Appendix G – Bridge Habitat for Canopy-Dependent Wildlife

Sarah Reif, Habitat Program Manager, Region 2, Arizona Game and Fish Department
Neil McCusker, 4FRI Silviculturist
Mark Nigrelli, 4FRI GIS Specialist
Bill Noble 4FRI Wildlife Biologist

Introduction

Because much of the 4FRI landscape is dominated by mid-aged trees, the 4FRI project would not achieve desired conditions on all treatment acres immediately post-treatment. It would take time for the largely even-aged forests to develop uneven-aged structure, for trees to mature into larger diameter classes, and for tree canopies within tree groups to reach the desired interlocking crown condition. Because of this time lag, some stakeholders are concerned that post-treatment conditions within the 4FRI project area would not provide sufficient habitat for canopy-dependent wildlife in the short term.

The wildlife species of concern identified by our publics, relative to the delay in achieving desired conditions, include northern goshawks, Mexican spotted owls, Abert's squirrels, turkeys, mule deer, black bears, and some songbird species. The information provided in this appendix clarifies how post-treatment conditions within the 4FRI project area would provide habitat for canopy-dependent wildlife in the short term. We are referring to those areas as "bridge habitat", suggesting that these more densely-forested areas would be available to wildlife to bridge the time between treatment and the attainment of desired conditions across the broader landscape.

Bridge Habitat at the Landscape Scale

For purposes of this discussion, the landscape is considered to be the 988,764-acre 4FRI Coconino and Kaibab NFs' analysis area. All treatment area acreages are calculated based on alternative C because it has the most comprehensive set of potential treatments that could impact canopy-dependent wildlife and it is the preferred alternative. To how much bridge habitat would be available to canopy-dependent wildlife post-treatment at the landscape scale it is important to review the acres of treatment and exclusion categories within the project area (table 166). About 40 percent of the project area was excluded from management consideration under this EIS.

Two bridge habitat categories ("other projects" and "wilderness, slopes, PACs") were analyzed at the scale of the total project area to demonstrate the patch-mosaic of deferrals versus treated areas across the larger landscape. The remainder of the bridge habitat categories that were analyzed were within the ponderosa pine treatment area (507,839 acres) scale. This scale was used to demonstrate how bridge habitat would persist where mechanical treatments and prescribed fire are proposed. The percentages provided for each category are not necessarily additive. Some categories are merely subsets of other categories but they provide several different ways of looking at how we account for closed-canopy species through project design. As table 166 demonstrated, there is a highly diverse mosaic of forest structure that would vary in terms of overall density and openness post-treatment at the landscape scale.

Table 166. Acres of treatment and non-treatment areas within the 4FRI project area

Area	Description	Acres
Project Area	Total area within 4FRI project boundary	988,764
Exclusions	Other projects	213,090
	Special management areas (wilderness, research natural areas, inventoried roadless areas, Camp Navajo, and experimental forests)	30,668
	Non-FS lands	145,156
	Miscellaneous (other cover types, no-treatment protected activity center (PAC) core areas, inaccessible areas, etc.)	11,138
	Total excluded areas within 4FRI project boundary	**400,052**
Treatment Area	Ponderosa pine treatment area	507,839
	Other cover types treatment area	80,876
	Area within the proposed treatment boundary (includes mechanical treatment and prescribed burning)	**588,716**

Other Projects

Excluded fuels reduction and forest restoration projects account for 213,090 (22 percent) acres of the total project area (988,764 acres). We can assume that some proportion of these projects would/do retain closed-canopy conditions after treatment, or remain untreated. On average, about 37 percent of a given project on the Coconino and Kaibab NFs is untreated after implementation (Hampton et al. 2008, page 17). Untreated areas are a result of site-scale factors such as archaeological and historical sites, wildlife deferrals, funding issues, steep or rocky terrain, and areas with insufficient road access. Using the 37 percent estimate for untreated acres after project completion, we concluded about 78,843 acres would remain in deferral (i.e., untreated) due to site-scale logistics in the total 4FRI project area. There is no data to accurately estimate acres of closed-canopy conditions in excluded projects. However, we can assume that some proportion of this area would contribute habitat for canopy-dependent species.

Wilderness areas, slopes over 40 percent, and Mexican spotted owl protected activity centers (PACs) not identified for mechanical treatment

These areas have not been identified for mechanical treatment and are generally characterized by dense forest conditions used by canopy-dependent wildlife. These areas account for 8 percent (79,699 acres) of the total project area, including 81 of 99 Mexican spotted owl PACs. The 18 PACs with mechanical treatments were not included here, but little change in canopy conditions are expected in those PACs (see “Affected Environment section of the Wildlife report).

Ponderosa Pine Treatment Area Scale (507,839 acres)

Although the 4FRI proposes to treat over ½ million acres, treatment intensities are highly variable (table 167 and figure 78). Very open treatments include grasslands and savannas. The most common treatment in the open category would range from 40 to 55 percent open.

