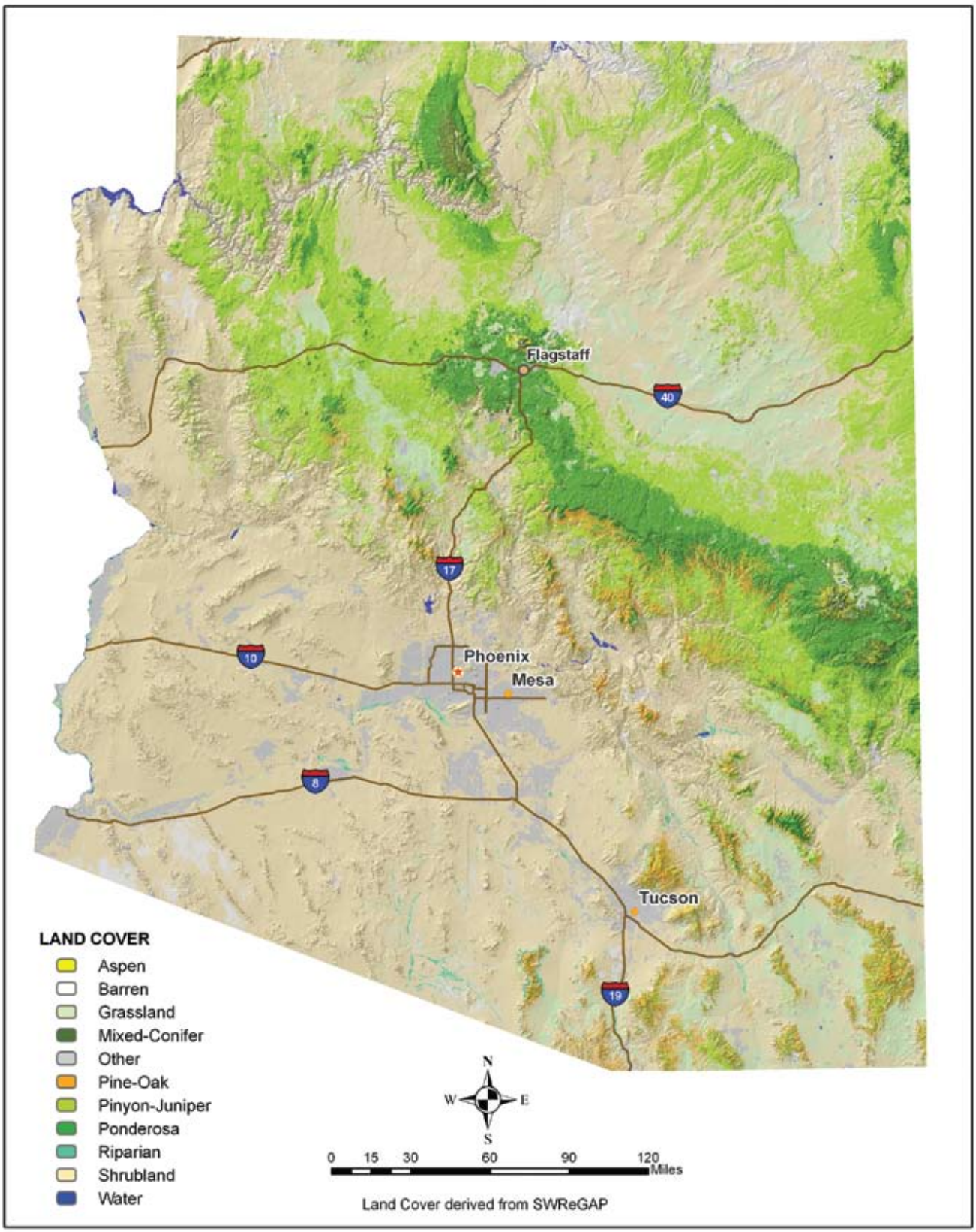
Statewide Strategy for Restoring Arizona's Forests

Sustainable Forests, Communities & Economies



Arizona's Forests

STATEWIDE STRATEGY FOR
RESTORING ARIZONA'S FORESTS

Land cover characterization in the Statewide Strategy

The 11 major land cover classes in Arizona, mapped on the facing page, are comprised of between one and 23 of 77 vegetation subclasses. For each class, we used a geographic information system to identify the dominant subclasses (by total area) within each major land cover class:

1. ***Aspen*** is dominated by Rocky Mountain aspen forest and woodlands;
2. ***Barren*** is dominated by Colorado Plateau mixed bedrock canyon and tablelands;
3. ***Grassland*** is dominated by semi-desert and inter-mountain grassland and steppe vegetation;
4. ***Mixed-conifer*** is dominated by Rocky Mountain montane dry-mesic mixed-conifer forest and woodland;
5. ***Other*** is characterized by developed areas and agriculture;
6. ***Pine-oak*** is dominated by Madrean encinal and pine-oak forest and woodland;
7. ***Pinyon-juniper*** is dominated by Colorado Plateau and Madrean pinyon-juniper woodland;
8. ***Ponderosa pine*** is dominated by Rocky Mountain ponderosa pine woodland;
9. ***Riparian*** is dominated by North American warm-desert riparian mesquite bosque, woodland, and shrubland;
10. ***Shrubland*** is dominated by Sonoran paloverde-mixed cacti desert scrub and Sonoran-Mojave creosotebush-white bursage desert scrub;
11. ***Water*** is characterized by open water features.

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Statewide Strategy for Restoring Arizona's Forests

June 2007

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Contents

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STATE OF ARIZONA

JANET NAPOLITANO
GOVERNOR

OFFICE OF THE GOVERNOR
1700 WEST WASHINGTON STREET, PHOENIX, AZ 85007

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June, 2007

Dear Arizona Citizens:

Arizona forests are vital to its citizens. They are home to tens of thousands of residents in mountain cities and towns such as Flagstaff, Prescott, Payson, Show Low, Heber, Overgaard, Pinetop, Lakeside, Whiteriver, McNary, Eagar, Springerville and numerous smaller communities. Forests occupy large and critical portions of the watersheds of the Salt, Verde, and Gila Rivers, which supply water for the people, farms, and industries of central and southern Arizona, including the Phoenix metropolitan area. They provide essential habitat for numerous species of wildlife, including deer, elk, bear, and wild turkey as well as game birds, birds of prey, and small mammals. Arizona's Forests are also significant sources of wood, biomass, and livestock forage. Finally, they are an enormous recreational resource, providing camping, hunting, fishing, hiking, and bicycling opportunities, as well as relief from the desert heat, for hundreds of thousands of visitors, both from in-state and out-of-state. The income from these visitors is critical to the economy of much of rural Arizona.

Despite years of effort our forests remain unhealthy and vulnerable to unnatural fire because of accumulated fuels, overcrowding and drought. Restoring the health of the state's forests and reducing the threat of wildfire to our communities are central priorities of my administration.

Arizona is a national leader in forest restoration. Communities across the state have prepared Community Wildfire Protection Plans to guide action that will reduce the threat of fire to our communities. Our universities are national leaders in restoration science, and individual Arizonans repeatedly demonstrate a commitment to solving this problem by taking personal responsibility for treating their homes and property.

Therefore it should be no surprise that Arizona citizens, under the framework of my two Forest Health Councils, have created the "Statewide Strategy for Restoring Arizona's Forests". This strategy is a unified, consensus-based approach for what we ***must do*** and how we ***must do it*** to solve our forest health problems. It articulates a bold vision and identifies the necessary steps we all must take to achieve this goal. The strategy also demonstrates that if we work with conviction and efficiency across jurisdictions we can be successful.

I am excited by the progress we have made in Arizona and our shared vision for the future. Together we can make the "Statewide Strategy for Restoring Arizona's Forests" a reality.

Yours very truly,

Janet Napolitano
Governor

STATEWIDE STRATEGY FOR
RESTORING ARIZONA'S FORESTS

Executive Summary

Background

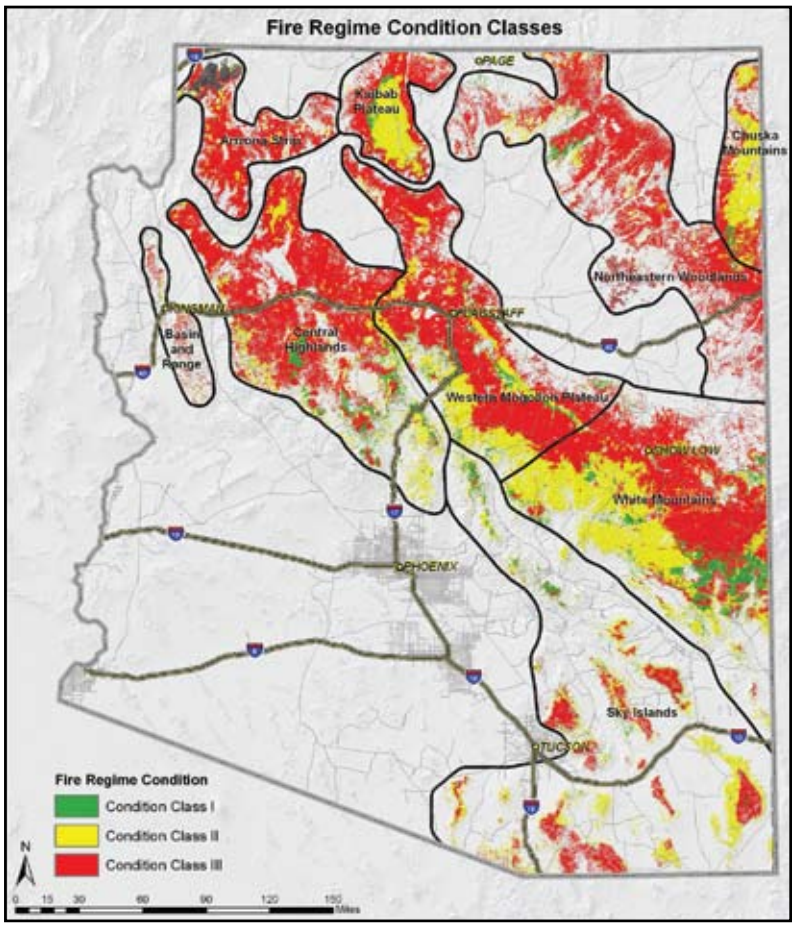
In 2003, Governor Janet Napolitano created the Forest Health Advisory Council and the Forest Health Oversight Council in response to the escalating number, frequency, and intensity of unnatural wildfires threatening Arizona's forests and communities (Executive Order 2003-16). The Councils were directed to develop scientific information and policy recommendations to advise the Governor's administration on matters of forest health, unnaturally severe forest fires, and community protection. Council membership was designed to be inclusive to maximize opportunities for collaboration and defuse the controversy surrounding forest management.

Initially, the Oversight Council's policy recommendations were reactive—responding to year-to-year circumstances. However, members quickly realized that success would demand a proactive multi-year, integrated set of actions designed to maximize efficiency and effectiveness of treatment activities. In 2005 the Councils established a subcommittee to begin work on a 20-year strategy to restore forest health, protect communities from fire, and encourage appropriate, forest-based economic activity. The actions identified in this document are a product of that subcommittee's work, and represent a starting point for on-the-ground implementation of a statewide strategy. Encouraging adoption and implementation of the actions specified here by the entities responsible for their execution is a critical next step. Fortunately, Arizonans have repeatedly demonstrated support for restoring forests. It is our hope that this document provides the road map and inspiration to get us there.

Critical findings

Arizona's forests are an invaluable asset in need of increased attention and public investment. The diverse array of native forests and woodlands, from the cottonwood bosques hugging our river courses to the subalpine firs cloaking our tallest peaks, forms a stunning panorama across the state, providing recreational and aesthetic resources, surface and ground water, wildlife habitat, and many other benefits to every resident. These forests contribute to our quality of life, enhancing the unique character of our state that attracts a creative workforce and fuels our economic success. But an assessment of forest health reveals that Arizona's forests are in need of attention and improved stewardship. The reality of climate change, drought, and the increasing threat of destructive wildfires and insect outbreaks to our forested watersheds challenge us to examine our approach to forest management and take bold action to restore the resilience and health of Arizona's forests, and protect forest values for future generations.

Unhealthy conditions across many of Arizona's forests developed gradually during the past century due to a combination of factors, including human land uses, fire suppression, and climate change. Despite the scale of the forest health problem, solutions exist. Scientists, land managers, and restoration practitioners across the state have



Fire Regime Condition characteristics of forests across the state illustrate the unhealthy condition of Arizona forests. Areas in red have diverged significantly from their natural fire regimes, and unnaturally severe fires in these areas are likely to cause significant damage.

demonstrated practical ways of restoring forest integrity, through judicious use of thinning, and the appropriate application of fire as a restoration tool.

Local communities have shown a willingness to collaboratively forge strategic solutions to local forest health problems. The fruits of their labor are reflected by the large number of completed community wildfire protection plans (CWPPs), as well as the ongoing work of collaborative organizations such as the Prescott Area Wildland Urban Interface Commission, the Greater Flagstaff Forests Partnership, the Pinaleño Partnership, and the Natural Resource Working Group of the White Mountains. Many citizens are urging establishment of policies and ordinances that require neighbors and members of Homeowner Associations to reduce fuels on their private property. These people are justifiably worried that without collective action individual efforts will be insufficient in the face of fire.

Beyond their inherent value, healthy forests are a vital piece of a healthy state economy. Forests are now the backbone for the tourist-based economies of much of rural Arizona—an economic driver that has far eclipsed the value of harvesting saw logs at a statewide level. In 2002, tourism in Arizona was estimated to contribute $30 billion to the economy in direct, indirect, and induced expenditures, representing 20% of the economy and providing $1 billion in tax revenue. Moreover, the water that Arizona's forests supply and purify is more valuable today than ever before , due to Arizona's burgeoning population. Forests also hold the potential for supporting development of a new generation of manufactured wood products and providing restoration-based work opportunities that will bring good jobs to rural Arizona. Finally, forests have received increased attention as a source of renewable biomass energy, a less-polluting energy source that can help to reduce our dependence on foreign fossil fuels.

We cannot afford further delays in action. Partial solutions will not suffice. Although some uncertainty will always exist about how to proceed, we now know enough to move forward using the best available science. We must demand the human and financial resources from responsible authorities at a level sufficient to meet long-term restoration, community protection, and fire management goals. Recognizing that fires currently have the potential to burn at uncharacteristically large scales, we must coordinate forest and fire management activities across jurisdictional boundaries. We must allocate our financial and human resources strategically, maximizing the effectiveness of all dollars spent. Realizing the potential for wood and forest-based businesses to support on-the-ground work, we must support the development of appropriately-scaled industry. Finally, we must continue to build public awareness of and support for this ambitious, forward-looking forest management strategy.

We have decades of vitally important work yet to be done across the state. Arizona is well-positioned to lead the nation in meeting what some consider an insurmountable challenge. Today is not too soon to meet that challenge.

Vision

Our vision for Arizona's forests is clear and deceptively simple: healthy, diverse stands, supporting abundant populations of native plants and animals; thriving communities in attractive forested landscapes that pose little threat of destructive wildfire; and sustainable forest industries that strengthen local economies while conserving natural resources and aesthetic values. These characteristics are the components of a healthy, restored forest and their dependent communities.

This vision unites Arizonans, but there is consensus that many forests across the state are unhealthy, reducing their value and raising the risk of unnaturally severe wildfire and degraded streams and waterways. State, regional, and national agencies and organizations recognize the urgent need to improve the conditions of southwestern forests and are taking action, but much more needs to be done. We must increase on-the-ground activity, including the thinning of dense stands, increase use of prescribed and natural fire to achieve ecological and public safety objectives, and initiate appropriately scaled utilization of forest restoration by-products to help make forest restoration affordable.

Despite broad agreement about the need for forest restoration, a practical strategy has not yet been clearly articulated in a policy-relevant form. Our vision, therefore, extends beyond the restoration of forest health and includes a commitment to public involvement, coordinated government initiatives, and strategic planning to guide forest management in our rapidly changing state.

Recommendations and actions

The Strategy incorporates statewide stakeholder input that originates from the first Forest Health Summit convened by Governor Napolitano in March, 2003. The Forest Health Councils started the formal process of preparing the strategy in late 2005 by establishing a representative subcommittee that included non-Council members. In May, 2006, a workshop was held in Flagstaff to receive input from interested stakeholders. Various iterations of outlines, chapters and drafts were shared with the Councils during 2006. A final working draft of the Strategy was presented and approved for distribution to the public on April 12, 2007. In May, 2007, six public meetings were held in Tucson, Flagstaff, Phoenix, Pinetop, Prescott and Kykotsmovi (Hopi Reservation), where 103 citizens took the opportunity to discuss the Strategy, suggest changes and offer endorsements. There were 75 total comments provided at the meetings and via e-mails that directly supported the content of the document.

The Councils approved the final document on June 14, 2007, and conveyed it to the Governor on June 21, 2007.

The Statewide Strategy for Restoring Arizona Forests integrates knowledge and experience from science, community collaboration, and economics to identify the steps needed to increase the rate and effectiveness of forest restoration across the state. Because local ecological, social and economic conditions vary across the state, the Statewide Strategy presents local, landscape-specific recommendations in the Landscapes section of the document (pages 43-144). All recommendations are explained and synthesized in the Key Strategies section (pages 5-15).

Five Key Strategies: A foundation for action

Five key strategies provide the framework for successfully restoring Arizona's forests. These strategies evolved from discussions among experts, land managers and stakeholders who are actively working to improve forest health. To accomplish strategic and efficient restoration in 20 years the public and private sector must work together to:

1. *Increase the human and financial resources dedicated to restoring Arizona's forests and protecting communities.*
2. *Coordinate and implement action at the landscape-scale.*
3. *Increase the efficiency of restoration, fire management, and community protection activities.*
4. *Encourage ecologically sustainable, forest-based economic activity.*
5. *Build public support for accomplishing restoration, community protection and fire management across the state.*

Sixteen overall recommendations have been identified as necessary for implementation of the key strategies described above. For the purposes of the Executive Summary, the recommendations and their associated action items are grouped according to the entity responsible for their implementation. Consequently, some of the recommendations that pertain to more than one entity appear several times below. Entities responsible for implementing the Strategy include Congress, federal land management agencies, the Arizona State Legislature, the Governor and her executive agencies, county and local government, citizens, and the Forest Health Advisory and Oversight Councils.

Congress

The federal government and Arizona Indian tribes own and manage the majority of forested land in Arizona, making participation by the federal land management agencies and tribes critically important to the success of any strategy. At the current level of funding and operation, the tribes and federal land management agencies will not be able to accomplish effective restoration in 20 years. The Congress is largely responsible for appropriating funds that pay for such forest management activities. In addition, Congress develops and executes the policies that motivate or hinder action. Therefore, many of the recommendations in the Strategy are directed at Congress.

***Recommendation #1*- Congress should increase funding to federal and tribal land management agencies and the state to furnish the capacity needed to collaboratively design, implement and monitor restoration treatments. (1.1.)**

Actions:

- Vegetation and fuel treatment funding should be increased to a minimum of $30 million/year for 3 years for the U.S. Forest Service; and $10 million/year for 3 years for Department of Interior agencies (Bureau of Land Management - BLM, National Park Service - NPS, Bureau of Indian Affairs - BIA, and the U.S. Fish and Wildlife Service – U.S. F&WS). Funding should increase by 15% per year for 20 years. (1.1.1.)
- Funding for CWPP implementation should be increased to $5 million per year, and the dollars should be allocated to local communities through the State Forester. (1.1.2.)
- Program funding should be provided to federal land management agencies to ensure adequate human resources are available to facilitate treatment action. This includes capacity for all facets of developing and applying treatments including: environmental review, contracting, community collaboration and implementation. (1.1.3.)
- Funding should be provided to U.S. Forest Service research stations in cooperation with universities to convene land managers, organizations with applicable expertise, and stakeholders to identify practical monitoring approaches that require the minimum effort and funding needed to produce appropriate information for informing and adapting management at multiple scales. (1.1.4.)
- Congress should maintain funding to complete the White Mountain Stewardship Contract. (1.1.5.)
- Congress should fund recruitment and training programs for forest and wood-products workers in cooperation with forest and wood-products employers and educational institutions. (4.3.4.)

***Recommendation #2*- Congress should restore funding to enable communities, stakeholder groups, and Arizona Indian tribes to collaborate and be involved in land management activities, including utilization and marketing of small-diameter wood and biomass. (2.3.)**

Action:

- Congress should revitalize the Economic Action Program, or create a new source of funds dedicated to assisting local communities throughout the West in their efforts to support collaborative approaches to restoration and to develop utilization and marketing opportunities for small-diameter wood and biomass. (1.2.1.)

***Recommendation #3*- Congress should increase funding for developing and translating the best available biophysical, ecological, and social science into forms needed by land managers and stakeholders. (2.4.)**

Action:

- Congress should fund universities, colleges, research stations and other organizations with applicable expertise to conduct applied biophysical, ecological, social science and economic research that informs and improves forest health and the vitality of rural communities. (1.3.2.)

Federal Land Management Agencies

Land managed by the U.S. Forest Service dominates forested acreage in Arizona. However, other federal land management agencies—BLM, NPS, and the BIA—manage or oversee land that has a significant effect on the forests and citizens of Arizona as well. Most of the following recommendations are directed at the U.S. Forest Service. However, all the federal agencies have a role to play.

