats. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure increases resulting in indirect adverse effects.

Water quality and riparian conditions would be adversely affected on a wide-scale basis (Water Quality and Riparian report), resulting in indirect adverse effects. Under the No Action Alternative, there would no restoration of springs and no restoration of ephemeral channels. These areas would continue to exhibit downward trends in functional condition or remain in static condition for the foreseeable future (Water Quality and Riparian report) resulting in degradation of potential habitat for Western red bat.

Cumulative Effects

The area analyzed for cumulative effects for Western red bat is the project area. This alternative would continue to result in indirect impacts to spotted bats, which may combine with ongoing activities that have similar effects. Cumulative effects from indirect impacts to Western red bat would be limited to increased tree densities resulting in limited herbaceous understory limiting the availability of insects and consequently reducing prey for bats and reduced tree growth resulting in limited large trees and consequently recruitment snags impacting the ability of bats to successfully forage locate roost sites. Degradation of habitat facilitated by this alternative would cumulatively combine with other Forest activities, high-impact recreational use, livestock grazing, use of non-jurisdictional roads, and habitat loss and degradation on private lands and climate change would continue to fragment key roosting and foraging habitat. Prescribed burning treatments in adjacent projects and grazing may result in short-term impacts to habitat, but these are not expected to result in long-term cumulative impacts and are expected to be localized in nature. This alternative would result in the most stress on meadow, grassland and ponderosa pine habitats and thus would have the greatest negative contribution to potential dwarf shrew habitat.

Determination of Effect

Alternative A may impact Western red bat, but is not likely to cause a trend to federal listing or loss of viability.

Alternative B Proposed Action

Direct/Indirect Effects

Under the Proposed Action, all known caves would be buffered from thinning treatments within 300 feet of the cave. This would eliminate the potential for damage to the cave from mechanized equipment or increased sedimentation and would eliminate disturbance to Western red bats if they are roosting in caves. Under the Proposed Action, thinning and prescribed burning activities could potentially disturb red bats if they are roosting in trees and caves or hibernating among leaf litter within the ponderosa pine treatment area. Prescribed burning occurring when bats are rearing young (April –July) or in deep hibernation (mid-winter) can have negative effects on local populations. However, most prescribed burning would occur in the spring and fall and burn plans within ½ mile of known roosts/hibernacula would be designed to limit smoke at critical times (April –July and mid-winter).

Prescribed burning may also result in the loss of snags which could affect roosting bats; however mitigation including managing for retention of all snags 18” diameter and greater would reduce the impact. Recruitment snags will be provided by retaining trees 18 inches in diameter and greater with dead tops and lightning damage. The Proposed Action is expected to result in a slight short-term decrease in snags followed by an increase over the long-term. This short term loss of snags is not expected to affect the overall distribution of Western red bats on the forest.

Alternative B calls for a diverse range of mechanical treatments that would vary from 10 to 90% open depending on site conditions. Prescribed burning after mechanical treatments would result in the removal of cover and food; however it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. The reduction of dense forest canopy and increased growth in the herbaceous vegetation on the forest floor would result in indirect beneficial impacts to bats. Forest conditions after treatment would improve bat habitat within the project area by increasing diversity and density of understory vegetation provides habitat for prey populations as many invertebrates are tied to specific understory plant species. Indirect benefits could potentially result from restoring meadows encroached by pine trees and reducing uncharacteristic tree densities and patterns in the ponderosa pine forest resulting from fire exclusion. These efforts would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit western red bats and their prey. Moving these habitats towards historic conditions would also increase resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire.

Under the Proposed Action, spring, seep and ephemeral channel restoration would improve riparian vegetation, increasing availability of food for bats over the long-term, resulting in indirect beneficial effects.

Determination of Effect

Alternative B may impact the Western red bat, but is not likely to cause a trend to federal listing or loss of viability.

Alternative C

Direct/Indirect Effects

This alternative would improve the most habitats for this bat than the other two alternatives. Alternative C adds 48,206 acres of grassland treatments. The overall increase in grassland treatments would have a beneficial impact on spotted bat prey resulting in indirect beneficial effects.

Determination of Effect

Alternative C may impact the Western red bat, but is not likely to cause a trend to federal listing or loss of viability.

Alternative D

Direct/Indirect Effects

This alternative has similar effects as Alternative B however the lack of prescribed burning after thinning treatments would deteriorate patterns of surface vegetation, as shrubs and other species adapted to fire decline (Huffman and Moore 2004, Moir 1988). The lack of burning means no nutrient pulse into the system, further limiting understory response. Alternative D produces the lowest response of understory biomass of all the action alternatives limiting prey and resulting in indirect adverse affects to Western red bat.

Determination of Effect

Alternative D may impact the Western red bat, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects from all Action Alternatives

The area analyzed for cumulative effects for Western red bat is the project area. There may be potential short-term disturbance to potential foraging and roosting habitat with long-term benefits. Short-term disturbance to bats would occur during thinning, hauling and prescribed burning activities and may cause disturbance in nearby areas for the duration of the activity. These short-term impacts added to similar impacts from other past, present and reasonably foreseeable projects were considered. Implementation of other fuel reduction project activities could occur simultaneously; however, it is not anticipated to combine to cause a negative effect. Ungulate grazing within the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. Generally grazing systems are managed on a rotational grazing system to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative impacts. However wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows and around waters.

Allen's Lappet-browed Bat

Alternative A No Action

Direct/Indirect Effects

Under the No Action Alternative, there would be no disturbance and no direct effects to Allen's lappet-browed bats. Habitat would still exist for this species, however, the high fire hazard potential would persist, and a large crown wildfire event could have the potential to affect individuals. Although habitat would be provided for this species, most of the forested area within the project area is in a moderately closed or closed canopy condition. Under the No Action alternative grasslands and forest openings would not be restored, thus there would be no benefits to bats. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure increases resulting in indirect adverse effects.

Cumulative Effects

The area analyzed for cumulative effects for Allen's lappet-browed bat is the project area. This alternative would continue to result in indirect impacts to Allen's lappet-browed, which may combine with ongoing activities that have similar effects. Cumulative effects from indirect impacts to Allen's lappet-browed bat would be limited to increased tree densities resulting in limited herbaceous understory limiting the availability of insects and consequently reducing prey for bats and reduced tree growth resulting in limited large trees and consequently recruitment snags impacting the ability of bats to successfully forage locate roost sites. Degradation of habitat facilitated by this alternative would cumulatively combine with other Forest activities, high-impact recreational use, livestock grazing, use of non-jurisdictional roads, and habitat loss and degradation on private lands and climate change would continue to fragment key roosting and foraging habitat. Prescribed burning treatments and grazing may result in short-term impacts to habitat, but these are not expected to result in long-term cumulative impacts and are expected to be localized in nature. This alternative would result in the most stress on meadow, grassland and ponderosa pine habitats and thus would have the greatest negative contribution to potential Allen's lappet-browed bat habitat.

Determination of Effect

Alternative A may impact Allen's lappet-browed bat, but is not likely to cause a trend to federal listing or loss of viability.

Alternative B Proposed Action

Direct/Indirect Effects

Under the Proposed Action, thinning and prescribed burning activities could potentially disturb Allen's lappet-browed bats if they are roosting in trees within the ponderosa pine and pinyon juniper treatment areas. Prescribed burning occurring when bats are rearing young (April–July) or in deep hibernation (mid-winter) can have negative effects on local populations. However, most prescribed burning would occur in the spring and fall and burn plans within ½ mile of known roosts/hibernacula or unsurveyed caves and mine shafts would be designed to limit smoke at critical times (April–May and mid-winter). Prescribed burning may also result in the loss of individual snags which could affect roosting bats; however mitigation including managing for retention of all snags 18" diameter and greater would reduce the impact. Recruitment snags will be provided by retaining trees 18 inches in diameter and greater with dead tops and lightning damage. The Proposed Action is expected to result in a slight short-term increase in snags followed by a continuing increase over the long-term.

Prescribed burning would result in the removal of cover and food, however it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. The reduction of dense forest canopy and increased growth in the herbaceous vegetation on the forest floor would result in indirect beneficial impacts to bats. Forest conditions after treatment would improve bat habitat within the project area. Increasing diversity and density of understory vegetation provides habitat for prey populations. Many invertebrates are tied to specific understory plant species (Capinera 2010). Indirect benefits could potentially result from restoring meadows encroached by pine trees and reducing uncharacteristic tree densities and patterns in the ponderosa pine forest resulting from fire exclusion. These efforts would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit Allen's lappet-browed bats and their prey. Moving these habitats towards historic conditions would also increase resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire.

Under Alternative B there are over 1,100 miles of closed roads that would be decommissioned. Roads often encourage removal of snags as hazard trees and provide easy access for fuelwood cutting potentially reducing snags along roadways. Ganey found an inverse relationship between snags and roads (*pers. comm.*, 2012), so the proposed decommissioning of roads means more snags will be available in the future within Allen's lappet-browed bat habitat providing more roosting structures.

Under the Proposed Action, spring seep and channel restoration would improve riparian vegetation, increasing availability of food for bats over the long-term, resulting in indirect beneficial effects.

Determination of Effect

Alternative B may impact Allen's lappet-browed bat, but is not likely to cause a trend to federal listing or loss of viability.

Alternative C

Direct/Indirect Effects

This alternative has similar effects as Alternative B and D however; this alternative would improve the most habitats for this bat. Alternative C treats the most acres, adding 48,206 acres of grassland restoration treatments, and elicits the greatest response of understory biomass of all action alternatives. The overall increase in understory biomass would have a beneficial impact on Townsend's big-eared bat prey resulting in indirect beneficial effects.

Determination of Effect

Alternative C may impact Allen's lappet-browed bat, but is not likely to cause a trend to federal listing or loss of viability.

Alternative D

Direct/Indirect Effects

This alternative has similar effects as Alternative B however the lack of prescribed burning after thinning treatments would deteriorate patterns of surface vegetation, as shrubs and other species adapted to fire decline (Huffman and Moore 2004, Moir 1988). The lack of burning means no nutrient pulse into the system, further limiting understory response. Alternative D produces the lowest response of understory biomass of all the action alternatives limiting prey and resulting in indirect adverse affects to Allen's lappet-browed bat.

Determination of Effect

Alternative D may impact Allen's lappet-browed bat, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects for all Action Alternatives

The area analyzed for cumulative effects for Allen's lappet-browed bat is the project area. Current, ongoing and reasonably foreseeable projects are listed in Appendix 12 and include fuels reduction, forest health, aspen regeneration, tornado rehabilitation and powerline development and maintenance. There may be potential short-term disturbance to potential foraging and roosting habitat with long-term benefits. Short-term disturbance to bats would occur during thinning, hauling and prescribed burning activities and may cause disturbance in nearby areas for the duration of the activity. These short-term impacts added to similar impacts from other past, present and reasonably foreseeable projects were considered. Implementation of other fuel reduction project activities could occur simultaneously; however, it is not anticipated to combine to cause a negative effect. Ungulate grazing within the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. Generally grazing systems are managed on a rotational grazing system to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative impacts. However wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows and around waters. The Travel Management Rule has reduced the number of roads near Allen's lappet-browed bat roost locations.

Pale Townsend's Big-eared Bat

Alternative A No Action

Direct/Indirect Effects

Under the No Action Alternative, there would be no disturbance and no direct effects. As tree densities become greater there would be less edge habitat thereby reduced foraging opportunities. Seeps and springs would not be restored continuing to reduce availability of riparian associated host plants for noctuid moths on which they prey. High fire severity potential would persist, and a large crown wildfire event would have the potential to affect many individuals. Thirty-nine percent of the ponderosa pine and 8 percent of grassland habitat would support a crown fire. Fire intensity would continue to increase overtime as vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects to bat habitat. Seventy percent of the ponderosa pine and 12 percent of grassland habitat is at high risk of losing key ecosystem components such as, species composition, forest structure, soil characteristics and hydrologic function, in the event of high severity fire. Marginal foraging habitat would still exist for this species, however, the high fire hazard potential would persist, and a large crown wildfire event could have the potential to affect individuals, resulting in indirect adverse effects.

Cumulative Effects

The area analyzed for cumulative effects for pale Townsend's big-eared bat is the project area. This alternative would continue to result in indirect impacts to Townsend's big-eared bat, which may combine with ongoing activities that have similar effects. Cumulative effects from indirect impacts to Townsend's big-eared bat would be limited to increased tree densities resulting in limited herbaceous understory limiting the availability of insects and consequently reducing prey for bats and reduced tree growth resulting in limited large trees and consequently recruitment snags impacting the ability of bats to successfully forage locate roost sites. Degradation of habitat facilitated by this alternative would cumulatively combine with other Forest activities, high-impact recreational use, livestock grazing, use of non-jurisdictional roads, and habitat loss and degradation on private lands and climate change would continue to fragment key roosting and foraging habitat. Prescribed burning treatments and grazing may result in short-term impacts to habitat, but these are not expected to result in long-term cumulative impacts and are expected to be localized in nature. This alternative would result in the most stress on meadow, grassland and ponderosa pine habitats and thus would have the greatest negative contribution to potential Townsend's big-eared bat habitat.

Determination of Effect

Alternative A may impact pale Townsend's big-eared bat, but is not likely to cause a trend to federal listing or loss of viability.

Alternative B Proposed Action

Direct/Indirect Effects

Under the Proposed Action, all known caves would be buffered from thinning treatments within 300 feet of the cave. This would eliminate the potential for damage to the cave from mechanized equipment or increased sedimentation and would eliminate disturbance to Townsend's bats if they are roosting in caves. Thinning and prescribed burning activities could potentially disturb Townsend's bats if they are roosting in trees within the ponderosa pine treatment area. Prescribed

burning occurring when bats are rearing young (April –July) or in deep hibernation (mid-winter) can have negative effects on local populations. However, most prescribed burning would occur in the spring and fall and burn plans within ½ mile of known roosts/hibernacula or unsurveyed caves and mine shafts would be designed to limit smoke at critical times (April –May and mid-winter). Prescribed burning may also result in the loss of individual snags which could affect roosting bats; however mitigation including managing for retention of all snags 18” diameter and greater prior to prescribed burning would reduce the impact. The Proposed Action is expected to result in a slight short-term increase in snags followed by a continued increase over the long-term.

Prescribed burning would result in the removal of cover and food however it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Indirect effects would result from vegetation modification activities such as thinning and prescribed burning. These activities would disturb or remove understory vegetation, subsequently reducing availability to insects. These effects would be short-term and would be minimized due to activities being temporally and spatially separated. In contrast, reducing canopy closure, removing trees in and at edges of meadows, restoring meadows and prescribed burning would encourage the development of understory vegetation, and increase the amount of edge increasing availability of food for the bat over the long-term. Increasing diversity and density of understory vegetation provides habitat for prey populations. Many invertebrates are tied to specific understory plant species (Capinera 2010). Indirect benefits could potentially result from restoring meadows encroached by pine trees and reducing uncharacteristic tree densities and patterns in the ponderosa pine forest resulting from fire exclusion. These efforts would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit pale Townsend’s big-eared bats and their prey. Moving these habitats towards historic conditions would also increase resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire.

Under Alternative B there are over 1,100 miles of closed roads that would be decommissioned. Roads often encourage removal of snags as hazard trees and provide easy access for fuelwood cutting potentially reducing snags along roadways. Ganey found an inverse relationship between snags and roads (*pers. comm.*, 2012), so the proposed decommissioning of roads means more snags will be available in the future within Townsend’s big-eared bat habitat providing more roosting structures.

Under the Proposed Action, spring, seep and channel restoration would improve riparian vegetation, increasing availability of food for Noctuids and therefore Townsend’s big-eared bat over the long-term, resulting in indirect beneficial impacts.

Determination of Effect

Alternative B may impact pale Townsend’s big-eared bat, but is not likely to cause a trend to federal listing or loss of viability.

Alternative C

Direct/Indirect Effects

The effects are the same as Alternative B. One documented cave roost is located within an Arizona Game and Fish Research site however these treatments are designed to provide group sizes up to 15 acres in size and can be designed to buffer cave locations as needed. All

alternatives are designed to buffer cave locations to eliminate noise disturbance and protect sites from damage during implementation. This alternative would improve the most habitats for this bat than the other two alternatives. Alternative C adds 48,206 acres of grassland restoration treatments. The overall increase in grassland treatments would have a beneficial impact on Townsend's big-eared bat prey resulting in indirect beneficial effects.

Determination of Effect

Alternative C may impact pale Townsend's big-eared bat, but is not likely to cause a trend to federal listing or loss of viability.

Alternative D

Direct/Indirect Effects

This alternative has similar effects as Alternative B however the lack of prescribed burning after thinning treatments would deteriorate patterns of surface vegetation, as shrubs and other species adapted to fire decline (Huffman and Moore 2004, Moir 1988). The lack of burning means no nutrient pulse into the system, further limiting understory response. Alternative D produces the lowest response of understory biomass of all the action alternatives limiting prey and resulting in indirect adverse affects to Townsend's big-eared bat.

Determination of Effect

Alternative D may impact pale Townsend's big-eared bat, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects for all Action Alternatives

The area analyzed for cumulative effects for pale Townsend's big-eared bat is the project area. Current, ongoing and reasonably foreseeable projects are listed in Appendix 12 and include fuels reduction, forest health, aspen regeneration, tornado rehabilitation and powerline development and maintenance. Past and ongoing grassland activities include 8,951 acres of prescribed burning and 2,034 acres of mechanical treatments. There may be potential short-term disturbance to potential foraging and roosting habitat with long-term benefits. Short-term disturbance to bats would occur during thinning, hauling and prescribed burning activities and may cause disturbance in nearby areas for the duration of the activity. These short-term impacts added to similar impacts from other past, present and reasonably foreseeable projects were considered. Implementation of other fuel reduction project activities could occur simultaneously; however, it is not anticipated to combine to cause a negative effect. Ungulate grazing within the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. Generally grazing systems are managed on a rotational grazing system to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative impacts. However wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows and around waters. The Travel Management Rule has reduced the number of roads near Townsend's big-eared bat roost locations.

Greater Western Mastiff Bat

Alternative A No Action

Direct/Indirect Effects

Under the No Action Alternative, there would be no disturbance and no direct effects to greater western mastiff bats. Habitat would still exist for this species, however, the high fire hazard potential would persist, and a large crown wildfire event could have the potential to affect individuals. Although foraging habitat would be provided for this species, most of the forested area within the project area is in a moderately closed or closed canopy condition. Under the No Action alternative grasslands and forest openings would not be restored, thus there would be no benefits to foraging bats. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure increases resulting in indirect adverse effects.

Cumulative Effects

The area analyzed for cumulative effects for greater western mastiff bat is the project area. This alternative would continue to result in indirect impacts to greater Western mastiff bat, which may combine with ongoing activities that have similar effects. Cumulative effects from indirect impacts to greater Western mastiff bat would be limited to increased tree densities resulting in limited herbaceous understory limiting the availability of insects and consequently reducing prey for bats. Degradation of habitat facilitated by this alternative would cumulatively combine with other Forest activities, high-impact recreational use, livestock grazing, use of non-jurisdictional roads, and habitat loss and degradation on private lands and climate change would continue to fragment key roosting and foraging habitat. Prescribed burning treatments and grazing may result in short-term impacts to habitat, but these are not expected to result in long-term cumulative impacts and are expected to be localized in nature. This alternative would result in the most stress on meadow, grassland and ponderosa pine habitats and thus would have the greatest negative contribution to potential greater western mastiff bat habitat.

Determination of Effect

Alternative A may impact greater Western mastiff bat, but is not likely to cause a trend to federal listing or loss of viability.

Alternative B Proposed Action

Direct/Indirect Effects

Under the Proposed Action, disturbance from thinning and prescribed burning activities is highly unlikely. In addition, direct effects to roosting greater western mastiff bat from project implementation are not anticipated.

Prescribed burning would result in the removal of cover and food; however it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Indirect effects would result from vegetation modification activities such as thinning and prescribed burning. These activities would disturb or remove understory vegetation, subsequently reducing availability to insects. These effects would be short-term and would be minimized due to activities being temporally and spatially separated. In contrast, reducing canopy closure, removing trees in meadows, restoring meadows and prescribed burning would encourage the development of understory vegetation, increasing availability of

food over the long-term. Increasing diversity and density of understory vegetation provides habitat for prey populations. Many invertebrates are tied to specific understory plant species (Capinera 2010). Indirect benefits could potentially result from restoring meadows encroached by pine trees and reducing uncharacteristic tree densities and patterns in the ponderosa pine forest resulting from fire exclusion. These efforts would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit greater western mastiff bats and their prey. Moving these habitats towards historic conditions would also increase resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire.

Under the Proposed Action, spring and water tank exclosures would improve riparian vegetation, increasing availability of food for bats over the long-term, resulting in indirect beneficial impacts.

Determination of Effect

Alternative B may impact greater Western mastiff bat, but is not likely to cause a trend to federal listing or loss of viability.

Alternative C

Direct/Indirect Effects

The effects for Alternative C are similar as Alternative B and D however; Alternative C treats the most acres and elicits the greatest response in understory and the greatest availability of food for bats.

Determination of Effect

Alternative C may impact greater Western mastiff bat, but is not likely to cause a trend to federal listing or loss of viability.

Alternative D

Direct/Indirect Effects

This alternative has similar effects as Alternative B however the lack of prescribed burning after thinning treatments would deteriorate patterns of surface vegetation, as shrubs and other species adapted to fire decline (Huffman and Moore 2004, Moir 1988). The lack of burning means no nutrient pulse into the system, further limiting understory response. Alternative D produces the lowest response of understory biomass of all the action alternatives limiting prey and resulting in indirect adverse affects to greater western mastiff bat.

Determination of Effect

Alternative D may impact greater Western mastiff bat, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects for all Action Alternatives

The area analyzed for cumulative effects for greater Western mastiff bat is the project area. Current, ongoing and reasonably foreseeable projects are listed in Appendix 12 and include fuels reduction, forest health, aspen regeneration, tornado rehabilitation and powerline development and maintenance. Past and ongoing grassland activities include 8,951 acres of prescribed burning and 2,034 acres of mechanical treatments. There may be potential short-term disturbance to

potential foraging and roosting habitat with long-term benefits. Short-term disturbance to bats would occur during thinning, hauling and prescribed burning activities and may cause disturbance in nearby areas for the duration of the activity. These short-term impacts added to similar impacts from other past, present and reasonably foreseeable projects were considered. Implementation of other fuel reduction project activities could occur simultaneously; however, it is not anticipated to combine to cause a negative effect. Ungulate grazing within the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. Generally grazing systems are managed on a rotational grazing system to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative impacts. However wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows and around waters.