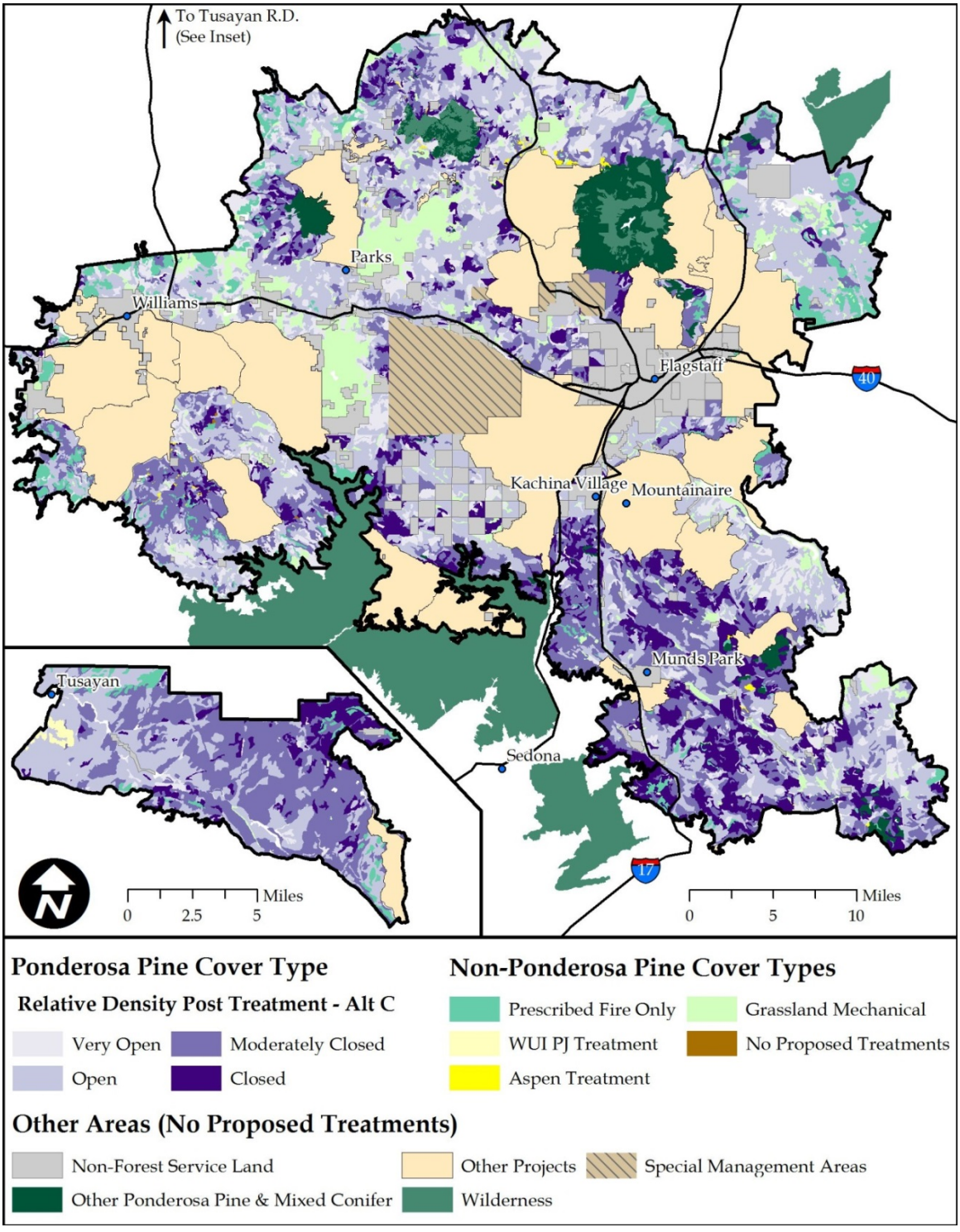

Figure 78. Relative, post-treatment forest density across the 4FRI project area, alternative C

Table 167. Acres of proposed treatment in terms of post-treatment openness

Post-treatment Openness Category	Acres	Percent of Ponderosa Pine Treatment Area
Very Open	67,553	13
Open	228,860	45
Moderately Closed	141,530	28
Closed	69,897	14
Total	**507,839**	**100**

Closed and Moderately-Closed Conditions

This category includes mechanically treated and prescribed fire only areas where post-treatment conditions maintain 60 to 90 percent forested cover. Included in this category were some Mexican spotted owl and northern goshawk habitats. Post-treatment openness would range from 10 to 25 percent and 25 to 40 percent open. Mexican spotted owl restricted and target/threshold habitats, and 18 Mexican spotted owl PACs proposed for mechanical treatment would also be in this openness category. About 211,427 acres (42 percent) of the ponderosa pine treatment area would be in this category. About 69,897 acres (14 percent) of the ponderosa pine treatment area would remain in closed condition (75 to 90 percent forested) post-treatment. This percentage includes all those areas listed above, but excludes areas in the 25 to 40 percent open category and areas that are not currently in a closed condition.

Mexican Spotted Owl Protected, Target and Threshold, and Restricted Habitats

These habitat designations have specific guidelines per the Mexican spotted owl Recovery Plan to ensure denser forest conditions selected for by the owl. Within the 4FRI project, these designations could be ranked in terms of their forest density, and therefore their provision for other closed-canopy species. Protected habitat is generally densely forested, target and threshold habitats are similar to protected habitat, and restricted habitat is less dense than protected but more densely forested relative to areas outside Mexican spotted owl designations. In regards to 4FRI, habitat definitions are specific to pine-oak forest.