***Recommendation #1*- Federal land management agencies should collaboratively develop and implement integrated, landscape-scale restoration, community protection, and fire management for forests across the state. (2.1.)**

Actions:

- The U.S. Forest Service should support the collaborative planning and implementation of integrated restoration, community protection, and fire management strategies across the state within the Forest Plan revision process. (2.1.1.)
- The U.S. Forest Service should develop, revise, and update annual Fire Management Plans using the best available science and in a transparent, collaborative fashion. (2.1.2.)
- National forest plans should provide clear performance measures that allow the agency and the public to evaluate progress toward meeting restoration, community protection, and fire management objectives. (2.1.3.)

***Recommendation #2*- All federal, state, tribal, and local governments should increase coordination of forest restoration, fire management, and community protection planning and implementation across jurisdictional boundaries. (2.3.)**

Action:

- Federal land management agencies should provide treatment data to update the Arizona Fire Map. (2.3.3.)
- Federal land management agencies should prioritize treatments to protect important infrastructure, e.g., telecommunication installations, power lines, and transportation corridors. (2.3.5.)

***Recommendation #3*- The federal land management agencies, counties and local governments should use Community Wildfire Protection Plans (CWPPs) to inform and prioritize treatments in their jurisdiction. (2.4.)**

Action:

- Federal agencies should place priority on implementing projects identified within CWPPs. (2.4.2.)

***Recommendation #4*- State and federal land managers should design forest management practices to integrate wildlife habitat and biodiversity conservation protection with restoration, community protection, and fire management. (2.5.)**

Action:

- The Arizona Game and Fish Department should work with the Arizona Forest Health Council, federal agencies and other stakeholders with applicable expertise to collaboratively develop a set of principles and strategies for integrating wildlife habitat and biodiversity conservation with community protection, restoration and fire management. This should include educating the public about these strategies. (2.5.1.)

***Recommendation #5*- Federal and state land management agencies should collaboratively and strategically place treatments in order to increase efficiency and maximize benefits. (3.1.)**

Actions:

- Federal land management agencies should develop short-term (2-5 year) and longer-term (10-20 year) treatment plans based on priorities developed at the landscape scale. (3.1.1.)
- Federal land management agencies should complete and implement plans for using prescribed fire and Wildland Fire Use where and when appropriate. (3.1.3.)
- Federal land management agencies should initiate treatments in places where a collaborative process has preliminarily identified and prioritized landscape attributes at risk. (3.1.4.)
- A national forest in Arizona should take a landscape-scale approach that systematically evaluates existing ecological conditions and then identifies, applies and monitors the effectiveness of strategically placed treatments that in theory should modify extreme fire behavior and reduce the probability of large, unnaturally severe fire. (3.1.5.)
- State and federal authorities should work collaboratively with stakeholders to identify and develop restoration and fire management strategies for watersheds of critical importance across the state. (3.1.6.)

***Recommendation #6*- Land managers should work with stakeholders to clarify the amount, availability, and location of wood and biomass generated through restoration, community protection, and fire management across the region. (4.1.)**

Action:

- The U.S. Forest Service and other federal land management agencies should fund and participate in a collaborative and objective evaluation of the amount and characteristics of wood and biomass available for utilization across Arizona. (4.1.1.)

***Recommendation #7*- Federal, state, and local governments should identify and enhance opportunities for utilizing small-diameter wood and biomass generated from forest treatments. (4.2.)**

Actions:

- The Forest Products Lab of the Forest Service, the U.S. Department of Energy, and the U.S. Department of Agriculture should conduct a study to identify utilization and marketing opportunities for products created from pinyon-juniper as well as ponderosa pine. (4.2.1.)
- The U.S. Forest Service should continue to use, and other federal land management agencies should initiate, best-value contracts and other tools that ensure continuous wood flow, where such contracts support collaborative and science-based forest management, and promote economic and social stability in rural communities. (4.3.1.)

Governor and Executive Branch Agencies

Restoring forest health and reducing the risk of catastrophic fire in Arizona was established as the first environmental priority of Governor Napolitano's administration in 2003. Under her leadership, state agencies can carry out the strategies and actions identified in this document.

Recommendation #1- Arizona state agencies should develop land use policies and practices that support forest restoration, community protection, and fire management efforts. (2.2.)

Actions:

- The State Fire Marshall should adopt and enforce an Urban Wildland Interface Code to protect communities and property from wildfire. (2.2.2.)
- The Arizona State Land Department should develop long-term forest restoration and fire management plans for state lands. (2.2.8.)

***Recommendation #2*- All federal, state, and local levels of government should increase coordination of forest restoration, fire management, and community protection planning and implementation across jurisdictional boundaries. (2.3.)**

Action:

- The State Forester should work with the Arizona Interagency Wildland Fire Prevention Team or a similar organization to improve coordination between all agencies and tribes on treatment implementation, as well as fire preparedness. (2.3.1.)

***Recommendation #3*- State and federal land managers should design forest management practices to integrate wildlife habitat and biodiversity conservation protection with community protection, restoration, and fire management. (2.5.)**

Action:

- The Arizona Game and Fish Department should work with the Arizona Forest Health Council, federal agencies and other stakeholders with applicable expertise to collaboratively develop a set of principles and strategies for integrating wildlife habitat and biodiversity conservation with community protection, restoration, and fire management. This should include educating the public about these strategies. (2.5.1.)

***Recommendation #4*- Federal and state land management agencies should collaboratively and strategically place treatments in order to increase efficiency and maximize benefits. (3.1)**

Actions:

- State land management agencies should develop restoration, fire management, and community protection performance standards that measure progress toward objectives. Measuring these performance standards can then lead to refinements of strategies, as necessary. (3.1.2.)
- State and federal authorities should work collaboratively with stakeholders to identify and develop restoration and fire management strategies for watersheds of critical importance across the state. (3.1.6.)
- The state should ensure that all state-identified communities at risk have completed a CWPP or its equivalent. (3.1.7.)

***Recommendation #5*- Federal, state, and local governments should identify and enhance opportunities for utilizing small-diameter wood and biomass generated from forest treatments. (4.2.)**

Actions:

- Arizona state agencies should use treatment-generated material whenever possible. Specifically, the State of Arizona should actively apply Arizona Executive Order 2005-05, which calls for all new state-funded buildings to derive their energy from renewable sources, such as woody biomass. (4.2.2.)
- State agencies should encourage the retrofitting of existing heating systems in public and private buildings to promote greater use of wood biomass. (4.2.3.)
- The Arizona Department of Transportation should use restoration treatment by-products generated in Arizona for guard rails and other transportation and highway maintenance applications. (4.2.5.)

***Recommendation #6*- All levels of government should work together to support wood products industries capable of utilizing small-diameter wood and biomass. (4.3.)**

Action:

- The Arizona Department of Commerce should fund a position designed to assist rural communities to recruit and support forest and wood-products enterprises. (4.3.3.)

Arizona State Legislature

The Arizona State Legislature will play a critical role in achieving forest restoration during the next 20 years by providing the financial resources and authorities required to accomplish the actions outlined in this document.

***Recommendation #1*- The Arizona State Legislature should provide funding for restoration treatments, community protection, and fire management on non-federal lands. (1.4.)**

Actions:

- The state government should provide financial support to universities and other organizations with applicable expertise such that staff of these entities can provide scientific support to, and serve as neutral conveners within collaborative processes, as necessary. (1.4.1.)
- The Arizona State Legislature should allocate $5 million per year to community protection activities identified in CWPPs. Activities to be supported would include completion of CWPPs and funding for community collaboration. (1.4.2.)
- The State of Arizona should provide adequate financial support to Arizona Fire Map. This tool provides the foundation for sharing treatment information across jurisdictional boundaries. (2.3.2)

***Recommendation #2*- The Arizona State Legislature should increase funding for developing and translating the best available ecological, biophysical, and social science into forms needed by land managers and stakeholders. (1.3.)**

Action:

- The Arizona State legislature should provide financial support to universities, state agencies, and other organizations with applicable expertise to conduct applied research, translate scientific information, and serve as neutral conveners within collaborative processes. (1.3.1.)

***Recommendation #3*- The Arizona State Legislature should develop land-use policies and practices that support forest restoration, community protection, and fire management efforts. (2.2.)**

Actions:

- The Arizona State Legislature should delegate authority to counties to manage development in the Wildland Urban Interface, to enhance protection from wildfire, and to protect public safety. (2.2.5.)
- The Arizona State Legislature should develop incentives to encourage landowners to maintain defensible space. (2.2.6)
- The Arizona State Legislature should work with local governments to revise planning requirements under Growing Smarter legislation to deal with fire risk at the landscape scale. (2.2.7.)

***Recommendation #4*- Federal, state, and local governments should identify and enhance opportunities for utilizing small-diameter wood and biomass generated from forest treatments. (4.2.)**

Action:

- The Arizona State Legislature should work with the Arizona Department of Commerce to identify incentive programs that encourage the use of restoration-generated materials by businesses across the state. (4.2.4.)

***Recommendation #5*- All levels of government should work together to support wood products industries capable of utilizing small diameter wood and biomass. (4.3.)**

Actions:

- The Arizona State Legislature should fund a position that is designed to help rural communities convene, recruit, and support forest and wood-products enterprises. This position will reside in either the State Forester's Office or the Department of Commerce. (4.3.2.)
- The Arizona State Legislature should fund recruitment and training programs for forest and wood-products workers in cooperation with forest and wood-products employers and educational institutions. (4.3.4.)

***Recommendation #6*- The Arizona State Legislature, working with the State Forester and local units of government, should educate the public about restoration, sustainable restoration-based businesses, fire management, and community protection needs and responsibilities. (5.1.)**

Action:

- The Arizona State Legislature should fund the education coordinator position under the State Forester to coordinate and promote public education about forest restoration, sustainable restoration-based businesses, fire management, and community fire protection needs and responsibilities (5.1.2.)

Counties and Local Government

Arizona has identified 159 Communities-At-Risk of fire through the Arizona Communities-at-Risk (CAR) process. In response to the Healthy Forest Restoration Act, 13 communities have prepared Community Wildfire Protection Plans (CWPPs) to guide treatment activity and attract federal funding for treatments. In addition to preparing CWPPs, the counties and local units of government have authority to adopt and enforce building codes intended to provide protection from fire. The counties and local units of government have an important and strategic role to play in motivating citizens to take action and guiding development to minimize the risk of wildfire and conflict with restoration-related activities.

***Recommendation #1*- Counties and local government should develop land use policies and practices that support forest restoration, community protection, and fire management efforts. (2.2.)**

Actions:

- Counties and local governments should classify undeveloped lands based on relative fire hazard. (2.2.1.)
- Counties and local governments should adopt and enforce building and Wildland Urban Interface fire codes to minimize communities' exposure to fire danger. (2.2.3.)
- Planners should work with developers to incorporate appropriate buffer zones, based on anticipated fire hazard, into the design of new developments to allow for maintaining conditions in adjacent forests where natural or prescribed fires may continue or be reintroduced. (2.2.4.)
- The counties and local governments should develop incentives to encourage landowners to maintain defensible space. (2.2.6.)

***Recommendation #2*- Local governments should increase coordination of forest restoration, fire management, and community protection planning and implementation across jurisdictional boundaries. (2.3.)**

Action:

- Counties and local units of government should provide treatment data to update the Arizona Fire Map. (2.3.3.)

***Recommendation #3*- Counties and local governments should use Community Wildfire Protection Plans to inform and prioritize treatments in their jurisdictions. (2.4.)**

Actions:

- Local governments in communities-at-risk should complete CWPPs. (2.4.1.)
- Local units of government should ensure that wood utilization opportunities and challenges are clearly identified in CWPPs. (4.1.2.)

***Recommendation #4*- All levels of government should work together to support wood products industries capable of utilizing small-diameter wood and biomass. (4.3.)**

Action:

- Local governments should develop and use policies, planning, and tax incentives to encourage businesses that will diversify the economy, are appropriately scaled to the amount of material available from the forest, and keep jobs and dollars in rural Arizona. (4.3.3.)

***Recommendation #5*- Local governments should educate the public about restoration, sustainable restoration-based businesses, fire management, and community protection needs and responsibilities. (5.1.)**

Action:

- County and local governments should create and/or promote education programs to help residents of forest communities understand the risks inherent in living in fire-prone areas, and to educate developers and the community about steps that can be undertaken to reduce exposure to fire hazard and to improve forest health. Much has been done already under the FIREWISE, USA program. (5.1.1.)

Citizens

Private landowners provide the first line of defense for protecting their property. Education and treatment cost-share programs exist to assist homeowners to reduce fuels on their property and reduce the risk of their homes burning. Individual action will do much to make Arizona communities safe from fire.

***Recommendation #1*- Citizens should take action to protect their communities and properties from fire. (5.2.)**

Action:

- Citizens should seek assistance from their local fire district, fire department, homeowners association or visit http://www.firewise.org/usa/ to learn what they can do to protect their home and property. (5.2.1.)

The Governor's Forest Health Council

Implementing the Statewide Strategy will require coordinated and concerted effort with annual monitoring to assess progress and adapt strategies to new conditions. The Forest Health Council, which represents broad stakeholder interests and serves as a forum to collaboratively and constructively address problems, can provide the oversight and motivation required to make effective, timely progress.

***Recommendation #1*- The Governor's Forest Health Council, working closely with the State Forester, the U.S. Forest Service and other federal agencies, should develop and administer on a yearly basis a "Forest Health Scorecard" based in part upon the Western Governor's Association's 10-Year Strategy Implementation Plan. (5.3.)**

Action:

- In 2007, the Forest Health Council should develop a scorecard based on the Statewide Strategy for Restoring Arizona's Forest to measure progress. (5.3.1.)

Conclusion

We must act now to strategically and efficiently restore our forests. In a spirit of collaborative engagement, informed analysis, and coordinated practical action, the Statewide Strategy for Restoring Arizona's Forests provides a vision to guide forest management for the coming decades.

Part One

1. A Vision for Arizona's Forests

2. Purpose of the Statewide Strategy

3. Key Strategies and Recommendations

1 A Vision for Arizona's Forests

Arizona's forests are an invaluable asset in need of increased attention and public investment. The diverse array of native forests and woodlands, from the cottonwood bosques hugging our river courses to the subalpine firs cloaking our tallest peaks, form a stunning panorama across the state, providing recreational and aesthetic resources, watershed values, wildlife habitat, and many other benefits to every resident. These forests contribute to our quality of life, enhance the unique character of our state, and help to attract a creative, diverse workforce that fuels our economic success. But an assessment of forest health reveals that Arizona's forests are in need of attention and improved stewardship. In addition, Arizona's population growth is among the fastest in the nation, with more people moving into forested areas where they face the risk of uncharacteristically severe wildfires. Drought, warming temperatures, and dense forest conditions increase the threat of destructive wildfires and require that we examine our approach to management and take bold action to restore forest health and protect forest values for future generations.

Our vision for Arizona's forests is clear and deceptively simple: healthy, diverse stands, supporting abundant populations of native plants and animals; thriving communities in attractive forested landscapes that pose little threat of destructive wildfire; and sustainable forest industries that strengthen local economies while conserving natural resources and aesthetic values. This vision unites Arizonans, but there is an emerging consensus that we are on the wrong track, and that many forests across the state are unhealthy and degraded, reducing their value and raising the risk of destructive and dangerous wildfire.

State, regional, and national agencies and organizations recognize the urgent need to improve the conditions of Southwestern forests, and have provided helpful guidance; but much more needs to be done. The next decade must be one of increased on-the-ground action, including the thinning of dense stands, increased use of prescribed and natural fire to achieve ecological and public safety objectives, and appropriate utilization of forest products to fuel the sustainable economic activity that will help make forest restoration affordable. Across the state, local groups are developing innovative approaches to forest restoration and fire management. However, coordination between over-arching policy and local, on-the-ground management has been inadequate. Despite broad agreement about the need for forest restoration, a practical strategy has not yet been clearly articulated in a policy-relevant form. Our Vision, therefore, extends beyond the restoration of forest health and includes a commitment to public involvement, coordinated government initiatives, and strategic planning to guide forest management in our rapidly changing state.

2 Purpose of the Statewide Strategy

The Statewide Strategy for Restoring Arizona's Forests focuses attention on the current condition of our forests and the steps required to restore their health and vigor. It describes approaches for achieving long-term ecosystem restoration, fire risk reduction around communities, natural fire management in wildlands, and the development of appropriate restoration-related economic opportunities. Based on sound ecological and social science, the Statewide Strategy incorporates valuable insights and techniques from the successful and innovative efforts already underway in Arizona. The primary purpose of the Statewide Strategy is to foster the implementation of a comprehensive, systematic effort to restore the ecological integrity of Arizona's forests and woodlands, while at the same time describing how rural communities can benefit from their aesthetic, ecological, and economic resources without compromising forest health and public safety.

The restoration of forests and woodlands, and the transition of rural economies and lifestyles to promote sustainable and safe communities, will not happen overnight. The Statewide Strategy is a twenty-year vision that draws on the innovative spirit and practical experiences of Arizonans across our state. The large and diverse team assembled to develop the Strategy agreed that success required an integrated approach that would:

- Use the best available science from ecological, economic, social, and political disciplines.
- Increase Arizona forests' resilience to stresses, including drought, unnatural fire, climate change, and insect outbreaks; and help forests respond to the ebb and flow of natural ecological processes without constant and costly intervention.
- Restore natural fire regimes, to the greatest extent possible, and prepare communities so that when fires do ignite, people respond in a manner that protects public safety and ecological values simultaneously.
- Encourage a diverse mix of community-supported wood utilization businesses, operating in a manner that can be sustained, ecologically and economically, over the long term.

The Statewide Strategy takes a science-based approach to the restoration challenge, while emphasizing that success depends on citizen leadership and participation in planning and implementation. It is important to honor local, collaborative approaches, while at the same time developing the capacity to address technical issues that require expert knowledge and the methods of science. In order to restore ecologically resilient forests and natural fire regimes, it will be necessary to employ strategic forest treatments—involving tree thinning, prescribed fire, and other measures—and to coordinate treatment strategies that span large areas and long time lines. These are controversial issues that spark intense debate and frequent disagreement. The Statewide Strategy strives to clarify the salient issues and focus our attention, so that important issues can be addressed openly and appropriate actions can be taken in a meaningful time frame. If Arizona is to reverse the decline in forest health and the upsurge of destructive wildfire, we must move confidently between strategic planning and on-the-ground actions, increasing effectiveness and efficiency as we move toward forest restoration goals.

In order to encourage this transition from problem identification and planning to appropriate action, the Statewide Strategy is grounded in several fundamental concepts that combine scientific insight and democratic principles:

1. Forests occur in more-or-less independent landscapes, of which there are a relatively small number across the state. While all forests share some key qualities, each landscape has unique characteristics, and informed stewardship requires attention to local conditions, both ecological and social. Forest restoration and management efforts must be coordinated at the landscape level, rather than implemented through hundreds of small, unrelated projects.
2. Analysis, assessment, and decision-making should be transparent, should involve a diverse cross-section of Arizonans in all phases, and must be carried out in a democratic framework, where ideas, values, and policy responses are openly debated.
3. The incorporation of science into forest policy and management must focus on the use of science to inform public debate, rather then transferring power from stakeholders to experts; ultimately, the fate of Arizona's forests depends on the long-term actions of landowners, communities, and public servants working together.

While the Statewide Strategy takes a community- and landscape-based approach, it is clear that there is a unique and essential role to be played by government. With limited funding for restoration and fuels reduction treatments, the development of sustainable forest enterprises that achieve restoration goals while helping offset costs is a pressing need. The Statewide Strategy sets a clear vision for the encouragement of appropriately-scaled industry, the coordination of a long-term, sustainable supply of small-diameter trees, and the development of new markets for products developed from small-diameter wood. But even with these accomplishments, greater federal investment will be needed.

Success depends on many coordinated actions inspired by our common vision and purpose. Specific steps for rapid progress are presented in Chapter 3, Key Strategies and Recommendations, which build on the Guiding Principles of the Governor's Forest Health Advisory Councils (2005), and related local, state, and regional efforts to articulate practical approaches to improved forest management. By calling on all citizens, and all levels of government, to work in a coordinated manner toward the pressing goal of forest restoration, this Statewide Strategy provides a roadmap to ensure that policy decisions and management actions affecting forested lands will be informed by the best available information and guided by the interests and needs of all Arizonans.

3 Key Strategies and Recommendations

Arizona's citizens have been working diligently for more than a decade to restore their forests, protect their communities, and manage fires appropriately across millions of acres of fire-prone forests and woodlands. In the process, stakeholders across the state have recognized the need to address several key strategic challenges as they continue working towards a future in which forest and woodland ecosystems exist within their natural range of variability, nearby human communities are adequately protected from high-intensity crown fire, and restoration-based economies are thriving. These strategic challenges center around five key requirements for progress:

1. *Increased capacity for collaborative, science-based restoration, fire management, and community protection across Arizona's forests.*
2. *Increased integration of restoration, fire management, and community protection planning and implementation at landscape scales.*
3. *Increased strategic efficiency of restoration, fire management, and community protection activities.*
4. *Increased support for ecologically sustainable forest-based economic activities.*
5. *Increased public awareness of the need and opportunities for, as well as progress towards achieving integrated restoration, fire management, and community protection goals.*

Description of Strategic Challenges

1. Increased capacity for collaborative, science-based restoration, fire management, and community protection.

Many of Arizona's citizens agree that forest restoration activities, and hazardous fuel reduction treatments intended to protect communities, should be proceeding at a faster pace and with greater effectiveness. Given the reality that a majority of Arizona's forests are National Forest lands, it is reasonable to assume that much of the responsibility for funding and implementing restoration and community protection activities lies with the federal government. However, state and local authorities, collaborating with local homeowners, also share significant responsibility for ensuring that effective restoration and hazardous fuel reduction occurs on state and private land. They are also responsible for consulting and coordinating with federal authorities on public lands forest management.