Spotted Bat

Alternative A No Action

Direct/Indirect Effects

Under the No Action Alternative, there would be no disturbance and no direct effects to spotted bats. Habitat would still exist for this species, however, the high fire hazard potential would persist, and a large crown wildfire event could have the potential to affect individuals. Seventy percent of the ponderosa pine and 12 percent of grassland habitat is at high risk of losing key ecosystem components such as, species composition, forest structure, soil characteristics and hydrologic function, in the event of high severity fire. Although habitat would be provided for this species, most of the forested area within the project area is in a moderately closed or closed canopy condition. Under the No Action alternative grasslands and forest openings would not be restored, thus there would be no benefits to bats. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure increases resulting in indirect adverse effects.

Cumulative Effects

The area analyzed for cumulative effects for spotted bat is the project area. The cumulative effects for the No Action Alternative are similar to the indirect effects discussed above. The No Action Alternative would not add any additional disturbance to wildlife species or modify habitat components within the project area. Therefore, there would be no direct cumulative effect from this alternative.

Determination of Effect

Alternative A may impact spotted bat, but is not likely to cause a trend to federal listing or loss of viability.

Alternative B Proposed Action

Direct/Indirect Effects

Under the Proposed Action, thinning and prescribed burning activities could potentially disturb spotted bats if they are roosting in rock crevices within the ponderosa pine treatment area. Prescribed burning occurring when bats are rearing young (April –July) or in deep hibernation (mid-winter) can have negative effects on local populations. However, most prescribed burning

would occur in the spring and fall and burn plans within ½ mile of caves, mines or cliff habitats would be designed to limit smoke at critical times (April –May and mid-winter).

Prescribed burning would result in the removal of cover and food; however it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Indirect effects would result from vegetation modification activities such as thinning and prescribed burning. These activities would disturb or remove understory vegetation, subsequently reducing availability to insects. These effects would be short-term and would be minimized due to activities being temporally and spatially separated. In contrast, reducing canopy closure, removing trees in meadows, restoring meadows and prescribed burning would encourage the development of understory vegetation, increasing availability of food for the bat over the long-term. Increasing diversity and density of understory vegetation provides habitat for prey populations. Many lepidopterans are tied to specific understory plant species (Waltz and Covington 2004). Indirect benefits could potentially result from restoring meadows encroached by pine trees and reducing uncharacteristic tree densities and patterns in the ponderosa pine forest resulting from fire exclusion. These efforts would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit spotted bats and their prey. Moving these habitats towards historic conditions would also increase resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire. Under the Proposed Action, spring, seep and channel restoration would improve riparian vegetation, increasing availability of food for bats over the long-term, resulting in indirect beneficial impacts.

Determination of Effect

Alternative B may impact spotted bats, but is not likely to cause a trend to federal listing or loss of viability.

Alternative C

Direct/Indirect Effects

The effects for Alternative C are similar as Alternative B and D; however, Alternative C treats the most acres and elicits the greatest response in understory and the greatest availability of food for bats.

Determination of Effect

Alternative C may impact spotted bats, but is not likely to cause a trend to federal listing or loss of viability.

Alternative D

Direct/Indirect Effects

This alternative has similar effects as Alternative B; however, the lack of prescribed burning after thinning treatments would deteriorate patterns of surface vegetation, as shrubs and other species adapted to fire decline (Huffman and Moore 2004, Moir 1988). The lack of burning means no nutrient pulse into the system, further limiting understory response. Alternative D produces the lowest response of understory biomass of all the action alternatives limiting prey and resulting in indirect adverse affects to spotted bat.

Determination of Effect

Alternative B may impact spotted bats, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects for all Action Alternatives

The area analyzed for cumulative effects for greater spotted bat is the project area. Current, ongoing and reasonably foreseeable projects are listed in Appendix 12 and include fuels reduction, forest health, aspen regeneration, tornado rehabilitation and powerline development and maintenance. Past and ongoing grassland activities include 8,951 acres of prescribed burning and 2,034 acres of mechanical treatments. There may be potential short-term disturbance to potential foraging and roosting habitat with long-term benefits. Short-term disturbance to bats would occur during thinning, hauling and prescribed burning activities and may cause disturbance in nearby areas for the duration of the activity. These short-term impacts added to similar impacts from other past, present and reasonably foreseeable mechanical vegetation management and fuels reduction projects were considered. Implementation of other vegetation management and fuel reduction project activities could occur simultaneously; however, it is not anticipated to combine to cause a negative effect. Ungulate grazing within the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. Generally grazing systems are managed on a rotational grazing system to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative impacts. However wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows and around waters.

Narrow-headed Garter Snake

Alternative A No Action

Direct/Indirect Effects

Under the No Action Alternative, habitat conditions for wildlife would remain in their current condition, notwithstanding natural processes. Because there are no known narrow-headed garter snakes on the project area, the probability of direct effects to narrow-headed garter snake from the current condition are low. However, dense forest conditions would still occur and the high fire hazard potential would persist. Large crown-wildfires could adversely affect potential habitat by destroying understory and overstory vegetation. As a result overland flow would increase, and soil erosion would increase with potentially high sediment loads. Water quality and riparian conditions would be adversely affected on a wide-scale basis (Water Quality and Riparian report), resulting in indirect adverse effects.

Determination of Effect

Alternative A may impact narrow-headed gartersnake, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects

The area analyzed for cumulative effects for narrow-headed garter snake is Subunit 3-5. The cumulative effects for the No Action Alternative are similar to the indirect effects discussed above. The No Action Alternative would not add any additional disturbance to wildlife species or

modify habitat components within subunit 3-5. Therefore, there would be no direct cumulative effect from this alternative.

Alternative B Proposed Action

Direct/Indirect Effects

Narrow-headed garter snakes are currently known from Oak Creek Canyon and the Verde River. There would be no direct effects to narrow-headed garter snakes from mechanical treatment and/or prescribed burning. The project would not be directly treating narrow-headed garter snake habitat.

It is unlikely that any of the Action Alternatives would contribute enough sediment or other pollutants to ephemeral or intermittent drainages within the project area to result in impairment of any downstream waterbodies (Water Quality and Riparian report). Treatments in subunits connected to these watersheds could potentially lead to increased sedimentation and/or ash flow into narrow-headed garter snake habitat (Fisheries and Aquatics report). However, this increase in sediment or ash over background levels would not have negative impacts on habitat for this species. Conversely, moving the forested uplands towards historic conditions would increase resilience of these systems and decrease the risk of uncharacteristic, high-severity wildfire. Protective stream buffer strips would be employed along Sterling Canyon streamcourse for both Alternatives B and C to reduce the risk of sediment and ash flow into the Upper Oak Creek.

Under the Proposed Action spring restoration would increase riparian vegetation increasing availability of food and reproductive sites for these species over the long-term, resulting in direct beneficial effects to habitat.

Determination of Effect

Implementation of Alternative B may impact narrow-headed garter snake, but is not likely to cause a trend to federal listing or loss of viability.

Alternative C

Direct/Indirect Effects

The effects for Alternative C are the same as Alternative B.

Determination of Effect

Implementation of Alternative C may impact narrow-headed garter snake, but is not likely to cause a trend to federal listing or loss of viability.

Alternative D

Direct/Indirect Effects

The effects for Alternative D are the same effects as Alternative B and C however there would be no prescribed burning on slopes greater than 15% along the upstream portion of Oak Creek within Subunit 3-5 eliminating the need for a protective stream course buffer along the entire length of Sterling Canyon.

Determination of Effect

Implementation of Alternative D may impact narrow-headed garter snake, but is not likely to cause a trend to federal listing or loss of viability.

Cumulative Effects for all Action alternatives

The area analyzed for cumulative effects for narrow-headed garter snake is Subunit 3-5. No cumulative effects to narrow-headed garter snake would occur from implementation of any of the alternatives, when added to past, present and reasonably foreseeable future activities. Ongoing and foreseeable future projects include tornado rehabilitation and Turkey Barney Fuels Reduction and Forest Health project. Implementation of other these projects could occur simultaneously; however it is not anticipated to combine to cause a negative effect. BMPs are implemented for all projects and would curtail soil erosion and minimize potential for inflow into potential narrow-headed garter snake habitat.

Golden and Bald Eagle Protection Act

Alternative A No Action

Direct/Indirect Effects

Refer to the section in this document where the effects analysis was done for the bald eagle as a Forest Service Sensitive species.

There are no direct effects to golden eagles as no habitat altering activities or disturbance associated with project implementation would occur. The No Action Alternative would not treat meadows within the project area and trees would continue to encroach, reducing potential habitat for small mammal and consequently golden eagles. Tree densities would continue to be high slowing their growth into larger diameter classes and thereby limiting the development of larger diameter (≥ 18 -inch) trees important for nesting and perching. Habitat conditions would remain in their current condition, not withstanding natural processes. Dense forest conditions would still occur and the high fire hazard potential would continue to place potential golden eagle breeding, nesting and foraging habitat at risk with respect to stand-replacing fire.

Cumulative Effects

The area analyzed for cumulative effects for the golden eagle is the project area and within $\frac{1}{2}$ mile of the project boundary. Continued pine tree encroachment into grasslands and private development in grasslands would result in a cumulative impact along with such activities as grazing and high impact recreational use to limit meadow and grassland habitats. Prescribed burning on 98,800 acres in adjacent projects may result in short-term impacts to habitat, but these are not expected to result in long-term cumulative impacts and are expected to be localized in nature. This alternative would result in the most stress on meadow and grassland habitats and thus would have the greatest negative contribution to potential golden eagle habitat.

Alternative B Proposed Action

Direct/Indirect Effects

Refer to the section in this document where the effects analysis was done for the bald eagle as a Forest Service Sensitive species.

Direct effects would be from activities that cause disturbances (smoke, auditory or visual) to golden eagles nesting or foraging within or adjacent to the project. Under the Proposed Action, there would be no direct adverse effects to nesting eagles as project design features would eliminate disturbance near known nesting sites. No vegetation treatments would occur within ½ mile (2,500 feet), unless mitigated by topography, of an occupied golden eagle nest between March 1 and August 31. Drift smoke from prescribed fire is expected in most places; however, concentrations of smoke that might settle in an area for more than one or two nights when a female is on the nest could have adverse effects to individuals. Prevailing southwest winds and the topography of the area typically act to lift smoke, carrying it away from ignition sites. Nests on cinder cones and other raised topographic features and in Sycamore and Oak Creek Canyons or in canyons immediately adjacent to Sycamore and Oak Creek Canyons or the Mogollon Rim are not expected to have smoke settle in them long enough to cause measurable effects to eagles because of the air movement in these landscape-scaled features. Conversely, nests in areas occurring in small canyons or valleys may have dense smoke settle in nesting locations.

When smoke settles into low-lying areas it typically does not last more than 1 or 2 nights. Limited smoke at nest locations would be expected to expose adult eagles to negligible effects as this would repeat an aspect of their evolutionary environment. However, on occasion dense smoke may settle into specific nest locations. Dense smoke settling into nest areas early in the season (March through June) could disturb brooding females. If the female flushed long enough to affect incubation this could result in loss of viability of the eggs. Dense smoke settling for multiple consecutive nights could affect developing lungs of nestlings. Unlike mammals, damaged avian lungs do not repair themselves through time (Hedwall, pers comm. 2012). Causing the female to discontinue incubating eggs or affecting lung development of nestlings would cause long-term adverse effects. Outside of these examples, smoke settling in nest locations would typically be short-term and not likely to cause adverse effects.

Within the project area, subunits were designed using 6th code watersheds as boundaries; FWS and fire specialists identified subunits as an appropriate boundary for determining smoke impacts. Fire specialists and biologists reviewed all current and historic golden eagle nests potentially affected by the project to determine if smoke would be expected to settle for greater than 24 hours at nest locations (Table 95). Of the 29 nests, 6 are in areas where smoke would settle if conditions are not optimal and fuels loads are heavy. In consultation with FWS, the Forest Service designed mitigation for those specific nest locations to include monitoring to determine if the nest is occupied/active and if so, a timing restriction would be placed on initial entry burning within the subunit where the nest was located until young had fledged. Table 95 lists confirmed and potential golden eagle nests by Forest and subunit and identifies whether there is potential for smoke to settle for extended periods at nest location. Subunits that could be restricted are 1-1, 1-3, 3-5 and 5-2.

Under the Proposed Action, mechanical treatments, prescribed, burning, road construction and decommissioning, hauling of timber and other restoration activities may cause visual or auditory disturbance to foraging golden eagles. This disturbance would be localized, of short duration and low intensity and would not be expected to substantially interfere with normal feeding behavior. Approximately 10,000 acres of prescribed burning and 30,000 acres of mechanical treatment would occur annually; however, these are short-term effects and would be minimized due to activities being spatially and temporally separated.

Indirect effects to the golden eagle include affects to eagle habitat, eagle prey species, or prey species habitat. There are no anticipated adverse effects to prey species or their habitats. Grassland and savanna treatments would maintain and improve foraging habitat on 11,185 acres of grassland and 45,496 acres of savanna habitat improving prey species habitat resulting in an indirect beneficial affect.

Table 95. Confirmed and potential golden eagle nests potentially affected by the 4FRI.

Status	Name	Subunit	Forest	Potential for Smoke to Settle	Comments
Confirmed	Colton Crater	4-3 (border)	CNF	No	0.3 miles from Forest boundary.
Confirmed	Mount Elden Sandy Seep	5-2	CNF	No	Nest located in cliff with no eagles seen. In treatment area.
Confirmed	Red Mountain	4-3	CNF	No	Cliff nest. Not in treatment area.
Confirmed	Red Mountain	4-3	CNF	No	Alternate nest site at Red Mountain. Not in treatment area.
Confirmed	Secret Mountain (aka north of Lost Mountain and Boynton Canyon).	3-5	CNF	No	Outside treatment area. At the edge of Munds Mountain- Secret Mountain Wilderness
Confirmed	Upper Lake Mary South	1-3	CNF	Yes	Tree nest. In treatment area.
Confirmed	Walnut Canyon	1-1	CNF	Yes	Outside treatment area. Within Walnut Canyon National Monument.
Confirmed	Johnson Canyon	4-2	KNF	No	Outside treatment area.
Confirmed	Eagle Rock	4-4	KNF	No	Outside treatment area.
Confirmed	Cedar Mountain	4-3	KNF	No	Outside treatment area.
Confirmed	Wild Horse Canyon	4-3	KNF	No	In treatment area.
Confirmed	Eagle Nest Mountain	4-1	KNF	No	Outside treatment area.

Status	Name	Subunit	Forest	Potential for Smoke to Settle	Comments
Confirmed	Double A Knoll	4-1	KNF	No	Outside treatment area.
Confirmed	Steiger Tank	4-1	KNF	No	Outside treatment area.
Confirmed	Rabbit Bill (aka Flat Mesa)	3-1	KNF	No	Outside treatment area.
Confirmed	MC Canyon	3-1	KNF	No	In treatment area.
Confirmed	Muleshoe	4-2	KNF	No	Outside treatment area.
Confirmed	Grand Canyon Trading (aka Prairie Dog Tank)	4-2	KNF	No	Outside treatment area.
Potential	O'Leary	5-2	CNF	No	Outside treatment area. Golden eagles often seen in area.
Potential	Dry Lake	3-5	CNF	No	Could be a roost site.
Potential	Bear Sign Canyon	3-5	CNF	No	No data on this sight. Eagles seen in area during surveys in 2009 and 2010.
Potential	San Francisco Wash	5-2	CNF	Yes	No data or information on this site. Digitized point appears to be in bottom of wash, road on top. In treatment area. Within 0.1 mile of powerline.
Potential	Upper Lake Mary North	1-3	CNF	Yes	Tree nest. Record isn't clear if this is a confirmed nest or not. In treatment area.
Potential	Deadwood Draw (aka Walker Creek)	2-0	CNF	No	Reported to FS, not confirmed. Non-FS. Not in project area.
Potential	Woody Ridge	3-5	CNF	Yes	Outside treatment area. No data or information on this site.

Status	Name	Subunit	Forest	Potential for Smoke to Settle	Comments
Potential	Cedar Flat	1-6	CNF	No	Outside treatment area.
Potential	Lee Mountain	2-0	CNF	No	No in treatment area.
Potential	Bill Williams Mountain	3-1	KNF	No	Outside treatment area. Nest sight not yet located but nest building expected.
Potential	Red Butte Mountain	6-2	KNF	No	Location not confirmed. In pinyon-juniper on Tusayan RD. Outside treatment area.

Alternative C

Direct/Indirect Effects

Refer to the section in this document where the effects analysis was done for the bald eagle as a Forest Service Sensitive species.

The effects of Alternative C are similar to those of Alternative B and D. Alternative C would have 48,206 acres more grassland restoration than Alternative B or D restoring more acres of potential foraging habitat for golden eagles. The added mechanical treatments within grasslands would maintain and improve more foraging habitat for golden eagles. There are no nests or roosts within the additional grassland treatments or research areas and no additional effects from disturbance.

Alternative D

Direct/Indirect Effects

Refer to the section in this document where the effects analysis was done for the bald eagle as a Forest Service Sensitive species.

This alternative has the same effects as Alternative B however the lack of prescribed burning after thinning treatments would deteriorate patterns of surface vegetation, as shrubs and other species adapted to fire decline (Huffman and Moore 2004, Moir 1988) limiting prey and resulting in indirect adverse affects for golden eagles. The lack of burning means no nutrient pulse into the system, further limiting understory response.

Cumulative Effects for all Action Alternatives

The area analyzed for cumulative effects for the golden eagle is the project area and ½ mile of the project boundary. Past, present and reasonably foreseeable projects are listed in Appendix 12 and past projects have implemented thinning on 2,304 acres and prescribed burning on 8,951 acres in grasslands. There is no effect to nesting eagles; however, there may be potential short-term disturbance to potential foraging habitat with long-term benefits. Short-term disturbance to foraging eagles would occur during thinning, hauling, temporary and permanent road

construction and prescribed burning activities and may cause eagles to forage in nearby areas for the duration of the activity. Other activities occurring that may have similar effects include temporary disturbances caused by prescribed fire (104,750 acres) and thinning (104,990 acres) in adjacent projects, or effects to roosting habitat from utility infrastructure development and maintenance (500 acres). These short-term impacts added to similar effects from other activities were considered. Implementation activities of other fuel reduction project activities could occur simultaneously; however, it is not anticipated to combine to cause a negative effect.

Determination of Effects for All Alternatives

The proposed treatments and activities **would not result in take as defined in the Eagle Act for golden or bald eagles**. For bald eagles the Forest Service Sensitive species analysis showed that effects from implementation of the Proposed Action **may impact bald eagles, but is not likely to result in a loss of viability or trend toward federal listing**.

For golden eagles, all nests will be protected from disturbance during project implementation. Project design features will mitigate potential for disturbance from noise or smoke to nesting golden eagles. Project activities will not substantially interfere with foraging behavior. Restoration treatments will improve foraging habitat and reduced potential of high severity fire impacting nest locations.

Forest Service Management Indicator Species

Management Species Indicators for Late-seral Ponderosa Pine

The northern goshawk, pygmy nuthatch and wild turkey are all indicators for late-seral ponderosa pine habitat. There are documented goshawk nesting territories within the analysis area. Pygmy nuthatches are recorded in the analysis area during Forestwide surveys for both forests. Wild turkeys are known to occur within the analysis area (**Appendix 6**).

Most trees in the mature and older structural stages (VSS 5 and 6) will be retained across all alternatives. The main difference between the alternatives will be how many acres each alternative would grow into late-seral habitat. The change in acreage by year and alternative is based on the silvicultural report (McCusker, unpublished report) and is summarized in table 95 below. The acreage is based on no high severity wildfire occurring within the analysis area over the next 40 years.

Kaibab NF Late-seral Ponderosa Pine Habitat Trend

The forestwide habitat trend for the late-seral ponderosa pine is in an upward trend due to the forest emphasis on retaining groups of large trees and maintaining large-sized reserve trees. Forestwide, there are approximately 200,000 acres of ponderosa pine forest in trees greater than 18" dbh (Forest Service 2010). Within the analysis area there is approximately 27,921 acres of late-seral ponderosa pine on the Kaibab NF (McCusker, unpublished report), which is approximately 14% of this age class across the forest. However, the analysis occurs on 189,407 acres of ponderosa pine habitat which is approximately 37% of the ponderosa pine cover type acreage for the forest.

Table 96. Change in Late-seral Ponderosa Pine Habitat on Kaibab NF by Alternative

Alternative	Current acreage	Acreage at 2020	Different from current	Acreage at 2050	Different from current
A	27,921	25,288	-2,633	68,277	40,356
B	27,921	59,883	31,962	104,803	76,882
C	27,921	59,531	31,610	104,726	76,805
D	27,921	48,453	20,532	96,530	68,609

Alternative A would not have active management of the ponderosa pine within the analysis area. In the short term, Alternative A would not change the forestwide trend from increasing due to the small amount of habitat lost. While the long term predicted acres seem to show a continuation of the increasing trend forestwide, the likelihood of a large fires of high severity burns is high (Fire Ecology report). If no treatments occur in the analysis area, it is very likely that the forestwide trend would show a decreasing trend in the long term and it is possible in the short term could also change to a decreasing trend due to wildfires since the analysis area is 37% of the cover type.

Alternatives B, C, & D would continue the current increasing forestwide habitat trend for both the short and long term. Alternatives B and C are very similar in the amount of increase in acreage with B being slightly higher in the amount of acreage. Alternative D would have the least amount of increase in acreage over time.

Late seral Habitat Trends for the Kaibab NF

Alternative A: Short-term = stable to increasing; long-term = decreasing.

Alternatives B and C: Increasing for both the short- and long-term.

Alternative D: Increase for both the short- and long-term, but the amount of increase would be the least of the action alternatives.

Coconino NF Late-seral Ponderosa Pine Habitat Trend

The forestwide habitat trend for late-seral ponderosa pine is declining. The age class distribution of ponderosa pine has remained essentially the same, dominated by mid-seral stage, with some loss of old-growth and older trees, and some early-seral stage habitat created by wildfire (Forest Service 2002). Based in the VDDT model there is approximately 80,773 acres of late-seral ponderosa pine available forestwide. Within the analysis area there is approximate 56,615 acres of late-seral ponderosa pine (Silviculture report), which is approximately 70% of this age class across the forest. However, the analysis occurs on 322,772 acres of ponderosa pine habitat which is approximately 41% of the ponderosa pine PNVNT acreage for the forest.