- Protected owl habitat accounts for roughly 35,262 acres, which is about 7 percent of the ponderosa pine treatment area (table 168, see the “Mexican spotted owl PAC Mechanical” and “Protected Prescribed Fire Only” row in the “Post-treatment Density” column). Of this total, 26,120 acres are currently in a closed condition. This includes 70 PACs (18 of which are proposed for some mechanical thinning) and slopes over 40 percent (proposed for prescribed fire only). Protected owl habitat is designed to provide a multi-layered, more closed canopy condition relative to the other habitats in the ponderosa pine treatment area, with an emphasis on managing for large trees (18 inches d.b.h. or greater). The average basal area for protected habitat, based on modeled projections for the year 2020, is 155 square feet per acre.
- Target and threshold habitats include those areas that meet or are approaching nesting and roosting habitat conditions. These areas account for about 2 percent (8,692 acres) of the ponderosa pine treatment area (see Mexican spotted owl target and Mexican spotted owl threshold rows in table 168). Of this total, about 7,489 acres are currently in a closed canopy condition. Per the 1995 Mexican spotted owl Recovery Plan, target and threshold habitats are to be managed for at least 15 percent of total stand density index in each of the three defined ponderosa pine tree size classes (12- to18 inches d.b.h., 18- to 24 inches, and over 24 inches).

The revised Recovery Plan (USDI FWS 2012) addressed the misinterpretation of nest stand data, recommending a stand average of 110 square feet per acre or greater basal area with a preponderance of large trees (18 inches d.b.h. and larger).

- Restricted habitat accounts for 66,419 acres (table 168), which is 13 percent of the ponderosa pine treatment area. Of this total, 42,538 acres (about 64 percent) are currently in a closed condition and another 17,179 acres (about 26 percent) are currently in a moderately closed condition. The guidelines for restricted habitat are less specific in order to meet multiple objectives and operate in conjunction with ecosystem management and existing management guidelines. Objectives for the 4FRI include managing for an abundance of ponderosa pine trees 18 inches d.b.h. and greater, maintain tree form oak, and manage for a stand average of 70 to 90 square feet per acre basal area at the stand level.

Northern goshawk habitat

Closed canopy conditions would also be realized within areas managed according to the northern goshawk guidelines. Higher tree density, canopy cover, and larger group sizes would be retained in post-fledging family areas (PFAs) and lands outside post-fledging family areas (LOPFAs) where the current condition and proposed treatments are for 10 to 25 percent interspace (14,933 acres). Denser forest structure would also be retained in northern goshawk nest areas that currently have closed conditions (3,234acres). Areas within post-fledging family areas and landscapes outside of goshawk post-fledging areas that are proposed for prescribed fire only treatments or no treatments that are currently in a closed condition would retain higher tree densities and canopy cover post treatment (16,310 acres). Together, these categories account for about 7 percent of the ponderosa pine treatment area (about 34,477 acres). In addition, post-fledging family areas and landscapes outside of post-fledging areas currently in a moderate closed or closed condition and proposed for moderately-dense treatments (25 to 40 percent interspace) account for about another 8 percent of the ponderosa pine treatment area. Areas within post-fledging family areas, landscapes outside of post-fledging areas and goshawk nest areas that are proposed for prescribed fire only treatments or no treatments account for 22,312 acres, which is about 4 percent of the ponderosa pine treatment area. Together these two categories account for nearly 13 [8+4] percent of the ponderosa pine treatment area and would remain in a moderately closed condition post treatment.

About 41 percent of the ponderosa pine treatment area is landscapes outside of post-fledging areas and post-fledging family areas goshawk habitat proposed for low-density condition (savanna/grassland restoration and 40 to 55 percent interspace) (table 168).

Wildlife movement corridors

Efforts were taken to ensure habitat connectivity for canopy-dependent wildlife at the landscape scale using data from known wildlife movement corridors for black bear, turkey, mule deer, and tassel-eared squirrels (AGFD 2011, figure 51). While tassel-eared squirrels are dependent on sufficient areas with connected canopies, black bears and mule deer are habitat generalists that seek cover, but largely use habitat elements independent of forest canopy closure. Closed canopy forest corridors would provide hiding cover for these species. Landscape-scale movement corridors were examined on a stand-by-stand basis. Where closed canopy wildlife corridors overlapped with proposed mechanical treatments, treatment intensities were adjusted to provide closed or moderately-closed canopy conditions post-treatment. In addition to treatment areas that would remain in closed or moderately-closed conditions, roughly 4,169 acres were actively changed from more open to more closed treatments. Treatments were adjusted in five different wildlife movement corridors within the project area. The expected result is the retention of

thermal and hiding cover in addition to closed-canopy conditions to facilitate movement across the landscape for a suite of species.

In summary, there are four key considerations with regard to bridge habitat for closed-canopy species at the landscape and treatment scales:

1. A patch-mosaic of bridge habitat would remain available for canopy-dependent wildlife. At a minimum, 8 percent of the project area would be in deferral due to wilderness, slope, and untreated Mexican spotted owl PACs. Potentially another 8 percent of the project area would be in deferral as part of other excluded projects.
2. About 1 in 5 acres (nearly 22 percent of the ponderosa pine treatment area) would be managed as Mexican spotted owl habitat, creating conditions that also provide habitat for other canopy-dependent wildlife.
3. Bridge habitat would be maintained across 42 percent of the ponderosa pine treatment area.
4. Connectivity for closed-canopy species was specifically built into treatment designs separately from Mexican spotted owl and northern goshawk guidelines.

Table 168 provides a detailed summary of acreages and percentages for each treatment category within the ponderosa pine treatment area in terms of post-treatment density and contributions to bridge habitat. Table 168 illustrates the patch-mosaic of post-treatment forest density relative.