Collaboration among the many jurisdictions and stakeholders interested in community protection and forest restoration is difficult and time consuming. Yet, it is essential to building understanding and support for treatments, reducing controversy and litigation, and implementing high-quality treatments on the ground. In Arizona, collaborative efforts have provided valuable services to federal land management agencies. For example, the White Mountains Stewardship Contract Multiparty Monitoring Board plays an essential role in the implementation of the nationally significant White Mountain Stewardship Contract, and collaboration between the Greater Flagstaff Forest Partnership and Coconino National Forest has attracted several national awards. Furthermore, Arizona communities have led the nation in the development of Community Wildfire Protection Plans - collaborative planning projects encouraged as a part of the Healthy Forest Restoration Act.

Several factors hinder collaborative and science-based restoration, community protection, and fire management initiatives across the state. Understaffing and insufficient funding of on-the-ground treatments limit the pace at which forest management activities proceed at the federal level and, to a lesser but still significant degree, the state level. From an economic development standpoint, underdeveloped capacity to utilize byproducts of restoration and hazardous fuel treatments hinders progress (see Chapter 4 for additional description and recommendations). From a collaboration perspective, insufficient financial support for planning, combined with an inability to redirect funds to collaboratively defined priority areas, stifles support for, and the perceived benefits of, collaboration. If we are to make timely and effective progress in restoring forest ecosystems, protecting communities, and managing fires appropriately, these issues must be resolved.

Anticipating the effects of climate change on fire, insects, forest demography, and invasives species must be a central component of the response to maintain Arizona's forests in healthy condition. Because climate change has already been set in motion, the central principle must be to focus on maintaining the resilience and adaptability of Arizona's forests and woodlands. As regional climate moves outside of the recent historical range of variability, forest species and communities must be able to adapt in order to survive. To understand and manage these processes of resilience and adaptability, forest managers and scientists will need to develop new analytic and predictive tools. For example, geo-spatial modeling tools such as WALTER and ForestERA will be of increasing importance to predict where and when forest changes will occurin response to changes in climate, fire regimes, and other factors. In general, rapid climate change may shift the focus from a strict restoration strategy to one based more on adaptation to novel conditions and challenges.

Table 3.1. Recommendations and actions items for implementing the Statewide Strategy for Restoring Arizona's Forests.

Recommendations	Action Items
1.1. Congress should increase funding to federal and tribal land management agencies and the state to rebuild the capacity essential for collaboratively planning, implementing and monitoring restoration treatments.	1.1.1. Vegetation and fuel treatment funding should be increased to a minimum of $30 million/year for 3 years for the Forest Service; and $10 million/year for 3 years for Department of Interior agencies (BLM, NPS, BIA, and F&WS). Funding should increase by 15% per year for 20 years. 1.1.2. Funding for CWPP implementation should be increased to $5 million per year, and the dollars should be allocated to local communities through the State Forester. 1.1.3. Program funding should be provided to federal land management agencies to ensure adequate human resources are available to facilitate treatment action. This includes capacity for all facets of developing and applying treatments including: environmental review, contracting, community collaboration and implementation. 1.1.4. Funding should be provided to the U.S. Forest Service research stations in cooperation with universities, to convene land managers, organizations with applicable expertise and other stakeholders in identifying practical multi-scale monitoring approaches. 1.1.5. Congress should maintain funding to complete the White Mountain Stewardship Contract on the Apache Sitgreaves National Forest.
1.2. Congress should restore funding to enable communities, stakeholder groups and tribes to collaborate in the utilization and marketing of small-diameter wood and biomass.	1.2.1. Congress should revitalize the Economic Action Program or create a new source of funds dedicated to assisting local communities throughout the West in their efforts to develop utilization and marketing opportunities for small-diameter wood and biomass.

Recommendations	Action Items
1.3. Congress and the Arizona State Legislature should increase funding for developing and translating best available ecological, biophysical and social science into forms needed by land managers and stakeholders.	1.3.1. The Arizona State Legislature should provide financial support to universities and state agencies to conduct applied research, translate scientific information and serve as neutral conveners within collaborative processes. 1.3.2. Congress should fund applied biophysical, ecological, social science and economic research in universities, colleges, research stations, and other institutes with applicable expertise that informs and improves forest health and the vitality of rural communities.
1.4. The Arizona State Legislature should provide funding for restoration treatments, community protection, and fire management on non-federal lands.	1.4.1. The Arizona State Legislature should allocate $5 million per year to community protection activities identified in Community Wildfire Protection Plans (CWPPs). Activities to be supported would include completion of CWPPs and funding for community collaboration.

2. Increased integration of restoration, fire management, and community protection planning and implementation at landscape scales.

Given the current economic challenges constraining forest restoration, and the ecological complexity of our extensive, diverse, and dynamic forests across the state, we will only be able to thin and burn a portion of these forests over the next 20 years. Fire (sometimes intense and potentially dangerous) will continue to burn across portions of Arizona's forests. As such, we must prepare and plan for fire so that it burns in a manner that helps to meet restoration and community protection goals. We must also ensure that land-use policies support, rather than obstruct effective restoration, community protection, and fire management.

Planning for fire

Successful restoration, community protection, and fire management require the reintroduction and careful management of wildland fires. Fire is a keystone process in Arizona's forests, and reestablishing natural fire regimes where appropriate is an important step for their restoration and management. At the same time, wildfires may threaten important values, such as communities, infrastructure, and habitat for imperiled species. Entire landscapes should be classified and assigned spatially explicit fire management goals and objectives, in order to develop an ecologically sound, socially viable, and maximally efficient landscape-scale strategy for restoration and community protection. Implementation activities should be prioritized, sequenced, and coordinated within and between zones. Given the critical ecological, social, and economic roles played by fire across entire landscapes, collaborative science-based fire management planning should provide a starting point for all activities. Much as restoration provides a context for forest management across the state, fire management should also be considered a critical landscape-level factor guiding planning across the state.

The framework for fire planning rests in Federal Land Management and Fire Management plans. Because Fire Management Plans are updated annually for each National Forest, and because Arizona's National Forests are in the early phase of a periodic revision process, both planning venues are appropriate for addressing these issues in a timely manner.

Wildland Fire Implementation Plans will be of particular importance for safely managing wildland fire and restoring natural fire regimes. These plans, in coordination with Fire Management Plans, establish site- and condition-specific decision criteria for determining management responses to fire ignitions. Given the importance of such decisions and their inherent link to broader fire management and restoration objectives, developing plans in a science-based, collaborative context, and in a manner that complements other strategic planning goals, will be central to successful restoration and community protection.

Fire is inevitable in many forest types, and in these ecosystems it will occur either as undesirable wildfire, or as a tool for achieving and sustaining desired conditions. Our choice is not whether or not fire will occur, but where and how it occurs, and how we respond. Planning restoration and long-term fire management in the same spatial

and temporal contexts, and explicitly linking the corrective step of restoration with long-term fire management goals, will increase the likelihood that restoration will re-establish more natural fire regimes in ways that are both safe for communities and beneficial for ecosystems. Maximizing fire's benefits while reducing its costs remains a fundamental challenge facing Arizona's forests and communities, but the planning tools, collaboration and policy frameworks that will yield success are already in place.

Pursuing land use policies that support integrated restoration, community protection, and fire management

Because the character of some fire-adapted ecosystems and the fires they sustain has been altered during the past century, the inevitable effects of landscape-scale fires on widespread human development (current and future) is fundamentally challenging to society and to healthy ecosystems. Resolving or minimizing current and future conflicts between wildland fire and development will require new ways of thinking, new scientific and technical tools, and new ways of finding common ground and working together.

The front line on forest health issues in Arizona occurs in the Wildland-Urban Interface (WUI), where developed human communities and infrastructure interface with the natural environment. Managing the ongoing and active growth of the WUI emerges as a challenging policy goal, an expression of an important public interest, and the beginning of a path to sustainability in Arizona's forests. This does not mean that development should stop, but rather it must be done carefully, where it will not create new conflicts and hazards, so that wildfire risks and costs are minimized and forest sustainability is maximized. The State of Arizona should consider the social, environmental, and financial costs of continued uncontrolled development into fire-prone areas.

This consideration is important for reducing risk to lives and communities, and for preserving healthy, productive forests into the future. It will allow for the restoration and maintenance of appropriate fire as a keystone ecological process - critical for maintaining the health of fire-adapted ecosystems.

Recommendations	Action Items
2.1. Federal land management agencies should collaboratively develop and implement integrated landscape-scale restoration, community protection and fire management for forests across the state.	2.1.1. The U.S. Forest Service should support the collaborative planning and implementation of integrated restoration, community protection, and fire management strategies across the state within the Forest Plan revision process. 2.1.2. The U.S. Forest Service should develop, revise, and/or update annual Fire Management Plans using the best available science and in a transparent and collaborative fashion. 2.1.3. National forest plans should provide clear performance measures that allow the agency and public to evaluate progress towards meeting restoration, community protection, and fire management objectives.

Recommendations	Action Items
2.2. The Arizona State Legislature, county and local governments, tribal governments, and state agencies should develop land use policies and practices that support forest restoration, community protection, and fire management efforts.	2.2.1. Counties and local governments should classify undeveloped lands based on relative fire hazard. 2.2.2. The State Fire Marshall should adopt and enforce an Wildland Urban Interface Code to protect communities and property from wildfire. 2.2.3. Counties and local governments should adopt and enforce building and Wildland Urban Interface fire codes to minimize communities' exposure to fire danger. 2.2.4. Planners should work with developers to incorporate appropriate buffer zones, based on anticipated fire hazard, into the design of new developments to allow for maintaining conditions in adjacent forests where natural or prescribed fires may continue or be reintroduced. 2.2.5. The Arizona State Legislature should delegate authority to counties to manage development in the Wildland Urban Interface to enhance protection from wildfire, and to protect public safety. 2.2.6. The Arizona State Legislature, counties and local governments should develop incentives to encourage landowners to maintain defensible space. 2.2.7. The Arizona State Legislature should work with local governments to revise planning requirements under Growing Smarter legislation to deal with fire risk at the landscape scale. 2.2.8. The Arizona State Lands Department should develop long-term forest restoration and fire management plans for state lands.
2.3. All federal, state, tribal, and local governments should increase coordination of forest restoration, fire management, and community protection planning and implementation across jurisdictional boundaries.	2.3.1. The State Forester should work with the Arizona Interagency Wildland Fire Prevention Team or similar organization to improve coordination between all agencies and tribes on treatment implementation as well as fire preparedness. 2.3.2. The State of Arizona should provide adequate financial support to Arizona Fire Map. This tool provides the foundation for sharing treatment information across jurisdiction boundaries. 2.3.3. Federal land management agencies, counties and local governments should provide treatment data to update the Arizona Fire Map. 2.3.4. The federal land management agencies should actively collaborate with the state, local governments and the tribes to revise Forest Plans. 2.3.5. Federal land management agencies should prioritize treatments to protect important infrastructure, e.g., telecommunication installations, power lines, and transportation corridors.
2.4. The federal land management agencies, counties and local governments should use Community Wildfire Protection Plans to inform and prioritize treatments in their jurisdiction.	2.4.1. Local governments in communities at risk should complete Community Wildfire Protection Plans. 2.4.2. Federal agencies and national forest plans should place a priority on implementing projects identified within CWPPs.
2.5. State and federal land managers should design forest management practices to integrate wildlife habitat and biodiversity conservation protection with community protection, restoration, and fire management.	2.5.1 The Arizona Game and Fish Department should work with the Arizona Forest Health Council, federal agencies, and other stakeholders with applicable expertise to collaboratively develop a set of principles and strategies for integrating wildlife habitat and biodiversity conservation with restoration, community protection, and fire management. This should include educating the public about these strategies.

3. Increased strategic efficiency of restoration, fire management, and community protection activities.

Arizona's forest health challenges are great, and the costs to society of inappropriate or insufficient action are significant. The suppression of wildfires across the state cost $168 million in 2006, and will likely continue to rise in the face of increasingly large, unnaturally severe fires. In the broadest sense, shifting from reactive modes of forest and fire management to pro-active restoration, fire management, and community protection is at once ecologically appropriate and fiscally responsible (see Key Strategy #1, above, for further description of overall capacity needs and recommendations).

Beyond recognizing the need to shift from a reactive to proactive mode of forest and fire management, we must be as efficient as possible in allocating current funds and human resources. Even under significantly increased budget scenarios, selective thinning and burning treatments will likely occur across only a limited portion of Arizona's forests during the next twenty years, due to high cost and limited capacity. To meaningfully address restoration, fire, and community protection simultaneously, we must identify strategies for maximizing the effectiveness and efficiency of limited forest management resources. Here we offer four promising management approaches worth serious consideration.

Strategically prioritize restoration, fire management, and community protection activities at the landscape-level.

Watersheds span tens of thousands of contiguous acres in forests across the state and their integrity is essential for healthy ecosystems and human communities. Important wildlife habitat areas and movement corridors occur at similarly broad scales. Human communities and the ever-expanding WUI zone surrounding them extend across hundreds of thousands of acres in forests across the state, and unnaturally severe fires are now occurring at similar scales, sometimes burning hundreds of thousands of acres in a single fire event.

Even with a significant augmentation of resources and an increase in the number of projects aimed at reducing fire hazards, large and intense fires will almost certainly occur during the coming decades. We must prepare for these events by prioritizing and sequencing our forest and fire management efforts according to an integrated strategy that will maximize the value of every dollar spent. Such prioritization can and should occur at multiple levels—from the community level to the regional level. It is especially critical, however, to prioritize and sequence our efforts at and above the scale at which fires are likely to burn.

Arizona's citizens have participated in and supported several landscape-scale prioritization efforts over the past decade. Stakeholders with a variety of interests and perspectives have worked together to develop Community Wildfire Protection Plans (CWPPS), "Adaptive Landscape Assessments" in the Western Mogollon Plateau and White Mountains landscapes, and climate-linked adaptive management scenarios in the Sky Islands of southern Arizona.

These collaborative, science-based landscape assessments have demonstrated that it is quite possible to engage informed and interested citizens in strategic planning that can chart a practical course for forest management over the coming decades. Land managers and stakeholders should support, expand, and value recommendations from these efforts whenever and wherever possible.

Strategically place treatments to reduce the threat of landscape-scale fire events.

As described above, collaborative, science-based landscape assessments can be invaluable tools for identifying high-priority areas requiring fuel reduction or restoration treatments. The actual treatment and maintenance of these areas, however, will require significant increases in funding and human resources. Because this expansion of effort will take time, we need to determine and pursue realistic objectives across remaining lands. One reasonable goal for these areas might be to break up landscape-scale fuel continuity, so that overall fire spread rate is slowed, fire effects are diminished, fire size is reduced, and containment capacity is increased.

A number of potentially viable strategies have been proposed for breaking up fuel continuity across landscapes prone to uncharacteristic wildfire. For example, Dr. Mark Finney and colleagues at the U.S. Forest Service Fire Sciences Lab in Missoula, MT, suggest that thinning treatments can be designed to intercept and slow fires. By strategically locating many, relatively small treatments across the landscape, fire spread rates might be reduced, making it possible for natural precipitation events or modest suppression efforts to extinguish undesirable blazes (Figure 3.1.).

Alternative strategies for the strategic placement of forest treatments, such as developing containment boundaries along selected existing roads to create fuel breaks and allow firefighters greater access for initial

attack and control activities, should be evaluated and implemented as appropriate - especially in areas upwind (and in the fire path) of communities and other high-priority features in fire-prone landscapes.

Employ prescribed fire and Wildland Fire Use as restoration and fire management tools.

As mentioned above, restoration-based selective thinning plus burning treatments have been shown to be appropriate and needed in many of the state's fire-adapted forests, but application of these techniques is likely to be constrained due to high treatment costs and concerns about potentially negative ecological "side-effects" of logging, such as soil erosion, spread of invasive species, and disturbance of wildlife species sensitive to logging operations.

Recognizing this, the U.S. Forest Service has been attempting to restore fire to unthinned forests with lower-intensity prescribed burning during cooler, moister seasons. Additionally, fire managers have allowed some naturally-ignited wildland fires to burn when conditions permit. Although WFU fires are inherently risky during windy, warm conditions typical of the late spring and summer months, when fires typically burned prior to the disruption of natural fire regimes across the region, cautious application of this tool under appropriate conditions may allow forest managers to restore vastly larger areas than would otherwise be possible.

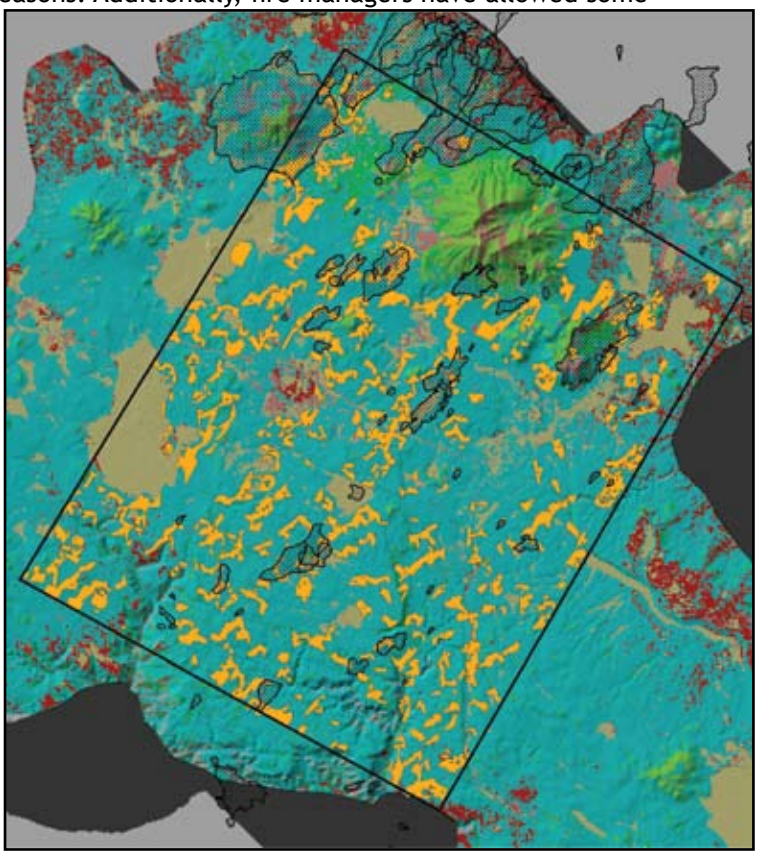


Figure 3.1. Researchers at the Fire Sciences Lab, working with Forest Ecosystem Restoration Analysis staff at Northern Arizona, developed one potential configuration of selective thinning and burning treatments that could be effective in slowing fire spread to the southwest of Flagstaff. Black stippled areas in the map above represent historic burn areas, while orange areas represent potential treatment areas. Using a fire simulation model, researchers found that treatments covering about 20% of the study area (as shown here) might significantly slow landscape-scale fires in the area.

The most effective and viable long-term strategy for restoring ponderosa pine forests will likely entail a careful and strategic sequencing of thinning and prescribed burning in areas of highest value and risk; strategically placed treatments to slow potential fires across remaining portions of the landscape; and careful application of prescribed burning and WFU fires. In combination, these treatments can effectively minimize the likelihood of very large fires, provide protection for communities and critically important wildlife habitats, and re-start fire-adapted forests on a restoration trajectory. As recommended in the section, above, land managers should complete and implement Fire Management Plans as promptly as possible to ensure that prescribed burning and Wildland Fire Use are integrated with complementary treatment approaches, so that they can be used as management tools to achieve maximum effectiveness, efficiency, and safety.

Employ adaptive management to continually refine management approaches and increase strategic efficiency.

While a great deal is known about the root causes of the decline in forest health – as well as the need for restoration, fire management, and community protection – uncertainty exists regarding the best strategies for managing fire at a landscape scale. To account for this uncertainty and to ensure that our management approaches are continually refined, we must employ an adaptive management process that includes monitoring and the adjustment of priorities and strategies, as deemed necessary by the scientific interpretation of monitoring data. As with the landscape assessment process described above, adaptive management can and should occur at multiple levels, from the project level to the regional level. Adaptive management is likely to be particularly valuable when applied at the scale at which fires are, and are likely to continue burning – across areas of tens to hundreds of thousands of acres.

Employ new tools for forest assessment and planning

Despite our general understanding of the forest health challenge and the need for action, guiding efficient and effective restoration projects is difficult. Much of what we know about forest ecology is derived from relatively small experiments and short-term observations, yet the answers to our most pressing questions require thinking at scales that encompass very large areas and long time lines. Furthermore, traditional scientific approaches often fail to address the social and economic issues that can control on-the-ground implementation of well-intended plans.

During recent years, scientific and technological advances have enabled rapid advances in the tools available for uniting approaches from the natural and social sciences in landscape assessments, forest planning, and the monitoring of restoration efforts. Three examples from Arizona illustrate the power of these approaches.

The Wildfire Alternatives (WALTER) project, initially focusing on lands in southern Arizona, helps guide fire management by using map-based information detailing forest conditions, combined with spatial data depicting temporal data on climatic conditions, to prioritize areas facing high fire risk. WALTER includes a stakeholder ranking tool that allows diverse participants to identify priorities in a rapid voting procedure that is electronically integrated with digital information in a Geographic Information System (GIS). Outputs can help forest managers track fire risk and identify high priorities for fire management activities, based on seasonal climate trends and high-value resources.

The Forest Ecosystem Restoration Analysis (ForestERA) Project uses similar GIS technology to integrate information on forest composition and structure, fire, wildlife habitat, and watershed conditions across landscapes comprising millions of acres. Applied across large areas of Arizona and New Mexico, ForestERA develops high resolution spatial data and the modeling tools needed to support stakeholder-driven workshops, where citizens work with forest managers, scientists, elected officials and other interest groups to identify priority areas for forest restoration, develop locally appropriate management scenarios, and compare the likely effects of different scenarios on issues of particular importance, such as fire threat, sensitive wildlife, and water supplies.