Table 97. Change in Late-seral Ponderosa Pine Habitat on Coconino NF by Alternative

Alternative	Current acreage	Acreage at 2020	Different from current	Acreage at 2050	Different from current
A	56,615	56,698	83	137,051	80,436
B	56,615	115,596	58,981	203,949	147,334
C	56,615	114,063	57,448	203,606	146,991
D	56,615	98,053	41,438	185,805	129,190

Alternative A would not have active management of the ponderosa pine within the analysis area. In the short term, Alternative A would not change the forestwide trend from decreasing since there is only a small change in amount of acres increased. While the long term predicted acres seem to show a potential to change to an increasing trend forestwide, the likelihood of a large fires of high severity burns is high (Fire Ecology report). If no treatments occur in the analysis area, it is very likely that the forestwide trend would continue to show a decreasing trend in the long term.

Alternatives B, C & D would change the current decreasing Forestwide habitat trend to increasing for both the short and long term. Alternatives B and C are very similar in the amount of increase in acreage with B being slightly higher in the amount of acreage. Alternative D would have the least amount of increase in acreage over time.

Late seral Habitat Trends for the Coconino NF

Alternative A: Short-term = stable to decreasing; long-term = decreasing.

Alternatives B and C: Increasing for both the short- and long-term.

Alternative D: Increase for both the short- and long-term, but the amount of increase would be the least of the action alternatives.

Northern Goshawk

Project Level MIS Assessment – Alternative A:

Northern goshawk Habitat quantity

In Alternative A, not implementing any actions to modify the vegetation would technically **increase** the relative percent of VSS 5 and 6 across the landscape for the project area to the desired percentage of 40% through density induced mortality.

Northern goshawk Habitat quality:

The quality of the habitat would **deteriorate** as canopies closed and tree densities increased and understory production decreased. Higher densities of trees with more closed canopies would lead to crowns lifting within the stands of ponderosa pine effectively reducing the amount of foliage and branches available for goshawk nesting platforms. Closed canopies associated with higher tree densities would not allow sunlight and water to reach the forest floor for understory

vegetation to grow and provide habitat for prey species including vegetative cover, nesting substrates, seeds and fruits, and grasses, forbs, and shrubs as evidenced by the declining index of biomass production. Increased tree densities would increase competition among trees with trees not being able to grow to larger sizes due to limited available resources and space.

Meanwhile, the lack of fire disturbance has led to increased tree density and fuel loads that increase the risk of uncharacteristically intense wildfire and drought-related mortality. When fires occur under current conditions, they tend to kill a lot of trees, including the large and old trees. These trees take longer to replace, moving the forest further from desired conditions, and increasing the time it would take to return to desired conditions. Another function of increased tree density is increased risk of insect and/or disease outbreak. Mortality created by these outbreaks also contributes to increased fuel loads and the associated increase in the risk of uncharacteristically intense wildfire.

Northern goshawk MRNG prey species habitat quality:

- **Snags:** Alternative A would increase the snags per acre both in the PFA and in the LOPFA, similarly to the action alternatives.
- **Downed logs:** Alternative A would increase the downed logs both in the PFA and the LOPFA slightly less than the action alternatives.
- **Woody debris:** Alternative A would increase the tons/ac of woody debris similarly to Alternative D and more than Alternatives B and C.
- **Openings:** The amount or prevalence of openings across the landscape would be inversely proportional to the %SDI, as the %SDI increases; openings across the landscape would decrease. Alternative A would lead to an increased %SDI in both the PFA and LOPFA habitat areas and therefore, fewer openings across the landscape. Increasing the current tree density as measured by % SDI would reduce the conditions that provide openings in the forest across the landscape for prey species habitat.
- **Large trees:** Increasing the total acres of VSS 5 and 6 where large trees would occur would increase the total amount of habitat for the 10 prey species for which this habitat feature is of medium/high importance for maintaining viable populations.
- **Herb, shrub, understory:** Using an index of biomass production in lbs/ac as a relative measure for the quantity and quality of herbaceous vegetation, there would be a decrease in the index of biomass production with this alternative from about 100 lbs/ac to less than 50 lbs/ac in 2050. Decreased index of biomass production across the landscape would indicate a potential decrease in both the amount of herbaceous vegetation produced per acre as well as the number of acres producing vegetation suitable for prey species habitat needs. This habitat feature is of high/medium importance for nine of the twelve prey species in the ponderosa pine type.

Alternative A summary:

Alternative A increases the total amount of late seral stage ponderosa pine thus increasing the amount of indicator habitat for the northern goshawk. The quality of goshawk nesting habitat would not be improved. The changes in habitat components for prey species are mixed. Four components that might be considered primarily structural and secondarily associated with food are expected to increase toward desired conditions: snags, large trees, logs and down woody material. Then, two components that might be more primarily food and secondarily structure are expected to decline away from desired conditions: openings and index of biomass production. If

prey species have the structural components without the sources of food, some aspects of habitat quantity may increase while other aspects of habitat quality decrease.

Project Level MIS Assessment - Alternatives B and C:

Northern goshawk Habitat quantity:

The large tree habitat components required by the goshawk for nesting will be more available across the landscape as the number of acres of large trees increases. Increasing the abundance and distribution of large trees across the landscape would provide additional nesting habitat for the goshawk in the ponderosa pine. Within the project area, the existing amount of late seral stage ponderosa pine in VSSs 5 and 6 is 17%. Alternatives B and C would increase the amount of late seral stage post-treatment to almost double the existing amount. Thirty years after treatments are completed the amount of late seral stage ponderosa pine in the project area would have increased by threefold, exceeding the desired amount for that habitat feature. Increasing the total acres of VSS 5 and 6 where large trees would occur would **increase** the total amount of habitat for which the northern goshawk is an indicator.

Northern goshawk Habitat quality:

The quality of the late seral stage ponderosa pine habitat would be expected to improve as stand conditions are moved closer to historic conditions with more open understories, less competition among trees, and healthier forest conditions. Opening the understories in these stands would **improve** the quality of this habitat for goshawk foraging by providing more open structure for detecting and pursuing prey. Also, trees used for nesting would be able to grow to larger size, retain more of their crowns, and live longer with less understory competition thus providing higher quality habitat for nesting and foraging.

Northern goshawk MRNG prey species habitat quality:

- **Snags:** Alternatives B and C would increase the snags per acre both in the PFA and in the LOPFA.
- **Downed logs:** Alternatives B and C would increase the downed logs both in the PFA and the LOPFA.
- **Woody debris:** Alternatives B and C would increase the tons/ac of woody debris from the existing conditions in both the PFA and LOPFA.
- **Openings:** Coupled with the design feature to create openings across the landscape, Alternatives B and C would lead to the greatest decrease in % SDI in both the PFA and LOPFA habitat areas and thus, the most openings across the landscape.
- **Large trees:** Alternatives B and C would produce the most increase in the total acres of VSS 5 and 6 where large trees would occur thus increasing the total amount of habitat for the 10 prey species for which this habitat feature is of medium/high importance for maintaining viable populations.
- **Herb, shrub, understory:** Using index of biomass production in lbs/ac as a relative measure for the quantity and quality of herbaceous vegetation, Alternatives B and C would produce the most increase in the index of biomass production from the existing 100 lbs/ac to over 250 lbs/ac in 2020 then dropping down to 150 lbs/ac in 2050 as the canopies begin to close after treatments. Increased index of biomass production across the landscape would indicate a potential increase in both the amount of herbaceous

vegetation produced per acre as well as the number of acres producing vegetation suitable for prey species habitat needs. This habitat feature is of high/medium importance for nine of the twelve prey species in the ponderosa pine type.

Alternatives B and C summary:

Alternatives B and C would produce the largest increase in the quantity of late seral ponderosa pine habitat as well as the most improvement in the quality of habitat for northern goshawks and their prey species as all elements move toward desired future conditions. Overall, Alternatives B and C increase habitat quantity and improve habitat quality for northern goshawk and its prey species slightly more than Alternative D.

Project Level MIS Assessment - Alternative D

Northern goshawk Habitat quantity:

The large tree habitat components required by the goshawk for nesting will be more available across the landscape as the number of acres of large trees increases. Increasing the abundance and distribution of large trees across the landscape would provide additional nesting habitat for the goshawk in the ponderosa pine. Within the project area, the existing amount of late seral stage ponderosa pine is 17%. Alternative D would **increase** the amount of late seral stage post-treatment to almost double the existing amount. Thirty years after treatments are completed the amount of late seral stage ponderosa pine in the project area would have increased by almost threefold, exceeding the desired amount for that habitat feature.

Northern goshawk Habitat quality:

The quality of the late seral stage ponderosa pine habitat would be expected to improve as stand conditions are moved closer to historic conditions with more open understories, less competition among trees, and healthier forest conditions.

Opening the understories in these stands would **improve** the quality of this habitat for goshawk foraging by providing more open structure for detecting and pursuing prey. Also, large trees used for nesting would be able to grow to larger size, retain more of their crowns, and live longer with less understory competition thus providing higher quality habitat for nesting and foraging. With less prescribed burning, the quality would be slightly less than Alternatives B and C as the conditions are moved as close to desired conditions as the other alternatives.

Northern goshawk MRNG prey species habitat quality:

- **Snags:** Alternative D would increase the snags per acre both in the PFA and in the LOPFA.
- **Downed logs:** Alternative D would increase the downed logs both in the PFA and the LOPFA.
- **Woody debris:** Alternative D would increase the tons/ac of woody debris from the existing conditions in both the PFA and LOPFA.
- **Openings:** Coupled with the design feature to create openings across the landscape, Alternative D would decrease the % SDI in both the PFA and LOPFA habitat areas slightly less than Alternatives B and C and thus, produce slightly fewer openings across the landscape.

- **Large trees:** Alternative D would increase the total acres of VSS 5 and 6 where large trees would occur slightly less than Alternatives B and C. This would increase the total amount of habitat for the 10 prey species for which this habitat feature is of medium/high importance for maintaining viable populations.
- **Herb, shrub, understory:** Using an index of biomass production in lbs/ac as a relative measure for the quantity and quality of herbaceous vegetation, Alternative D would produce an increase in the index of biomass production from the existing 100 lbs/ac to about 250 lbs/ac in 2020 then dropping just below 150 lbs/ac in 2050 as the canopies begin to close after treatments. Increased index of biomass production across the landscape would indicate a potential increase in both the amount of herbaceous vegetation produced per acre as well as the number of acres producing vegetation suitable for prey species habitat needs. This habitat feature is of high/medium importance for nine of the twelve prey species in the ponderosa pine type. These changes are only slightly less than the changes projected for Alternatives B and C.

Alternative D summary:

Increasing the total acres of VSS 5 and 6 where large trees would occur would increase the total amount of habitat for which the northern goshawk is an indicator. Alternative D improves habitat slightly less than Alternatives B and C in openings, large trees, and biomass production. Alternative D improves habitat more than Alternatives B and C in down woody material and is comparable to Alternatives B and C in snags and down logs. Overall, Alternative D increase habitat quantity and improves habitat quality for northern goshawk and its prey species slightly less than Alternatives B and C.

Kaibab National Forest level Northern goshawk MIS assessment

Goshawk indicator habitat and trends for the Kaibab NF are presented in Table 98.

Table 98. Existing Trends from Current Kaibab National Forest level MIS Report (2010)

Species	Relevance	Indicator Habitat	Habitat feature	Habitat trend	Population trend
Northern goshawk	Subject species	Ponderosa pine	Late seral	Positive	Declining

On the KNF, ponderosa pine forest covers approximately 515,148 acres (about 34% of the total Forest acreage) and occurs on all three Ranger Districts. Similarly, the corresponding PNVF covers 541,000 acres, approximately 35% of the total land area.

The Kaibab National Forest lies in three disjunct parts; two portions south of the Grand Canyon and one part north of the Grand Canyon. The Tusayan and Williams Ranger Districts lie south of the Grand Canyon and are within the Project area (see map on [page XX](#) of the DEIS). The NKRD (North Kaibab Ranger District) lies north of the Grand Canyon and is not within the project area. Of the 203 PFAs on the KNF, 135 are on the NKRD, 68 are on the southern portion of the KNF, and 36 are within the project area. Status of goshawk habitat on the Kaibab NF is displayed in Table 99.

Table 99. Kaibab NF Existing Conditions of late seral ponderosa pine

Existing Condition Measure - KNF	Acres	Relevance
Acres PIPO KNF Forestwide	515,148 (MIS report page 105)	Entire indicator vegetation type
Acres of late seral PIPO at the time of the Forest Plan.	Not available	“Reference condition”
Acres Late Seral (18”+ dbh) PIPO KNF Forestwide currently	200,000 (MIS Report graph page 116)	39% of the PIPO Forestwide
Acres of PIPO on KNF in Project Area	189,407	37% of the PIPO Forestwide
Acres of Late Seral (VSS 5&6) PIPO on KNF in Project Area	27,921	14% of the Late Seral PIPO Forestwide

Using 27,921 as the existing number of acres of late seral stage ponderosa pine in the KNF portion of the project area, Table 100 lists the projected net changes in acres of late seral stage ponderosa pine as a result of the various alternatives and the relevant percent that represents for the entire Kaibab National Forest. It is important to note that the changes to late seral stage ponderosa pine are only occurring on the two districts that lie south of the Grand Canyon.

Table 100. KNF Forestwide change (ac/%) in Late seral Ponderosa Pine

Alternative	2020	2050
Alternative A	-2,633 ac / -0.5%	+40,356 ac / +8%
Alternative B	+31,962 ac / +6%	+76,882 ac / +15%
Alternative C	+31,610 ac / +6%	+76,805 ac / +15%
Alternative D	+20,532 ac / +4%	+68,609 ac / +13%

Status of prey habitat and prey population trends are presented in tables in 101 and 102.

Table 101. KNF Summary of changes to MRNG prey species’ habitat features by Alternative 2050

Prey Species Habitat Component	Measure	Existing Condition	Alt. A	Alt. B	Alt. C	Alt. D
Snags >18”dbh	Snags/ac	0.4/ac – pfa 0.3/ac - outpfa	0.7/ac – pfa/outpfa			

Prey Species Habitat Component	Measure	Existing Condition	Alt. A	Alt. B	Alt. C	Alt. D
Downed Logs	CWD #/ac >12" diameter	0.24/ac – pfa 0.25/ac - outpfa	0.85/ac – pfa 0.81/ac - outpfa	1.3/ac pfa 1.1/ac - outpfa	1.3/ac pfa 1.1/ac - outpfa	1.2/ac pfa 1.0/ac - outpfa
Woody Debris	Tons/ac	Not calculated at the Forest Level. Results would be similar to those for the entire project area.				
Openings	Relevant to %SDI	39% - pfa 38% -outpfa	46% - pfa 45% - outpfa	32% - pfa 26% - outpfa		35% - pfa 29% - outpfa
Large trees Forestwide	% VSS 5 & 6	18%	+8%	+15%		+13%
Herb, Shrub, Understory	lbs/ac biomass production	Not calculated at the Forest Level. Results would be similar to those for the entire project area.				

Table 102. Goshawk prey species long-term summaries by alternative on the Kaibab NF

Prey Species	Indicator habitat	Habitat Quantity Trend Across Alternatives				Population Trend Across Alternatives			
		A	B	C	D	A	B	C	D
Hairy woodpecker	Snags in PP/MC/SF	Unknown	Increase	Increase	Increase	Unknown	Increase	Increase	Increase
Red-naped sapsucker	Aspen – late seral & snags	Decrease	Stable	Stable	Stable	Decrease	Stable	Stable	Stable
Abert's squirrel	Early Seral ponderosa pine	Decrease	Increase	Increase	Increase	Decrease	Increase	Increase	Increase

Alternative A

- **Habitat trend – Quantity:** Alternative A would have an 8% increase in % VSS 5 and 6 as measure of late seral PIPO on the Kaibab NF.
- **Habitat trend – Quality:** The quality of the habitat would **deteriorate** as canopies closed and tree densities increased and potential understory production decreased. Closed canopies would lead to crowns lifting within the stands of ponderosa pine effectively reducing the amount of foliage and branches available for goshawk nesting platforms. Closed canopies would not allow sunlight and water to reach the forest floor for understory vegetation to grow and provide habitat for prey species including hiding cover, nesting substrates, seeds and fruits, and grasses forbs and shrubs. Increased tree densities would increase competition among trees with trees not being able to grow to larger sizes due to limited available resources and space.

Meanwhile, the lack of fire disturbance has led to increased tree density and fuel loads that increase the risk of uncharacteristically intense wildfire and drought-related mortality. When fires occur under current conditions, they tend to kill a lot of trees, including the large and old trees. These trees take longer to replace, moving the forest further from desired conditions, and increasing the time it would take to return to desired conditions. Another function of increased tree density is a moderate risk of insect and/or disease outbreak. Mortality created by these outbreaks also contributes to increased fuel loads and the associated increase in the risk of uncharacteristically intense wildfire.

- **Population Trend:** Net increase in quantity of habitat with a decrease in quality of habitat coupled with some decreases in amounts of prey species' habitat and unknown to decreasing population trends for MIS prey species would be expected to have **static** impact on the population trend for the northern goshawk.

Alternatives B and C

- **Habitat trend – Quantity:** Alternatives B and C would eventually have a 15% **increase** in VSS 5 and 6 as the measure for the amount of late seral ponderosa pine on the Kaibab NF.
- **Habitat trend – Quality:** The quality of the habitat would **improve** as canopies were opened up and tree densities decreased and potential understory production increased. Openings in the canopies would lead to retaining the crowns within the stands of ponderosa pine thereby increasing the amount of foliage and branches available for goshawk nesting platforms. Canopies with openings would allow sunlight and water to reach the forest floor for understory vegetation to grow and provide habitat for prey species including cover, nesting substrates, seeds and fruits, and grasses forbs and shrubs. Decreased tree densities would decrease competition among trees with trees being able to grow to larger sizes due to available resources and space.
- **Population Trend:** Net increase in quantity of habitat coupled with an increase in quality of habitat combined with increased habitat components for MRNG prey species and positive changes to MIS prey species' habitat and increasing population trends would be expected to have **positive** impact on the population trend for the northern goshawk in Alternatives B and C.

Alternative D

- **Habitat trend – Quantity:** Alternative D would eventually have a 13% **increase** in VSS 5 and 6 as the measure for the amount of late seral ponderosa pine on the Kaibab NF (Table 102).
- **Habitat trend – Quality:** The quality of the habitat would **improve** as canopies were opened up and tree densities decreased and potential understory production increased. Openings in the canopies would lead to retaining the crowns within the stands of ponderosa pine thereby increasing the amount of foliage and branches available for goshawk nesting platforms. Canopies with openings would allow sunlight and water to reach the forest floor for understory vegetation to grow and provide habitat for prey species including cover, nesting substrates, seeds and fruits, and grasses forbs and shrubs. Decreased tree densities would decrease competition among trees with trees being able to grow to larger sizes due to available resources and space (Table 103).

- **Population Trend:** Net increase in quantity of habitat coupled with an increase in quality of habitat combined with increased habitat components for MRNG prey species and positive changes to MIS prey species' habitat and increasing population trends would be expected to have **positive** impact on the population trend for the northern goshawk in Alternative D (Table 104).

Summary

Table 103. KNF Summary of Project and Forest level trends for the Northern Goshawk

Measure	Alternative A	Alternative B	Alternative C	Alternative D
Project level habitat quantity	Increase	Increase	Increase	Increase
Project level habitat quality	Deteriorate	Most improvement	Most improvement	Some improvement
KNF Forest level habitat trend	Increase 8%	Increase 15%	Increase 15%	Increase 13%
KNF Forest level population trend	Static	Upward/Increasing	Upward/Increasing	Upward/Increasing

Coconino National Forest level Northern goshawk MIS assessment

Table 104. Existing Trends from Current Coconino National Forest level MIS Reports (2002, draft 2012)

Species	Relevance	Indicator Habitat	Habitat feature	Habitat trend	Population trend
Northern goshawk	Subject species	Ponderosa pine	Late seral	Declining	Inconclusive

There are close to 700,000 acres of the non-Wilderness ponderosa pine cover type (which includes ponderosa pine-Gambel oak), and cover type acreages have remained essentially the same (Table 104). At the time the Forest Plan was developed, there was not much late seral ponderosa pine. There has been some decline, particularly in the large tree component, due to both management activities and natural loss, since implementation of the Plan. Forest-wide, the mid-seral stage continues to dominate forest structure (70% or more of the acres). The remaining 30% would be divided between the early and late seral stages for ponderosa pine. No estimates of acres or percent are given for the late seral stage ponderosa pine in the current CNF MIS Report for reference conditions at the time of the Forest Plan. See [pages XX in the DEIS for a map](#) of those portions of the CNF that lie within the project area. For the Coconino NF, there are 70 PFAs on the forest (Overby, pers. comm.) and 38 of them are within the project area.

Table 104. Coconino NF Existing condition of late seral ponderosa pine

Existing Condition Measure - CNF	Acres	Relevance
Acres PIPO CNF Forestwide	700,000 (MIS Report page 9)	Entire indicator vegetation type
Acres of late seral PIPO at the time of the Forest Plan	Not available	“Reference condition”
Acres Late Seral (18”+ dbh) PIPO CNF Forestwide currently	Unable to discern from MIS Report	
Acres of PIPO on CNF in Project Area	322,772	-46% of the PIPO Forestwide
Acres of Late Seral (VSS 5&6) PIPO on CNF in Project Area	56,615	-8% of the PIPO Forestwide – -18% of the PIPO on CNF in Project area

Using 56,615 as the existing number of acres of late seral stage ponderosa pine in the CNF portion of the project area, Table 106 lists the projected net changes in acres of late seral stage ponderosa pine as a result of the various alternatives and the relevant percent that represents for the entire Coconino National Forest.

Table 106. CNF Forest-wide change (ac/%) in Late seral Ponderosa Pine

Alternative	2020	2050
Alternative A	+83 ac ac / 0%	+80,436 ac / +11.5%
Alternative B	+58,981 ac / +8%	+147,334 ac / +21%
Alternative C	+57,448 ac / +8%	+146,991 ac / +21%
Alternative D	+41,438 ac / +6%	+129,190 ac / +18.5%

Project effects to goshawk prey species are displayed in Tables 107 and 108.