Table 168. Post-treatment contributions to bridge habitat provided by each treatment designation

Treatment	Post-treatment Density	Landscape Scale Bridge Habitat	Mid-scale Bridge Habitat	Total Acres	Percent (%) of Ponderosa Pine Treatment Area
Mechanical Treatment					
Low Density	Savanna/Grassland Restoration	X	X	56,372	11
	landscapes outside of post-fledging areas 40–55% Interspace	X	Some	141,267	28
	post-fledging family areas 40–55% Interspace	X	Some	12,834	3
Low Density Total				210,472	41
Moderate Density	landscapes outside of post-fledging areas 25–40% Interspace	X	X	52,574	10
	Mexican spotted owl Restricted	X	X	62,785	12
	post-fledging family areas 25–40% Interspace	X	X	4,406	1
Moderate Density Total				119,766	24

Treatment	Post-treatment Density	Landscape Scale Bridge Habitat	Mid-scale Bridge Habitat	Total Acres	Percent (%) of Ponderosa Pine Treatment Area
High Density	landscapes outside of post-fledging areas 10–25% Interspace	X	X	29,511	6
	post-fledging family areas 10–25% Interspace	X	X	2,670	1
High Density Total				32,181	6
Very High Density	Mexican spotted owl Threshold	X	X	1,892	less than 1
	Mexican spotted owl Target	X	X	6,495	1
	Mexican spotted owl PAC Mechanical	X	X	10,284	2
Very High Density Total				18,672	4
Prescribed Fire Only Areas and Areas with No Proposed Treatments					
Low Density	landscapes outside of post-fledging areas Prescribed Fire Only	Some	Some	86,869	17
	landscapes outside of post-fledging areas No Proposed Treatments	Some	Some	858	less than 1
Low Density Total				87,728	17
Moderate Density	post-fledging family areas Prescribed Fire Only	X	X	3,216	1
	post-fledging family areas No Proposed Treatments	X	X	92	less than 1
	Restricted Prescribed Fire Only	X	X	4,187	less than 1
	Restricted No Proposed Treatments	X	X	1,280	less than 1
Moderate Density Total				6,898	1

Treatment	Post-treatment Density	Landscape Scale Bridge Habitat	Mid-scale Bridge Habitat	Total Acres	Percent (%) of Ponderosa Pine Treatment Area
High/Very High Density	post-fledging family areas Nest Area Prescribed Fire Only	X	X	6,836	1
	post-fledging family areas Nest Area No Proposed Treatments	X	X	4	less than 1
	Threshold Prescribed Fire Only	X	X	217	less than 1
	Threshold No Proposed Treatments	X	X	1	less than 1
	Target Prescribed Fire Only	X	X	84	less than 1
	Target No Proposed Treatments	X	X	2	less than 1
	Protected Prescribed Fire Only	X	X	25,714	5
	Protected No Proposed Treatments	X	X	244	less than 1
High/Very High Density Total				32,122	6
Grand Total				**507,839**	**100**

Bridge Habitat at the Restoration Unit Scale

At the restoration unit scale (figure 79), there are additional ways of accounting for bridge habitat. Factors contributing to bridge habitat at the restoration unit scale include the area remaining in closed and moderately-closed condition post-treatment and areas allocated for old growth.

Closed (less than 25 percent Interspace) to Moderately-Closed (25 to 40 percent Interspace) Canopy Conditions

Table 169 summarizes the range of post-treatment openness by restoration unit under alternative C. (Also, see table 64 in the silviculture specialist's report). The overall range in openness indicates a variety of conditions within restoration units post-treatment. Most of the area within each restoration unit would range from open to moderately closed canopy conditions. Very open and closed conditions would also be represented in each restoration unit, ranging from 2 to 20 percent and from 4 to 21 percent respectively. Restoration unit 1 has the highest percentage of post-treatment habitat in a closed condition, due in large part to ecological conditions such as soil, climate, and site quality that result in a denser reference condition relative to the other restoration units. Restoration unit 1 also contains the highest proportion of Mexican spotted owl habitat relative to the other restoration units. Note that restoration unit 3, 4, and 6 include large areas of savanna, grassland, and pine/sage habitats (e.g., Garland Prairie in restoration unit 3, Government Prairie in restoration unit 4, and pine-sage in restoration unit 6). Savanna and grassland

restoration is based on soil characteristics, and would total 56,372 acres of very open treatment. While maintaining adequate closed canopy conditions has been a topic of concern for some stakeholders, the lack of grassland and savanna habitat is a more significant issue ecologically (Merola-Zwartjes 2005, North American Bird Conservation Initiative 2011, Brown and Makings 2014).