A third example is the Southwest Forest Assessment Project (SWFAP), a cost-share agreement between Region 3 of the U.S. Forest Service and The Nature Conservancy. The main goal of the project is to synthesize the best available science and develop tools to assist the Forest Service in revising management plans for the National Forests. SWFAP includes data bases on historic conditions, current forest conditions, biodiversity, and employs models of vegetative change designed to address improve dialogue with the public about the need for change and options for achieving desired forest conditions over large areas.

No set of scientific assessment and planning tools can solve Arizona's forest health challenges, but they can make it easier for Arizona's diverse population to come together and work efficiently toward solutions that will work on the ground, and that have everyone's support. Without an integrated, science-based approach that honors diverse values and perspectives, ecological restoration will be very difficult to achieve. Landscape assessment tools are an important part of the Statewide Strategy, delivering the "big picture" perspective that has been lacking in many previous approaches to forest management.

Recommendations	Action Items
3.1. Federal and state land management agencies should collaboratively and strategically place treatments in order to increase efficiency and maximize benefits.	3.1.1. Federal land management agencies should develop short-term (2-5 year) and longer-term (10-20 year) treatment plans based on priorities developed at the landscape scale. 3.1.2. State land management agencies should develop restoration, fire management, and community protection performance standards that measure progress toward objectives and can lead to refinement of strategies as necessary. 3.1.3. Federal land management agencies should complete and implement plans for using prescribed fire and Wildland Fire Use where and when appropriate. 3.1.4. Federal land management agencies should initiate treatments where a collaborative process has preliminarily identified and prioritized landscape attributes at risk. 3.1.5. A national forest in Arizona should take a landscape-scale approach that systematically evaluates existing ecological conditions, then identifies, applies and monitors the effectiveness of strategically placed treatments that in theory should modify extreme fire behavior and reduce the probability of large, unnaturally severe wildfires. 3.1.6. Federal and state authorities should work collaboratively with stakeholders to identify and develop restoration and fire management strategies for watersheds of critical importance across the state. 3.1.7. The state should ensure that all state-identified communities at risk have completed a Community Wildfire Protection Plan or its equivalent.

4. Support ecologically sustainable forest-based economic activities

Many community forestry advocates believe that a sustainable forest economy that uses the by-products of restoration treatments can create jobs and support local economies while assisting the complementary goals of community protection and forest restoration. They reason that thriving forest and wood-products enterprises will pay for harvested material (saw logs, small-diameter trees, and woody biomass) and that this will help offset some of the costs of restoration, allowing restoration to move forward, more rapidly, over larger areas. In addition, new, sustainable forest businesses will help Arizona realize economic benefit from forest restoration products, rather than paying for dead tree removal and disposal.

Developing these forest and wood-product enterprises requires creative and cooperative efforts in order to derive profit from the marginal saw logs, small-diameter trees, and woody biomass harvested through restoration treatments. For example, more efficient ways of harvesting, transporting, and processing are needed in order to make these enterprises economically viable. Forest and wood-product enterprises need to develop value-added products based on emerging technologies, while cultivating new markets for these products. All of these efforts face barriers, such as access to capital, an antiquated forest industry infrastructure, an inadequate labor force, and underdeveloped markets for value-added wood products.

The State of Arizona and the federal government have taken important initial steps to encourage a forest and wood product economic sector. The state has established tax incentives and raised renewable energy standards for utilities, while the federal government has made grants available for biomass and infrastructure improvements. Entities such as the Southwest Sustainable Forests Partnership, Northern Arizona Wood Products Association, Prescott Area Wildland Urban Interface Commission, and Greater Flagstaff Forests Partnership provide resources and grant opportunities to support emerging businesses.

Significant challenges remain, but private citizens, non-governmental organizations, the business community, and government agencies—working together—have the power to establish thriving forest utilization businesses that advance local economies and help to accomplish forest restoration and community protection.

Recommendations	Action Items
4.1. Land managers should work with stakeholders to clarify the amount, availability, and location of wood and biomass generated through restoration, community protection, and fire management across the region.	4.1.1. The U.S. Forest Service and other land management agencies should fund and participate in a collaborative and objective evaluation of the amount and characteristics of the wood and biomass available for utilization across Arizona. 4.1.2. Local units of government should ensure that wood utilization opportunities and challenges are clearly identified in CWPPs.
4.2. Federal, state, and local units of government should identify and enhance opportunities for utilizing small-diameter wood and biomass generated from forest treatments.	4.2.1. The Forest Products Lab of the U.S. Forest Service, the U.S. Department of Energy, and the U.S. Department of Agriculture should conduct studies to identify utilization and marketing opportunities for products created from pinyon-juniper as well as ponderosa pine. 4.2.2. Arizona state agencies should use treatment-generated material whenever and wherever possible. Specifically, the State of Arizona should actively apply Arizona Executive Order 2005-05, which calls for all new state-funded buildings to derive their energy from renewable sources, such as woody biomass. 4.2.3. State agencies should encourage retrofitting of existing heating systems in public and private buildings to promote greater use of wood biomass. 4.2.4. The Arizona State Legislature should work with the Arizona Department of Commerce to identify incentive programs that encourage the use of restoration-generated materials by businesses across the state. 4.2.5. The Arizona Department of Transportation should use restoration treatment by-products generated in Arizona for guard rails and other transportation and other highway maintenance applications.
4.3. All levels of government should work together to support wood products industries capable of utilizing small diameter wood and biomass.	4.3.1. The Forest Service should continue to use, and other land management agencies should initiate, best-value contracts and other tools that ensure continuous wood flow, where such contracts support collaborative and science-based forest management, and promote economic and social stability in rural communities. 4.3.2. The Arizona State Legislature should fund a position that is designed to help rural communities convene, recruit, and support forest and wood-products enterprises. This position will reside in either the State Forester's Office or the Department of Commerce. 4.3.3. Local governments should develop and use policies, planning, and tax incentives to encourage businesses that will diversify the economy, are appropriately scaled to the amount of material available from the forest, and keep jobs and dollars in rural Arizona. 4.3.4. Congress and the Arizona State Legislature should fund recruitment and training programs for forest and wood-products workers in cooperation with forest and wood-products employers and educational institutions.

5. Increased public awareness of the need and opportunities for integrating restoration, fire management, and community protection goals

Although public support for restoration, fire management, and community protection remains high, transforming that support into action on a personal level requires that we continue to: 1) inform the general public about the need to treat hazardous fuels around homes; 2) build accountability at all levels of government by disseminating to the public information about progress made in addressing restoration, fire management, and community protection objectives; and 3) engage community members in collaborative discussions regarding forest management, both around communities and in wildlands.

The public must be well-informed and motivated to take action to reduce the risk of fire to private property and homes. Citizen involvement is a critical element of any comprehensive strategy to reduce the risk of fires to communities. Effective outreach employs a myriad of communication tools and multiple media approaches. Success requires full-time dedication to this effort, at the local, state, and federal levels.

Beyond the ever-present need to build awareness regarding forest health and restoration, it is important to provide a yearly accounting of progress - a "report card" of sorts. In the face of inevitable fires that will inevitably occur, such a report will reassure stakeholders and help the public understand the long-term nature of forest restoration efforts, and appreciate our continual progress towards meeting a clear set of objectives. The Western Governors' Association has developed a series of metrics for measuring progress in implementation the organization's "10-Year Strategy". These metrics relate to collaborative, science-based initiatives for fire prevention, hazardous fuels reduction, ecological restoration, post-fire recovery of fire-adapted ecosystems, and community assistance; as such, they constitute a helpful starting point for developing a reporting process for Arizona's Statewide Strategy.

By continuing to build awareness about forest restoration, fire management, and community protection needs, and by measuring progress across the state, the Statewide Strategy will build citizen interest in collaborative planning at the local, state, and regional levels. By actively engaging citizens, Arizona's capacity for addressing long-term, crux forest management challenges will increase substantively over the coming decades.

Recommendations	Action Items
5.1. The Arizona State Legislature should fund public education, and work with the State Forester and local governments to educate the public about restoration, sustainable forest and wood products businesses, fire management, and community protection needs and responsibilities.	5.1.1. County, local and tribal governments should create and/or promote education programs to help residents of forest communities understand the risks inherent in living in fire-prone areas, and to educate developers and the community about steps that can be undertaken to reduce exposure to fire hazard and to improve forest health. Much has been done already under the FIREWISE, USA program. 5.1.2. The Arizona State Legislature should fund an education coordinator position under the State Forester to coordinate and promote public education about forest restoration, sustainable forest and wood products businesses, fire management, and community fire protection needs and responsibilities.
5.2. Citizens should take actions to protect their communities and properties from fire.	5.2.1. Citizens should seek assistance from their local fire district, fire department, homeowners association or visit http://www.firewise.org/usa/ to learn what they can do to protect their home and property.
5.3. The Governor's Forest Health Council, working closely with the State Forester, the U.S. Forest Service and other federal agencies, should develop and administer an annual "Forest Health Scorecard" based in part upon the Western Governor's Association's 10-Year Strategy Implementation Plan.	5.3.1. In 2007 the Forest Health Councils should develop a scorecard based on the 20-Year Strategy to measure progress.

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Part Two

4. The State of Arizona's Forests
5. The Policy Context for Restoration
6. Economic Considerations for Restoring Forest Health
7. A Collaborative Foundation for the Statewide Strategy

4 The State of Arizona's Forests

"We came to a glorious forest of lofty pines, through which we have traveled ten miles. The country was beautifully undulating...every foot being covered with the finest grass, and beautiful broad grassy vales extending in every direction. The forest was perfectly open and unencumbered with brush wood, so that the traveling was excellent."

-E.F. Beale expedition, 1858

Arizona's pine forests bear little resemblance to those described by Beale in 1858. A century of fire-suppression, grazing and logging have eliminated the frequent surface fire regime that naturally thinned ponderosa pine forests. Now, many of these forests are choked with small trees that not only crowd out grasses and other understory plants, but supply the dense fuels that help fire spread into the crowns of the tallest trees. Climate data indicate that Arizona is in the midst of a pronounced drought, and most scientific analyses predict that dry conditions will continue for years to come, particularly if global climate change results in increased regional variability in rainfall and temperatures. The convergence of these factors leaves many of Arizona's forests stressed and vulnerable to rapid ecological changes due to insect and disease outbreaks, inappropriate land uses, and increasingly widespread and destructive wildfire.

Despite these changes and their negative consequences, we have many opportunities for action that can address emerging problems and return our forests to healthier, more resilient conditions. Unlike many ecosystems across North America, Arizona's forests are largely intact. While forest structure and, in particular, fire regimes are outside the natural range of variability, native species still predominate, sustaining the biological foundation necessary for successful restoration. More than a century of scientific investigation has provided us with much of the knowledge necessary to guide improved management of forest ecosystems. Most importantly, Arizona citizens and policy makers are committed to action, guided by the knowledge that investments in forest restoration will help to protect our communities, foster appropriate new forest-based businesses, and revitalize the economy and quality of life in rural Arizona.

Forest condition

Forestry professionals, scientists, land managers, and the public widely agree that most of Arizona's pine and mixed-conifer forests reflect the combined effects of a century of logging, livestock grazing, and fire suppression. The density of trees is now substantially greater, the size of trees much smaller, and the forest canopies more continuous across much larger areas. Large, mature "old growth" trees are significantly underrepresented across the state, and the remaining large, old trees are dying at a far greater rate than they are being replaced. According to U.S. Forest Service analysis, only 5% of the original old growth ponderosa pine forest remains in the Southwest.

Related to this fundamental change in forest structure is the decline in the diversity and abundance of forest understory plants, including native grasses, wildflowers, and shrubs. Less well understood are changes in the abundance and distribution of many wildlife species that were associated with the more open forests noted by many nineteenth century pioneers.

Arizona's pine forests evolved over thousands of years with recurrent ground fire, ignited either by lightning or as part of indigenous land management practices. Fires typically spread through understory grasses and shrubs, seldom climbing into the forest canopy. Fire served many beneficial functions, including the thinning of dense thickets of tree seedlings and saplings that often establish following a string of wetter-than-average years. Fire also kept the forest understory productive by consuming fallen needles and other fuels that can blanket the forest floor, and by opening up the forest so that light and moisture can reach the diverse plant community below. Although people frequently focus on the trees, the understory plants are the key producers that support the complex food webs that sustain wildlife and forest biodiversity.

Beginning in the 1860s, heavy livestock grazing reduced the extent of groundcover and fine fuels that enabled fires to spread. This activity, combined with fire suppression policies established in the early twentieth century, virtually eliminated natural fire regimes in Arizona's forests. This combination of factors led to widespread establishment of young pines in dense stands, and the concomitant decline in understory plants and the food webs they previously supported. Wildlife habitat suffered in many places as a result. Tree vigor declined due to drought and competition for nutrients and water among densely packed trees, lowering their resistance to disease and insects. Recent events, such as the 2002-2003 bark beetle eruption that killed mature trees over tens of thousands of acres, have exceeded previously recorded disturbances of this kind. Fire also played an important role in maintaining a shifting mosaic of forest types, such as the mix of conifer and aspen in alpine forests, and the mixture of pine-oak and pinyon-juniper at lower elevations. Our disappearing aspen forests and the spread of juniper across previously open grasslands are broad ecological changes that are likely linked to these twentieth century changes in land use and forest management.

An overwhelming majority of scientists now agree that we have entered a period of global climate change, and numerous studies predict dramatic changes in the distribution of plant and animal species as they respond to warming conditions. Most climate models suggest that the Southwest will experience higher temperatures and increased variability in precipitation, which will significantly affect fire regimes and forest health. Recent studies indicate that climate change effects on ecosystems in the western United States and Arizona may already have begun. For example, researchers have demonstrated that the recent increase in numbers of large forest fires in the western United States, including Arizona, is correlated with warming temperatures and earlier arrival of spring. Other studies suggest that the recent bark beetle-induced die-off of pinyon and ponderosa pine trees throughout the Southwest is probably more extensive and severe than previous die-offs as a consequence of unusually warm conditions during the current drought. While climate has always been variable over time, the extreme rapidity with which climate is changing now appears to be unprecedented during the last several thousand years. Rapid climate change creates cascading effects of tree mortality, increased catastrophic disturbance, and shifting zones of suitable habitat that could alter Arizona's forest landscapes dramatically.

The social context

Most of Arizona's forests are on public land managed by the federal government, or on private land managed by Arizona Indian tribes, with the remainder a complex mosaic of private property and lands administered by the state and other governmental entities. Forty-two percent of forest land in the state is administered by the USDA Forest Service (USFS), while 31% is Indian Trust lands and only 10% is private. Seven percent is administered by the Bureau of Land Management (BLM), 6% is state owned, and the remaining 4% is comprised of other public lands.

Forest management in Arizona, and throughout the country, has often been marked by social and political conflict, including litigation and appeals, about issues such as timber harvesting, endangered species protection, and fire management. However, opinion polls reveal that the public is deeply concerned about declining forest health and strongly supports aggressive action to restore forest ecosystems. While efforts to improve forest health and the safety of nearby communities will continue to generate controversy at times, most Arizonans agree on the overall goals. Reflecting this widespread agreement, stakeholders in forested areas across the state are working together to simultaneously improve the ecological, social, and economic health of local forests and communities. Many of these collaborative groups have developed Community Wildfire Protection Plans (CWPPs). To date, 12 CWPPs have been completed, covering 73 communities currently deemed to be "at risk" of possible wildfire. Several additional CWPPs are being developed (Figure 2.1). The extent of CWPP development across the state indicates how effectively Arizonans have come together since our forest health crisis was first widely recognized. In addition, a number of standing collaborative forest health groups, such as the Natural Resource Working Group of the White Mountains, the Pinaleño Partnership in Graham County, the Greater Flagstaff Forests Partnership, and the Prescott

Area Wildland-Urban Interface Commission have provided statewide leadership on broader issues related to forest health.

Ecological restoration

While Arizona's forests vary tremendously by geographic region, elevation, and local condition, one characteristic is common to all forests across the state: present day conditions diverge significantly from those that predominated prior to the arrival of European Americans in Arizona. Current conditions are not conducive to simply reinstating the historical fire regimes that maintained forest health in the past. Reintroduction of natural fire into the landscape will be difficult at best, and is likely impossible in some areas. In many locations, forest thinning is a necessary first step toward ecological restoration, while in other areas prescribed fire and Wildland Fire Use (allowing naturally ignited wildfires to burn for specific management purposes) can be used with appropriate caution, when and where conditions are favorable. These and other techniques, including the control of invasive plant species, reseeding of the forest understory, closing of unnecessary roads, and installation of erosion control structures, can be applied in a comprehensive approach to ecological restoration.

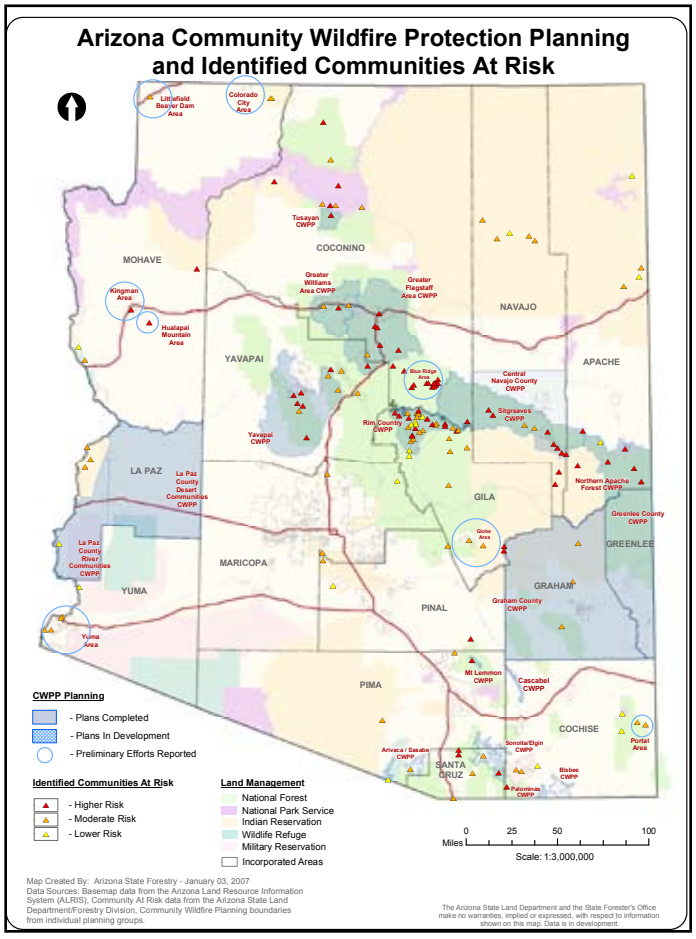

Figure 4.1. Arizona CWPPs: completed and in progress.

Just as Arizona's forests vary, so do public values in Arizona communities. Not only will the priorities and objectives for restoration-based forest management vary with forest type, they must also take into account public values. For example, rare, endangered, and endemic species are a major concern in the sky islands of southeastern Arizona, while concern about fuel loads and fire issues in the wildland-urban interface predominate in the central highlands. Restoration of ponderosa pine ecosystems is a primary concern across the Mogollon Plateau, while protection of old growth forests is a focus on the Kaibab Plateau. Because of variation in ecological, social, and economic factors, implementation of a Statewide Strategy requires different approaches in distinct landscapes.

Forest restoration and sustainable management require political will and the commitment of financial and human resources to bring about broad changes in the way we approach forest issues, including fire management, wildlife conservation, and the safety of forest communities. A strategic, cohesive solution to Arizona's forest health problem must link three emerging themes in forest management:

Landscape assessment - Locally-driven, science-based landscape assessments can depict current conditions across meaningful management areas, reveal values shared among diverse stakeholders, and explore management alternatives.

Strategic treatments - Not all forests need the same treatment, and not every acre needs to be treated. Forest restoration plans must be site-specific and tailored to local needs in a manner that maximizes their effectiveness.

Increased efficiency - Economic utilization of small-diameter trees can offset the cost of restoration treatments. As forest restoration activity spreads over larger areas, economies of scale will increase the attractiveness of opportunities for new, sustainable industries in Arizona. Entrepreneurial innovation will play a major role in increasing the efficiency of forest restoration efforts across the state.

Locally-driven, science-based forest restoration can serve as the foundation for protecting communities, improving wildlife habitat, supporting rural economies, conserving watersheds, and replenishing lost biological diversity across the state. This does not mean that restoration must occur everywhere, immediately, but it does suggest that community protection and forest management must be embedded within broader landscape-scale restoration initiatives, and that restoration, community protection, and economic activity can and should support one another.

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5 The Policy Context for Restoration

State, regional, and federal policies influence restoration, community protection, and fire management in Arizona. These policies provide some of the guidance necessary to improve forest health and the socio-economic health of the human communities that depend on forests. These policies include federal executive-level policies, such as the Healthy Forests Initiative; Congressionally-approved laws such as the Healthy Forests Restoration Act and Tribal Forest Protection Act; and collaboratively-developed strategies such as the Western Governors' Association's 10-year Plan and Implementation Strategy.

Many of the state and federal policies described below acknowledge the important role that ecological restoration plays in reversing declines in forest health and reducing unnaturally severe fires. They provide guidance for the collaborative development of forest treatment plans to protect structures, watersheds, and human lives from wildfire. They also highlight the need for developing wood products businesses whose activities might advance community protection, restoration, and fire management initiatives.