Table 107. Summary of changes to MRNG prey species’ habitat features by Alternative 2050

Prey Species Habitat Component	Measure	Existing Condition	Alt A	Alt B	Alt C	Alt D
Snags >18”dbh	Snags/ac	0.42/ac – pfa 0.40/ac -outpfa	1.14/ac – pfa 0.96/ac -outpfa	1.2/ac – pfa 0.97/ac - outpfa	1.2/ac – pfa 0.97/ac - outpfa	1.2/ac – pfa 0.97/ac - outpfa
Downed Logs	CWD #/ac >12” diameter	1.22/ac – pfa 0.58/ac -outpfa	2.04/ac – pfa 1.38/ac -outpfa	2.26/ac – pfa 1.63/ac - outpfa	2.26/ac – pfa 1.63/ac - outpfa	2.42/ac – pfa 1.63/ac - outpfa

Prey Species Habitat Component	Measure	Existing Condition	Alt A	Alt B	Alt C	Alt D
Woody Debris	Tons/ac	Not calculated at the Forest Level. Results would be similar to those for the entire project area.				
Openings	Relevant to %SDI	51% - pfa 42% - outpfa	54% - pfa 47% -outpfa	34% - pfa 27% - outpfa	38% - pfa 30% - outpfa	38% - pfa 30% - outpfa
Large trees	% VSS 5 & 6	8%	+11.5%	+21%	+18.5%	+18.5%
Herb, Shrub, Understory	lbs/ac biomass production	Not calculated at the Forest Level. Results would be similar to those for the entire project area.				

Table 108. Goshawk prey species long-term summaries by alternative on the Coconino NF

Prey Species	Indicator habitat	Habitat Quantity Trend Across Alternatives				Population Trend Across Alternatives			
		A	B	C	D	A	B	C	D
Hairy woodpecker	Snags in PP/MC/SF	Unknown	Increase	Increase	Increase	Unknown	Increase	Increase	Increase
Red-naped sapsucker	Aspen – late seral & snags	Decrease	Stable	Stable	Stable	Decrease	Stable to Increase	Stable to Increase	Stable to Increase
Abert's squirrel	Early Seral ponderosa pine	Decrease	Increase	Increase	Increase	Decrease	Increase	Increase	Increase

Alternative A

- **Habitat trend – Quantity:** In thirty years, Alternative A would result in an 11.5% **increase** in % VSS 5&6 as measure of late seral PIPO on the Coconino NF.
- **Habitat trend – Quality:** The quality of the habitat would **deteriorate** as canopies closed and tree densities increased and potential understory production decreased. Closed canopies would lead to crowns lifting within the stands of ponderosa pine effectively reducing the amount of foliage and branches available for goshawk nesting platforms. Closed canopies would not allow sunlight and water to reach the forest floor for understory vegetation to grow and provide habitat for prey species including hiding cover, nesting substrates, seeds and fruits, and grasses forbs and shrubs. Increased tree densities would increase competition among trees with trees not being able to grow to larger sizes due to limited available resources and space.

Meanwhile, the lack of fire disturbance has led to increased tree density and fuel loads that increase the risk of uncharacteristically intense wildfire and drought-related mortality. When fires occur under current conditions, they tend to kill a lot of trees, including the large and old trees. These trees take longer to replace, moving the forest

further from desired conditions, and increasing the time it would take to return to desired conditions. Another function of increased tree density is a moderate risk of insect and/or disease outbreak. Mortality created by these outbreaks also contributes to increased fuel loads and the associated increase in the risk of uncharacteristically intense wildfire.

- **Population Trend:** Net increase in quantity of habitat with a decrease in quality of habitat coupled with some decreases in amounts of prey species' habitat and unknown to decreasing population trends for MIS prey species would be expected to have **static** impact on the population trend for the northern goshawk.

Alternatives B and C

- **Habitat trend – Quantity:** Alternatives B and C would eventually have a 21% **increase** in VSS 5 and 6 as the measure for the amount of late seral ponderosa pine on the Coconino NF.
- **Habitat trend – Quality:** The quality of the habitat would **improve** as canopies were opened up and tree densities decreased and potential understory production increased. Openings in the canopies would lead to retaining the crowns within the stands of ponderosa pine thereby increasing the amount of foliage and branches available for goshawk nesting platforms. Canopies with openings would allow sunlight and water to reach the forest floor for understory vegetation to grow and provide habitat for prey species including hiding cover, nesting substrates, seeds and fruits, and grasses forbs and shrubs. Decreased tree densities would decrease competition among trees with trees being able to grow to larger sizes due to available resources and space.
- **Population trend:** Net increase in quantity of habitat coupled with an increase in quality of habitat combined with increased habitat components for MRNG prey species and positive changes to MIS prey species' habitat and increasing population trends would be expected to have **positive** impact on the population trend for the northern goshawk in Alternatives B and C.

Alternative D

- **Habitat trend – Quantity:** Alternative D would eventually have an 18.5% **increase** in VSS 5 and 6 as the measure for the amount of late seral ponderosa pine on the Coconino NF.
- **Habitat trend – Quality:** The quality of the habitat would **improve** as canopies were opened up and tree densities decreased and potential understory production increased. Openings in the canopies would lead to retaining the crowns within the stands of ponderosa pine thereby increasing the amount of foliage and branches available for goshawk nesting platforms. Canopies with openings would allow sunlight and water to reach the forest floor for understory vegetation to grow and provide habitat for prey species including hiding cover, nesting substrates, seeds and fruits, and grasses forbs and shrubs. Decreased tree densities would decrease competition among trees with trees being able to grow to larger sizes due to available resources and space.
- **Population trend:** Net increase in quantity of habitat coupled with an increase in quality of habitat combined with increased habitat components for MRNG prey species and positive changes to MIS prey species' habitat and increasing population trends would be expected to have positive impact on the population trend for the northern goshawk in Alternative D (Table 109).

Table 109. Trends for goshawks and their habitat on the Coconino NF

Measure	Alternative A	Alternative B	Alternative C	Alternative D
Project level habitat quantity	Increase	Increase	Increase	Increase
Project level habitat quality	Deteriorate	Most improvement	Most improvement	Some improvement
CNF Forest level habitat trend	Increase 8%	Increase 21%	Increase 21%	Increase 18.5%
CNF Forest level population trend	Static	Increasing/Upward	Increasing/Upward	Increasing/Upward

Pygmy Nuthatch

Alternative A would not result in an immediate change to the quantity or quality of habitat used by pygmy nuthatch on either Forest. Alternative A would continue to provide large patches of trees with higher basal area, canopy density, and snags. However, overstory suppression of grasses and forb diversity and productivity will continue to limit habitat for insects (Appendix 8). Late-seral ponderosa pine will continue to be threatened by unnatural stand densities, creating risk for uncharacteristic, high severity fire.

The proposed treatments in the action alternatives would protect nesting habitat. Thinning and burning treatments are designed to return forest structure and composition to within the range of natural variability, which should benefit native wildlife species (Kalies et al. 2010). The proposed thinning and burning activities would also increase the understory production within these stands. By increasing the understory this will also increase the plant and invertebrate richness (Appendix 8) in the analysis area. The vegetation design features for all action alternatives has the following requirements for snags. Snags would be managed to meet forest plan requirement and move toward desired conditions. Snags or hazard trees within a distance of twice their height from private land boundaries or along key roads may be felled. In all other areas conifer snags greater than 12" dbh would be maintain, with an emphasis on snags greater than 18 inches dbh, except in cases of human health and safety. Live conifer trees with potential to provide nesting habitat cavities will be favored for retention. Prescribed burns are designed to maintain desired forest structure, tree densities, snag densities and coarse woody debris levels (Silviculture report). Alternative D would be the most limited in providing these benefits of the three action alternatives because forest structure and its understory development would be limited by the reduce amount of prescribed burning in this alternative.

Kaibab NF Pygmy Nuthatch Population Trend

The pygmy nuthatch is believed to be stable to declining forestwide on the Kaibab National Forest. In areas that were treated with thinning and prescribed burns or have been thinned and burned naturally, pygmy nuthatches are likely stable to increasing (Forest Service 2010).

Alternative A would likely continue the current population trend for the pygmy nuthatch of stable to declining in the short term. With the likelihood of large scale stand replacing wildfires in the

future it is possible that in the long term that the forestwide population trend could change to decreasing.

Alternatives B, C, & D would likely change the forestwide population trend to increasing in the long term due to increase in late-seral habitat over a large area of ponderosa pine habitat on the forest. While pygmy nuthatches appear to have a localized populations increase in areas where thinning and prescribed burns have occurred, the short term effects might not be enough to move the species to an increasing trend. For the short term, these alternatives would likely continue the stable forestwide population trend, while moving toward an increasing trend. Alternatives B and C would have similar impacts on the species and Alternative D would not be as beneficial.

Coconino NF Pygmy Nuthatch Population Trend

The Forestwide trend is stable, although there are dramatic population fluctuations in the short term, and small, local populations, such as those in snowmelt drainages, may be temporarily extirpated (Forest Service 2002).

Alternative A would likely continue the current forestwide population trend for the pygmy nuthatch of stable in the short term. With the likelihood of large scale stand replacing wildfires in the future it is possible that in the long term that the forestwide population trend could change to decreasing.

Alternatives B, C, & D would likely change the forestwide population trend to increasing in the long term due to increasing in late-seral habitat over a large area of ponderosa pine habitat on the forest. While pygmy nuthatches appear to have a localized populations increase in areas where thinning and prescribed burns have occurred, the short term effects might not be enough to move the species to an increasing trend. For the short term, these alternatives would likely continue the stable forestwide population trend, while moving toward an increasing trend. Alternatives B and C would have similar impacts on the species and Alternative D would not be as beneficial.

Turkey

Alternative A would not result in an immediate change to the quantity or quality of habitat used by turkey on either Forest. Alternative A would continue to provide large patches of trees with higher basal area, canopy density, and interlocking crowns thereby providing thermal and hiding cover for turkey. However, overstory suppression of oak, grass, and forb diversity and productivity will continue to limit forage habitat for turkey in Alternative A. Tree encroachment into openings and meadows will also limit turkey foraging habitat. Late-seral ponderosa pine will continue to be threatened by unnatural stand densities, creating risk for uncharacteristic, high-severity fire.

The proposed treatments in the action alternatives would protect nesting and roosting habitat. The proposed thinning and burning activities would create the clumpy-groupy habitat favored by turkeys and would also increase the understory production within these stands. By increasing the understory this will also increase the plant and invertebrate richness (Appendix 8) in the analysis area. The vegetation design features would protect most Gambel oaks within the analysis area and would remove most ponderosa pines that are over-topping the oak. Of the three action alternatives, Alternative D would be the most limited in providing these benefits of the three action alternatives because forest canopy and its understory development would be limited by the reduce amount of prescribed burning in this alternative.

Kaibab NF Turkey Population Trend

Wild turkey population trend on the forest is considered to be variable but overall increasing (Forest Service 2010). Turkeys are found primarily in ponderosa pine forest with a mix of meadows, oak and juniper. They use larger older trees for nesting and roosting.

Alternative A would likely continue the current forestwide population trend for the turkey as increasing in the short term. With the likelihood of large scale stand replacing wildfires in the future, loss of Gambel oak to shading from pines, and lack of understory development, it is possible that in the long term that the population trend could change to decreasing.

Alternatives B, C, & D would likely continue the forestwide population trend as increasing in both the short and long term. The population trend is influence by other habitat factors than the development of late-seral ponderosa pine, with the main factor being the state hunt structure. Alternatives B and C would have similar impacts on the species and Alternative D would not be as beneficial.

Coconino NF Turkey Population Trend

The Forestwide population trend is increasing. The trend was variable in the early part of the Plan implementation period (late 80's and early 90's), although AGFD standard survey procedures did not provide good data due to low number of observations along survey routes. AGFD developed a better index of turkey populations in the mid 1990's. Data from 1997-2001 indicate a modestly increasing trend. For the last five years (1997-2002), GMU 7 shows a relatively stable trend, with all other GMUs showing a general increasing trend for both percent of archery elk hunters seeing turkeys and the number of turkeys seen per day (Forest Service 2002; also see Appendix 6).

Alternative A would likely continue the current forestwide population trend for the turkey as increasing in the short term. With the likelihood of large scale stand replacing wildfires in the future, loss of Gambel oak to shading from pines, and lack of understory development, it is possible that in the long term that the forestwide population trend could change to decreasing.

Alternatives B, C, & D would likely continue the forestwide population trend as increasing in both the short and long term. The population trend is influence by other habitat factors than the development of late-seral ponderosa pine, with the main factor being the state hunt structure. Alternatives B and C would have similar impacts on the species and Alternative D would not be as beneficial.

Mangaement Species Indicators for Early-seral Ponderosa Pine

Elk and Abert's squirrels are indictors for early-seral ponderosa pine habitat. Abert's squirrels have been seen in the analysis area during Forestwide surveys on both forests. Since both of these species are part of the state permitted hunt structure, this will affect population trends both species at the state and local levels. Elk forestwide populations are managed primarily by the state through their permitted hunt structure.

According to the Arizona Game and Fish Department (AGFD), the 4FRI project area includes portions of four elk herds. One herd includes Game Management Units (GMU) 5A/5B/6A and occurs on the Coconino NF. The second herd includes 6B, 8, and Camp Navajo, which overlaps with both forests. The third is contained within GMU 7, which overlaps with both forests. GMU 7 has some population exchange with the fourth herd in GMU 9, which occurs primarily on the

Tusayan Ranger District of the Kaibab NF. It is important to note that elk that intermix among herds do not always go back to their respective GMU after winter, which complicates interpretation of both population- and habitat-utilization data for this species (see Appendix 6).

Kaibab NF Early-seral Ponderosa Pine Habitat trend

There is approximately 40,000 acres of early-seral ponderosa pine habitat across the forest (Table 109). Current habitat trend for early-seral ponderosa pine is considered stable at this time (Forest Service 2010). Within the analysis area there is approximate 7,411 acres of early-seral ponderosa pine (Silviculture report), which is approximately 18% of this age class across the forest. However, the analysis occurs on 189,407 acres of ponderosa pine habitat which is approximately 37% of the ponderosa pine cover type acreage for the forest.

Alternative A would not have active management of the ponderosa pine within the analysis area. In the short and long term, Alternative A would change the forestwide habitat trend from stable to decreasing due to the small amount of habitat that is current available forestwide in early-seral (Table 109). While the long term predicts a total loss of early-seral acres, the likelihood of large fires of high severity burns is high (Fire Ecology report). While this could create a large amount of early-seral habitat, it could damage soils and require a long period of time for ponderosa pine to develop into the early-seral stages. Nor is it desirable for large blocks of habitat to be converted to early-seral habitat.

Alternatives B, C & D would change the current stable forestwide habitat trend to increasing for both the short term. For the long term the habitat would move back to a stable level since there is not much different between 10 years and 40 years in the models. (Table 110). All three action alternatives would have similar effects to the habitat trend.

Early seral Habitat Trends for the Kaibab NF

Alternative A: Short-term = decreasing; long-term = decreasing.

Alternatives B, C, and D: Short-term = increasing; long-term = stable.

Table 110. Change in Early-seral Ponderosa Pine Habitat on Kaibab NF by Alternative

Alternative	Current acreage	Acreage at 2020	Different from current	Acreage at 2050	Different from current
A	7,411	1,926	-5,485	0	-7,411
B	7,411	17,862	10,451	16,188	8,777
C	7,411	17,658	10,247	15,984	8,573
D	7,411	18,113	10,702	14,494	7,083

Coconino NF Early-seral Ponderosa Pine Habitat Trend

Forestwide trend for early-seral ponderosa pine is stable. The age class distribution of ponderosa pine has remained essentially the same, dominated by mid-seral stage stands, with some loss of old growth and older trees, and some early seral stage habitat created by wildfire (Forest Service 2002). Based in the VDDT model there is approximately 152,836 acres of late-seral ponderosa

pine available forestwide. Within the analysis area there is approximate 14,525 acres of early-seral ponderosa pine, which is approximately 10% of this age class across the forest. However, the analysis occurs on 322,772 acres of ponderosa pine habitat which is approximately 41% of the ponderosa pine PNVt acreage for the forest.

Alternative A would not have active management of the ponderosa pine within the analysis area. In the short and long term (Table 110), Alternative A would change the forestwide habitat trend from stable to decreasing due to the small amount of habitat that is current available forestwide in early-seral. While the long term predicts a total loss of early-seral acres, the likelihood of large fires of high severity burns is high (Fire Ecology report). While this could create a large amount of early-seral habitat, it could damage soils and require a long period of time for ponderosa pine to develop into the early-seral stages. Nor is it desirable for large blocks of habitat to be converted to early-seral habitat.

Alternatives B, C & D would move the current stable forestwide habitat trend toward increasing for in the short term due to the amount of habitat currently available forestwide (Table 111). For the long term the habitat would move back to a stable level since there is not much different between 10 years and 40 years in the models. All three action alternatives would have similar effects to the habitat trend.

Early seral Habitat Trends for the Coconino NF

Alternative A: Short-term = decreasing; long-term = decreasing.

Alternatives B, C, and D: Short-term = increasing; long-term = stable.

Table 111. Change in Early-seral Ponderosa Pine Habitat on Coconino NF by Alternative

Alternative	Current acreage	Acreage at 2020	Different from current	Acreage at 2050	Different from current
A	14,525	3,687	-10,838	274	-14,251
B	14,525	20,388	5,863	19,528	5,003
C	14,525	20,218	5,693	19,372	4,847
D	14,525	22,953	8,428	19,629	5,104

Elk

Alternative A would not result in an immediate change to the quantity or quality of habitat used by elk on either Forest. Alternative A would continue to provide large patches of trees with higher basal area, canopy density, and interlocking crowns thereby providing thermal and hiding cover for elk. However, pine encroachment into grassy openings and meadows will continue to limit foraging habitat for elk in alternative A. Under alternative A, the current unnatural stand densities will threaten sustainability of elk habitat over time by limiting understory production and creating risk for uncharacteristic, high-severity fire.

The action alternatives would promote thinning small-diameter trees and prescribed burning in ponderosa pine would open the canopy and decrease fine fuels on the forest floor. The result would be increased growth of herbaceous and shrub-level vegetation, which would provide

increased forage in the long term. Reducing tree densities and ladder fuels will reduce available thermal and hiding cover for elk. However, thermal protection for elk will continue to be available in areas maintained for higher BA and canopy density including MSO nesting and restricted habitat, NOGO nest stands, bald eagle roosts, buffer around caves, and areas excluded from mechanical treatment such as wilderness or areas with slope greater than 40%. Due the lower amount of prescribed burning in alternative D, this alternative will improve a lesser amount of habitat.

Kaibab NF Elk Population Trend

During the analysis for the forestwide elk population trend in 2010, the population trend was considered to be stable at that time (Forest Service 2010.) Analysis (see figures 25 and 26 in Affected Environment) using current data from the AGFD shows that the elk population is in a decreasing trend (Appendix 6). Both forests have been working with AGFD to decrease the amount of elk on the forest for protection of forest resources. The elk numbers have primarily been affected by the hunting and the amount and type of hunting tags issued.

While alternative A would likely continue the decrease in forestwide elk population trend, this is due to the removal of habitat components for the elk in both short and long term and the current trend of the AGFD efforts to decrease the local herd size on the forest.

Alternatives B, C, and D will improve other forest habitat beside the increase of early-seral habitat for elk and would change the current decreasing forestwide population trend to increasing. However, population trends for elk are influenced more by hunting than by forest management and will remain decreasing until the AGFD, along with the input from the forest, determine the population level desirable for these elk herds.

Coconino NF Elk Population Trend

The Forestwide population trend is stable based on the analysis done in 2002. Elk numbers on the Forest increased in the early to mid-1990's, with a gradual decline through 2001 to roughly the 1980's level (Forest Service 2002). However, analysis (see figure 1 and 2) using current data from the AGFD shows that the elk forestwide population is in a decreasing trend (Appendix 6).

While alternative A would likely continue the decrease in forestwide elk population trend, this is due to the removal of habitat components for the elk in both short and long term and the current trend of the AGFD efforts to decrease the local herd size on the forest.

Alternatives B, C, and D will improve other forest habitat beside the increase of early-seral habitat for elk and would change the current decreasing population trend to increasing. However, population trends for elk are influenced more by hunting than by forest management and will remain as decreasing trend until the AGFD, along with the input from the forest, determine the population level desirable for these elk herds.

Abert's Squirrel

Alternative A would continue to provide large patches of trees with higher basal area, canopy density, and interlocking crowns thereby providing wintering habitat for squirrels on both Forests. However, Alternative A will threaten the long term viability of squirrels. Under alternative A, the current unnatural stand densities will threaten sustainability of squirrel habitat over time by reducing vigor and health, limiting pine cone production, and creating risk for uncharacteristic,

high-severity fire. Vigor and health of trees in the VSS 4, 5, and 6 categories is important for sustaining squirrel nesting habitat over time. Pine cone production is important for squirrel foraging and nutritional demands. Large-scale losses of squirrel habitat from uncharacteristically large, stand-replacing fire will affect squirrel populations across both Forests.

With rare exception, the action alternatives will not remove old growth trees, and there will be an emphasis on retention of large-diameter trees (Silviculture report) which should benefit Abert's squirrels for nesting and for winter cover. Project design criteria include tree thinning under the goshawk guidelines. This should result in a mosaic of vegetative structural stages, interrupt canopy closure, and allow more sunlight to reach the forest floor. In the moderate- to high-severity treatments, the reduction in canopy connectedness will reduce safe travel routes for Abert's squirrels and expose them to higher rates of predation. These higher-severity treatments will also expose more of the forest floor to direct sunlight which could remove the microsite habitat for mycorrhizal fungi production, thereby reducing an important food source for squirrels. However, Dodd et al. (2006) postulated that up to 75% of a forested landscape could be treated and still provide suitable squirrel habitat if treatments were applied as a mosaic of patches and areas of optimal habitat were retained. The alternatives are also designed to provide closed corridors throughout the analysis area to provide for connectivity for squirrels and other species selecting closed canopies (Figure 51).