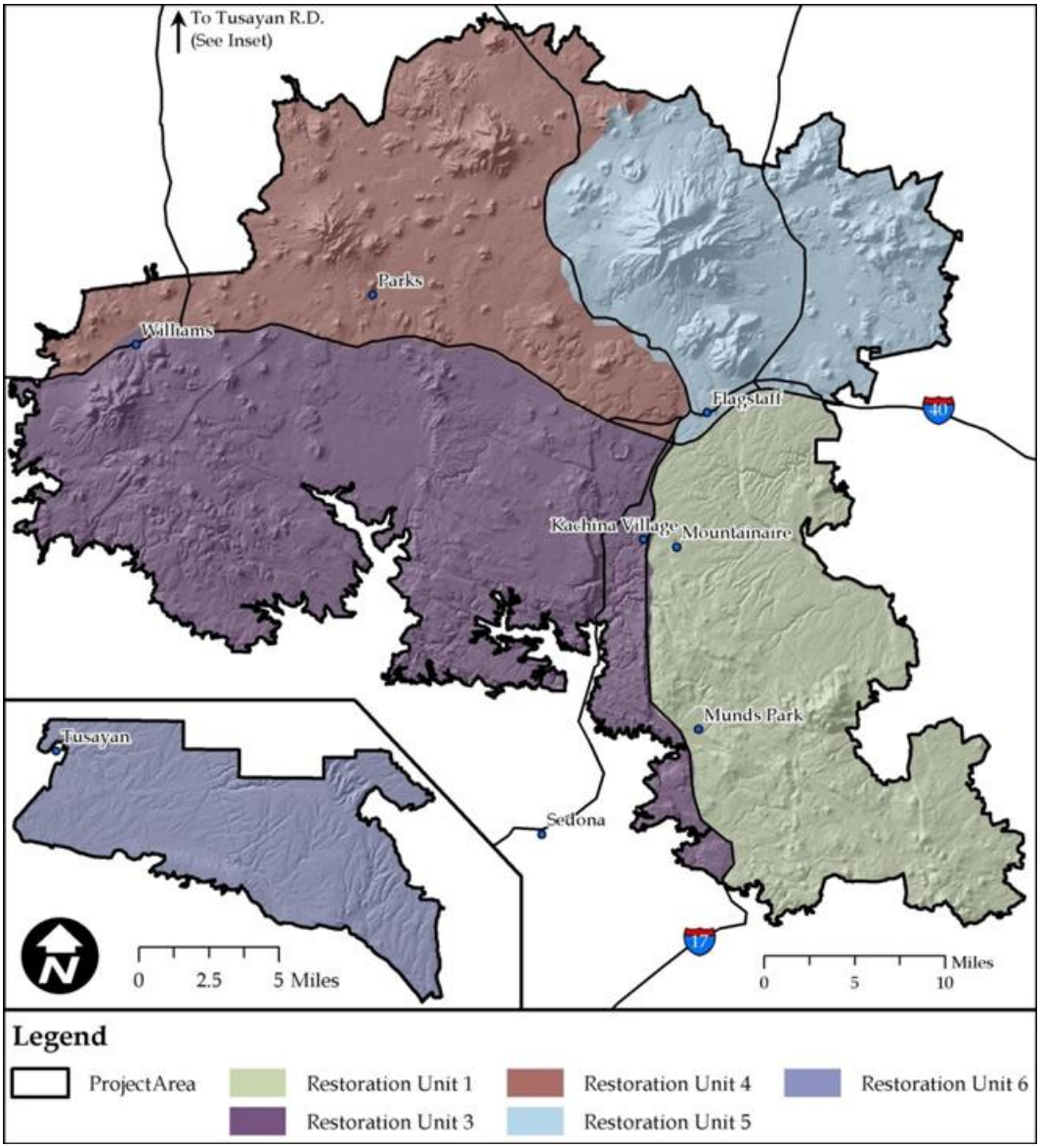

Figure 79. Restoration unit boundaries within the 4FRI treatment area

Table 169. Proposed post-treatment openness condition (percent) by restoration unit

restoration unit	Very Open	Open	Moderately Closed	Closed
1	11%	40%	29%	21%
3	13%	40%	32%	15%
4	20%	52%	18%	10%
5	14%	58%	24%	4%
6	2%	41%	47%	11%

Old-growth Allocations

Desired conditions for old growth in ponderosa pine under the Coconino forest plan direction:

- 20 trees per acre at 18 inches d.b.h. and greater and at least 180 years old,
- one snag per acre at least 14 inches d.b.h. and 25 feet tall,
- two down dead tree pieces 12 inches in diameter and 15 feet long,
- basal area at least 90 square feet, and
- canopy cover of at least 50 percent.

Guidelines from the Kaibab forest plan include:

Multi layered canopy, interlocking canopy and old growth

Ponderosa Pine Desired Condition: Fine-scale: Crowns of trees within the mid-aged to old groups are interlocking or nearly interlocking and consist of approximately 2 to 40 trees per group. Where Gambel oak comprises more than 10 percent of the basal area, it is not uncommon for canopy cover to be greater than 40 percent. Mid-scale: The ponderosa pine forest vegetation community is characterized by variation in the size and number of tree groups depending on elevation, soil type, aspect, and site productivity. The mosaic of tree groups generally comprises an uneven-aged forest with all age classes and structural stages present. Forest conditions in some areas contain 10 to 20 percent higher basal area in mid-aged to old tree groups than in the general forest (e.g. goshawk post-fledging family areas, Mexican spotted owl nesting and roosting habitat, drainages, and steep north facing slopes). Landscape: The ponderosa pine forest vegetation community is a mosaic of forest conditions composed of structural stages ranging from young to old trees. The forest is generally uneven-aged and open. Groups of old trees are mixed with groups of younger trees. Denser tree conditions exist in some locations such as north facing slopes, canyons, and drainage bottoms. Old growth occurs throughout the landscape, generally in small areas as individual old growth components, or as clumps of old growth. Old growth components include old trees, dead trees (snags), downed wood (coarse woody debris) and structural diversity. The location of old growth shifts on the landscape over time as a result of succession and disturbance (tree growth and mortality).

Vegetation Management in All Forested Communities Guideline: Projects in forested communities that change stand structure should generally retain at least historic frequencies of trees by species across broad age and diameter classes at the mid-scale. On suitable timberlands, projects should retain somewhat higher frequencies of trees across broad diameter classes to allow for future tree harvest. Project design should manage for replacement structural stages to assure continuous representation of old growth over time.

The microhabitat diversity provided by the old trees, multi-storied canopies, snags, and downed logs within old growth areas are rare across the landscape. Functional Mexican spotted owl habitat and portions of northern goshawk habitat are comprised of old-growth forest (see chapter 1, existing and desired conditions for more details). The Coconino forest plan direction is to allocate and maintain at least 20 percent old growth forest within each ecosystem management unit (EMU). For the purposes of the 4FRI project, an ecosystem management unit resembles the 4FRI restoration units, therefore old growth was allocated by restoration unit (see table 38 in the silviculture specialist report).