Tribal and federal policies, programs, and authorities affirm tribal sovereignty and guide wildfire protection and forest restoration efforts on tribal lands. Arizona is home to 21 federally recognized tribal entities. Tribes are sovereign nations as recognized through the US Constitution, hundreds of treaties and agreements, and federal legislation and case law. The Bureau of Indian Affairs (BIA) primarily carries out the federal government's trust responsibility to tribes. However, other federal agencies are required through executive orders and other federal legislation and authorities to work government-to-government with tribes.

We recognize that some forest management policies are controversial, especially at the federal level, but it is not our intent to debate these controversies here. Instead, we examine these policies in order to interpret the latitude they may provide the State of Arizona for implementing the recommendations contained throughout this document. The following section provides a short overview of important state, regional, and federal policies, and a brief description of their role in guiding future forest management activities across the state.

Arizona

Beginning with Governor Hull's administration, citizen stakeholders have assembled in advisory groups to help identify and promote the state actions required to restore forests. In 2003, Governor Janet Napolitano created the Forest Health Advisory Council and the Forest Health Oversight Council to develop scientific guidelines and policy recommendations, respectively, for her administration.

The first major action of the Arizona Forest Health Advisory Council was to develop a set of guiding principles that provide a framework for planning and implementing forest ecosystem restoration and community protection. The Guiding Principles (Table 5.1) represent a significant zone of agreement between stakeholders across the political spectrum and across the state, and they provide the foundation for recommendations presented in the Statewide Strategy.

Numerous policies at regional to national levels provide broad guidance for proceeding with forest restoration, community protection, and fire management in Arizona. The following section provides a short overview of these programs and a brief description of their role in guiding future forest management activities across the state.

Major Federal, Regional and State Policy Themes

Forest Restoration

The Arizona Forest Health Advisory Council's "Guiding Principles" document focused forest management issues around the unifying objective of restoring forest ecosystems, just as forest restoration gained increased prominence through a host of forest policies developed during the past decade at regional and national levels. The Healthy Forests Restoration Act (HFRA) (see Table 5.2) describes the need to reduce the risk of high intensity crown fires to through forest fuels reduction and restoration treatments. Under this law, treatments are intended to contribute towards the restoration forest structure to approximate conditions that prevailed prior to aggressive fire suppression in the Southwest. HFRA also includes language intended to protect old-growth forests and the retention of large, old trees. Administrative changes under the Healthy Forests Initiative (HFI) exempt some of

Table 5.1.

Arizona Forest Health Advisory Council's

Guiding Principles for Forest Ecosystem Restoration and Community Protection

Integration
1. The overall strategy for restoring forest ecosystem health and protecting communities must be dynamic, comprehensive and integrated.
Sustainable Communities and Economies
2. Sustainable economies are linked to sustainable ecosystems.
3. The immediate focus should be on protecting human communities at risk, critical infrastructure, along with key watersheds and habitats.
4. Close collaboration among all stakeholders is essential to a community-based approach to forest ecosystem restoration and community protection.
5. Decision-making about forest ecosystem restoration and community protection must occur with a serious commitment to rigorous adaptive management.
Ecological Integrity
6. Appropriate restoration methods are based on ecological need.
7. Effective forest ecosystem restoration should reestablish fully functioning ecosystems.
8. Forest ecosystem restoration and community protection treatments should protect and enhance water and soil resources.
9. Forest ecosystem restoration should protect and promote development of old-growth trees and large trees needed to restore ecosystem structure and function.
10. Landscape scale forest ecosystem restoration should maintain native plant and wildlife populations and habitat features.
11. Project work should be based upon landscape assessments of risks to and status of aquatic and terrestrial resources and of the potential for restoration to be successful.
Land Use and Planning
12. Forest ecosystem restoration must include evaluating and changing public land use practices that are scientifically demonstrated to contribute to forest health degradation.
13. Forest ecosystem problems and solutions exist in a context of land use.
14. Forest ecosystem restoration requires effective community protection to establish and maintain a fire-resistive condition for structures, improvements and vegetation.
Funding and Compliance
15. Forest ecosystem restoration and community protection requires a sustained investment of federal, tribal, state, local and private resources.
16. Forest ecosystem restoration and community protection actions should comply with all applicable environmental laws and regulations.
Practices
17. Forest ecosystem restoration and community protection programs should use the lowest impact techniques that will be effective and efficient.
18. All forest ecosystem restoration and community protection treatments should use locally adapted native plant materials to the greatest extent possible.

the management actions needed to achieve this goal from environmental review and administrative appeal. The Western Governors Association's (WGA) 10-year Comprehensive Strategy and Implementation Plan articulates actions, assigns tasks, and describes measures needed to meet the regional goal of "restoration of fire-adapted ecosystems." This Statewide Strategy, in turn, incorporates ecological restoration of Arizona's forests as a guiding principle, and outlines strategies for implementing restoration actions at effective scales.

Community protection of both public and non-public resources

The Arizona Forest Health Advisory Council's "Guiding Principles" identify community protection as a principal objective of forest management. Community protection is also recognized within policy documents, including the WGA's 10-year Implementation Strategy and many of the policies outlined in Table 4.1. Both HFRA and HFI provide incentives and guidance for forest treatments in the wildland urban interface (WUI), and both emphasize collaboratively-developed wildfire protection planning by local entities. In particular, HFRA provides guidance and incentives (in the form of prioritized funding and mandated consideration within NEPA analyses) for communities to collaboratively develop Community Wildfire Protection Plans. The Statewide Strategy recognizes the important work done by local communities and tribal entities, and suggests mechanisms for continuing that work as rapidly and effectively as possible.

For non-public tribal land resources, the Tribal Forests Protection Act (TFPA) encourages the USFS and BLM to enter into contracts with tribes, whose trust lands border or adjoin federal lands, to coordinate forest management activities and protect tribal resources from fire, insect outbreaks, or other threats. This act complements HFRA legislation in that it provides a mechanism for planning and implementing forest management treatments across jurisdictional boundaries, without infringing upon tribal self-determination and governance.

A variety of forest and fire policies influence disaster planning and fire and natural resource management. Cities, counties, and tribes are required by Federal and state law to prepare these plans. In many cases, these plans overlap in content and require a critical evaluation to ensure goals and objectives are aligned. Tribes are required to develop a variety of plans that deal with forest management (Forest Management Plans), fire protection, prevention, or suppression (Fire Management Plans and Wildland Fire Prevention Plans) and all-hazard mitigation (FEMA Disaster Mitigation Act). Tribes may also choose to develop an integrated resource management plan or community wildfire protection plan to ensure community protection and qualify for certain federal funding sources.

Fire management

Restoring natural or management-ignited fire is a key element of ecological restoration, and is recognized as such in the Statewide Strategy. The Federal Wildland Fire Management Policy, originally created in 1995 and updated in 2001, recognizes the important natural ecological role of fire in fire-adapted forests. It calls for the use of wildland fire "to protect, maintain, and enhance resources and, as nearly as possible," and suggests that fire "be allowed to function in its natural ecological role." The Statewide Strategy provides guidance for the use of fire as part of a cohesive strategy to improve forest health throughout Arizona's public forest lands (see Chapter 3: Key Strategies and Recommendations).

Business and workforce development

The Arizona Forest Health Advisory Council's "Guiding Principles" recognize the importance of sustainable restoration-centered economies across the state. The Arizona Forest Health Advisory and Oversight Councils' "Guiding Principles for a New Economy Based on Forest Restoration" further encourage and support the development of businesses and workforce capacity to support forest restoration treatments. Policies such as HFRA and the WGA's 10-year Strategy and Implementation Plan (in addition to several policies outlined in Table 5.1.) support the development of industries that can use the by-products of restoration and fuels reduction treatments. In Chapter 4, the Statewide Strategy identifies needs and opportunities for business and workforce development to support forest restoration and community protection, and it provides a strategy for operationalizing the guidance contained in many of the relevant policy documents.

Table 5.2. A Summary of major federal, regional, and state forest health policies

Policy Document	Summary	Relationship to Statewide Strategy
Arizona Forest Health Advisory Council's Guiding Principles for Forest Ecosystem Restoration and Community Protection	Suggests a number of social, economic, and ecological parameters to guide forest restoration in the state of Arizona.	Serves as the basis for the Statewide Strategy's approach to forest restoration and community protection
Arizona Forest Health Advisory and Oversight Councils' Guiding Principles for a New Economy Based on Forest Restoration	Provides eleven principles to guide the development of businesses, jobs, and infrastructure based on forest restoration in Arizona.	Serves as the basis for the Statewide Strategy's approach to restoration-based business and workforce development.
Western Governor's Association 10-year Comprehensive Strategy and Implementation Plan, 2006 revision	Serves as the action plan for implementing the goals of the 10-year comprehensive strategy and constitutes the primary vehicle for implementing the National Fire Plan. Goals include hazardous fuel reduction, restoration of fire-adapted ecosystems, and community support. The Plan is based on, and emphasizes, collaboration at all levels of policy development and implementation.	The Statewide Strategy serves as the state-specific action strategy for implementing key goals and actions of the WGA's 10-year implementation plan.
Healthy Forests Restoration Act of 2003 (HFRA)	Directs the Secretary of Agriculture, who oversees the Forest Service, and Secretary of Interior, who oversees the Bureau of Land Management, to plan and conduct hazardous fuel reduction projects on specified types of federal lands, including on certain lands that contain threatened and endangered species habitat. Directs the agencies to maintain or contribute toward the restoration of, the structure and composition of old-growth stands according to the pre-fire suppression old-growth conditions characteristics of the forest type. Streamlines NEPA review, and limits appeals and judicial review.	The Statewide Strategy clarifies steps needed to restore forest ecosystems, protect communities, and manage fires across the state. It identifies key challenges, opportunities, and strategies inherent to the broad policy guidance offered by HFRA.
Healthy Forests Initiative (HFI)	The HFI attempts to implement the core components of the National Fire Plan, and reduce procedural requirements for various activities by permitting some fuel reduction projects to be categorically excluded from full environmental analysis and documentation. It also broadens the categories of logging activities that are exempt from NEPA documentation and judicial appeal. Categorical exclusions (CE) under HFI are limited to 4,500 acres for prescribed fire and 1,000 acres for fuel treatments. CE projects must be identified through a collaborative framework and cannot be appealed	The Statewide Strategy supports the strategic identification of high priority projects across the state, and attempts to clarify a zone of agreement on crux issues that will expedite restoration, community protection, and fire management progress.
Federal Wildland Fire Management Policy, 2001 Update	Reviews and largely endorses the earlier 1995 policy; includes a set of guiding principles related to ecological restoration and public safety. Encourages use of wildland fire.	The Statewide Strategy provides steps to integrate wildland fire into approaches for restoring forest ecosystems.
National Forest Management Act of 1976 (NFMA) and 2005 NFMA regulations	The intent of NFMA is to engage the American public in the creation and review of forest plans, to require the consideration of non-timber values in forest management, and to limit how the Forest Service administers timber sales. 2005 NFMA implementing regulations emphasize collaboration at several levels (public, inter-governmental, tribal), but exempted forest plans from the NEPA process. In April 2007, the United States District Court in Northern California ordered the Forest Service not to use the 2005 Planning Rule in on-going forest planning processes. The Office of General Counsel is reviewing the decision.	The Statewide Strategy is based on extensive collaborative efforts in Arizona, and recommendations contained within the Strategy should be integrated within Forest Plan revisions throughout Arizona.

Policy Document	Summary	Relationship to Statewide Strategy
Stewardship Contracting Authorities (Omnibus Appropriations Act of 1999, reauthorized as semi-permanent in 2003)	Provides authority for the USFS and BLM to use stewardship contracts to reduce hazardous fuels. Stewardship contracts permit the trading of goods (commercially valuable timber) for stewardship services (other activities in the same area, such as thinning or watershed restoration). This contracting tool allows the agencies to select contractors that will meet the employment and management needs of rural communities.	The Statewide Strategy supports the integration of forest restoration and sustainable economic development, and provides steps to achieve these interrelated goals.
National Indian Forest Resources Management Act (NIFRMA) of 1990, amended 1994	NIFRMA acknowledges Indian tribal self-determination in managing their forested lands and allows tribes to develop forest management plans for their reservations. NIFRMA reaffirmed many aspects of the existing Indian forestry program and established a new direction for cooperative agreements, tribal forestry programs, forestry education assistance, and other programs.	The Statewide Strategy respects tribal self-determination and provides resources that can be used by sovereign tribal entities. The Strategy was developed in consultation with representatives of tribal forestry programs.
Tribal Forests Protection Act of 2004 (TFPA)	Provides a contractual process that allows tribes to plan and implement forest management activities with federal agencies across jurisdictional boundaries. Requires the Secretary of Agriculture to submit a report to Congress about stewardship contracting on federal and tribal lands.	The Statewide Strategy recognizes the need to plan and work across all jurisdictional boundaries, including tribal boundaries.

The Statewide Strategy for Restoring Arizona's Forests is a cohesive response to the various policies, reports, and initiatives that strive to restore forests and build sustainable communities and economies. The actions outlined in this document support the major directives identified in relevant policies, and they provide a framework for local decisions to guide on-the-ground projects. At the same time, the Strategy reveals gaps that must be addressed and the actions needed to plug those gaps. By advancing ideas for coordinated and cohesive action, the Strategy strives to ensure that the investments of time and resources into community protection planning, economic development, collaborative partnership building, and scientific research will pay dividends in the form of healthy, restored forests and thriving communities.

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6 Economic Considerations for Restoring Forest Health

Forests have always contributed to Arizona's economy and quality of life. When Arizona was a territory, forests were viewed as a source of natural resources to be extracted for economic development and expansion. The forest was the source of forage for cattle and sheep, trees for mine timbers and railroad ties, game for consumption, and water for irrigation and municipal uses. After World War II, forests sustained a timber industry that provided jobs to many rural Arizonans and fueled a half-century of rural development. When the most valuable timber had been harvested, and as tourism and watershed protection became more important to Arizona's rapidly growing population, significant shifts in rural economies and the objectives of forest management occurred. However, the importance of forests to the Arizona economy has not changed. Forests remain the economic and aesthetic foundation of many rural communities that are increasingly dependent on amenities-based economic drivers that includes tourism, recreation, and a growing market for vacation homes. Larger communities benefit from quality-of-life factors that draw mobile professionals seeking aesthetic and health factors associated with healthy forests. While globalization, modern communications, and urbanism have reshaped Arizona's economy, our diverse forests remain an essential component of the state's economic success, and their restoration is likely to be one of the best possible investments in the future.

Today, Arizonans demand more goods and services from our forests that ever—from amenities like hiking trails and hunting grounds, to harvestable resources, especially fresh water. Balancing these demands presents continuous management challenges. However, the science of ecology informs us that forests must be managed in a manner that sustains their natural composition, structure, and function if they are to continue providing us with the wealth of services people have come to expect from them. In other words, the management and uses of the forest should be "sustainable"; they should not diminish the health and productivity of the forest for future generations.

The cost of inaction

Restoring forest health will protect one of Arizona's priceless assets. While ecological restoration is expensive (an estimated $350-$1,000/acre in the WUI) the cost of inaction is far greater. Many of today's dense forests contain unhealthy accumulations of biomass that can fuel rapidly moving crown fires that – like the 2002 Rodeo-Chediski fire – can have destructive effects over large areas. Especially in times of drought and climate change, these fires threaten the economic and social well being of rural communities, and the loss of large forest tracts to unnatural fire affects all Arizonans. For example, the Rodeo Chediski Fire burned over 450,000 acres at an estimated cost the state of Arizona of over $400 million. While such cost accounting is difficult and subject to considerable uncertainty, it is clear that investment in ecological restoration, while expensive, is a sound long-term strategy that creates new jobs and develops critical skills in a rural workforce that is increasingly important in forested landscapes.

The challenges of wood utilization

Most forest restoration in Arizona is publicly subsidized. However, there are not enough federal and state dollars to pay for treatments on all the acres that need restoration. Competition for public dollars is fierce, and the myriad of other budget priorities reduce the appropriations available for forest management. Developing private, forest-based enterprises that can pay for wood and biomass harvested by treatments and, therefore, generate funding that will offset treatment costs is critically important to a successful restoration strategy.

There are, however, many challenges to creating this new restoration-based economy. These include: 1) the loss of skilled labor and forest harvest infrastructure, 2) the fear that short-term economic incentives will undermine science-based forest restoration and management, 3) fear of another era of boom-and-bust forest economies, and 4) the risk of investing in businesses that rely on a steady wood supply from federal land.

Forest-based private enterprise is in a period of transition. In the 1990s, Arizona lost most of the businesses, workforce, and infrastructure associated with the harvesting and processing of large saw logs. Today, many forested communities in the state have little or no capacity to efficiently or economically process the small-diameter material that is a by-product of forest restoration. In addition, the cost of transportation precludes economically feasible restoration in areas far removed from processing facilities.

Determining socially acceptable approaches to and levels of wood harvest has a history of controversy. The idea of reinvigorating wood-extraction businesses concerns environmental organizations and citizens who fear that industry, not science, will drive forest management decisions. The Statewide Strategy establishes science-based restoration of forest health as key to creating long term ecological and economic sustainability. Focusing action on the restoration of forests as a first priority, and encouraging business development based on restoration by-products, is one approach to addressing these concerns.

Many Arizonans are also concerned about the long-term economic stability of new businesses and their relationship to rural communities. When forest operations shut down in the 1990s, many rural Arizona communities suffered serious social and economic dislocation as sawmills and forest-based industries closed. As a result, some civic leaders are wary of businesses that will boom and then bust, leaving communities once again in a state of social and economic turmoil. However, there are several measures that should be taken to alleviate these concerns. First, forest managers should manage wood supply to encourage a mix of different-sized businesses that produce different products, thereby buffering communities from overdependence on a single enterprise. Such businesses can be ideal corporate citizens, especially when they can demonstrate through their business plans the ability and willingness to respond to different types and levels of wood supply. Second, businesses that are committed to operating in Arizona, long term, should be given preference over out-of-state and international companies that export the dollars earned in the state. Ultimately, the goal is to encourage a mix of locally focused businesses that will provide economic resiliency as the amount and type of harvested material changes over time.

An important role for sustainable forest-based enterprises

Many community forestry advocates believe that a sustainable forest economy that uses the by-products of restoration treatments can create jobs and support local economies while assisting the complementary goals of community protection and forest restoration. They reason that thriving forest and wood-products enterprises will pay for harvested material (saw logs, small-diameter trees, and woody biomass) and that this will help offset some of the costs of restoration, allowing restoration to move forward, more rapidly, over larger areas. In addition, new, sustainable forest businesses will help Arizona realize economic benefit from forest restoration products, rather than paying for dead tree removal and disposal.

Developing these forest and wood-product enterprises requires creative and cooperative efforts in order to derive profit from the marginal saw logs, small-diameter trees, and woody biomass harvested through restoration treatments. For example, more efficient ways of harvesting, transporting, and processing are needed in order to make these enterprises economically viable. Forest and wood-product enterprises need to develop value-added products based on emerging technologies, while cultivating new markets for these products. All of these efforts face barriers, such as access to capital, an antiquated forest industry infrastructure, an inadequate labor force, and underdeveloped markets for value-added wood products.

The State of Arizona and the federal government have taken important initial steps to encourage a forest and wood product economic sector. The state has established tax incentives and raised renewable energy standards for utilities, while the federal government has made grants available for biomass and infrastructure improvements. Entities such as the Southwest Sustainable Forests Partnership, Northern Arizona Wood Products Association, Prescott Area Wildland Urban Interface Commission, and Greater Flagstaff Forests Partnership provide resources and grant opportunities to support emerging businesses.

Significant challenges remain, but private citizens, non-governmental organizations, the business community, and government agencies—working together—have the power to establish thriving forest utilization businesses that advance local economies and help to accomplish forest restoration and community protection. For example, Congress has enacted “stewardship end-result contracting” to provide a new tool to achieve forest management

while simultaneously meeting local and rural community needs. Awarded on a best-value basis—not simply on lowest cost—the Forest Service or BLM can consider factors that reflect solid business experience and benefits to the local community. They are also a good tool for guaranteeing wood supply because they are long-term agreements. The largest stewardship contract in the country is currently being administered by the Apache-Sitgreaves National Forest. According to Dr. Lay Gibson of the University of Arizona, in 2006 the White Mountain Stewardship Contract supported 15 firms with total annual expenditures of almost $16 million. In addition, the forestry firms employ 245 full time equivalent employees (FTE) with an additional 85 FTE created through the multiplier process.

Strategies for developing and sustaining forest-based enterprises

The Statewide Strategy for Restoring Arizona's forests articulates a balanced vision and identifies complementary actions for achieving long-term ecological restoration of our forests, fire risk reduction for communities, and sustainable restoration-based economic enterprises. The following strategies serve as a guide for developing sustainable forest and wood-product enterprises.