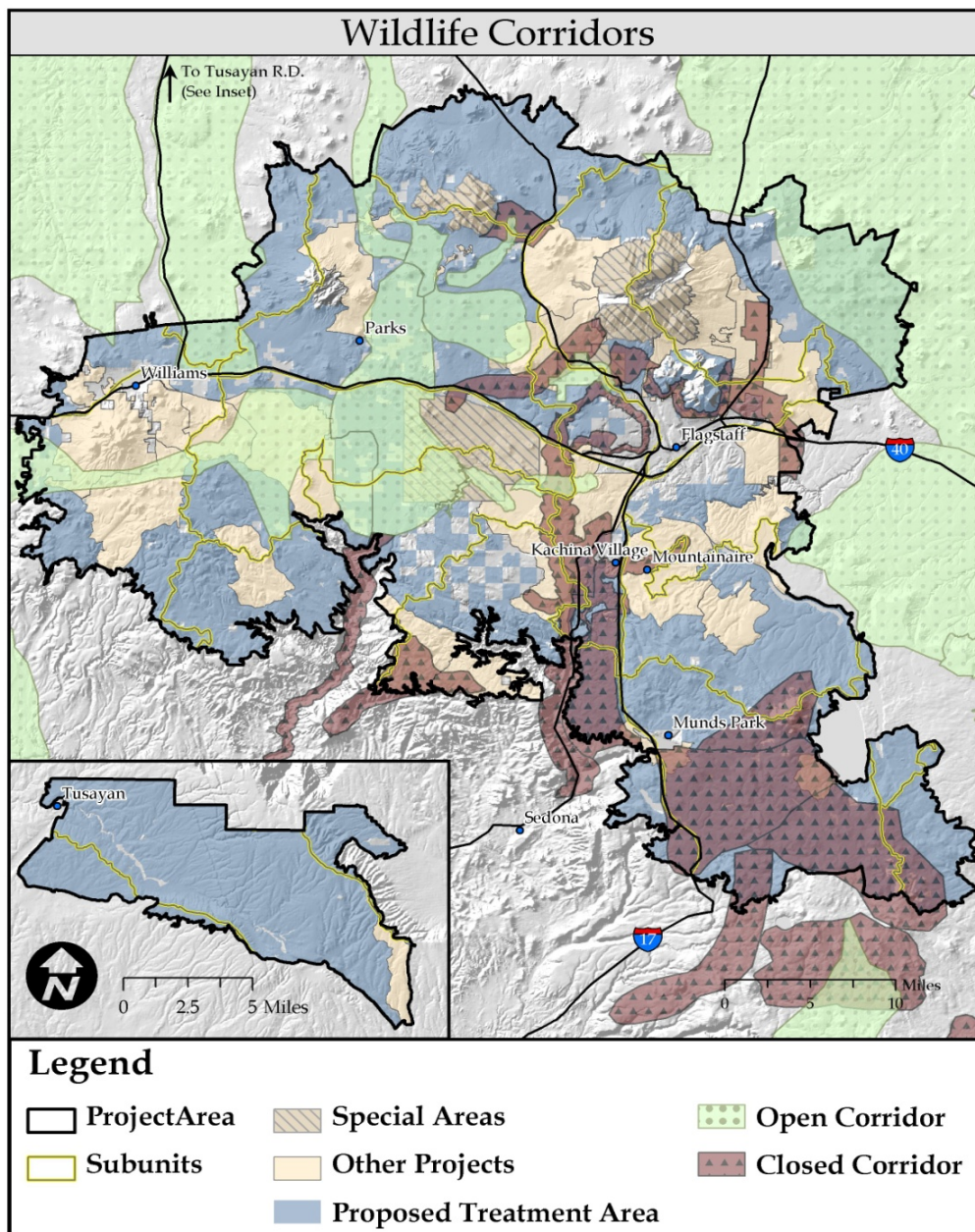


Figure 51. Proposed Wildlife Habitat Wildlife Corridors for the 4 Forest Restoration Initiative

The proposed action calls for a diverse range of mechanical treatments that will vary from 10-90% open with variable basal area, trees per acre TPA, and stand density index depending on localized site conditions (Silviculture report). Areas that will likely maintain a basal area and canopy cover high enough to support Abert's squirrels include MSO protected and restricted habitat, NOGO nest stands, bald eagle roosts, buffers around caves, and areas excluded from mechanical treatment such as wilderness or areas with slope greater than 40 percent. As such, the

patches of forest within the mosaic proposed by the action alternatives would vary in terms of Abert's squirrel habitat quality. A ratio of optimal to sub-optimal patches that is skewed toward a more open condition will be less desirable to the squirrel and could lead to a short term reduction in current squirrel populations. However, long term, post-treatment conditions will include tree growth and increased canopy connectedness which should have a positive impact to squirrel populations when viewed over longer time horizons.

Despite the proposed reduction in dense forest conditions, the proposed action will also provide for sustainable forests that include large, cone-bearing trees either as individual legacy trees or in groups and clumps of mature and old-growth trees interspersed with patches suitable for fungi production. Canopy connectivity will be retained, but in small groups rather than across whole landscapes. In the long term this should provide for more sustainable squirrel habitat over time because the risk of stand-replacing fire and therefore long-term degradation or loss of squirrel habitat will be significantly reduced (Forest Service 2010).

Kaibab NF Tassel-eared Squirrel Population Trend

The tassel-eared squirrel was selected as an indicator of early-seral ponderosa pine forest (Forest Service 2010.) For this project, the Abert's squirrel represents the species. Tassel-eared squirrel were first selected as an indicator for mid-seral ponderosa pine which was later dropped and incorporated with early-seral ponderosa pine, which is not primary habitat for the tassel-ear squirrel. Forestwide the tassel-eared squirrel population is currently stable (Forest Service 2010.)

Alternative A would not change the current stable forestwide Abert's squirrel population trend in the short term but in the long term could shift the trend to decreasing. This is due to the over dense stands and chance for large scale removal of habitat from fires in the long term.

Alternatives B, C, and D could have short term negative impacts but is not known if that would change the forestwide population trend to decreasing in the short term since the project only includes approximately 37% of the ponderosa pine habitat on the forest. However, for the long term, all alternatives would likely change the forestwide stable population trend to an increasing trend. These habitat trends are based on other habitat components than early-seral ponderosa pine habitat.

Coconino NF Abert's Squirrel Population Trend

Forestwide population trend is inconclusive since there is little Forest-specific data. Statewide information indicates a stable trend for hunter harvest of squirrels (Forest Service 2002). Additional population trend information is available for the Coconino NF, AGFD feeding sign surveys were conducted from 2005 - 2010 in association with Forest Service vegetation management projects in the Flagstaff wildland-urban interface (Appendix 6). Feeding sign survey results indicate a stable trend in tassel-eared squirrel abundance on the Forest (Figure 27, page 114).

Alternative A would not change the current stable forestwide Abert's squirrel population trend in the short term but in the long term would change the trend to decreasing.

Alternatives B, C, and D could have short term impacts that could change the forestwide population trend to decreasing in the short term since project area includes approximately 41% of the ponderosa pine habitat on the forest. However, for the long term, all alternatives would likely

change the forestwide population trend to an increasing trend. These habitat trends are based on other habitat components than early-seral ponderosa pine habitat.

Management Species Indicators for Snags Ponderosa Pine

Hairy woodpecker

Alternative A would be shown to increase in the amount of late-seral stands in the long term. The risk of a large-scale wildfire is high. While, fires promote recruitment of large snags, but in one study conducted locally, 40% of fire-killed snags fell within 7 years (Chambers and Mast 2005). Over 80% of ponderosa pine snags created by high severity fire fell within 10-years post-fire (Chambers pers. comm., Mast pers. comm.). In addition, high severity patches created from today's stand-replacing fires can reach several hundred hectares in size. Hairy woodpeckers do not use interior portions of larger burned areas, making these large patches less valuable than smaller more historical patches (Forest Service 2010).

The three action alternatives are designed to restore ponderosa pine stands closer to historical range of variation. The vegetation design features for all action alternatives has the following requirements for snags. Snags would be managed to meet forest plan requirement and move toward desired conditions. Snags or hazard trees within a distance of twice their height from private land boundaries or along key roads may be felled. In all other areas conifer snags greater than 12 inches dbh would be maintained, with a preference for snags greater than 18 inches dbh, except in cases of human health and safety. Live conifer trees with potential to provide nesting habitat cavities will be favored for retention. Prescribed burns are designed to maintain desired forest structure, tree densities, snag densities and coarse woody debris levels (Silviculture report). Using the goshawk guidelines to direct management practices should have a positive effect to the species, as this prescription results in forest structure that more closely resembles historic forests than those present today, including large trees and an abundance of snags (Forest Service 2010). Alternative D would have the least amount of positive effects with its reduce amount of prescribed fire, since returning fire to the ponderosa pine system would also produce habitat component for the hairy woodpecker (Forest Service 2010).

Kaibab NF Hairy Woodpecker Habitat and Population Trends

Based on FIA data for the Kaibab National Forest, snags in all three cover types (ponderosa pine, mixed conifer & spruce-fir) types have increased between 1995 and 2007. It is believed that this habitat is in an increasing trend. There is approximately 681,158 acres of hairy woodpecker habitat currently available on the forest (Forest Service 2010). The analysis area contains 189,407 acres of ponderosa pine, which is approximately 28% of the PNVF for the three cover types across the forest. The hairy woodpecker forestwide population trend is considered to be stable (Forest Service 2010.)

Alternative A would not change the short term forestwide habitat or population trend for the hairy woodpecker since it continue the current level of activities on the forest. In the long term, it is likely the forestwide habitat and population trends would be between stable to decreasing for the species due of large stand replacing wildfires. It is hard to predict the change in forestwide trends since it depends on the amount of area and the size of the high-severity burn patches within burns on how the woodpecker would use the area. It is unknown how this would also change the forestwide population and habitat trends. We do know although large amounts of snags are created from wildfires, they do not remain on the landscape except for a short time in most cases.

Alternatives B, C, & D would likely continue the forestwide habitat and population trend as stable in the short term due to the amount of time it would take stands to grow and produce large snags. In the long term, three alternatives would change the forestwide habitat and population trend to increasing.

Coconino NF Hairy Woodpecker Habitat and Population Trends

In 2002 the Forest estimated that trends for snags in ponderosa pine habitats were probably declining (Forest Service 2002). However, a recent study by Ganey and Vojta (2007) conducted on the Coconino suggest that within ponderosa pine and mixed conifer habitats, model projections suggest that, at least in the short term, snag numbers will continue to increase and densities of large snags will increase. Despite these increases, densities of large snags, > 18" dbh, would remain below Forest Plan guidelines. The PNVT data for acreage in ponderosa pine, mixed-conifer and spruce-fir for the forest is approximately 900,426 acres. The project area contains 322,772 acres for ponderosa pine, which is approximately 36% of the PNVT for the three cover types across the forest.

The forestwide population trend for the hairy woodpecker is stable, or slightly increasing. Minor population decreases occur on a short term scale of 1-3 years, but are generally followed by a recovery (Forest Service 2002).

Alternative A would not change the short term forestwide habitat or population trend for the hairy woodpecker since it continue the current level of activities on the forest. In the long term, it is likely the forestwide habitat and population trends would between stable to decreasing for the species due of large stand replacing wildfires. It is hard to predict the change in forestwide trends since it is depends on the amount of area and the size of the high-severity burn patches within burns on how the woodpecker would use the area. It is unknown how this would also change the forestwide population and habitat trends. We do know although large amounts of snags are created from wildfires, they do not remain on the landscape except for a short time in most cases.

Alternatives B, C, & D would likely continue the forestwide habitat and population trend as stable in the short term due to the amount of time it would take stands to grow and produce large snags. In the long term, three alternatives would change the forestwide habitat and population trend to increasing.

Management Species Indicators for Late-seral Aspen and Snags in Aspens

Red-naped sapsucker

Alternative A would continue the decline of aspen across the analysis area due to the fact where aspens are being converted to conifer stands would continue and for most areas where regenerating sprouts are occurring they are being impacted by ungulate grazing unless protected barriers have already been constructed around the area.

All three action alternatives propose to mechanically thin and burn 1229 acres of aspen habitat and would construct up to 82 miles of barriers (fences or jackstrawing) around most of the stands treated to prevent ungulate grazing. The mechanical thinning of ponderosa pine trees from the stands would help prevent the loss of older aspen to conifer encroachment and make the trees more resilient to weather extremes. The mechanical treatment would occur in all the alternatives. Alternative D would burn approximately 200 acres less habitat on the Coconino than alternatives B and C. The fencing around aspen stands that are treated will help in recruitment of young aspen

that is needed to provide for future late seral aspen. If stands are treated without fencing, then the probability of recruiting large trees in the future is unlikely.

Kaibab NF Red-naped sapsucker Habitat and Population Trends

Alternative A would not change the current stable forestwide red-naped sapsucker habitat or population trend in the short term but in the long term would change both forestwide habitat and population trend to decreasing. The Forestwide Assessment (Forest Service 2010) shows a decreasing habitat and population trend is likely in the future unless aspen stands are restored.

The three action alternatives would continue the forestwide population and habitat trend as stable. While it would improve habitat in the areas proposed for treatment, due the fact that only 1% of the aspen on the forest it would not change the population or habitat trend for the red-naped sapsucker in the short or long term.

Coconino NF Red-naped sapsucker Habitat and Population Trends

Alternative B and C would treat approximately 1064 acres and 1083 acres respectively of aspen within the analysis area which is approximately 11% of the aspen habitat forestwide for both alternatives. Alternative D would treat 875 acres of aspen, which is approximately 9% of aspen forestwide (Silviculture report).

Alternative A would not change the current stable red-naped sapsucker forestwide habitat trend in the short or long term from decreasing. Alternative A would likely not change the red-naped sapsucker forestwide population trend in the short term; however, it is likely that the forestwide population trend would change to decreasing in the future. The decreasing trend is due to the fact that the approximately 11% of the aspen on the district would not be treated and would likely continue to decline or large trees could be lost to wildfires.

The three action alternatives would change the forestwide habitat trend to stable in the short term and increasing in the long term. While it would improve habitat in the areas proposed for treatment in the short term, it will take a while for large trees to be recruited into the system. The three action alternatives would continue the stable forestwide population trend for the red-naped sapsucker in the short term. In the long term, the forestwide population trend is likely to either stable or increasing due to the fact that approximately 9 to 11% of the habitat on the forest is proposed for treatment.

Management Species Indicators for Early-seral Aspen and Pinyon-juniper

Mule Deer

Alternative A would continue to provide large patches of trees with higher basal area, canopy density, and interlocking crowns thereby providing thermal and hiding cover for mule deer. However, overstory suppression of browse diversity and productivity will continue to limit forage habitat for mule deer in Alternative A. Tree encroachment into openings and meadows will also limit mule deer foraging habitat. Early-seral aspen will continue to decline in the absence of natural disturbances such as fire and without management intervention. Under Alternative A, the current unnatural stand densities will threaten sustainability of mule deer habitat by creating risk for uncharacteristic, high-severity fire. Alternative A would not improve habitat condition in the limited amount of pinyon-juniper within the analysis area.

The proposed action calls for thinning under the goshawk guidelines, which will result in a mosaic of interspersed vegetative structural stages that provide both bedding sites and foraging areas for mule deer. Thinning and burning in the pine-sage, pine-oak, and pure pine will also provide opportunities for browse increase which should positively influence mule deer populations over time.

The action alternatives would reduce tree densities and ladder fuels will reduce available thermal and hiding cover for mule deer. However, thermal protection will continue to be available in areas maintained for higher BA and canopy density including MSO nesting and restricted habitat, NOGO nest stands, bald eagle roosts, and areas excluded from mechanical treatment such as wilderness or on slope >40%. Thinning small-diameter trees and burning in Gambel oak thickets could also reduce hiding and thermal cover for mule deer in the short term. This risk however, must be weighed against the increased likelihood for stand replacing fire events and mass habitat loss over larger areas (Appendix 6).

All three action alternatives propose to mechanically thin and burn 1229 acres of aspen habitat and would construct up to 82 miles of protective barriers around most of the stands treated to proven ungulate grazing. The mechanical thinning of ponderosa pine trees from the stands and prescribe burning of stands would promote regeneration of aspen sprouts. The mechanical treatment would occur in all the alternatives. Alternative D would burn approximately 200 acres less habitat (burn only with no mechanical treatments) on the Coconino than alternatives B and C. The protective barriers around aspen stands that are treated will help in recruitment of young aspen that is need for late seral aspen in the future. If there are stands that are treated and no fencing occur than the likelihood of the treated area successful keeping sprouts from being removed from ungulate grazing is unlikely. While this will help promote successful recruitment of early-seral aspen, the areas would not be available for mule deer habitat. Since this is only a small portion of the habitat used by mule deer it does not contribute to the forestwide population trend for the species.

The all three action alternatives would include prescribed burning (24,850-25,123 acres) within pinyon-juniper stands that are within the burn units for ponderosa pine. The alternatives would also mechanically thin and burn 535 acres of pinyon-juniper. All three alternatives would leave approximately 67% (15,626 acres) of the acreage in old growth pinyon-juniper (Silviculture report). Therefore only 7,690 acres would be potentially managed as early-seral pinyon-juniper. However, the thinning and burning in the pinyon-juniper would open up the canopy and allow the development of understory plants (Appendix 8) which would increase the forage potential for mule deer in these areas.

Kaibab NF Mule Deer Habitat and Population Trends

Alternative A would not change forestwide habitat trend in neither the aspen or pinyon-juniper habitat in the short or long term. The early-seral aspen will continue to decline due to the lack of recruitment. The pinyon-juniper habitat will continue to be stable due to the fact that the project would only affect 1% of the habitat on the forest. Alternative A would not change the mule deer forestwide population trend in the short term, since the population trend is due mainly to hunting and not management actions. There is potential for a decreasing population trend forestwide in the long term due to the potential of large scale stand replacing wildfires.

While Alternatives B, C, and D would promote the development and recruit of aspen early-seral habitat it would not change the short and long term early-seral forestwide habitat trend due to the

fact it will only affect about 1% of the aspen forestwide. The alternatives would also not change the current stable forestwide habitat trend for pinyon-juniper habitat due to the fact that less than 1% of the pinyon-juniper habitat forestwide will be affected. The action alternatives would likely move the mule deer forestwide population trend to stable both in the short and long term due to the improvement in other habitat components that will benefit the deer, however, forestwide population trends are more affected by hunting than forest management.

Coconino NF Mule Deer Habitat and Population Trends

Alternative A would not change forestwide habitat trend in neither the aspen or pinyon-juniper habitat in the short or long term. The early-seral aspen will continue to decline due to the lack of recruitment. The pinyon-juniper habitat will continue to be stable this is due to the project would only affect 2% of the habitat on the forest. Alternative A would not change the mule deer population trend in the short term, since the population trend is due mainly to hunting and not management actions. There is potent for a decreasing trend in the long term due to the potential of large scale stand replacing wildfires.

Alternatives B, C, and D would promote the development and recruit of aspen early-seral habitat could change the forestwide habitat trend toward stable in the short and long term due to the fact the alternatives would improve between 9 to 11% of the aspen forestwide. The alternatives would also not change the current stable forestwide habitat trend for pinyon-juniper habitat due to the fact that less than 1% of the pinyon-juniper habitat forestwide will be affected. The action alternatives would likely keep the mule deer forestwide population trend at stable both in the short and long term due to the improvement in other habitat components that will benefit the deer, however, forestwide population trends are more affected by hunting than forest management.

Management Species Indicators for Early and Late-seral Grasslands

Juniper Titmouse

Alternative A would continue to maintain or increase the tree density on both forests. As tree density and canopy cover increases, juniper titmouse breeding density decreases. Increased tree density and canopy cover increases the likelihood of high-severity stand-replacing fires rather than the low-severity understory fires that historically were common in many pinyon-juniper woodlands (Forest Service 2010).

The all three action alternatives would include prescribed burning (24,850-25,123 acres) within pinyon-juniper stands that are within the burn units for ponderosa pine. The alternatives would also mechanical thin and burn 535 acres of pinyon-juniper. All three alternatives would leave approximately 67% (15,626 acres) of the acreage in old growth pinyon-juniper (Silviculture report). However, the thinning and burning in the pinyon-juniper would open up the canopy and allow the development of understory plants (Appendix 8) which would improve habitat conditions for the juniper titmouse in these areas. Alternative D would treat the least amount of acres. The vegetation design features for all action alternatives has the following requirements for snags. Snags would be managed to meet forest plan requirement and move toward desired conditions. Snags or hazard trees within a distance of twice their height from private land boundaries or along key roads may be felled. In all other areas conifer snags greater than 12 inches dbh would be maintained, with a preference for snags greater than 18 inches dbh, except in cases of human health and safety. Live conifer trees with potential to provide nesting habitat

cavities will be favored for retention. Prescribed burns are designed to maintain desired forest structure, tree densities, snag densities and coarse woody debris levels (Silviculture report).

Kaibab NF Juniper Titmouse Habitat and Population Trends

Alternative A would not change forestwide habitat trend in pinyon-juniper habitat in the short or long term. The pinyon-juniper habitat will continue to be stable due to the fact that the project would only affect 1% of the habitat on the forest. Alternative A would not change the juniper titmouse forestwide population trend in the short term or long term.

While Alternatives B, C, and D would help reduce the tree density and develop understory components in the pinyon-juniper stands it would not change the short or long term forestwide habitat or population trend from stable due to the fact that less than 1% of the pinyon-juniper habitat forestwide will be affected.

Coconino NF Juniper Titmouse Habitat and Population Trends

Alternative A would not change forestwide habitat or population trend in the short or long term. The trends will continue to be stable due to the fact that the project would only affect 1% of the habitat on the forest.

While Alternatives B, C, and D would help reduce the tree density and develop understory components in the pinyon-juniper stands it would not change the short or long term forestwide habitat or population trend from stable due to the fact that less than 1% of the pinyon-juniper habitat forestwide will be affected.

Pronghorn

Availability of grasslands, meadows and savannahs would continue to be limited for pronghorn use under Alternative A. Tree density and canopy cover within historic meadows and grasslands would continue to limit sighting distances and suppress productivity of grasses and forbs for foraging and fawn hiding cover. Connectivity of pronghorn habitat would continue to decline under this alternative. Grassland and meadow habitats will continue to decline in the absence of natural disturbances such as fire and without management intervention.

Alternatives B and D would burn 48,493 acres of grasslands on both forests. The burning would restore disturbances that work to maintain grasslands, meadows, and savannahs. Low-severity fire is expected to increase growth and diversity of herbaceous vegetation, which would provide increased forage in the long term, with expected benefits as soon as 1-2 years following prescribed fire. Burning from April 15 – June 15 will be avoided in known fawning areas to prevent impacts to young, less-mobile fawns.

Alternative C would mechanically remove encroaching conifers and burn 48,160 acres and burn 664 acres over both forests. This will benefit pronghorn habitat connectivity and invigorate productivity of grasses and forbs. Sight distances will be improved. Herbaceous productivity, including grass, forb, and shrub species diversity is expected to increase within 1-2 years post-treatment (Appendix 8), which should improve pronghorn foraging and fawning habitats. These treatments would occur in Garland Prairie and Anderson Mesa both important fawning areas for pronghorn. Thinning and burning from April 15 – June 15 will be avoided in known fawning areas to prevent impacts to young, less-mobile fawns.

Beside the treatments in the grasslands, all the alternatives will restoration of 11,222 acres historic grasslands and meadows, which are currently shown as conifer stands, and 45,469 acres of savannah by thinning out encroaching pines. This will benefit pronghorn habitat connectivity and invigorate productivity of grasses and forbs. Sight distances will be improved these alternatives. Grass-forb species diversity is expected to increase within 1-2 years post-treatment, which should improve pronghorn foraging and fawning habitats. Approximately 18% of treated areas are expected to be restored to an open condition preferred by pronghorn (<30% in forested cover). This will be a significant increase in pronghorn habitat (Appendix 6).