Forty percent of the ponderosa pine treatment area on the Coconino NF (127,009 acres) and 35 percent (65,810 acres) of the Kaibab NF are allocated for old growth. Old-growth conditions do not currently occur in sufficient quantity on the Coconino and Kaibab NFs. Areas selected for old-growth allocation represent current conditions that most closely resemble old growth. The 4FRI has incorporated a large tree retention policy and alternative C (the preferred alternative) would also include an old tree protection strategy. It is the intent of the 4FRI project to manage allocated areas according to old growth standards to move them towards mature, diverse forests over time. Similar provisions were made for pinyon-juniper habitats. A portion of these areas currently support closed canopy conditions and will continue to do so. More closed canopy conditions will develop in these areas over time, contributing further to closed canopy habitat.

Bridge Habitat at the Mid-Scale

Bridge habitat for canopy-dependent wildlife would also occur at the mid-scale in the 4FRI project. Some densely forested areas would be deferred simply due to the vagaries of implementation. The 4FRI project also intentionally plans for bridge habitat at the mid-scale through its desired conditions, design features/best management practices/mitigation, the old and large tree implementation plans, and the silvicultural design and implementation guide. These factors are described below.

Desired Conditions for Bridge Habitat

The 4FRI EIS describes treatments intended to meet the described desired conditions. During implementation of the 4FRI project, site specific prescriptions would be developed to implement the treatments and they too would be based on meeting desired conditions. The following subset of desired conditions would help ensure bridge habitat is maintained in the proposed project area (see chapter 1 purpose and need for the full set of desired conditions):

- 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 protected, target, threshold, and restricted habitats and goshawk nest areas.
- At the fine scale, the desired condition is a ponderosa pine ecosystem consisting of groups of trees that typically range in size from 0.1 acre to 1.0 acre in size. Tree groups would exceed 1-acre in size as needed to respond to site-specific conditions such as the presence of pre-settlement trees or mature trees that are developing old-tree characteristics.
- Tree groups in the mid-age and older VSS classes would have canopies that provide moderate-to-closed conditions and connectivity for wildlife that are dependent on this type of habitat. These conditions are widely distributed on the landscape. At the landscape scale (extent of ponderosa pine vegetation), all canopy density conditions exist and provide for heterogeneity.
- Moderate-to-closed canopy conditions (and the connectivity between groups supporting these conditions) are met in a variety of ways: habitat for goshawk and Mexican spotted owl, steep slopes, buffers for several resources including bald eagle roosts, other raptor nests, heron rookeries, caves, sink holes, and special designations that would not be treated (including wilderness and most research natural areas).
- There is a need to use management strategies that: (1) promote tree regeneration and understory vegetation, (2) move tree canopy density, tree group pattern and interspaces towards the historic range of variability, and (3) provide a mix of open, moderately-closed,

and closed-canopy conditions at the fine (group) to landscape (ponderosa pine vegetation) scale.

- There is a need to implement uneven-aged management strategies and manage for high-density, relatively uneven-aged stands in Mexican spotted owl restricted habitat, including target and threshold habitats to meet forest plan and Mexican spotted owl Recovery Plan requirements.

Wildlife Design Features/Best Management Practices/Mitigation Measures

Design features, best management practices, and mitigation measures are intended to avoid or minimize adverse effects of management actions on natural resources. They provide safeguards for wildlife and other resources during the implementation phase. Some of these actions would result in a well-distributed network of bridge habitat for wildlife across the larger landscape (table 170). A more complete list of design features, BMPs, and mitigation can be found in appendix C and appendix D of the EIS (the silvicultural design and implementation guide). Selected silvicultural design features that contribute to bridge habitat are described in greater detail below.

Table 170. Design features, BMPs, and mitigation measures contributing to bridge habitat

Species/Resource	Description
Bald Eagle Nests	No mechanical treatments would occur within a 300-foot radius of bald eagle nest trees (about a 6 acre patch for each nest).
Bald Eagle Roosts	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).
Vegetation Structural Stages 4, 5, and 6	Within group density – Manage mid-aged tree groups for a range of density and structural characteristics by thinning approximately 50 percent of the mid-aged groups to the lower range of desired stocking conditions, approximately 20 percent each to the middle and upper range of desired stocking conditions, and approximately 10 percent would not be thinned. Within group structure – Enhance and maintain mid-aged, mature, or old group structure by retaining individual and clumps of vigorous ponderosa pine seedlings, saplings, and poles within the larger group.
Caves and Sinkholes	A 300-ft no mechanical treatment buffer would be designated around 34 cave entrances (about 6.5 acres each) and around an undetermined number of sink holes (i.e., karst) to protect cave ecosystems from siltation, protect human health and safety, and reduce potential disturbance to roosting bats. Existing roads could be used for mechanical harvest but no new skid trails would be created.
Dependable Waters	Hiding cover would be maintained near dependable waters by not targeting drainages for interspaces and openings and through implementation of watershed BMPs.
Great Blue Herons	No dominant or co-dominant trees would be cut in rookeries. Nest trees will be prepped prior to implementing prescribed fire.
Mexican spotted owl	Trees greater than 24 inches d.b.h. would not be harvested.
Mixed Conifer	4FRI activities would not include mechanical or fire treatments in the mixed conifer inclusions within the ponderosa pine forest (e.g., Mexican spotted owl core areas in treated PACs). Similarly, islands of ponderosa pine within mixed conifer forest would not be treated as part of this project.