1. Require that forest health priorities drive the utilization of restoration by-products

- Forest health is the first priority of the Statewide Strategy. Planners and practitioners should recognize that community protection and sustained economic benefit can only be accomplished in the context of a well-managed, healthy forest ecosystem.
- Forest utilization enterprises must be based on the type, quality, and quantity of the material that is removed as a result of forest restoration treatments. Much of the material that will be made available from restoration treatments will come from under-utilized material, such as immature ponderosa pine and juniper, often referred to as small-diameter timber. The largest and traditionally least valuable category of material that forest restoration treatments produce is woody biomass. It includes slash and round wood that cannot be processed at a mill. Sustainable forest products businesses must have a plan for using woody biomass to generate energy, for manufacturing products, or for sale as minimally processed products.
- Forest products businesses must be appropriately-sized, based upon the supply of woody material made available by forest treatments. It would be unwise to recruit businesses or industries that depend on an amount or type of forest material that cannot be sustained, over the long-term, without degrading the health of the forest. The ideal business will have the agility to adjust operations as the supply of wood varies by amount and type over time.
- Legitimate concerns have been raised about the effects over-harvesting on soil nutrient levels. Watershed level studies (e.g., Gosz 1980) have indeed demonstrated that the majority of the nitrogen (the nutrient most limiting to ecosystem productivity) is stored in the soil and the tree canopies in contemporary ponderosa pine forests. However, most of the nitrogen and other limiting nutrients stored in the trees are found in the foliage and branches (Little and Shainsky 1995). Thus, restoration treatments that remove only the boles of the trees should not negatively affect site nutrient availability. Studies of nutrient availability following restoration (e.g., Kaye et al. 1999), indicate that restoration increases nutrient cycling and enhances nutrient mobilization, but not to the point that excess nutrient leaching from the soil should occur.

2. Identify and evaluate the short-term and long-term supply of woody material available for restoration treatments and economic utilization.

- The U.S. Forest Service should conduct a regional supply analysis to determine availability of woody material and help guide coordination of restoration treatments.
- The U.S. Forest Service should coordinate restoration treatments across the Southwestern Region and develop a wood supply management mechanism to ensure that a consistent supply of woody materials is available.
- The U.S. Forest Service should develop and encourage new, creative contracting techniques that help to ensure a consistent wood supply, engage a larger number of bidders, and provide a longer term access to supply.

- Community Wildfire Protection Plans, Tribal Forestry Plans, and other collaborative community based efforts should include language that addresses the use of restoration by-products. U.S. Forest Service managers and planners should consider these restoration and utilization plans when developing national forest management plans and related project-level plans.

3. Identify, promote, and support businesses that use forest restoration by-products.

- State, local, and federal governments should increase funding to provide assistance for the development of restoration-based forest enterprises, and they should develop financial incentives for the use of restoration products.
- Federal, state, and local authorities should recruit new start-up businesses and encourage existing businesses to retool and use products from the emerging restoration-driven forest products industry. These incentives should be flexible enough to consider local circumstances and conditions.
- Utilization experts should identify opportunities where existing businesses or agencies can use locally produced forest products. For example, landscaping businesses and nurseries could use mulch and compost produced from the woody biomass generated by local restoration projects.
- State, local and federal governments should promote "green building" across all sectors, including business, structures that use materials more efficiently and result in reduced environmental impacts. Green buildings are often constructed with locally obtained recycled and natural building materials, and they use alternative energy sources. Properly processed and marketed wood by-products from restoration treatments could find a strong niche market if green building was supported by all levels of government.
- Government and business should increase investment in research about pinyon-juniper ecosystems, the development of efficient harvesting and transportation of pinyon-juniper material, and the development and marketing of products made from pinyon and juniper. This is an important economic issue because pinyon-juniper woodlands comprise a large portion of Arizona's forests (7.7 million acres or 42% of Arizona's forest land, compared to 3 million acres or 17% for ponderosa pine), and are found in every landscape identified in the Statewide Strategy.

4. Support the establishment of a diverse multi-scale, restoration-based forest economy that can sustain long-term forest restoration efforts.

- Federal authorities should ensure that stewardship contracts include provisions for directing that a certain percentage of harvested material be reserved for smaller-scale local businesses.
- All stakeholders in forest restoration efforts—including local, state, and federal governments, private businesses, and non-profit organizations—should support the formation of a consortium that would provide support for appropriately scaled existing and developing wood-products enterprises. This support would include:

  -consulting services

  -management and dissemination of important industry related information

  -research and development of new techniques, methods, equipment, and products to advance
  -sustainable wood-products enterprises

  -assistance in coordinating transportation of harvested material

  -assistance in obtaining required permits

  -assistance in identifying appropriate locations for new operations

  -assistance in recruiting and coordinating businesses to develop a cluster of enterprises that can capture economies of scale and co-location

  -assistance and support for forest and wood-product enterprises that have the capacity - or potential
  -capacity to finance future restoration treatments.

  This organization should be results-oriented, with the goal of developing an environmentally and economically sustainable forest and wood products industry in Arizona.

Western Moulding Company, Inc.: A Smallwood Success Story

by James Tuvell

For Don Gonsalves, small diameter wood equals success. Don, a second generation moulding mill owner/operator, transformed a moribund mill, closed in 2000 after 50 years of operation, into a profitable enterprise. He did it by diversifying and updating his products, processes and services in numerous ways.

"The key," says Don, "was, and is, innovation and attention to details."

- He continually strives to create innovative new products and services and to add value to old ones. Don and his wife have developed new products, and added the equipment needed to produce them.
- His attention to detail helps Don to make the small, incremental improvements in the mill's processes and equipment that give him and his bottom line an edge. He uses thinner cuts, less handling, and experiments with different sizes and cuts to minimize waste and maximize useable material.
- He stays on top of the latest industry advances through trade shows, trade journals and by participating in industry organizations; always looking for those incremental improvements.
- He puts the grant money that he has receives into capital improvements, not operations. "Not only will the machine I buy with the grant pay for itself but it will continue to produce operating revenue, wages for my employees, taxes for the government and net income for the business."

Don believes reviving the regional forest products industry depends on the proper scaling of the industry to the supply of material from the surrounding forests.

"The growth of the industry has to track the amount of material available. We stand a better chance of creating a long-term sustainable forest products industry and a long-term sustainable healthy forest if we match the growth of the industry to the amount of material coming off the forests. The goal for all of us is a healthy industry and a healthy forest."

Don Gonsalves and Western Moulding are showing that both are achievable.

- State, local, and federal governments, along with the business sector, should support the development and employment of a diverse, stable, professional labor force to accomplish ecological restoration and maintain forest health.
- Because less than 1% of Arizona's total workforce is currently employed by forestry operations, it will be necessary to develop training programs, both on-the-job and within educational institutions. It will also be necessary to recruit trainees for such programs, as well as groom potential forest professionals and technicians, beginning at the high-school level.

Conclusion

The development of sustainable, restoration-based forest and wood-products enterprises that can pay for wood and biomass will help offset the costs associated with forest restoration. This is critically important to achieving the complementary goals of community protection and ecological restoration. The fact is that our forests need restoration now, yet state and federal agencies have been unable to undertake significant new initiatives through government channels alone. Public-private partnerships are needed, and the development of an appropriately scaled, sustainable forest industry in Arizona makes sense from both economic and ecological perspectives.

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7 A Collaborative Foundation for the Statewide Strategy

The Statewide Strategy for Restoring Arizona's Forests is a collaborative vision. It draws its inspiration from the successful pioneering efforts of Arizona's citizens, including community leaders, forest managers, scientists, and public servants across the state. By recognizing, studying, and learning from these many successes, the State of Arizona has committed to fostering a bolder, broader implementation of collaborative forest restoration work.

Forest communities are embedded in larger landscapes that are linked by ecological processes, including fire, the movement of wildlife populations, and the flow of rivers and groundwater collected within watersheds. Thus, successful restoration efforts require the integration of many local efforts. Independent efforts by individual landowners or communities will ultimately be pointless if they are not part of a coherent and unified strategy to improve forest health across large areas. Neighboring land parcels should be restored and subsequently managed in an integrated, collaborative manner, so that the cumulative effects of many different projects will complement, rather than conflict with each other. Efforts to achieve this sort of cooperation through government mandates and regulation have had mixed results in the past.

When community members, including local residents and others with a direct interest in the management of Arizona's forests, come together to address common problems they often craft creative and practical solutions. The Forest Service's stewardship contract for the White Mountains evolved through prolonged citizen involvement in federal planning efforts, and the implementation of this innovative strategy has united ecological restoration with economic development. Similarly, where diverse citizens have come together in open processes to develop Community Wildfire Protection Plans, they are often better able to integrate fire and wildlife planning than committees of government officials.

Collaborative approaches to forest restoration and planning provide an additional benefit: they encourage the meaningful public discourse that is necessary for working through the deep divisions that have plagued forest management in recent decades. Taking appropriate action to safeguard communities, restore forests, and protect wildlife habitat is often stymied by disagreements--real and perceived--about which management actions are appropriate. Without the committed engagement of Arizona residents, it is difficult, if not impossible, to translate the shared but often vague objectives for improving forest health into publicly supported actions in specific places. Strong consensus, emerging from a mix of agreement and trust, is necessary to chart a new course for forest management that is characterized by restoration, sustainable use, and collaborative management. This important shift engages people of diverse backgrounds and interests from around the state, yet relies on scientific principles and adaptive approaches to management.

Inspired by successful collaborative efforts across the Southwest, the Statewide Strategy will strengthen and extend the growing network of creative initiatives to improve forest conditions, restore key ecological processes, protect wildlife and their habitats, and develop economically viable approaches for ongoing management, use, and conservation of Arizona's forest resources. By building on local successes to implement the Statewide Strategy, the restoration of Arizona's forests will proceed in a manner driven by on-the-ground collaborative efforts, and supported by integrated polices and appropriate levels of government support and involvement.

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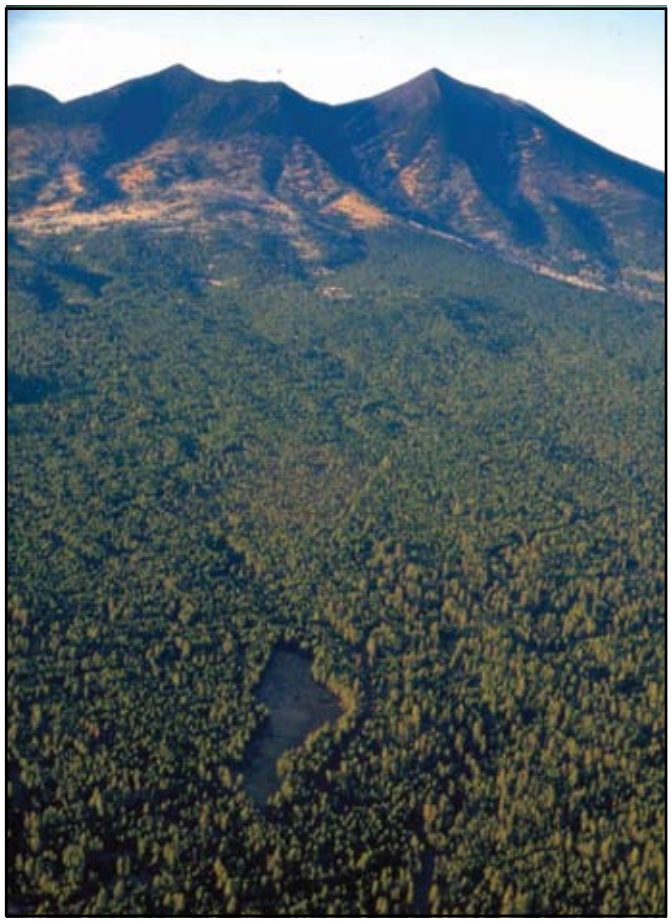
Part Three

8. Restoring Forests and Protecting Communities: A Landscape Approach

9. Arizona's Forested Landscapes

8 Restoring Forests and Protecting Communities: A Landscape Approach



Arizona is a large and diverse state with extensive forests. Climate, topography, flora and fauna vary tremendously, from the widespread savannah woodlands dominated by juniper and pinyon, to subalpine spruce forests at the highest elevations. This great natural variation is not evenly or randomly distributed across the state. Many forces, including the influences of human settlement and timber harvests, have shaped Arizona's forests into distinct landscapes, each with its own history and unique characteristics. For example, the extensive ponderosa pine forest occupying the relatively flat Western Mogollon Plateau was heavily logged during the first half of the twentieth century, and this, coupled with fire suppression and other forces, led to a dramatically different forest, characterized by a substantially decreased abundance of old-growth trees and a greater number of small trees, often occurring in dense stands that are more susceptible to crown fires than their widely spaced old-growth ancestors. The flat topography that had once allowed ground fires to burn slowly, and beneficially, across the forest floor now helps the spread of crown fire across large areas, as it moves rapidly through interlocking tree canopies. Conversely, the pine and mixed-conifer forests of the Southern Sky Islands—many also heavily logged in the past century—occupy generally steeper slopes, where they have always been subject to fires of different intensities, from cool ground fires creeping down steep slopes, to crown fires spreading in patchy patterns across the rugged, mountainous topography. Differences in the ecological conditions on the Mogollon Plateau and in the Sky Islands identify them as distinct landscapes that require different, locally grounded approaches to forest restoration and management.

The principles of landscape ecology, a rapidly developing discipline that studies large-scale patterns and processes in nature, indicate that there are a relatively small number of distinct forested landscapes in Arizona. The fates of these of these landscapes are largely independent, because 1) they are isolated from one another, and 2) because important processes, such as fire, drought, and urban expansion, operate at scales that affect different landscapes in very different ways. For example, periodic shifts in the jet stream may bring increased moisture to southern Arizona, while the northern forests are stressed by drought. Similarly, crown fires on the Mogollon Plateau in 2002 flared into the massive Rodeo-Chediski complex that restructured a half-million acres, while other forested landscapes suffered no negative effects during Arizona's worst fire season in recent history.

These examples demonstrate that there is a natural scale for planning and management of Arizona's forests. This scale leads us to identify landscapes as those distinct areas that are linked together, internally, by key driving forces—fire, climate, and human activities—that determine forest conditions and influence their future development. In Arizona, rugged topography, variable climate, and differing fire regimes suggest that there are less than a dozen large landscapes, each differing from one another, each characterized by a unique set of environmental conditions and ecological processes, and each on an independent trajectory into the future. Adopting a landscape perspective is an important step toward addressing forest health responsibly, because it recognizes that conditions, challenges, and solutions almost certainly vary across our state, and that our actions should be governed by ecological reality, rather than abstract concepts that underlie outdated "one-size-fits-all" approaches to forest restoration and management.

The Statewide Strategy embraces a landscape perspective that acknowledges the great variability of Arizona's forests, while providing the integrated "big picture" view that can unite the interests of the state's residents. Our map of the state distinguishes nine forested landscapes. These landscapes were identified, reviewed, and debated by committee; and as such, their number and boundaries are the products of compromise and represent a working definition that is subject to future review and revision. Boundaries drawn on maps are much less obvious in nature, and it is clear that there are other valid ways to map Arizona's forested landscapes. Nevertheless, the map presented here provides a helpful way to break down a very complex issue into manageable parts. It allows clear presentation of the different conditions, problems, and potential solutions to Arizona's forest heath challenge, a challenge that is addressed in subsequent sections on a landscape-by-landscape basis. By considering each landscape as an integral whole, we are then able to identify common themes across the state and develop policies that are scientifically grounded and locally effective, yet integrated into a strategy that can be effectively implemented at multiple scales, from the development of state- or forest-wide policy, to a community wildfire protection plan, to a series of on-the-ground forest management projects. This is the strength of the landscape perspective.

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9 Arizona's Forested Landscapes

Arizona Strip

Basin and Range

Central Highlands

Chuska Mountains

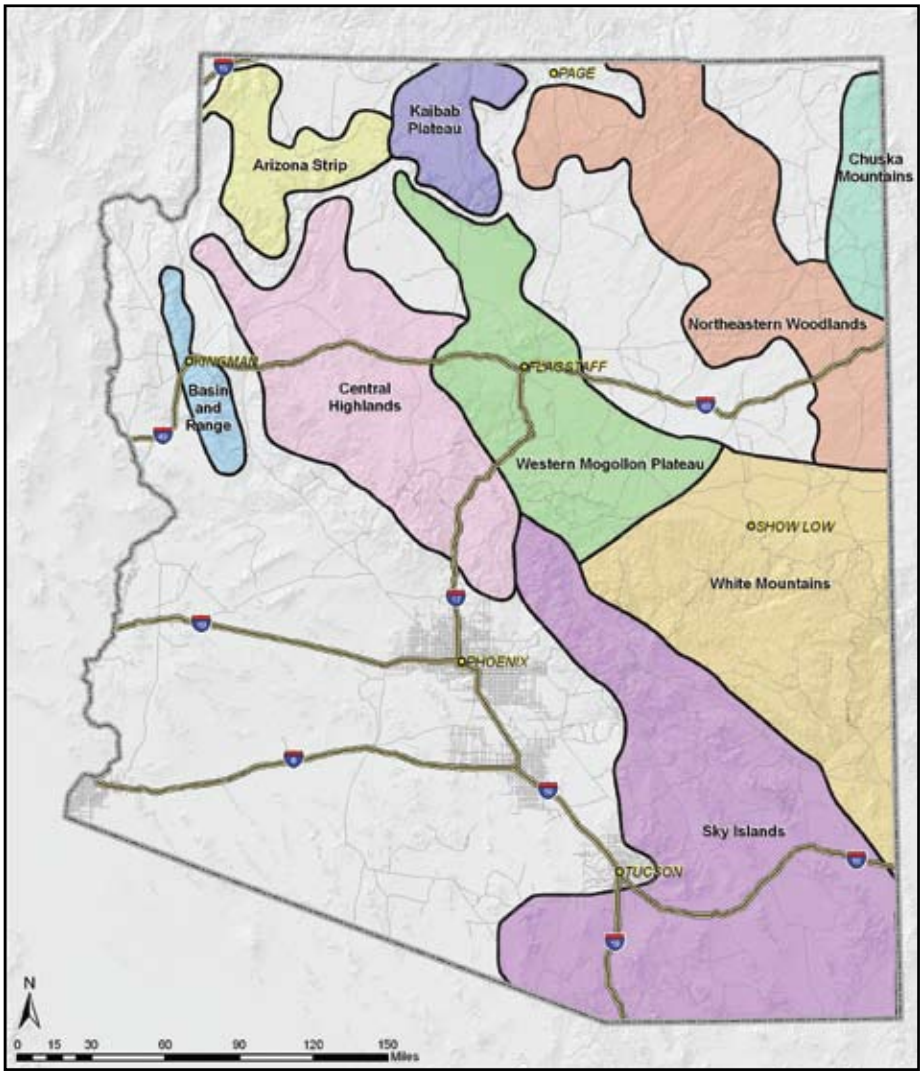
Kaibab Plateau

Northeastern Woodlands

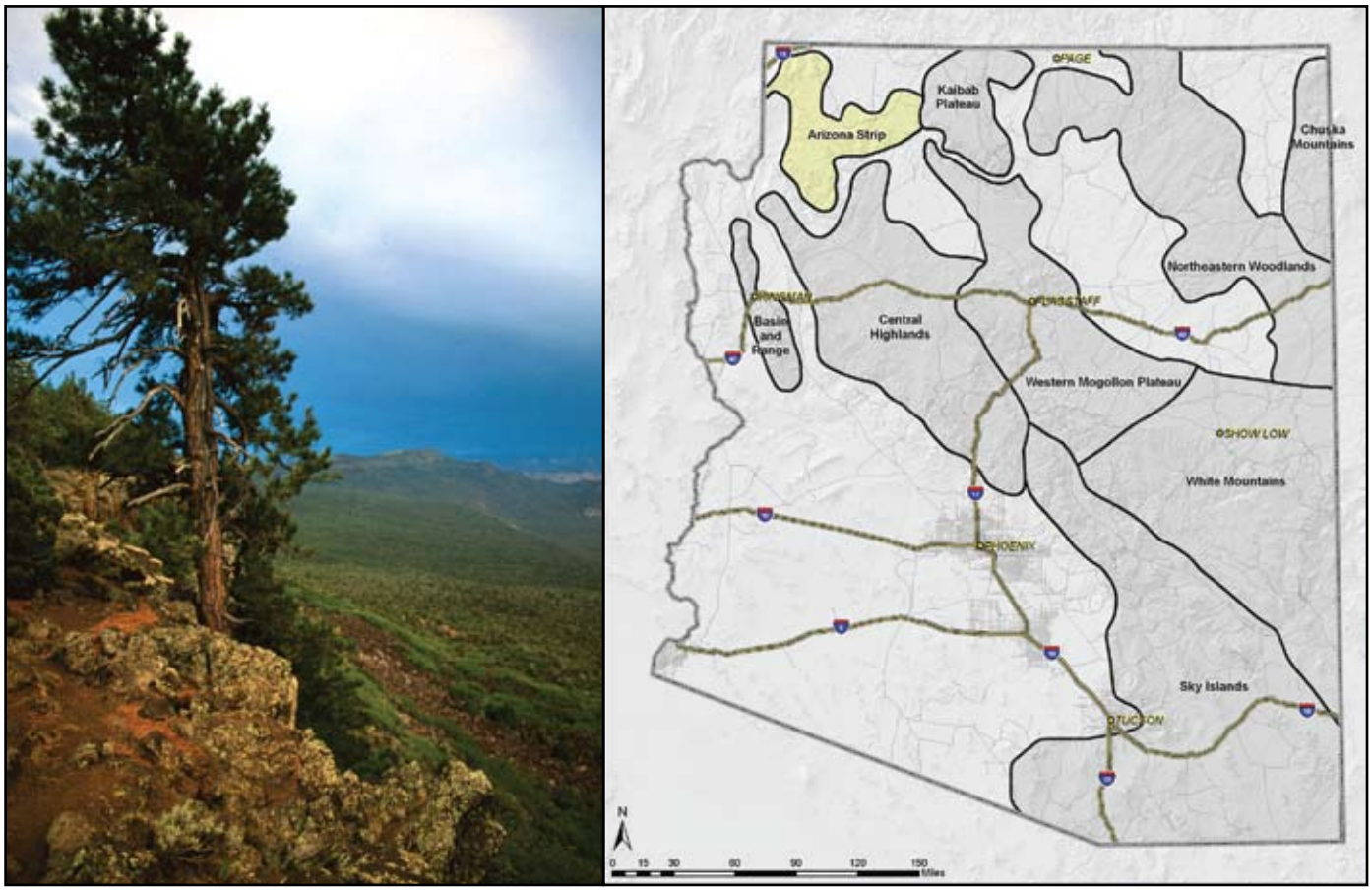
Sky Islands

Western Mogollon Rim

White Mountains



Arizona Strip



Traditionally, the entire portion of Arizona that lies north of the Colorado River is referred to as the Arizona Strip. However, for the purposes of Statewide Strategy, we differentiated the elevated Kaibab and Paria Plateaus as a separate forested landscape, reserving the remaining lands in the northwestern corner of the state for the Arizona Strip landscape. Ecologically, the Arizona Strip spans a transition from ponderosa pine forests and high desert shrublands to the Mohave Desert and western Great Basin. Culturally, the region is one of the most sparsely populated in Arizona, although it is affected by rapidly growing populations in nearby cities in Nevada and Utah.