Tree and shrub cover are occasionally used by pronghorn, indicating some selection for savannah conditions as well as grasslands. Isolated, large trees will receive some use by pronghorn for shade during hot summer months. And low shrubs can play a key role as hiding cover for fawns. Figure 3 (above) shows how the alternatives would provide for connectivity for the pronghorn open corridor areas. The use of AGFD connectivity data has been used to inform spatial arrangement of mechanical thinning treatments that favor grassland wildlife such as pronghorn. This treatment design, used in combination with soils information and historic evidences, will enhance connectivity for pronghorn populations (Appendix 6).

Kaibab NF Pronghorn Habitat and Population Trends

Alternative A would not change the current stable pronghorn forestwide habitat or population trend in the short term but in the long term would change both forestwide habitat and population trend to decreasing. The decreasing trend would be due to the continued decline in grassland conditions with conifer and shrub components encroachment. The project area also contains important fawning areas for the forest that would affect forestwide population trends.

While Alternatives B and D would help increase diversity and productivity of herbaceous plants it would likely not remove large conifer trees in the grasslands. However an additional 9620 acres of grassland would be created in the long-term. These alternatives would keep the forestwide grassland habitat trend at stable to increasing depending on how much conifer and shrub are removed. The alternatives would likely keep the forestwide pronghorn population trend as stable to increasing. While there would be an improvement of connectivity in the forested area and frequent fire will increase diversity and productivity of herbaceous plants which will improve foraging and fawning habitat for pronghorn, the forestwide population trends for pronghorn are largely influenced by hunting and drought.

Alternative C would change the forestwide grassland habitat trend to increasing in both short and long term. This is due to the removal of trees in current grasslands and the restoration of historical grasslands. The alternative would have the pronghorn forestwide population trend as stable to increasing. While there would be an improvement of increased sighting distances and connectivity of pronghorn habitats and frequent fire will increase diversity and productivity of herbaceous plants which will improve foraging and fawning habitat for pronghorn, the forestwide population trends for pronghorn are largely influenced by hunting and drought.

Coconino NF Pronghorn Habitat and Population Trends

There is approximately 22,672 acres of burning grassland within the analysis area (9 percent of total grassland acres) in alternative B and D. Alternative C has 22,672 acres of grassland treatments (mechanical and burning) within the analysis area. All alternatives would restore

approximately 1,600 acres of historical grassland that is now considered pine habitat back toward grasslands.

Alternative A would not change the current stable pronghorn forestwide habitat or population trend in the short term but in the long term would change both forestwide habitat and population trend to decreasing. The decreasing trend would be due to the continued decline in grassland conditions with conifer and shrub components. The project area also contains important fawning areas for the forest that would affect forestwide population trends.

While Alternatives B and D would help increase diversity and productivity of herbaceous plants it would likely not remove large conifer trees in the grasslands. However an additional 1,600 acres of grassland would be created in the long-term. These alternatives would keep the forestwide grassland habitat trend at stable to increasing depending on how much conifer and shrub are removed. The alternatives would likely have the forestwide pronghorn population trend as stable to increasing. While there would be an improvement of connectivity in the forested area and frequent fire will increase diversity and productivity of herbaceous plants which will improve foraging and fawning habitat for pronghorn, the forest population trends for pronghorn are largely influenced by hunting and drought.

Alternative C would change the forestwide grassland habitat trend to increasing in both short and long term. This is due to the removal of trees in current grasslands and the restoration of historical grasslands. The alternative would keep the forestwide pronghorn population trend as stable to increasing. While there would be an improvement of increased sighting distances and connectivity of pronghorn habitats and frequent fire will increase diversity and productivity of herbaceous plants which will improve foraging and fawning habitat for pronghorn, the forestwide population trends for pronghorn are largely influenced by hunting and drought.

Cumulative Effects for Management Indicator Species

Some MIS are much more mobile than others. Therefore, it is important to recognize habitat outside the analysis area as the affected environment for some animals. The affected environment for cumulative effects varies by species (Table 112). The analysis includes the combined impacts of all activities within the area as evaluated by each alternative. For example, the Abert's squirrel typically does not travel far: They stay in ponderosa pine forest year-round instead of migrating to lower elevations for the winter. Therefore, its affected environment is the ponderosa pine habitat type within the project area. On the other hand, elk use much larger areas to mate, calve, graze and overwinter. Therefore, the affected environment for elk includes habitat outside the analysis area.

The effects of projects that already have been implemented were used to help describe current conditions of the analysis area and will not be discussed in this section. Ongoing and reasonably foreseeable activities are listed in Table 37 (page 154) of the Cumulative Effects Section. Cumulative effects can be an integral part of the effects analysis for wildlife and will be discussed for each species.

Table 112. Area of Analysis for Cumulative Effects by Species

Area of Analysis	Species	Reason for Selection
Within analysis area	Pygmy nuthatch, turkey, Abert's squirrel, hairy woodpecker, red-naped sapsucker, juniper titmouse	Abert's squirrel use limited areas focused on their nest stands. Birds may move to other areas, but their nesting habitat is the most limiting factor for these species.
½ mile buffer around analysis area	Goshawk	The ½ mile buffer takes into account potential disturbance activities for these species found within the analysis area.
Game Management Unit	Elk, mule deer, pronghorn	These species have wider mobility; GMUs are designed to encompass herd movements.

Alternative A

Coconino and Kaibab NFs

The cumulative effects of these treatments under the 4FRI “no action” alternative would improve the habitats of goshawk, pygmy nuthatch, turkey, hairy woodpecker, elk, mule deer and Abert's squirrel by in the long term. Movement corridors and savannah treatments incorporated into ponderosa pine on the Kaibab NF would benefit pronghorn by creating forage and movement corridors.

Aspen treatments would have limited effects to red-naped sapsuckers in the short term, but should improve habitat in the long-term.

Fuelwood gathering would affect the goshawk, pygmy nuthatch, hairy woodpecker, red-naped sapsucker and juniper titmouse by removing snags and logs needed for nesting or prey species.

Because only a small amount of pinyon-juniper habitat will be treated, impacts to populations of titmice are not expected. The proposed activities could benefit pronghorn locally by creating openings to support browse and improve landscape permeability.

ROW maintenance would benefit species that use open habitat like pronghorn, elk, and turkey by keeping liner strips of grassland open across the forest. These areas could also support prey species for goshawks. ROW maintenance can also remove snags, logs, shrubs, and large trees, negatively affecting species tied to these habitat features such as the pygmy nuthatch, hairy woodpecker, and mule deer.

Development on private lands, particularly in the grassland and savanna habitats, will reduce habitat quantity and quality and affect movement corridors for pronghorn, deer and elk. Additionally, the exurban development and the additional training ranges on the Navajo Army Depot will likely limit use by and movement of deer and elk in many of these areas.

In summary, the following cumulative effects apply to the MIS for both the Coconino and Kaibab NFs: For the goshawk and pronghorn, the improvement of habitat across the southern part of the forest would not change the forest-wide habitat trend, but would help stabilize forest-wide population trends. The forest-wide habitat trend for the pygmy nuthatch would be improved by thinning projects that retain and enhance the large tree component within the ponderosa pine

forest. This may help the forest-wide population trend to stabilize. The tassel-eared squirrel, mule deer, elk, red-naped sapsucker, wild turkey, hairy woodpecker, and juniper titmouse forest-wide population and habitat trends would not change.

Alternative B, C, and D

Kaibab NF

The planned thinning and burning of 35,790 to 50,041 acres of ponderosa pine habitat will help reduce small tree densities and help move habitat towards historical stand structures. These treatments would have the same benefits discussed in alternative A, but when added to the additional treatments in the action alternative, would provide for improvement across the landscape. These treatments would affect the goshawk, pygmy nuthatch, turkey, hairy woodpecker, elk, mule deer and Abert's squirrel by improving their habitats in the long term. The pygmy nuthatch forest-wide habitat trend would be improved by thinning projects that retain and enhance the large tree component within the ponderosa pine forest. The ponderosa pine savannah treatments would benefit the pronghorn by creating forage and corridors for movement between areas.

The proposed aspen treatments are planned for areas that are a high priority for restoration. While this would only impact about 4 percent of the forest aspen stands when combined with the proposed treatments in the action alternatives, these are stands most at risk of being lost in the near future. These treatments would have limited improvement of the red-naped sapsucker in the short term, but should improve their habitat in the long-term.

Fuelwood gathering and travel management requirements together help determine where the public collects fuelwood. Since travel off road is allowed in fuelwood areas only, this will limit how far the public will go to gather fuelwood. This will likely leave a high density of dead and down woody material in areas that are further from the road. Within fuelwood areas and close to roads less dead woody material will remain available and could fall below forest plan requirements for snags, logs, and dead and down woody material. Proposed treatments should help limit the amount of area not meeting forest requirements. This would affect the goshawk, pygmy nuthatch, hairy woodpecker, red-naped sapsucker and juniper titmouse by removing snags that are needed for nesting or prey species.

Pinyon-juniper thinning and burning, ROW maintenance and development on private and other federal lands would have the same impacts as described above for Alternative A.

The cumulative effects along with proposed activities in the action alternatives for MIS are as follows: For all the species, the cumulative effects of the above projects will not change the predicted forestwide habitat and population trends.

Coconino NF

The planned thinning and burning in ponderosa pine of 96,736 to 157,842 acres of ponderosa pine habitat will help reduce small tree densities and help move habitat towards historical stand structures. These treatments would have the same benefits discussed in alternative A, but when added to the additional treatments in the action alternative, would provide for improvement across the landscape. These treatments would affect the goshawk, pygmy nuthatch, turkey, hairy woodpecker, elk, mule deer and Abert's squirrel by improving their habitats in the long term.

The proposed aspen restoration is planned for areas that contain the majority of the aspen outside of the wilderness areas. This would impact 46 percent of the forest aspen stands. These treatments would have limited improvement of the red-naped sapsucker in the short term, but should improve habitat components in the long-term. When combined with the proposed treatments in the action alternatives, this would improve most of the aspen stands outside of wilderness areas.

Fuelwood gathering and travel management requirements together help determine where the public collects fuelwood. Off road travel is only allowed for loading cut fuelwood. This will decrease miles driven off road by people scouting for firewood. This will limit how much fuelwood is removed away from roads and increase fuelwood removal along roads. Proposed treatments should help limit the amount of area not meeting forest requirements. This would affect the goshawk, pygmy nuthatch, hairy woodpecker, red-naped sapsucker and juniper titmouse by removing snags that are needed for nesting or prey species.

Pinyon-juniper thinning and burning, ROW maintenance and development on private and other federal lands would have the same impacts as described above for the Kaibab.

The cumulative effects along with proposed activities in the action alternatives for MIS are as follows: For all species, the cumulative effects of the above projects will not change the predicted forestwide habitat and population trends.

Migratory Birds and Important Bird Areas

Ponderosa Pine Forest

Table 113 displays by alternative how much treatment will occur within the ponderosa pine habitat. Treatment data is from silvicultural report for the 4FRI project (Silviculture report).

Table 113. Ponderosa Pine Treatment Acres by Alternative

Alternative	Mechanical thinning & burning	Burning Only	No Treatment
B	386,762	120,446	4,970
C	384,078	128,100	242
D	386,762	100,471	24,945

All of the alternatives are designed to maintain or enhance late-seral ponderosa pine trees and protect all MSO PACs and goshawk nesting areas and PFAs. The vegetation design features for all action alternatives have the following requirements for snags:

- Snags would be managed to meet forest plan requirement and move toward desired conditions
- Snags or hazard trees within a distance of twice their height from private land boundaries or along key roads may be felled
- In all other areas conifer snags greater than 12 dbh would be retained, with a preference for snags greater than 18 inches dbh, except in cases of human health and safety

- Live conifer trees with potential to provide nesting habitat cavities will be favored for retention (e.g., live trees with deadtops or lightning strikes)
- Prescribed burns are designed to maintain desired forest structure, tree densities, snag densities and coarse woody debris levels (Silviculture report)

Wildlife design features (this report) also include the following mitigations that would reduce impacts to bird species are as follow:

- No treatments would occur in PACs within a ¼ mile of nests and roosts during the breeding season (March 1 to August 31) if occupied
- If nest or roosts are not known no treatments will occur within ¼ mile buffer of core areas unless surveys indicate the PAC is unoccupied
- Within goshawk PFA, no treatments will occur from March 1 to September 30
- Apply fire prescriptions to maintain forest plan levels of coarse woody debris
- Rotate season of burn so a given area does not burn in successive seasons or have repeat burns occurring in the same season of the year

APIF and the USFWS designated eight different species of bird to represent ponderosa pine habitat (Table 34, page 124).

Aspen Habitat

Table 114 displays by alternative how much treatment will occur within the aspen habitat. Treatment data is from silvicultural analysis for the project (Silviculture report).

Table 114. Aspen Treatment Acres by Alternative

Alternative	Mechanical thinning & burning	Burning Only	No Treatment
B	1229	223	19
C	1229	242	0
D	1229	32	210

All three action alternatives propose to mechanically thin and burn 1229 acres of aspen habitat and would construct 82 miles of fence around most of the stands treated to prevent ungulate grazing of the new sprouts. If stands are treated and no fencing occur than the likelihood of the treated area be able to recruited large trees in the future is unlikely. Alternative D would burn approximately 210 acres fewer habitats on the Coconino than alternatives B and C (Silviculture report). Snag and burning requirements that are described in the ponderosa pine section would also apply to aspen treatments. APIF and the USFWS designated the red-naped sapsucker to represent ponderosa pine habitat.

Pinyon-Juniper Habitat

Table 115 displays by alternative how much treatment will occur within the pinyon-juniper habitat. Treatment data is from silvicultural analysis for the project (Silviculture report).

Table 115. Pinyon-Juniper Treatment Acres by Alternative

Alternative	Mechanical thinning & burning	Burning Only	No Treatment
B	535	25,117	6
C	535	25,123	0
D	535	24,850	273

The all three action alternatives would include various levels of prescribed burning within pinyon-juniper stands that are within the burn units for ponderosa pine. The burn objective in pinyon-juniper is simply to facilitate meeting burn prescriptions in ponderosa pine. These operational burns would allow the fire to pass through the pinyon-juniper to reach ponderosa pine stands that would otherwise require building firebreaks or not be available for burning. The alternatives would also mechanically thin and burn 535 acres of pinyon-juniper. All three alternatives would leave approximately 67 percent (15,626 acres) of the acreage in old growth pinyon-juniper (Silviculture report). However, the thinning and burning in the pinyon-juniper would open up the canopy and provide potential for understory plant development (Appendix 8). Alternative D would treat the least amount of acres. Burning requirements described in the ponderosa pine section would also apply for pinyon-juniper treatments. Management objectives include retaining one snag per acre across 75 percent of the area (forest plan direction calls for one snag per acre over 50 percent of the area). APIF and the USFWS designated five different species of bird to represent ponderosa pine habitat.

High Elevation Grassland Habitat

Table 116 displays how much treatment will occur within the grassland habitat by alternative. Treatment data is from the project silvicultural analysis (Silviculture report).

Table 116. High Elevation Grassland Treatment Acres by Alternative

Alternative	Mechanical thinning & burning	Burning Only	No Treatment
B	0	48,493	281
C	48,196	579	0
D	0	48,358	416

Alternatives B and D would burn approximately 48,400 acres of grasslands on both forests. The burning would restore disturbances that work to maintain grasslands, meadows, and savannahs. Low-intensity prescribed fire is expected to increase growth and diversity of herbaceous vegetation, which would provide increased forage in the long term. Expected benefits could occur as soon as one to two years following prescribed fire. However, most post-settlement trees would likely remain after grassland burn prescriptions. Burning from April 15 – June 15 will be avoided in known pronghorn fawning areas to prevent impacts to young, less-mobile fawns.

Alternative C would mechanically remove encroaching conifers and burn 48,196 acres and treat 579 acres with burn-only prescriptions across both forests. This will invigorate productivity of grasses and forbs. Herbaceous productivity, including grass, forb, and shrub species diversity is expected to increase within 1-2 years post-treatment. Thinning and burning from April 15 – June 15 will be avoided in known pronghorn fawning areas to prevent impacts to young, less-mobile fawns.

For all action alternatives, wildlife design feature include the following: Raptor nests located during project surveys will be monitored prior to project activities. Known nest trees for any raptor species would be prepped prior to prescribed burning. Buffers will match forest plan direction. In addition, VSS 5 and 6 tree groups will be retained. Potential effects to migratory birds from the action alternatives are shown in Table 117.

Table 117. Migratory Bird Species and Their Associated Habitats Likely to be Affected by the Action Alternatives

PIF High Priority Species and FWS BCC	Projected Changes Likely to Affect Species
Ponderosa Pine Forest	
Northern Goshawk	There would be no measureable negative effect to the goshawk population.
Flammulated Owl	The three action alternatives for the most part will be retain all snags >12". Snags within a distance twice their height from private land boundaries or along key road or snags that may causes problems with human health and safety may be removed. If snag removal occurs during the nesting season, there is a potential for killing the young of the year. Only a small percentage of snags would be removed and not all removed snags would have active nest sites. The removal of any eggs or fledgling would not result in a measurable negative effect to the flammulated owl population from any of the 3 action alternatives.
Olive-sided Flycatcher	All three alternatives would help establish the clumpy and open mature forests. Live mature trees would not be removed during treatments except in rare circumstances. Alternative D would burn approximately 20,000 less acres and would not be as beneficial in creating foraging and singing areas. If a mature pine tree is removed during the nesting season, it is potential for killing the young of year. Alternative C has a less chance of removal of mature pine trees due to the modified large tree retention strategy. Due the fact it would be rare for a large mature pine tree to removed, the removal of any eggs or fledgling would not result in a measurable negative effect to the olive-sided flycatcher population from any of the 3 action alternatives.

PIF High Priority Species and FWS BCC	Projected Changes Likely to Affect Species
Cordilleran Flycatcher	All 3 action alternatives will maintain late-successional forest habitat and all three would move stands toward mature conditions. Live mature trees would not be removed during treatments except in rare circumstances. The three action alternatives for the most part will be retain all snags >12". Snags within a distance twice their height from private land boundaries or along key road or snags that may causes problems with human health and safety may be removed. Thinning, snag removal, and burning during the breeding season could potentially kill the young of the year. Alternative D would have approximately 20,000 acres of less burning and could have less of impact than the other 2 action alternatives. Due to several factors there would be no measurable negative effect to the Cordilleran flycatcher population from any of the 3 action alternatives. It would be rare for snags to be removed. The project will thin between 20,000 to 30,000 acres/yr and burn 60,000 acres/yr and not all this is in mid to late successional ponderosa pine or during the breeding season over the approximately 593,211 acres analysis area. Not all of the species habitat will be treated within the same year
Grace's Warbler	All three alternatives would help establish the clumpy and open mature forests. Live mature trees would not be removed during treatments except in rare circumstances. If a mature pine tree is removed during the nesting season, it is potential for killing the young of year. Alternative C has a less chance of removal of mature pine trees due to the modified large tree retention strategy. Due the fact it would be rare for a large mature pine tree to remove and the benefit to the species by restoration of pine ecosystem, the removal of any eggs or fledgling would not result in a measurable negative effect to the Grace's warbler population from any of the 3 action alternatives.
Lewis's Woodpecker	This species is primary associated with pine savanna habitat. All 3 action alternatives will treat 45,469 acres of former and current pine savanna habitat to restore it pre-settlement tree density and pattern. Alternatives would retain pre-settlement trees and largest post settlement trees that most closely resemble old trees in size and form as replacement trees adjacent to pre-settlement tree evidences. Manage for a range of 70 to 90% of the treatment area as interspace between tree groups or individuals. If a nest tree is removed during the breeding season, there is the potential for loss of the young of the year. Since the species prefers to nest in open canopy it is likely we would not remove very many nest trees. The removal of any eggs or fledgling would not result in a measurable negative effect to the Lewis' woodpecker population with any of the 3 action alternatives.

PIF High Priority Species and FWS BCC Projected Changes Likely to Affect Species	
Purple Martin	This species is primary associated with pine savanna habitat. All 3 action alternatives will treat 45,469 acres of former and current pine savanna habitat to restore it pre-settlement tree density and pattern. Alternatives would retain pre-settlement trees and largest post settlement trees that most closely resemble old trees in size and form as replacement trees adjacent to pre-settlement tree evidences. Manage for a range of 70 to 90% of the treatment area as interspace between tree groups or individuals. Snags will be maintained using the vegetation design features. There would be no expected loss of young of year due to habitat removal.
Cassin's Finch	All three alternatives would help establish the clumpy and open coniferous forests. Live mature trees would not be removed during treatments except in rare circumstances. If a nest tree is removed during the nesting season, it is potential for killing the young of year. Alternative C has a less chance of removal of mature pine trees due to the modified large tree retention strategy. Due to several factors there would be no measurable negative effect to the Cassin's finch population from any of the 3 action alternatives. It would be rare for a large mature pine tree to remove and there are benefits to the species by restoration of pine ecosystem to create habitat were currently there is none. The project will thin between 20,000 to 30,000 acres/yr and not all this is in ponderosa pine or during the breeding season. Most of the project area is considered to only be wintering habitat for the species.
Aspen	
Red-naped sapsucker	The mechanical thinning of ponderosa pine trees from the stands would help prevent the loss of older aspen being loss to conifer encroachment and make the trees more resilient to weather extremes. There is a potential of removal of some aspen and snags during the treatment of the stands. A nest tree could be removed during the treatment of stands either by thinning activities or burning. If a nest tree is removed during the nesting season, there is potential for killing the young of year. The project only occurs within 4% of the aspen that occurs over both forests. Only a small percentage of aspen or snags would be removed and not all removed trees would have active nest sites due to either not being nest trees or treatments occurring outside of breeding season. The removal of any eggs or fledgling would not result in a measurable negative effect to the red-naped sapsucker population from any of the 3 action alternatives.
Pinyon-Juniper Woodland	

PIF High Priority Species and FWS BCC	Projected Changes Likely to Affect Species
Gray Vireo	All 3 action alternatives will open up the canopy and allow the development of understory plants. Most large trees will not be removed and 67% of the area will be managed for late seral habitat. The mechanical treatment and all burning could remove nest sites if these act ivies occurred during breeding season. The project only occurs within <1% of the pinyon-juniper that occurs over both forests. Not all treatments would occur during the breeding season. The removal of any eggs or fledgling would not result in a measurable negative effect to the gray vireo population from any of the 3 action alternatives.
Pinyon Jay	Approximately 67% of the pinyon-juniper will be managed for late seral habitat. The burning will open up the canopy to allow for a development of understory which would help support prey species during the time of few pinyon cones. The mechanical treatment and all burning could remove nest sites if these act ivies occurred during breeding season. The project only occurs within <1% of the pinyon-juniper that occurs over both forests. Not all treatments would occur during the breeding season and the species will renest if removal of a nest occurs. The removal of any eggs or fledgling would not result in a measurable negative effect to the pinyon jay population from any of the 3 action alternatives.
Juniper Titmouse	Approximately 67% of the pinyon-juniper will be managed for late seral habitat. The thinning and burning in the pinyon-juniper would open up the canopy and allow the development of understory plants which would improve habitat conditions for the juniper titmouse in these areas. Alternative D would treat the least amount of acres. The mechanical treatment, snag removal, and all burning could remove nest sites if these act ivies occurred during breeding season. The project only occurs within <1% of the pinyon-juniper that occurs over both forests. It is not likely that very many snags would be removed within this habitat type. Not all treatments would occur during the breeding. The removal of any eggs or fledgling would not result in a measurable negative effect to the juniper titmouse population from any of the 3 action alternatives.