Species/Resource	Description
Northern Leopard Frogs	A no-treatment buffer (no thinning, no direct ignition) would extend ¼-mile from tanks with known northern leopard frog sites, or be designated along logical topographic breaks. In some cases, the district wildlife biologist could work with implementation teams to determine the habitat protection buffer boundary.
Northern Leopard Frogs	A 200-ft protection zone (100 feet either side of streamcourse) would be established around designated stream courses for northern leopard frogs. There would be no thinning and no direct ignition of prescribed burning within the protection zones. Designated skid trail crossings through the buffer zones are allowed.
Raptor Nests	No mechanical treatment buffers would be designated around raptor nests. Sharp-shinned hawk nests = 10 acres, Cooper's hawk nests = 15 acres, osprey nests = 20 acres, other raptors = no mechanical treatment buffers within a 50 foot radius (about 0.2 of an acre).
Snags	Emphasize retention of snags at least 18 inches d.b.h..
Snags	Retain trees at least 18 inches d.b.h. with dead tops, cavities, and lightning strikes wherever possible to provide cavity nesting/foraging habitat (i.e., the living dead).
Streamside Management Zones	On areas to be prescribed burned, establish filter strips (also known as streamside management zones). Applies to riparian and non-riparian streamcourses. Deferral widths range from 35 to 120 feet on each side of the streamcourse.
Turkeys	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.
Wildlife Cover	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: Within UEA, IT, SI, and wildland-urban interface treatments, pinyon/juniper seedling/sapling and young/mid-aged trees may be cut within a 40-foot radius of individual or groups of old ponderosa pine (as defined in the old tree implementation strategy). Within savanna and wildland-urban interface pinyon-juniper mechanical treatment areas, pinyon/juniper seedling/sapling and young/mid-aged trees may be cut.
Habitat Heterogeneity	Manage mid-aged tree groups for a range of density and structural characteristics by thinning approximately 50 percent of the mid-aged groups to the lower range of desired stocking conditions, approximately 20 percent each to the middle and upper range of desired stocking conditions and approximately 10 percent remain unthinned.
Canopy Cover/ Habitat Heterogeneity	Enhance and maintain mid-aged, mature and old group structure by retaining individual and clumps of vigorous ponderosa pine seedlings, sapling and poles within the larger group.

Old and Large Tree Implementation Plans

In response to public input from several stakeholders requesting a design feature that included no cutting of pre-settlement old-growth trees, the 4FRI project would implement an Old Tree Protection Strategy. Old trees (approximately 150 years and older) would be retained regardless of their diameter within the 4FRI project area. Exceptions would be made for threats to human health and safety and those rare circumstances where the removal of an old tree is necessary in

order to prevent additional habitat degradation (e.g., moving a road out of stream channel). However, exceptions are not expected. Retention of old trees as individuals and groups will contribute significantly to bridge habitat, providing old growth structure for wildlife in the short term.

In response to input from some stakeholders, alternative C includes a Large Tree Retention Strategy. The strategy identifies areas where post-settlement trees 16 inches d.b.h. and larger would be retained and exceptions where removal of trees 16 inches d.b.h. and larger would be necessary to move toward ecological desired conditions. Elsewhere, those trees would be retained, adding to the mid-scale provision of bridge habitat for canopy-dependent wildlife.

Silvicultural Design and Implementation Guide

Vertical and horizontal heterogeneity are important components of wildlife habitat in ponderosa pine forests. Restoring variability and diversity to forest structure and pattern is a central desired condition of the 4FRI project. The silvicultural design and implementation guide (hereafter "implementation guide"; appendix D, attachment 1) is intended to translate desired conditions, management direction, and design features into guidance for the district silviculturists responsible for writing site-specific prescriptions in the implementation phase. The intent is to balance the need for flexibility to adapt to on-the-ground realities while ensuring adequate sideboards to minimize or avoid impacts to important resources. Below are examples of how maintenance of bridge habitat would be ensured through the implementation guide.

Implementation Guide—Mexican Spotted Owls

Several features of the implementation guide treatment design for the Mexican spotted owl would serve as a proxy for other canopy-dependent wildlife. Design features for the owl are too numerous to list here, but those listed below serve to illustrate specifically how bridge habitat would be maintained at the mid-scale:

- Each PAC has a 100-acre (or greater) core area that would not have mechanical treatments.
- Each PAC to be thinned would have an upper diameter limit of trees that may be cut.
- Manage for 110 to 150 square feet of basal area (depending on alternative) in protected, target, and threshold habitats; basal area in restricted other habitat would range from 70 to 90 ft^2.
- Individual trees and tree groups would occupy approximately 60 to 75 percent of the area within restricted other habitat.
- Treatments are designed to manage for old age trees and to sustain as much old forest structure as possible across the landscape. Treatments would follow the Old Tree Protection Plan.
- No trees larger than 18 inches d.b.h. would be cut in protected habitat and no trees larger than 24-inches d.b.h. would be cut in restricted habitats.
- In restricted other habitat, tree groups would, on average, range in size from 0.1 to 1 acre; northerly aspects and highly productive microsites would have larger average group sizes.
- In restricted other habitat, manage for tree groups with different age classes by retaining individual and clumps of vigorous ponderosa pine seedlings, saplings and poles within the larger mid-aged, mature or old tree groups.

- In restricted other habitat, interspace width between tree groups would average from 25 to 60 feet with a maximum width of 200 feet.
- Manage for large oak and pine snags.
- Retain non-ponderosa pine species in the canopy.
- Retain young trees growing within the dripline of old trees in PACs to maximize roosting potential.