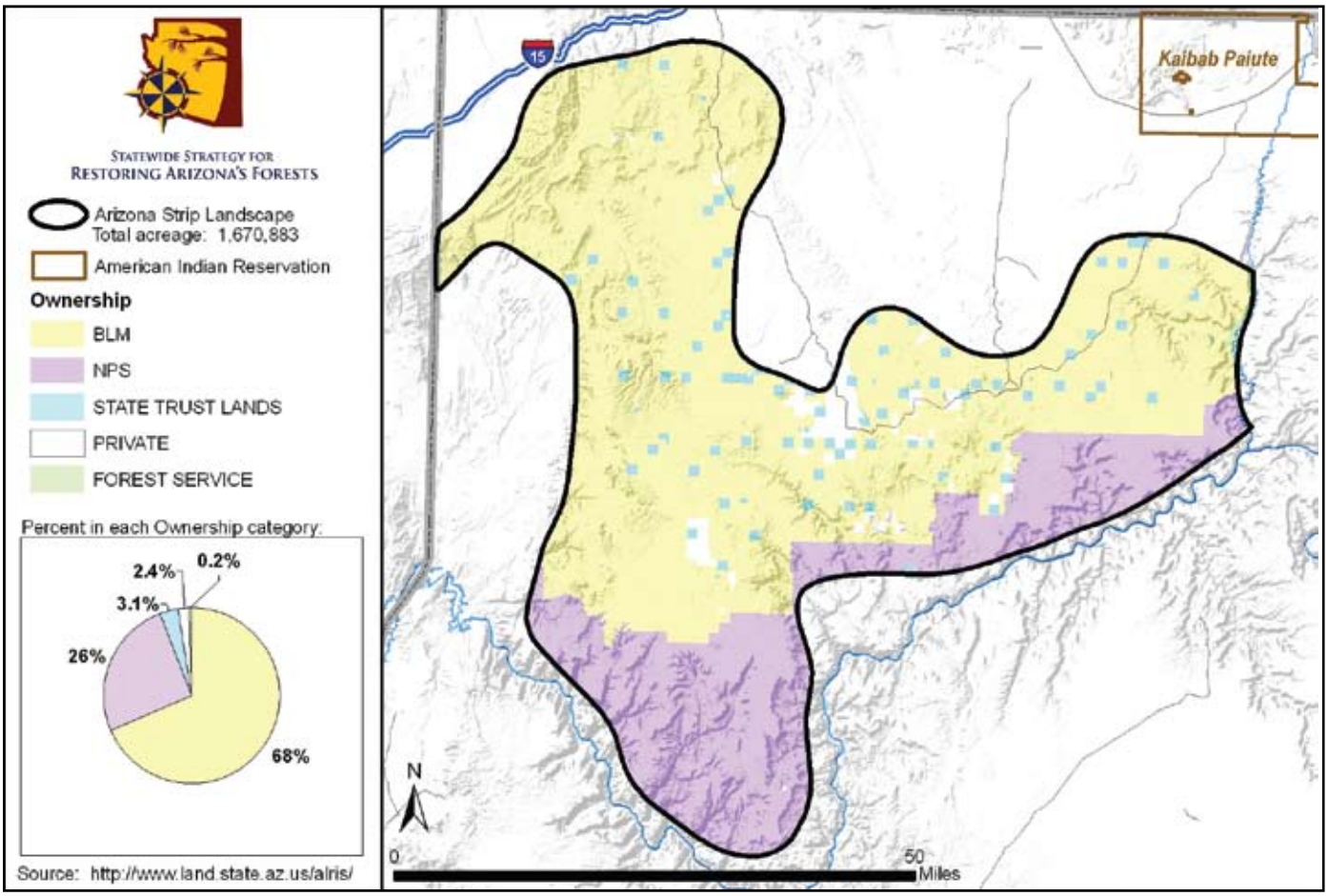
Elevations across the Arizona Strip region range from about 1,400 feet near Lake Mead to just over 8,000 feet at the peaks of Mt. Trumbull and Mt. Bangs. Vegetation includes desert shrublands at lower elevations, extensive pinyon-juniper woodlands, and ponderosa pine-Gambel oak forests on isolated “sky island” mountaintops. Water sources on the Arizona Strip include numerous springs, which are very important for wildlife and humans, but few perennial streams, except for the Virgin River in the far northwestern corner of the region and small tributaries of the Grand Canyon, including Kanab Creek, Parashant Canyon, and Grand Wash.

Politically, the region lies within Mohave and Coconino counties, but socially and economically the Arizona Strip has as much in common with southern Utah as it does with the southern portions of these Arizona counties. The northwestern region of the Arizona Strip has very few paved roads: a portion of Interstate 15 through the Virgin River Gorge, US highway 89A to Fredonia, and State Route 389. A network of unpaved roads, many impassible in wet weather, spans the vast acres of public and private lands in the area. A high-voltage utility line crosses the northern portion of the region.

Land Ownership

The Bureau of Land Management's Arizona Strip Field Office manages more than two-thirds of the Arizona Strip region, including Grand Canyon/Parashant National Monument. One quarter of the region's lands are owned and managed by Grand Canyon National Park (Figure 9.1.1.). The Kaibab National Forest and scattered private and State Trust lands comprise the remainder. Several designated Wilderness Areas are located in the Arizona Strip, including the Paiute, Beaver Dam and Grand Wash Cliff wilderness areas in the west, and the Mt. Trumbull, Mt. Logan, Cottonwood, Paria Canyon/Vermilion Cliffs and Kanab Creek wilderness areas in the southeast.

The ponderosa pine forests in the Arizona Strip region are limited to higher mountains primarily under federal ownership (BLM and NPS). Pinyon-juniper woodlands and desert shrublands are found under more mixed ownership, including BLM, State of Arizona, and private lands.

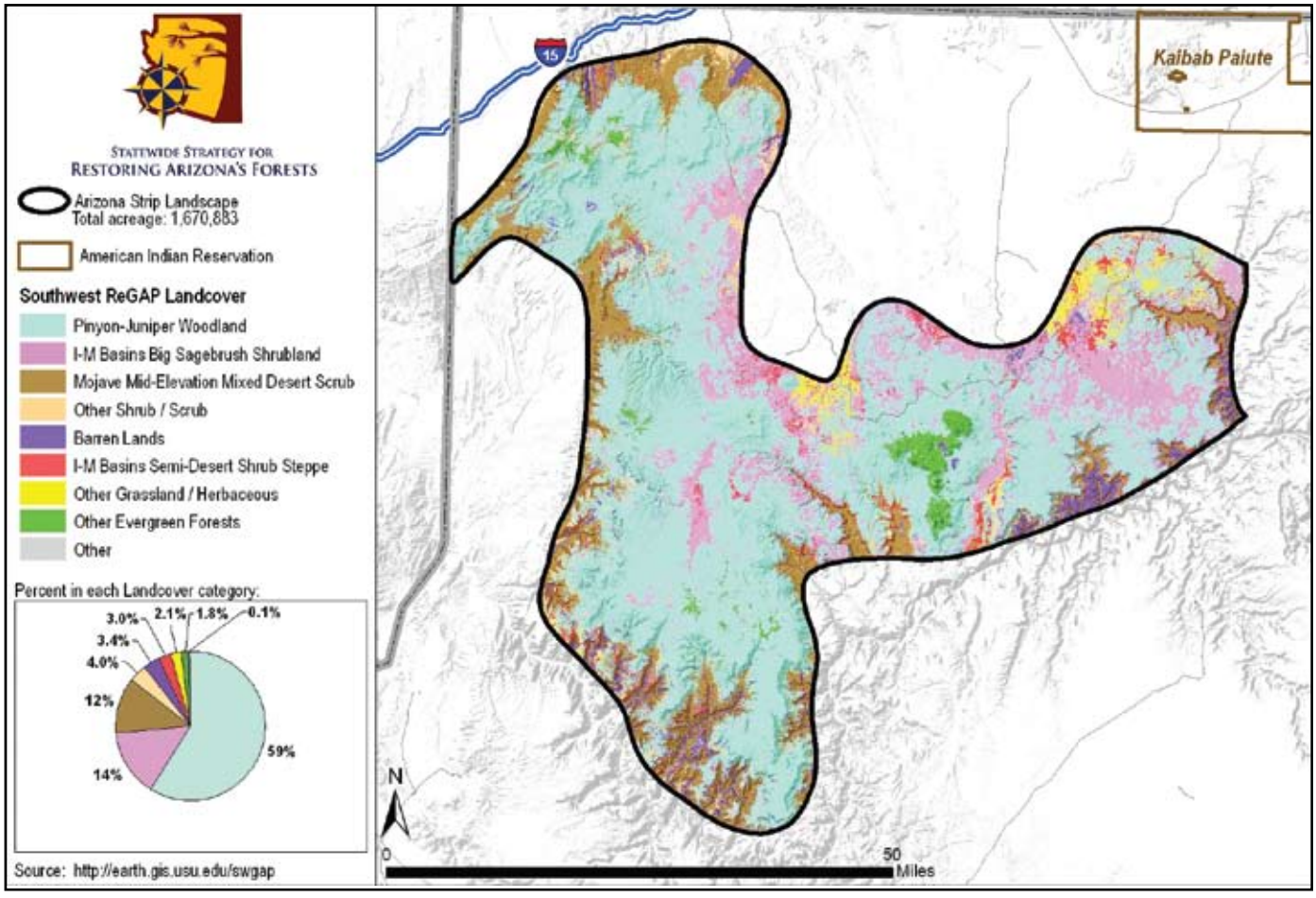


▲ Figure 9.1.1. Land Ownership status in the Arizona Strip landscape.

Forests

The forests of the Arizona Strip region are comprised mostly of conifers interspersed with deciduous oaks, grasslands, and extensive shrub communities (Figure 9.1.2.). Ponderosa pine-Gambel oak forests cover roughly 34,000 acre. They occur mostly in forested highlands from 6,500 to 8,000 feet in the southern portion of the region (Mt. Trumbull, Mt. Logan, Mt. Emma, Mt. Dellenbaugh), as well as in a small portion of the Virgin Mountains. The forests were sporadically harvested from 1870 onward, leaving an unusually high component of large, old-growth trees in the Mt. Trumbull area. Gambel oak and New Mexican locust are important deciduous species. Gambel oak is particularly valuable for acorns and as snag habitat for cavity nesting birds. Understory plants include a diverse array of native shrubs, grasses, and forbs.

Pinyon-juniper woodlands cover about 30% of the landscape at elevations ranging from 5,000 to 6,500 feet. These woodlands have become denser and, in some cases, have invaded former grasslands, as a result of livestock grazing and exclusion of fire. Pinyon-juniper woodlands are valuable for wildlife habitat, and also contain the majority of the region's archaeological sites.

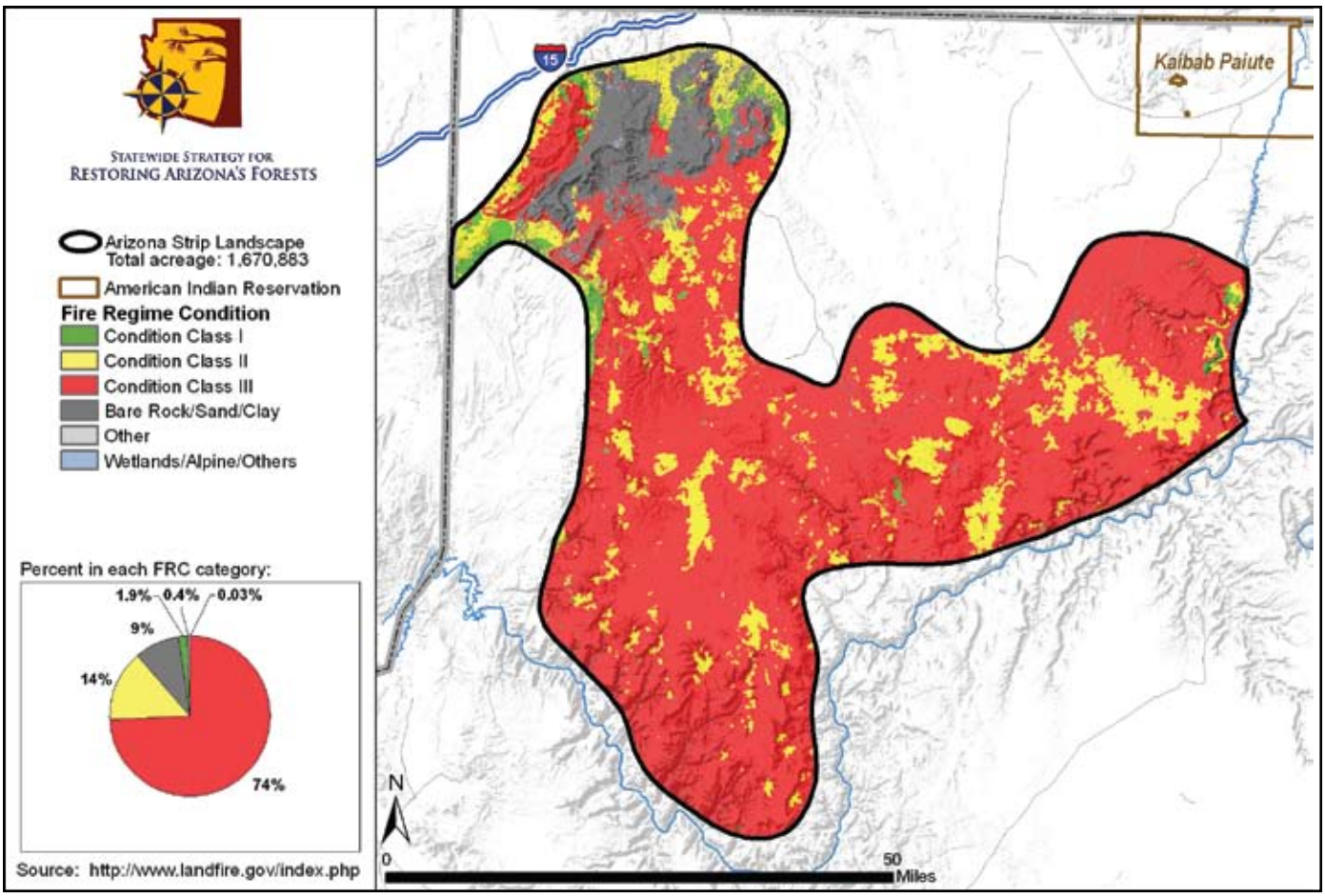


▲ Figure 9.1.2. Vegetation characteristics of the Arizona Strip landscape.

Current Conditions

Annual precipitation averages just below 17 inches at Nixon Flat near Mt. Trumbull, but year-to-year variation is great, with six out of the past ten years well below average. A severe drought occurred in 2002, when precipitation was the third lowest total recorded during the past one hundred years.

The U.S. Forest Service has classified the vast majority of the landscape (74%) as Fire Regime Condition Class 3. This means that there is a high risk of losing key ecosystem components to fire (Figure 9.1.3.). At particularly high risk are Mohave Desert, pinyon-juniper, and ponderosa pine communities. The natural surface fire regime of the ponderosa pine forest was disrupted after 1870 when large herds of sheep and cattle were introduced. Currently, ponderosa forests are relatively dense and susceptible to stand-replacing fire. The natural fire regimes of pinyon-juniper woodlands are poorly understood, but a mix of surface and stand-replacing fires was probably typical. Current conditions in woodlands across the Arizona Strip are capable of supporting intense fire across greater areas than were the historic woodlands.



▲Figure 9.1.3. Fire Regime Condition characteristics of vegetation in the Arizona Strip landscape.

Communities

Communities within the Arizona Strip district are small and include: Littlefield/Beaver Dam, Colorado City, Moccasin, Fredonia, and the Kaibab Paiute communities of Six Mile Village, Eagle Mountain, Red Cliffs, Juniper, and Kaibab. Total population of these communities is about 7,000. The economy is largely agricultural—ranching and farming—and also includes mining, tourism, and government jobs.

Due to the mild climate, tourists visit the Arizona Strip region year-round, but generally they are widely dispersed. Apart from the highly trafficked Virgin River corridor, the National Park Service's Ranger Station at Tuweep is probably the single most-visited recreation site in the area. In general, apart from a few small towns and ranching operations, development and infrastructure is sparse.

The Arizona Strip has a rich, but poorly documented history, beginning more than 12,000 years ago with prehistoric Native Americans called the Paleo-Indians. Evidence of the once-extensive Anasazi and Southern Paiute cultures is found throughout the Strip. Spanish and Mexican forays into the area began in 1776 and were focused along the Old Spanish Trail during the 1820s and 1830s. Mining activities, timber cutting and settlement by farmers and ranchers began by the 1870s. While there is a significant concentration of archaeological and historical sites on the Arizona Strip, most are unknown because only about 1% of the Strip has ever been surveyed.

Wildlife

A wide array of wildlife and plant diversity has evolved on the Arizona Strip, in large part due to the geological diversity of the lands. More than 200 plant species are native to the area. One hundred and fifteen bird and 49 mammal species live in the Arizona Strip region, including the endangered California condor (*Gymnogyps californianus*) and desert tortoise (*Gopherus agassizii*), mule deer (*Odocoileus hemionus*), wild turkeys (*Meleagris gallopavo*), desert bighorn sheep (*Ovis canadensis*), pronghorn (*Antilocapra americana*) and mountain lion (*Puma concolor*).

The northern goshawk (*Accipiter gentilis)*, identified by the Forest Service as a sensitive species in the Southwest, occurs in pine-oak forests. Goshawks make use of dense forest patches for nest sites, but hunt in more open and diverse forest stands, where they find prey that includes birds, squirrels, and other small mammals. Habitat for the Mexican spotted owl (*Strix occidentalis lucida*) also occurs in pine-oak forests, although owls do not presently reside in the forests on the Arizona Strip. The ponderosa pine-dependent Kaibab squirrel (*Sciurus aberti kaibabensis*), a subspecies of tassel-eared squirrel, was introduced to the sky islands on the Arizona Strip in the 1960s. The squirrel is valued as a attractive and recognizable forest resident, as prey for avian and mammalian predators, and for hunting. At lower elevations, the desert tortoise (*Gopherus agassizii*) is a threatened species. Pronghorn (*Antilocapra americana*) are also found throughout the open country of the Arizona strip, but their habitat is threatened by the loss of native grassland and the encroachment by pinyon-juniper woodlands.

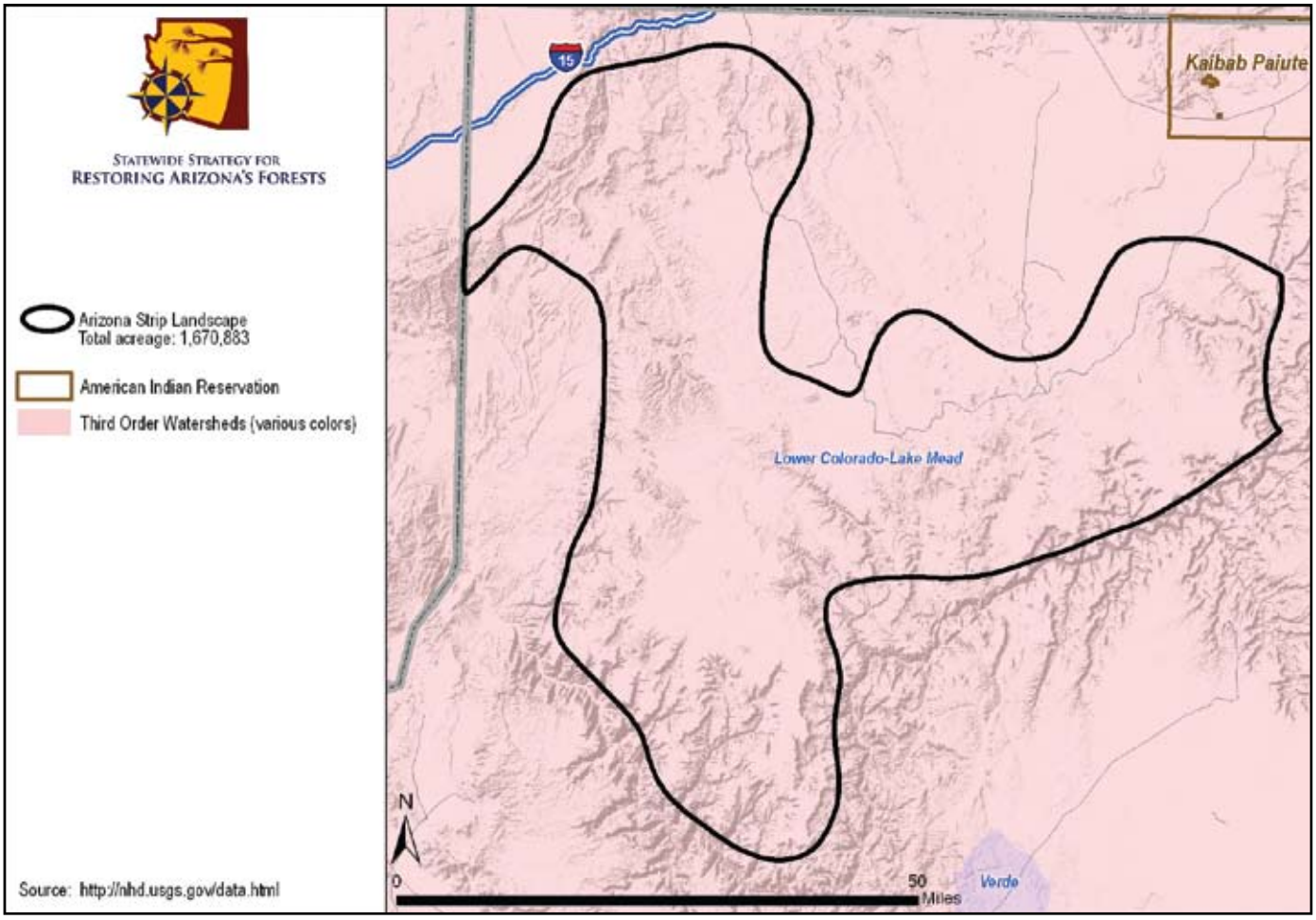
Fire

Those implementing fire management on the Arizona Strip are faced with many challenges: (1) extensive areas of continuous forest and woodland vegetation are subject to uncharacteristically intense wildfire, (2) these wildfires can negatively affect watersheds, soils, and native species and habitats, and (3) invasive cheatgrass can establish near monocultures following severe fire, increasing fine fuels and permanently altering fire regimes, especially at low and middle elevations. Ignition risks include human activities, but also lightning, which is especially intense on the rim of Grand Canyon and nearby plateaus. The remote character of the Arizona Strip limits fire response, with fire crews needing to travel long distances over rough roads to reach fires.