PIF High Priority Species and FWS BCC	Projected Changes Likely to Affect Species
Black-throated Gray Warble	All 3 action alternatives will open up the canopy and allow the development of understory plants. Most large trees will not be removed and 67% of the area will be managed for late seral habitat. The mechanical treatment and all burning could remove nest sites if these activities occurred during breeding season. The project only occurs within <1% of the pinyon-juniper that occurs over both forests. Not all treatments would occur during the breeding season. The removal of any eggs or fledgling would not result in a measurable negative effect to the black-throated gray warbler population from any of the 3 action alternatives.
Gray Flycatcher	All 3 action alternatives will open up the canopy and allow the development of understory plants. Most large trees will not be removed. The mechanical treatment and all burning could remove nest sites if these activities occurred during breeding season. The project only occurs within <1% of the pinyon-juniper that occurs over both forests. Not all treatments would occur during the breeding season. The removal of any eggs or fledgling would not result in a measurable negative effect to the gray flycatcher population from any of the 3 action alternatives.
High Elevation Grasslands	
Swainson's Hawk	All 3 action alternatives would burn most of the grasslands within the analysis area. The burning would improve foraging habitat for the Swainson's hawk. While Alternative C would mechanically remove post-settlement trees from the grasslands, this would not affect nest sites since they will be protected. All alternatives would protect the nests from disturbance during the breeding season. There would be no expected loss of this species due to habitat removal.
Ferruginous Hawk	Nest sites would be protected and no unintended take of species is expected.
Burrowing Owl	There would be no measureable negative effect to the burrowing owl population.
Grasshopper Sparrow	All 3 action alternatives would burn most of the grasslands within the analysis area. The burning would improve habitat in the long term. Alternative C would mechanically remove post-settlement trees from the grasslands, this would improve habitat for the species since they prefer pure grasslands. The mechanical treatment through trampling of nest and all burning could remove nest sites if these activities occurred during breeding season. The project only occurs on only a small percentage of the sparrows range on the Coconino NF. Not all treatments would occur during the breeding season. The removal of any eggs or fledgling would not result in a measurable negative effect to the grasshopper sparrow population from any of the 3 action alternatives.

PIF High Priority Species and FWS BCC	Projected Changes Likely to Affect Species
Bendire's Thrasher	All 3 action alternatives would burn most of the grasslands within the analysis area. The burning would improve habitat in the long term. Alternative C would mechanically remove post-settlement trees from the grasslands, this would improve habitat for the species since they prefer open grasslands. All burning could remove nest sites if these act ivies occurred during breeding season. The project only occurs on only a small percentage of the sparrows range on the Coconino NF. Not all burning would occur during the breeding season. The removal of any eggs or fledgling would not result in a measurable negative effect to the Bendire's thrasher population from any of the 3 action alternatives.

Important Bird Area

Most of the major vegetation cover types within the Anderson Mesa IBA would be affected by action alternatives (Table 118). However, only alternative C addresses conifer encroachment in grassland habitat.

Table 118. Treatments by Acreage and Habitat Type

Treatments	Alternative B	Alternative C	Alternative D
Ponderosa pine mechanical/burning	27,757	27,103	27,776
Ponderosa pine Burn only	2,683	3,558	1,371
Ponderosa pine Grassland restoration	954	954	954
Ponderosa Pine Savanna	7,770	7,770	7,770
Aspen Burn only	10	21	0
Pinyon-juniper Operational burn	476	476	455
Grassland Burn Only	4,696	2	4,696
Grassland Conifer removal/ burning	0	4,694	0
Oak woodland Operational burn	173	173	173
Total acres	44,529	44,751	43,195

Overall, treatment objectives are to help restore stands to their historical range of variation. Grassland restoration will move stands dominated by ponderosa pine back to a grassland state.

The objectives are similar for savannas, although more tree cover would be retained in these treatments. Pinyon-juniper and oak woodland stands surrounded by ponderosa pine would be allowed to burn so that fire carries into the associated ponderosa pine stands. Burn prescriptions are for low to moderate severity fire. Alternatives B and D include burn-only treatments in grasslands. Alternative C would mechanically remove encroaching conifers as well as prescribe burn grasslands.

Overall, project treatments including road decommissioning and spring and stream channel restoration will help restore the area to more natural conditions. This should improve habitat conditions for all bird species that use the project area. There could be some limited impacts to species due to activities that might occur during the breeding season. Since only a small amount of pinyon juniper is being treated it not likely to have much effect on species associated with this habitat and would not affect local populations. Most wetland birds would be unaffected because wetland habitat is not proposed for treatment. It is expected that the habitats for which the IBA was established will benefit from the proposed treatments.

Cumulative Effects for Migratory Birds

Because of their seasonal movement, the primary management concern for migratory birds is nesting habitat and, for bald eagles, winter roost sites. The cumulative analysis area for migratory birds is the project area. Past, present and reasonably foreseeable activities are listed Appendix 12. The effects of projects already implemented were used to describe existing conditions of the analysis area and will not be discussed in this section.

There are many on-going or planned projects that will thin ponderosa pine habitat. These thinning treatments vary greatly and include noncommercial thinning, group selection, sanitation thinning, and shelterwood cuts. Slash treatments associated with these thinning treatments include lopping and scattering, hand and dozer piling and burning, and prescribed burning. There is an estimated 86,290 acres of thinning from other projects within the treatment area.

Many of the thinning projects include prescribed burning. There are also additional burn-only areas within the ponderosa pine habitat. There are also many areas that have maintenance burns occurring on five to 20-year cycles. There is an estimated 153,211 acres of burning in the treatment area. There will also be 4,416 acres of ponderosa pine savannah restoration occurring on the Kaibab NF.

Both forests are actively trying to restore aspen stands. The majority of the aspen on the Coconino NF is found within wilderness areas whereas aspen is usually found in small patches scattered within the ponderosa pine stands on the south zone Kaibab NF. There are 683 acres of planned aspen restoration and subsequent barrier construction planned on the Kaibab NF and 4,637 acres of planned aspen restoration with associated barriers on the Coconino NF. In total, 5,320 acres of aspen restoration are planned or ongoing within the 4 FRI treatment area.

Both the Coconino and Kaibab NFs have implemented travel management within the analysis area. These efforts will affect impacts from fuelwood cutting, hunting, and recreational camping across both forests. On the Coconino NF, the public is allowed to travel cross country to collect cut fuelwood with the proper permit. On the Kaibab NF, the public is only allowed to drive off-road to collect fuelwood within designated areas. While there are species-specific rules for cutting dead trees, it is not uncommon for larger snags to be cut. This occurs closer to roads and

decreasing miles of open road should decrease the loss of the resource. The Kaibab NF will allow for retrieval of elk during hunting season in all GMUs while the Coconino will allow elk retrieval in all GMU except 5a and 5b. The Coconino NF designated 300-foot camping corridors for people wanting to get away from roads. The Kaibab will allow camping up to 35 feet away from all open roads but does not have designated areas for driving off-road beyond that distance for camping.

Pinyon-juniper thinning and burning is occurring on both forests. The Kaibab and Coconino NFs have planned 7,040 acres to be treated within the project area. Grassland restoration treatments include removal of encroaching conifers and prescribed burning to rejuvenate grasses and forbs. Within the project areas there are 9,840 acres of planned grassland treatments.

Both forests have on-going maintenance of right of ways (ROW) for power and gas lines. This involves thinning and burning within the ROWs to keep the area clear of trees and shrubs. ROWs include 32,344 acres with the majority of the area on the Coconino NF.

Grazing is occurring through the project area on both forests. Grazing is an on-going activity and the timing of season of use varies by allotment. On average, 30-40% of the forage is allowed for utilization by livestock and wildlife. There is no proposal to increase any livestock numbers within these allotments. Therefore there is no additional affects beyond existing conditions.

There is approximately 150,000 acres of non-Forest Service administered lands within the project area. These areas include housing tracts, Navajo Army Depot, vacation homes, and ranchland. The Navajo Army Depot is planning development of new training ranges and thinning and prescribed burning. The Department of Defense is planning 17,049 acres of thinning and burning in ponderosa pine and some grasslands restoration. The Greater Flagstaff Forest Partnership is planning to burn and thin 535 acres of ponderosa pine habitat around the Flagstaff area.

Alternative B, C, and D

Resulting forest structure from planned thinning and burning of 243,917 acres of ponderosa pine habitat outside of the 4FRI should result in habitat resembling the historical range of variation. In the long-term, wildlife species are less likely to be adversely affected by treatments that result in habitat conditions consistent with those their evolutionary past and so are expected to respond positively to the ongoing and proposed thinning projects (Kalies et al. 2010). These treatments would improve habitat for most birds species associated with the ponderosa pine cover type in the long term (e.g., bark gleaners, woodpeckers, and flycatchers), but may negatively affect foliage gleaners in the short term (Patton and Gordon 1995, George et al. 2005).

The proposed aspen restoration is planned for areas that are a high priority for restoration on both forests. Cumulatively, this will treat the stands outside of wilderness that are at most risk of being lost in the near future. These treatments would yield limited improvements for the red-naped sapsucker in the short term, but should improve their habitat components in the long-term.

Fuelwood gathering and travel management requirements together help determine where the public collects fuelwood. The public will be limited in where they can travel off road to gather fuelwood on both the Coconino and Kaibab NFs. This will likely leave higher densities of dead and down woody material in areas further from roads. Less dead woody material would be expected to remain within fuelwood areas and areas closer to roads. Designated fuelwood areas on the Kaibab NF may not always meet forest plan requirements once wood gathering activities

are terminated. Areas adjacent to roads may be deficit on the Coconino NF. This could have a negative effect on species that use snags or down material in the ponderosa pine, aspen, and pinyon-juniper. In grasslands, the travel management requirements will benefit grassland species by preventing the cross country travel into their habitat.

Pinyon-juniper thinning and burning has the potential to both remove habitat and improve habitat for the birds that use this habitat type. The proposed activities could result in loss of young of year depending on timing of activities. The effects to Pinyon-juniper associated species are expected to be limited because only a small amount of this habitat would be treated within the cumulative effects analysis area.

ROW maintenance will help keep strips of land open and create the equivalent of relatively narrow, linear grasslands. While this may affect individual birds, there is not likely to be a cumulative effect to any species because of the limited space and spatial configuration of this habitat.

Development on private land and other federal lands continue to remove habitat within and adjacent to the project area. With the development of the additional training ranges on the Navajo Army Depot this will likely move more species out of area. The cover type with the most development occurring is within grasslands and savannah habitat. This will reduce the amount of ha

The Coconino NF has implemented an innovative management strategy to protect wetlands from grazing and prolonged drought within the Anderson Mesa IBA by regulating the timing and duration of livestock grazing in permitted areas. Wetlands are being protected from livestock by constructing fences that still allow passage of wildlife. Habitat restoration, including the restoration of grasslands, is in progress. Ranchers are actively engaged through the Diablo Trust and numerous conservation organizations have assisted in achieving conservation objectives for the site.

The cumulative effects for the migratory birds could result in some incidental mortality caused by project implementation activities. How much mortality would be proportional to how many acres are treated during the spring nesting season of April, May, June, and July. Seasonal restrictions would limit project implementation activities between March 1 and September 30 in goshawk nest area and PFA stands and within MSO PACs, which would reduce potential of loss for species listed in ponderosa pine habitat. Prescribed burning occurs also in the fall, outside of the spring nesting season. Since only a small percentage of habitats would be treated at any one time, the loss of eggs or nestlings would not result in a measurable negative effect to the migratory birds populations listed above.

Forest Plan Compliance - Hiding and Thermal Cover

Forest plan direct for wildlife calls for at least 30 percent (Coconino) to 40 percent (Kaibab) cover. The Coconino forest plan stipulates cover be assessed in 10 thousand acre blocks. Of this total at least one third should be thermal cover, one third hiding cover, and the remaining one third in either thermal or hiding cover. Results from the queries done to assess wildlife cover (see page 28) indicate the existing landscape is dominated by cover (Table 119). Restoration Unit summaries are presented below to facilitate discussion; subunit summaries are included in Appendix 5. The column Hiding/Thermal cover indicates the stands meet the definitions for both

cover types. Restoration Units commonly support 30 to 50 percent hiding cover and 30 to 55 percent hiding cover. Exceptions include: Restoration Unit 3 (pine-oak is high in thermal cover); Restoration Unit 5 (pure pine is low in both hiding and thermal cover – while there is enough cover currently to meet forest plan standards 63 percent of the area does not meeting either), and Restoration Unit 6 (high in hiding cover due to presence of sagebrush). Cover continues to increase through time and the percent of the area that provides no cover approaches zero by the year 2050 under the no action alternative.

Table 119. Percent Hiding (HC), Thermal Cover (TC), Both Hiding and Thermal Cover (Both), and Neither Form of Cover (No) Across the 4FRI Treatment Area by Restoration Unit (RU) in Alternative A

RU	Acres	2010 % Hiding/Thermal				2020 % Hiding/Thermal				2050 % Hiding/Thermal			
		HC	Both	TC	No	HC	Both	TC	No	HC	Both	TC	No
Pine-Oak	112,546	47	53	0	1	41	56	3	0	13	75	11	0
CNF	85,482	44	55	0	1	40	57	3	0	4	81	15	0
1	61,231	45	55	0	0	39	57	3	0	4	79	17	0
3	21,678	41	58	0	0	40	56	4	0	1	90	9	0
4	547	47	53	0	0	27	67	6	0	0	80	20	0
5	2,026	47	46	0	7	49	43	7	0	14	52	33	0
KNF	27,063	55	44	0	1	46	53	0	1	42	57	0	1
3	25,476	56	44	0	0	47	53	0	0	43	57	0	0
4	1,587	47	42	0	11	34	55	0	11	31	58	0	11
Pine	399,633	37	33	7	24	38	44	13	5	10	50	38	1
CNF	237,289	30	33	7	30	36	43	18	3	10	43	47	0
1	84,562	38	36	7	19	41	45	9	5	10	51	39	0
3	36,649	32	53	5	10	34	54	8	3	8	61	32	0
4	56,434	31	37	9	23	35	48	13	4	10	41	49	0
5	59,644	17	13	7	63	30	29	40	1	14	21	65	0
KNF	162,344	47	32	6	15	40	46	7	7	10	62	25	3
3	45,422	32	38	11	19	26	51	13	10	5	53	38	4
4	75,733	38	38	6	18	30	54	7	9	5	61	30	4
6	41,188	80	14	0	6	76	24	0	0	25	74	2	0
Total	512,178	39	37	5	19	39	47	11	4	11	56	32	1

Table 120. Percent Hiding (HC), Thermal Cover (TC), Both Hiding and Thermal Cover (Both), and Neither Form of Cover (No) Across the 4FRI Treatment Area by Restoration Unit (RU) in Alternative B

RU	Acres	2010 % Hiding/Thermal				2020 % Hiding/Thermal				2050 % Hiding/Thermal			
		HC	Both	TC	No	HC	Both	TC	No	HC	Both	TC	No
Pine-Oak	112,546	47	53	0	1	36	51	4	9	12	65	14	9
CNF	85,482	44	55	0	1	33	54	5	8	7	67	18	8
1	61,231	45	55	0	0	34	54	5	7	8	65	20	7
3	21,678	41	58	0	0	32	54	4	10	6	75	9	10
4	547	47	53	0	0	34	55	6	5	0	75	20	5
5	2,026	47	46	0	7	38	50	7	5	13	49	33	5
KNF	27,063	55	44	0	1	44	42	0	13	28	59	0	13
3	25,476	56	44	0	0	45	42	0	13	28	59	0	13
4	1,587	47	42	0	11	33	42	0	24	25	51	0	24
Pine	399,633	37	33	7	24	22	18	11	49	4	27	29	40
CNF	237,289	30	33	7	30	16	20	16	48	1	21	36	42
1	84,562	38	36	7	19	10	16	16	58	1	15	34	49
3	36,649	32	53	5	10	14	24	14	48	0	22	37	41
4	56,434	31	37	9	23	14	21	14	51	1	20	36	44
5	59,644	17	13	7	63	27	24	17	32	0	29	40	31
KNF	162,344	47	32	6	15	31	16	3	50	10	36	18	36
3	45,422	32	38	11	19	16	14	5	64	10	14	22	54
4	75,733	38	38	6	18	18	18	3	61	8	27	25	40
6	41,188	80	14	0	6	72	14	0	14	14	75	2	10
Total	512,178	39	37	5	19	25	26	9	40	6	35	26	33

Table 121. Percent Hiding (HC), Thermal Cover (TC), Both Hiding and Thermal Cover (Both), and Neither Form of Cover (No) Across the 4FRI Treatment Area by Restoration Unit (RU) in Alternative C

RU	Acres	2010 % Hiding/Thermal				2020 % Hiding/Thermal				2050 % Hiding/Thermal			
		HC	Both	TC	No	HC	Both	TC	No	HC	Both	TC	No
Pine-Oak	112,546	47	53	0	1	38	49	4	9	15	62	14	9
CNF	85,482	44	55	0	1	36	51	5	7	9	65	19	7
1	61,231	45	55	0	0	36	51	6	7	10	62	21	7
3	21,678	41	58	0	0	34	52	4	10	7	73	10	10
4	547	47	53	0	0	34	55	6	5	0	75	20	5
5	2,026	47	46	0	7	38	50	7	5	13	49	33	5
KNF	27,063	55	44	0	1	44	43	0	13	32	55	0	13
3	25,476	56	44	0	0	45	43	0	12	32	55	0	12
4	1,587	47	42	0	11	33	42	0	24	25	51	0	24
Pine	399,633	37	33	7	24	19	19	11	51	2	27	29	42
CNF	237,289	30	33	7	30	15	21	16	48	0	22	37	42
1	84,562	38	36	7	19	9	16	16	59	0	15	34	51
3	36,649	32	53	5	10	13	27	14	45	0	24	38	39
4	56,434	31	37	9	23	14	23	14	49	0	21	36	42
5	59,644	17	13	7	63	27	24	17	32	0	29	40	31
KNF	162,344	47	32	6	15	25	16	3	56	4	36	18	42
3	45,422	32	38	11	19	8	14	5	73	2	15	22	62
4	75,733	38	38	6	18	12	18	3	66	2	27	25	46
6	41,188	80	14	0	6	68	14	0	18	11	75	2	12
Total	512,178	39	37	5	19	23	26	9	42	5	35	26	34

Table 122. Percent Hiding (HC), Thermal Cover (TC), Both Hiding and Thermal Cover (Both), and Neither Form of Cover (No) Across the 4FRI Treatment Area by Restoration Unit (RU) in Alternative D

RU	Acres	2010 % Hiding/Thermal				2020 % Hiding/Thermal				2050 % Hiding/Thermal			
		HC	Both	TC	No	HC	Both	TC	No	HC	Both	TC	No
Pine-Oak	112,546	47	53	0	1	34	53	4	9	15	63	14	9
CNF	85,482	44	55	0	1	32	56	5	8	9	66	18	8
1	61,231	45	55	0	0	33	56	5	7	9	64	20	7
3	21,678	41	58	0	0	29	57	4	10	7	73	9	10
4	547	47	53	0	0	24	66	6	5	3	72	20	5
5	2,026	47	46	0	7	42	46	7	5	17	45	33	5
KNF	27,063	55	44	0	1	40	46	0	13	35	52	0	13
3	25,476	56	44	0	0	41	46	0	13	35	52	0	13
4	1,587	47	42	0	11	29	47	0	24	26	50	0	24
Pine	399,633	37	33	7	24	27	21	10	42	10	27	26	37
CNF	237,289	30	33	7	30	22	22	14	41	7	20	34	39
1	84,562	38	36	7	19	21	19	13	47	12	15	30	43
3	36,649	32	53	5	10	18	25	16	41	5	22	34	39
4	56,434	31	37	9	23	19	23	13	44	6	18	35	41
5	59,644	17	13	7	63	28	26	16	31	1	28	40	30
KNF	162,344	47	32	6	15	36	19	3	42	16	36	15	34
3	45,422	32	38	11	19	21	20	6	54	17	16	18	50
4	75,733	38	38	6	18	23	24	4	49	13	29	20	38
6	41,188	80	14	0	6	75	11	0	14	20	70	1	9
Total	512,178	39	37	5	19	29	28	8	34	11	34	24	31

The action alternatives reduce hiding cover through the thinning and opening of current forest conditions. Results are similar between alternatives overall. Restoration Units continue to meet or exceed forest plan direction in the year 2020, except for Restoration 3 under alternative C. The main difference between action alternatives and no action is in the year 2050 when much percentages of the area do not meet either hiding or thermal cover. This suggests wildlife cover can be met, even when using dated forms of evaluation, while successfully moving forest conditions towards the historical range of variation. Given the historical conditions documented for northern Arizona forests and the fact that target ratios for cover were developed to optimize

deer and elk habitat in northeastern Oregon, a decrease in overall cover values likely represents an increase in forest resiliency and sustainability.