Implementation Guide—Northern Goshawks

Several features of the treatment design for the northern goshawk would serve as a proxy for other canopy-dependent wildlife. Design features that would contribute towards this goal are numerous, but a few key features are highlighted to illustrate maintenance of bridge habitat. Relevant design features from table 170 are not repeated below.

- Treatments are designed to manage for old age trees, following the Old Tree Protection Plan.
- Treatments would strive to attain an overall stand average density ranging from 40 to 90 square feet of basal area and 15 to 40 percent of maximum stand density index. Density would vary within this range depending on treatment type, intensity, existing stand structure, and site conditions.
- Tree group density would be managed to meet the canopy cover requirement of 40 plus percent within mid-aged forest (VSS4), mature forest (VSS5), and old forest (VSS6) tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature.
- To achieve overall stand average density targets, basal area and stand density index within tree groups would often need to exceed average target values. Table 171 illustrates how this could work for basal area (see the implementation guide for greater detail). For example, a treatment intensity of 10 to 25 should result in 10 to 25 percent of a stand open and 75 to 90 percent treed. If the objective for a specific stand was 20 percent interspace and 80 percent trees, including 10 percent regeneration, then 70 percent of the treed area would be groups and individual tree. If the overall target basal area was 60, tree groups in the 70 percent treed area would have to average 86 basal area.
- Within-group structure specific to mid-aged to old tree classes (VSS 4 to 6) would include open understories, interlocking tree crowns, abundant large limbs, and shade.
- Tree groups, on average, would range in size from 0.1 to 1 acre. Overall average group size would vary within this range depending on existing stand structure, and pre-settlement tree evidence.
- Maximum interspace width of 200 feet.
- Maximum regeneration opening size of 4 acres or 200 feet wide.
- One group of reserve trees, three to five trees per group, would be left in created regeneration openings larger than 1 acre in size.
- Manage for large oaks.
- Within the proposed Arizona Department of Game and Fish research areas, tree group size is dependent on experimental design and would range in size from 1 to 15 acres.

Table 171. Excerpt from section D of the 4FRI implementation guidelines

Treatment Intensity	Percent Area		Percent Area with Tree Cover		Average Group Basal Area to Achieve Overall Basal Area					
	Interspace	Tree	Groups & Individuals	Regeneration	40	50	60	70	80	90
10–25	**10**	**90**	90	0		56	67	78	89	100
			85	5		59	71	82	94	
			80	10		63	75	88	100	
			75	15		67	80	93	107	
			70	20		71	86	100	114	
	15	**85**	85	0		59	71	82	94	106
			80	5		63	75	88	100	
			75	10		67	80	93	107	
			70	15		71	86	100	114	
			65	20		77	92	108	123	
	20	**80**	80	0		63	75	88	100	113
			75	5		67	80	93	107	
			70	10		71	86	100	114	
			65	15		77	92	108	123	
			60	20		83	100	117	133	

Conclusions about Bridge Habitat in the 4FRI Project

Closed-canopy, high-density, mid-aged forest conditions are currently common in the 4FRI project area. To achieve ecological objectives (e.g., achieve or move towards the natural range of variability, increase forest resiliency to continuing climate change, maintain existing large and old trees and increase large tree growth rates) and modify landscape-scale fire behavior, continuity of canopy connectedness and overall forest density must be significantly reduced. Given the evolutionary history of canopy-dependent wildlife on this landscape, we can assume that closed-canopy conditions were present within the natural range of variability. The question of how much of the pre-settlement landscape was in this condition remains unanswered, but the literature, including historic stand inventories, stand reconstructions, and site descriptions, combined with soil mapping and photo documentation, consistently concludes that this was not the predominant condition. Nevertheless, the 4FRI project proposes to maintain more closed canopy conditions than likely occurred historically. Some closed canopy forest areas are proposed for long-term management (e.g., Mexican spotted owl habitats) and others could change the next time a management planning analysis is conducted on this landscape (e.g., nest and roost sites for other raptor species that might not be in use in the future). Together, they would provide bridge habitat for canopy-dependent wildlife to span the time between restoration treatments and achievement of desired conditions.

In summary, bridge habitat would be managed for at the mid-scale in four key ways:

1. Desired conditions that strive to attain the full range of natural variability which includes areas for canopy-dependent wildlife,

2. Design features/BMPs/mitigation measures would result in a well-distributed mosaic of small-scale deferrals in a landscape dominated by prescribed fire and mechanical treatments,
3. Implementation guidance for Mexican spotted owl habitat that retains higher forest density and canopy cover relative to the surrounding landscape, and
4. Implementation guidance for northern goshawks that allows for higher density within tree groups given the contribution of interspaces and openings to overall stand averages.

About 40 percent of the landscape within the 4FRI project boundary would be deferred from treatment (table 166). Of those acres treated, about 42 percent would remain in a moderately-closed to closed condition after treatment. Landscape-scaled movement corridors that were independent of site-specific treatment assessments were included in the project design. Old growth allocations account for 38 percent of the ponderosa pine treatment area and are well-distributed across the landscape and would be managed for closed canopy conditions in the long-term. A patch-mosaic of small deferrals would be created all across the 4FRI project area to maintain wildlife-related features such as sinkholes and hiding cover. Implementation guidance in Mexican spotted owl and northern goshawk habitats includes provisions for higher tree densities and canopy cover relative to the surrounding landscape. All of these measures would provide bridge habitat for canopy-dependent wildlife. It is our assumption that by providing more closed-canopy conditions than likely occurred historically, adequate habitat will be provided habitat for canopy-dependent wildlife. Monitoring would be an important test of this assumption, and adaptive management would be employed if outcomes prove otherwise.