Literature Cited [Not Complete]

- Abella, S. R. 2008. Managing Gambel oak in southwestern ponderosa pine forests: The status of our knowledge. USDA Forest Service General Technical Report RMRS-GTR-218.
- Abella, S. R., and P. Z. Fule'. 2008. Changes in Gambel oak densities in southwestern ponderosa pine forests since Euro-American settlement. Research Note RMRS-RN-36. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado.
- Austin, W., K. Day, S. Franklin, J. Humphrey, W.G. Hunt, C. Parish, R. Sieg, and K. Sullivan. 2007. Review of the second five years of the California condor reintroduction program in the Southwest. Southwest Condor Working Group and the USFWS Arizona Ecological Services Office, Flagstaff. 87pp.
- Arizona Game and Fish Department. 2011. The Coconino County Wildlife Connectivity Assessment: Report on Stakeholder Input. 52pp.
- Bagne, K. E., K. L. Purcell, and J. T. Rotenberry. 2008. Prescribed fire, snag population dynamics, and avian nest site selection. *Forest Ecology and Management* 255:99-105.
- Beier, P., E. C. Rogan, M. F. Ingraldi, and S. S. Rosenstock. 2008. Does forest structure affect reproduction of northern goshawks in ponderosa pine forests? *Journal of Applied Ecology* 45:342-350.
- Beier, P. and M. F. Ingraldi. 2012. Commentary: There is no evidence that the Forest Service's goshawk recommendations improve nest productivity. *Wildlife Society Bulletin* 36(1).
- Bowers et al 2004 (voles)
- Brown, D. E., and R. Davis. 1998. Terrestrial bird and mammal distribution changes in the American Southwest, 1890-1990. Pages 47–64 in B. Tellman, editor. *The future of arid grasslands: identifying issues, seeking solutions*. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado.
- Brown, P.M.; Kaye, M.W.; Huckaby, L.; Baisan, C. 2001. Fire history along environmental gradients in the Sacramento Mountains, New Mexico: Influences of local patterns and regional processes. *Ecoscience* 8:115-126.
- Capinera, J.A. 2010. *Insects and Wildlife: Arthropods and Their Relationships with Wild Vertebrate Animals*. Wiley-Blackwell, Oxford, UK. 486 pp.
- Chambers, C. L. 2002. Forest management and the dead wood resource in ponderosa pine forests: effects on small mammals. USDA Forest Service, Pacific Southwest Research Station, Albany, California.
- Chambers, C.L. 2008, 2009, 2010, 2011. Personal communications. Professor, wildlife ecology, School of Forestry, Northern Arizona University.
- Chambers, C. L., and J. N. Mast. 2005. Ponderosa pine snag dynamics and cavity excavation following wildfire in northern Arizona. *Forest Ecology and Management* 216:227–240.

Chambers, C.L., R.R. Doucett. 2008. Diet of the Mogollon Vole as Indicated by Stable-Isotope Analysis (C13 and N15). *Western North American Naturalist* 68(2) pp. 153-160

Chan-McLeod 2003 as cited in (USFWS 2007 -- CLF Recovery Plan).

CLIMAS. 2011. Climate Change in the Southwest. Online: <http://www.climas.arizona.edu/sw-climate/climate-change> accessed April, 2012.

Corbett, J. 2008. Report on evaluation of the abandoned mine features on the Kaibab National Forest Tusayan District, AZ. Final report from Bat Conservation International to the Regional Environmental Engineer, Region 3 of the US Forest Service, Albuquerque, New Mexico. 7pp.

Corman, T., C. Wise-Gervais. 2005. Arizona Breeding Bird Atlas. University of New Mexico Press. Albuquerque, NM. 636 pp.

Dargan, C.M. 1991. Roost site characteristics of bald eagles wintering in north-central Arizona. M.S. Thesis, Northern Arizona University, 73pp.

Delaney, D.K., T.G. Grubb. 2003. Effects of Off-Highway Vehicles on Northern Spotted Owls: 2002 Results. A Report to the State of California Department of Parks and Recreation, Off-Highway Motor Vehicle Recreation Division Contract Number No. 4391Z9-0-0055

Dewey, S.R., and P.L. Kennedy. 2001. Effects of supplemental food on parental-care strategies and juvenile survival of Northern Goshawks. *Auk* 118:352-365. Dodd et al. (1998)

Dodd, N.L., R.E. Schweinsburg, and S. Boe. 2006. Landscape-scale forest habitat relationships to tassel-eared squirrel populations: Implications for ponderosa pine forest restoration. *Restoration Ecology* 14:537-547.

Dixon, G.E. 2002. Essential FVS: A user's guide to the Forest Vegetation Simulator. Internal Rep. Fort Collins, CO: U. S. Department of Agriculture, Forest Service, Forest Management Service Center. 240p. (Revised: November 24, 2010)

Driscoll, J.T., K.V. Jacobson, G.L. Beatty, J.S. Canaca, and J.G. Koloszar. 2006. Conservation assessment and strategy for the bald eagle in Arizona. Nongame and Endangered Wildlife Program Technical Report 173. Arizona Game and Fish Department, Phoenix, Arizona.

Fairweather, M., Geils, B., and Manthei, M. 2008. Aspen Decline on the Coconino National Forest. In: McWilliams, M. G. comp 2008. Proceedings of the 55th Western International Forest Disease Work Conference; 2007 October 15-19; Sedona, AZ. Salem, OR; Oregon Department of Forestry.

Ffolliott, P. F., and G. J. Gottfried. 1991. Natural tree regeneration after clearcutting in Arizona's ponderosa pine forests: two long-term case studies. Res. Note RM-507. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 6 p.

Fule, P.Z., W.W. Covington, and M.M. Moore. 1997. Determining reference conditions for ecosystem management of Southwestern ponderosa pine forests. *Ecological Applications*, 7:895-908.

Fule, P. Z., W. W. Covington, M. M. Moore, T. A. Heinlein, and A. E. M. Waltz. 2002. Natural variability in forests of the Grand Canyon, USA. *Journal of Biogeography* 29:31-47.

Fule', P.Z., and J.E. Crouse, J.P. Roccaforte, and E.L. Kalies. 2012. Do thinning and/or burning treatments in western USA ponderosa or Jeffrey pine dominated forests help restore natural fire behavior? *Forest Ecology and Management* 269:68-81.

Furniss et al. 2010 ("prolonged periods of drought" in dwarf shrew)

Ganey, J. L. 1999. Snag density and composition of snag populations on two National Forests in northern Arizona. *Forest Ecology and Management* 117:169-178.

Ganey, J. L., and S.C. Vojta. 2005. Changes in snag populations in Northern Arizona mixed conifer and Ponderosa pine forests, 1997-2002. *Forest Science* 51:396-405.

Ganey, J. L., and S.C. Vojta. 2007. Modeling snag dynamics in northern Arizona mixed-conifer and ponderosa pine forests. Res. Pap. RMRS-RP-66WWW. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 15pp.

Ganey, J.L., and S.C. Vojta 2011. Tree mortality in drought-stressed mixed-conifer and ponderosa pine forests, Arizona, USA. *Forest Ecology and Management* 261 (2011) 162–168.

Ganey, J. L., and S.C. Vojta. 2012. Trends in Snag Populations in Drought-stressed Mixed-conifer and Ponderosa Pine Forests, 1997-2007. *International Journal of Forestry Research*

Ganey, J.L., and Carol L. Chambers. 2011. A reconnaissance of small mammal communities in Garland and Government Prairies, Arizona. *Western North American Naturalist* 71: 151–157.

Ganey, Joseph L.; Ward, James P. Jr.; Willey, David W. 2011. Status and ecology of Mexican spotted owls in the Upper Gila Mountains recovery unit, Arizona and New Mexico. Gen. Tech. Rep. RMRS-GTR-256WWW. Fort Collins, CO: USDA, Forest Service, Rocky Mountain Research Station. 94 p.

Ganey, J.L. 2012. Personal communications. USDA Forest Service, Rocky Mountain Research Station, Flagstaff, AZ

George, T.L., S. Zack, and W.F. Laudenslayer, Jr. 2005. A comparison of bird species composition and abundance between late- and mid-seral ponderosa pine forests. USDA Forest Service General Technical Report PSW-GTR-198.

Glinski, R.L. 1998. The Raptors of Arizona. The University of Arizona Press, Tucson, AZ. pp. 105-108.

Greenwald, D.N., C. Crocker-Bedford, L. Broberg, K.F. Suckling, and T. Tibbitts. 2005. A review of northern goshawk habitat selection in the home range and implications for forest management in the western United States. *Wildlife Society Bulletin*, 33(1):120-128.

Grubb, T.G. and C.E. Kennedy. 1982. Bald eagle winter habitat on the National Forest System in the Southwest. USDA Forest Service Southwestern Region. Wildlife Unit Technical Series. 116 pp.

Grubb, T.G., S.J. Nagiller, W.L. Eakle, and G.A. Goodwin. 1989. Winter roosting patterns of bald eagles (*Haliaeetus leucocephalus*) in north-central Arizona. *Southwestern Naturalist* 34(4):453-459.

Hedwall, S.J. 2011 and 2012. Personal communications. Senior Wildlife Biologist, USFWS Arizona Ecological Services Office, Flagstaff, AZ.

- Higgins, B.J. 2008. Personal communications. Forest Planner, Kaibab National Forest, Williams AZ.
- Hoffmeister, D.F. 1986. Mammals of Arizona. The University of Arizona Press. 602 pp.
- Hoffmeister, D.F. 1971. Mammals of Grand Canyon. The University of Illinois Press. 183 pp.
- Holden, Z. A., P. Morgan, M. G. Rollins, and R. G. Wright. 2006. Ponderosa pine snag densities following multiple fires in the Gila Wilderness, New Mexico. *Forest Ecology and Management* 221:140-146.
- Huffman, D.W. and M.M. Moore. 2004. Responses of Fendler ceanothus to overstory thinning, prescribed fire, and drought in an Arizona ponderosa pine forest. *Forest Ecology and Management* 198:105–115.
- Hurley, J.F., H. Salwasswer, and K. Shimamoto. 1982 Fish and wildlife habitat capability models and special habitat criteria. *California and Nevada Wildlife Transactions*. 4pp.
- Jacobson, K.V., J.S. Canaca, and J.T. Driscoll. 2005. Arizona bald eagle management program 2005 summary report. Nongame and Endangered Wildlife Program Technical Report 237. Arizona Game and Fish Department, Phoenix, Arizona.
- Joshi, P.2009. Night Roosts of Bald Eagles (*Haliaeetus leucocephalus*) Wintering in Northern Arizona. Thesis. Northern Arizona University.
- Joyce, L.A., G.M. Blate, and others. 2008. Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources. In: S. H. Julius, J. M. West, J. S. Baron et al. (editors). Washington D.C., U.S. Climate Change Science Program and the Subcommittee on Global Change Research: 3-1 to 3-127.
- Kalies, E.L., C.L. Chambers, and W.W. Covington. 2010. Wildlife responses to thinning and burning treatments in southwestern conifer forests: a meta-analysis. *Forest Ecology and Management* 259:333-342.
- Kalies, E.L., B.G. Dickson, C.L. Chambers and W.W. Covington. 2012. Community occupancy responses of small mammals to restoration treatments in ponderosa pine forests, northern Arizona, USA. *Ecological Applications*, 22(1). pp. 204-217.
- Kunzler, L.M.; Harper, K.T. 1980. Recovery of Gambel oak after fire in central Utah. *Great Basin Naturalist*. 40:127-130.
- Latta, M.J., C.J. Beardmore, and T.E. Corman. 1999. Arizona Partners in Flight Bird Conservation Plan. Version 1.0. Nongame and Endangered Wildlife Program Technical Report 142. Arizona Game and Fish Department, Phoenix, Arizona.
- Leonard, A. 2012. Kaibab National Forest's Climate Change Approach for Plan Revision. Unpublished report. Kaibab National Forest Supervisor's Office. Williams, Arizona.
- Long, J.N. 1985. A practical approach to density management. *Forestry Chronicle* 61:23-27.
- Martin, A.C., H.S. Zim, and A.L. Nelson. 1961. *American Wildlife and Plants: A Guide to Wildlife Food Habits*. Dover Publications, New York NY. 500pp.

Martin, T.E. and J.L. Maron. 2012. Climate impacts on bird and plant communities from altered animal-plant interactions. *Nature Climate Change* DOI: 10.1038/NCLIMATE1348.
Advance on-line publication: www.nature.com/natureclimatechange.

Marlon et al. 2009 (in dwarf shrew)

Mast, J.N. 2008 & 2011. Personal communications. Geography and Earth Science, School of Forestry, Carthage College, Kenosha, Wisconsin.

Mazerolle and Desrochers 2005 as cited in USFWS 2007 -- NLF.

McCall, T. 2011. personal communications. Game Specialist, Region 2, Arizona Game and Fish Department, Flagstaff.

Merritt, J.F. 2010. *The Biology of Small Mammals*. Johns Hopkins University Press, Baltimore, MD. 313 pp.

Mikesic, D.G. and J.R. Nysted. 2001. Species account for *Mustela nigripes*. Navajo Heritage Program. Window Rock, Arizona. Revised: 15 Feb 2005.

Millar et al. 2007 Long-term shifts in vegetation patterns are expected as a result of climate change

Moir, W.H. and Dieterich, J.H. 1988. Old-growth ponderosa pine from succession on pine-bunchgrass habitat types in Arizona and New Mexico. *Natural Areas Journal* 8: 17-24.

Moore, M.M., D.W. Huffman, J.D. Bakker, A.J. Sánchez Meador, D.M. Bell, P.Z. Fulé, P.F. Parysow, W.W. Covington. 2004. Quantifying Forest Reference Conditions for Ecological Restoration: The Woolsey Plots. Final Report to the Ecological Restoration Institute for the Southwest Fire Initiative

Morrison, M.L., B.G. Marcot, and R.W. Mannan. 2006. *Wildlife- Habitat Relationships: concepts and applications*, 3rd Edition. Island Press. Washington D.C. 493 pp.

NatureServe Explorer: An online encyclopedia of life [web application]. 2009. Version 7.1. NatureServe, Arlington, Virginia. Available: <http://www.natureserve.org/explorer> (Accessed June 29, 2009; July 9, 2010, December 2011).

Opler, P.A. and A.B. Wright. 1999. *A Field Guide to Western Butterflies*. Peterson Field Guide Series. Houghton Mifflin Company. New York, NY. 540pp.

Overby, C.M. 2012. Personal communications. Forest Biologist, Coconino National Forest. Coconino Supervisor's Office, Flagstaff, AZ.

Pagel et. al 2010 *Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocols; and Other Recommendations in Support of Golden Eagle Management and Permit Issuance*

Parish, C. 2012. Personal communications (email to Bill Noble, April 27, 2012). Peregrine Fund Condor Recovery Project.

Patton, D.R. 2011. *Forest Wildlife Ecology and Habitat Management*, 2011 CRC Press.

Patton, D.R., and J. Gordon. 1995. Fire, habitats, and wildlife. Final Report submitted to the USDA Forest Service Coconino National Forest. School of Forestry, Northern Arizona University, Flagstaff.

- Patton, D.R. and C.L. Chambers. 2002. R3HARE, A logical wildlife relationships data model for habitats on southwestern national forests. School of Forestry Faculty Document, Northern Arizona University, Flagstaff in D.R. Patton, Forest Wildlife Ecology and Habitat Management, 2011 CRC Press.
- Paxon, J. 2011. The monster reared its ugly head (again). Arizona Wildlife News *July-August* pp. 8-12.
- Prather, J. W., N. L. Dodd, B. G. Dickson, H. M. Hampton, Y.Xu, E. N. Aumack, and T. D. Sisk. 2006. Landscape models to predict the influence of forest structure on tassel-eared squirrel populations. *Journal of Wildlife Management* 70:723–731.
- Reineke, L.H. 1933. Perfecting a stand-density index for even-aged forests. *Journal of Agricultural Research*. 46:627-638.
- Ray, C. T. 2011. Predicting the effects of forest management policies on goshawk occurrence in northern Arizona ponderosa pine. Master's thesis. Northern Arizona University, Flagstaff, AZ. May 2011. 142pp.
- Reynolds, R. T., R. T. Graham, M. H. Reiser, R. L. Bassett, P. L. Kennedy, D. A. Boyce, G. Goodwin, R. Smith, and E. L. Fisher. 1992. Management recommendations for the northern goshawk in the southwestern United States U. S. Forest Service Southwest Region. General Technical Report RM-217, Fort Collins, Colorado, USA.
- Reynolds, R.T., R.T. Graham, and D.A. Boyce, Jr. 2008. Northern Goshawk Habitat: An Intersection of Science, Management, and Conservation. *The Journal of Wildlife Management* 72:1047-1055.
- Reynolds, R. T., D. A. Boyce, Jr., and R. T. Graham. 2012. Ponderosa pine forest structure and northern goshawk reproduction: response to Beier et al. (2008). *Wildlife Society Bulletin* 36:147–152.
- Roos, C.I., and T.W. Swetnam. 2011. A 1416-year reconstruction of annual, multidecadal, and centennial variability in area burned for ponderosa pine forests of the southern Colorado Plateau region, Southwest USA. *The Holocene* 22:281–290.
- Salafsky, S. R. 2004. Covariation Between Prey Abundance on Northern Goshawk Fecundity on the Kaibab Plateau, Arizona. M.S. thesis. Colorado State University. Fort Collins, CO.
- Salafsky, S. R., R. T. Reynolds, and B. R. Noon. 2005. Patterns of temporal variation in goshawk reproduction and prey resources. *Journal of Raptor Research* 39:237-246.
- Salafsky, S. R., R. T. Reynolds, B. R. Noon, J. A. Wiens. 2007. Reproductive responses of Northern Goshawks to variable prey populations. *Journal of Wildlife Management* 71(7):2274-2283.
- Saur. 2011. Goshawk BBS
- Saur and Link. 2011. Goshawk BBS
- Sauer et al. 2011. Goshawk BBS
- Smith, E. 2011. Relationships between Overstory and Understory Vegetation in Ponderosa Pine Forest of the Southwest. The Nature Conservancy, Tucson, Arizona.

- Solvesky, B. 2008. Personal communications. Wildlife biologist, US Fish and Wildlife Service, Sacramento, California.
- Solvesky, B. and C.L. Chambers. 2007. Bat Roost Inventory and Monitoring Project for Arizona Game and Fish Department Region 2. Final Report
- Solvesky, B.G. and C.L. Chambers. 2009. Roosts of Allen's lappet-browed bat in northern Arizona. *Journal of Wildlife Management* 73(5):677-682.
- Springer, A.E. and L.E. Stevens. 2008. Spheres of discharge of springs. *Hydrogeology Journal* (2009) 17: 83–93. DOI 10.1007/s10040-008-0341-y
- Taylor, D.A.R. 2006. Forest Management and Bats. Bat Conservation International. 13pp. www.batcon.org
- Swetnam, T.W.; Baisan, C.H. 1996. Historical fire regime patterns in the southwestern United States since AD 1700. Pp 11-32 in Allen, C.D. (ed.). 2nd La Mesa Fire Symposium; Los Alamos, NM. General Technical Report RM-GTR-286. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 216 pp.
- USDA Forest Service. 1987. Coconino National Forest Service Land and Resource Management Plan, as amended. Flagstaff, Arizona.
- USDA Forest Service. 1987. Kaibab National Forest Land Management Plan, as amended.
- USDA Forest Service. 2002. Management Indicator Species Status Report for the Coconino National Forest. Flagstaff, AZ: Coconino National Forest.
- USDA. 2006. Final Supplement to the Final Environmental Impact Statement for Amendment of Forest Plans. Forest Service, Southwestern Region, Arizona and New Mexico. 149pp.
- USDA Forest Service. 2010. Management Indicator Species of the Kaibab National Forest; an evaluation of population and habitat trends, Version 3.0, 2010. Williams, AZ: Kaibab National Forest.
- USDA Forest Service, Southwestern Region. 2010a. "Southwestern Climate Change Trends and Forest Planning A Guide for Addressing Climate Change in Forest Plan Revisions for Southwestern National Forests and National Grasslands."
- USDA Forest Service. 2008b. Forest insect and disease conditions in the Southwestern Region, 2007. USDA Forest Service, Southwestern Region, Forestry and Forest Health, PR-R3-16-4, 47 p. Albuquerque, New Mexico.
- USDI Fish and Wildlife Service. 1988. Black-footed Ferret Recovery Plan. U.S. Fish and Wildlife Service, Denver, Colorado. 154 pp.
- USDI Fish and Wildlife Service. 1995. Recovery Plan for the Mexican Spotted Owl: Vol. I. Albuquerque, NM. 172 pp.

- USDI Fish and Wildlife Service. 1996. 50 CFR Part 17 Endangered and Threatened Wildlife and Plants: Establishment of a Nonessential Experimental Population of California Condors in Northern Arizona. Final Rule. Federal Register 61 (201):54044-54060.
- USDI Fish and Wildlife Service. 2004. Endangered and Threatened Wildlife and Plants; 50 CFR Part 17 Final Designation of Critical Habitat for the Mexican Spotted Owl. Federal Register 69 (168):53182-53230.
- USDI Fish and Wildlife Service. 2011. Draft Recovery Plan for the Mexican Spotted Owl (*Strix occidentalis lucida*), First Revision. U.S. Fish and Wildlife Service. Albuquerque, New Mexico, USA. XX pp.
- Waddell, R.B., R. A. Ockenfels, and S.R. Boe. 2005. Management recommendations for pronghorn on Camp Navajo, Arizona Army National Guard, Northern Arizona. Final report submitted to DEMA/JP-F Arizona Army National Guard. 28pp.
- Waltz, A.E.M. and W.W. Covington. 2004. Ecological Restoration Treatments Increase Butterfly Richness and Abundance: Mechanisms of Response. *Restoration Ecology* 12:85–96.
- Ward, J. M., and P. L. Kennedy. 1996. Effects of supplemental food on size and survival of juvenile Northern Goshawks. *Auk* 113:200-208.
- Waskiewicz, J.D., P.Z. Fule', and P. Beier. 2003. Comparing classification systems for ponderosa pine snags in northern Arizona. *Western Journal of Applied Forestry* 22: 233-240.
- Westerling, A. L., H. G. Hidalgo, D. R. Cayan, and T. W. Swetnam. 2006. Warming and earlier spring increase western U.S. forest wildfire activity. *Science* 313:940–943.
- Western Bat Working Group. 2005. Western red bat species accounts. Available http://www.wbwg.org/species_accounts
- Western Bat Working Group 2005. Pale Townsend's big-eared bat species account. Available http://www.wbwg.org/species_accounts
- Western Bat Working Group. 2005. Western mastiff bat species accounts. Available http://www.wbwg.org/species_accounts
- Wiens, J. D., B. R. Noon, and R. T. Reynolds. 2006. Post-fledgling survival of northern goshawks: the importance of prey abundance, weather, and dispersal. *Ecological Applications* 16:406-418.
- Williams, A.P., C.D. Allen, C.I. Millar, T.W. Swetnam, J. Michaelsen, C.J. Still, and S.W. Leavitt. 2010. Forest responses to increasing aridity and warmth in the southwestern United States. *Proceedings of the National Academy of Sciences* 107: 21289–21294.
- Wisdom, M.J. and L.J. Bate. 2008. Snag density varies with intensity of timber harvest and human access. *Forest Ecology and Management* 255 (2008) 2085–2093.