Wildfires in recent years have impacted grass and shrublands, particularly those suffering from cheatgrass invasion. Ponderosa pine and pinyon-juniper forests are susceptible to stand replacing fire over large areas with particularly dense woody vegetation, however, in some areas conditions are suitable for the use of Wildland Fire Use, a practice which is being used increasingly in remote areas such as the Arizona Strip.

Watersheds

The Arizona Strip falls within the Lake Mead Lower Colorado River watershed (Figure 9.1.4.). Perennial water sources are few and far between in the remote landscape of the Arizona Strip. The Virgin River represents the only large perennial stream in the region, which is bordered on the east by perennial Kanab Creek, and on the south by the Colorado River in Grand Canyon. Watersheds in the northern portion of the region drain into the Virgin River, while southern watersheds drain into Grand Canyon. Springs are important water sources throughout the region, as are seasonal water sources, such as Death Valley Lake near Mt. Trumbull, which fill following periods of heavy precipitation.



▲ Figure 9.1.4. Third-order watersheds (basins) in the Arizona Strip landscape.

Collaborative Efforts

Collaboration has always been an important aspect of social life in the Arizona Strip. The isolation of communities and outlying ranches fostered a deep sense of community among early Anglo settlers, many of whom were Morman pioneers. Yet independence and self-sufficiency are valued traits in the Arizona Strip region because the population is sparse and widely distributed. While distances and settlement patterns make forest management difficult, the BLM, Arizona Game and Fish Department, and Northern Arizona University's Ecological Restoration Institute have sustained a progressive experiment in forest restoration in the Mt. Tumbull area for more than a decade. The key element of this collaboration has been the integration of research with management. Researchers have studied the effects of tree thinning and prescribed fire on variables including forest structure, fire behavior, understory plant response, and habitat suitability for arthropods, lizards, rodents, songbirds, and other wildlife species, at both the stand and landscape scales.

Since 1995, 2140 acres have been treated with tree-thinning and prescribed fire. Establishment of cheatgrass followed a recent severe drought, and its changing role in the plant community is providing opportunities to study the behavior of an invasive plant in a landscape undergoing ecological restoration. The importance of the Mt. Trumbull project led to its incorporation within the newly designated Grand Canyon-Parashant National Monument, where restoration is a featured aspect of land management.

Economics

Opportunities for economic utilization of restoration products are limited in this remote region, due to the long distances to markets and the predominance of low-value species such as sagebrush, pinyon, and juniper. Past utilization of forest and woodland species has been limited to fuel wood, juniper posts, Christmas trees and other vegetative products such as pinyon nuts and ponderosa pine cones. Seed companies collect native plant seed in shrub- and grasslands.

Future Restoration Needs

While the Arizona Strip has been the setting for some of the most ambitious experiments in ecological restoration, numerous challenges face residents and land managers in continuing efforts to restore forest health on the Arizona Strip. As in many locations funding and staff constraints make it difficult to implement restoration treatments in a timely manner, and the remoteness of the region make economic utilization of the woody biomass generated by restoration treatments unprofitable. While the use of fire as a restoration tool is possible in wildland areas, the region's remoteness, combined with generally hot and dry conditions make it difficult for fire managers to identify appropriate opportunities for prescribed burns and Wildland Fire Use.

Invasion of restored areas by non-native herbaceous species, such as cheatgrass, poses another challeng to forest restoration efforts. In addition, livestock grazing can make it more difficult to accumulate fine fuels for prescribed fire and future maintenance burns. However, grazing is a historic part of the Strip, and ecological restoration efforts will need to build on collaborative efforts involving ranchers and other residents if they are to enjoy the broad support necessary for long-term success.

Recommendations:

1. *Long-term ecological research is needed to provide the necessary information for long-term ecosystem restoration and management. Efforts initiated by the Ecological Resotoration Institute and Arizona Game and Fish Department, in conjunction with the BLM, should continue, and monitoring efforts should be ongoing.*
2. *An adaptive management is needed to guide management, given the high degree of scientific uncertainty and the prospect of climate change. Monitoring should focus on ecological, social, and economic indicators, with forest management decisions based on trends in monitoing data.*
3. *Cooperation among state and federal agencies, and universities, is essential. Ongoing efforts should continue, and expansion from the research focus to incorporate management planning and implementation would be helpful.*
4. *All forest restoration and managmenet efforts should be developed to complement, where possible, community and county priorities. Only with this type of integration will restoration treatments be able to meet the diverse needs of a wide range of people and ecological circumstances.*

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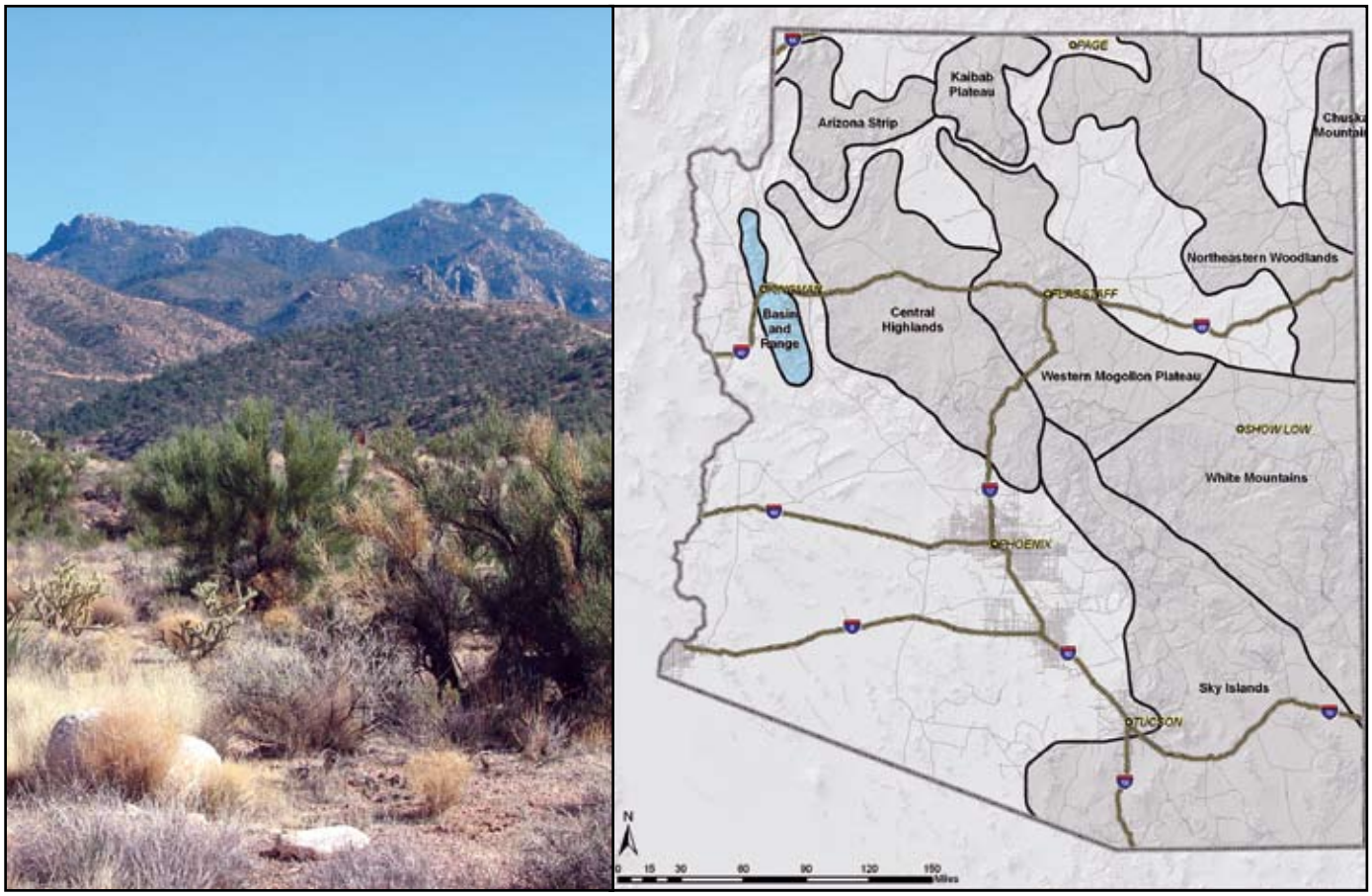
Contributions from Pete Fulé, Ecological Restoration Institute, and Ken Moore, Arizona BLM

Basin and Range



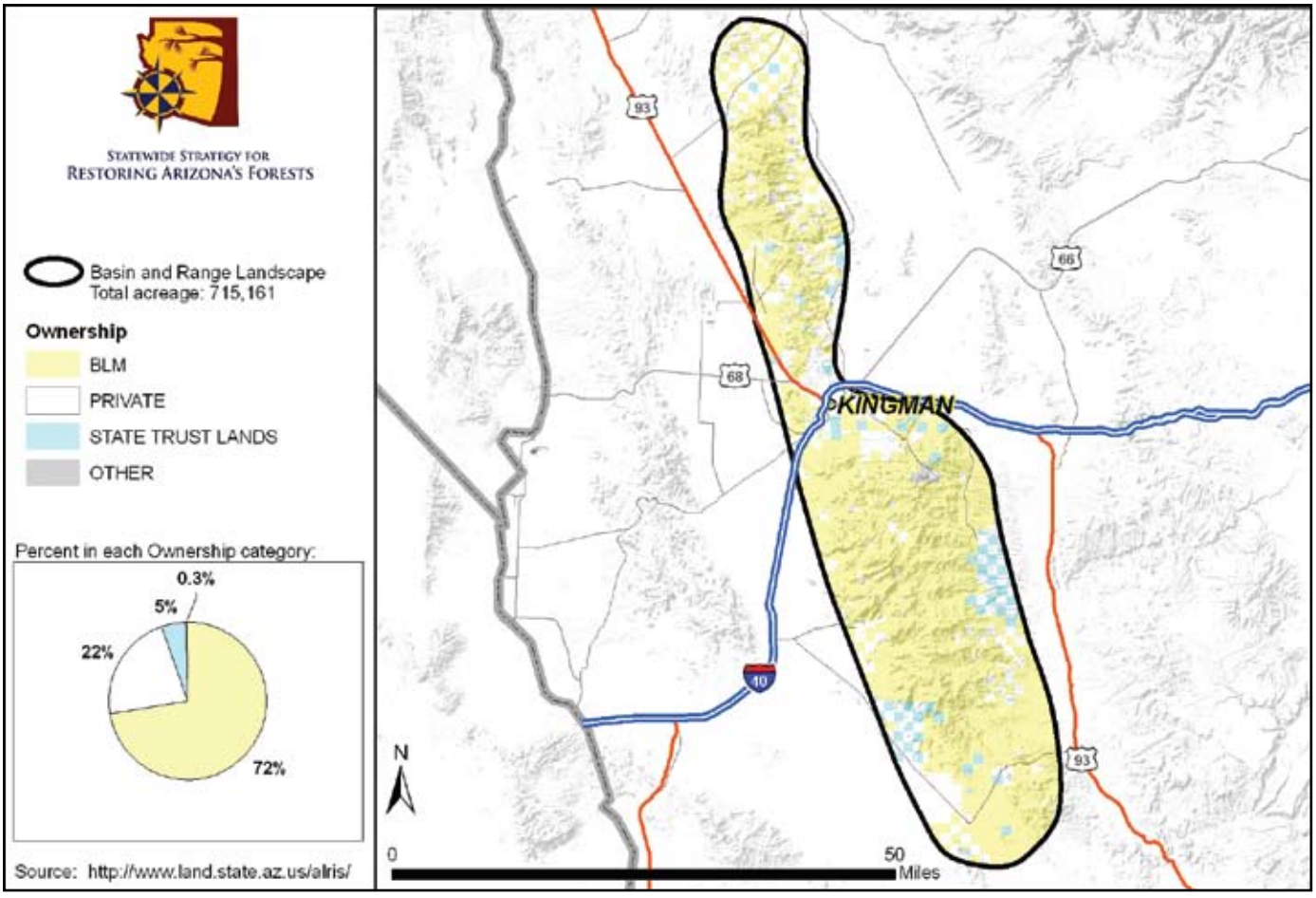
The Basin and Range landscape includes the Cerbat and Hualapai mountain ranges in Mohave County. These ranges are located immediately north and south of Kingman, and rise sharply from the Detrital and Sacramento valleys to the west, and the Hualapai and Big Sandy River valleys to the east.

Elevations range from about 3,000 feet above sea level in the valleys to more than 8,400 feet at Hualapai Peak in the Hualapai Mountains. Native vegetation varies widely due to the large range in elevation. Lower elevations of about 3,000 feet are dominated by Mohave and Sonoran Desert vegetative associations, transitioning to interior chaparral and pinyon-juniper woodlands at mid-elevations of about 5,000 feet, and to ponderosa pine/mixed-conifer forests at the highest elevations of about 7,000 feet. Average annual precipitation ranges from less than 10 inches at the lower elevations to more than 20 inches at the highest elevations. Soils are primarily shallow, well drained granitic complexes. Water from the north and west of this area drains directly into the Colorado River, while the eastern portion of the Hualapai Mountains drains into the Big Sandy River, then south to the Santa Maria River, and eventually into the Colorado River at Lake Havasu.

Land Ownership

Land ownership status within the Basin and Range region, as across much of Arizona, is dominated by public lands, with the BLM administering 72% of the landscape, Arizona State Trust Land comprising 5%, and a little less than 1% under Mohave County management. Twenty-two percent of the area is privately owned (Figure 9.2.1.).

Large portions of the Hualapai and Cerbat Mountain ranges are under BLM management, although small private in-holdings and some state and county lands occur throughout both ranges. The 40,000-acre Wabayuma Peak Wilderness and the 30,760-acre Mount Tipton Wilderness are also under BLM management, while the Hualapai Mountain Park covers about 2,226 acres of land managed by Mohave County in the north end of the Hualapai Mountains. The large number of private in-holdings and the mixed-ownership pattern can complicate management of forested areas in the Basin and Range landscape. Rapid urban development and growth in Mohave County also presents challenges when planning restoration treatments.



▲ Figure 9.2.1. Land ownership status in the Basin and Range landscape.

Forests

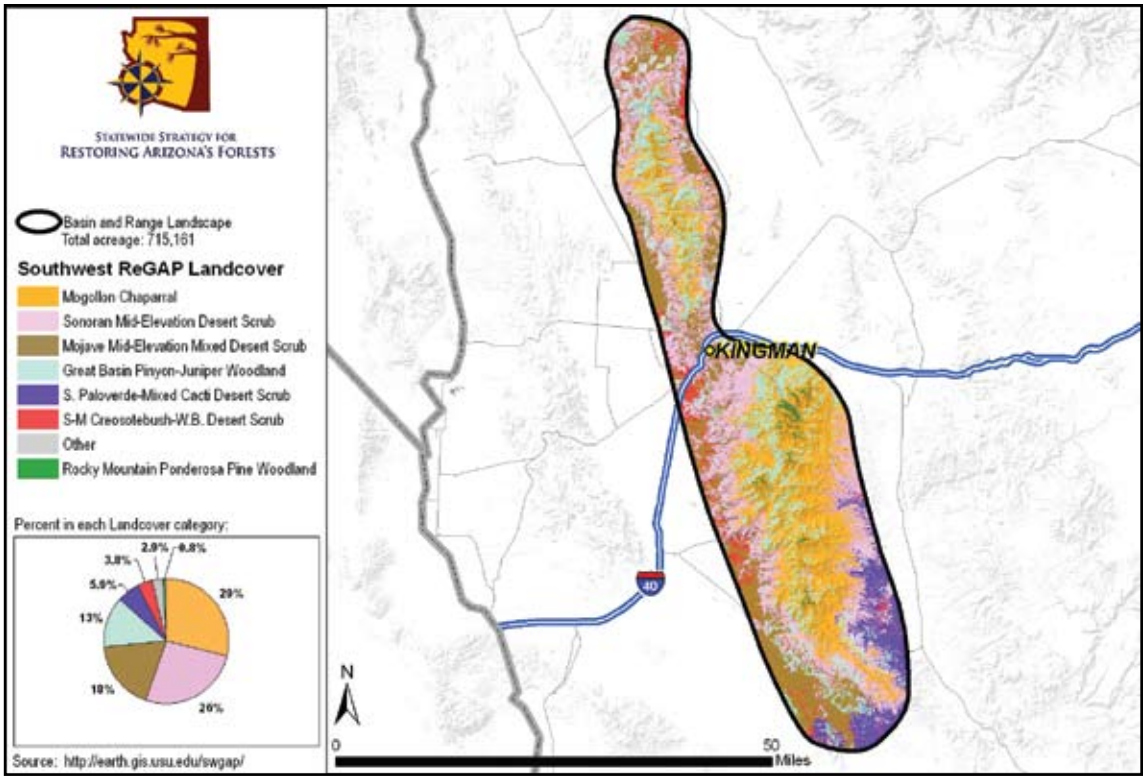
A highly diverse range of plant communities are found in the Cerbat and Hualapai Mountain ranges (Figure 9.2.2.). Mixed-conifer forest occur in small stands on north-facing slopes above 7,500 feet, primarily near Hualapai, Hayden, and Aspen peaks within the Hualapai Mountain Park. Dominant species in this association are ponderosa pine (*Pinus ponderosa*), white fir (*Abies concolor*), and Douglas fir (*Pseudotsuga menziesii*). A few small stands of aspen (*Populus tremuloides*) occur between Hayden and Aspen peaks.

Ponderosa pine is dominant across about 4,000 acres, principally on north-facing slopes down to 6,500 feet in the Hualapai Mountains and in the Cerbat Mountains near Mount Tipton. Gambel oak (*Quercus gambelii*) is found in association with ponderosa pine at higher elevations, while interior chaparral, pinyon pine, and juniper co-occur at the lower limits of the pine zone, down to about 5,600 feet.

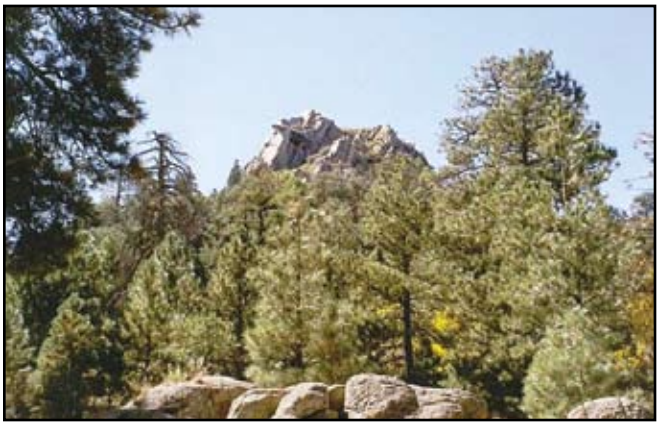
Pinyon-juniper woodlands occur throughout the Basin and Range area at elevations between 4,600 and 6,500 feet, and are composed primarily of single-leaf pinyon (*Pinus monophylla*) and Utah juniper (*Juniperous osteosperma*). These forest types occur primarily in association with Arizona interior chaparral, although ponderosa pine may occur at higher elevations, and Mohave and Sonoran desert scrub species may be found in these stands at lower elevations.

Arizona interior chaparral occurs primarily between elevations of 4,500 and 6,500 feet, although it occurs on the south-facing slopes of the highest peaks, and may be represented among desert scrub communities at lower elevations.

Interior chaparral consists of several shrub species, but is typically dominated by shrub live oak (*Quercus turbinella*) and manzanita (*Arctostaphylos* spp.). It occurs in many areas as pure stands, but is often associated with scattered pinyon and juniper trees.



▲ Figure 9.2.2. Vegetation composition in the Basin and Range landscape.

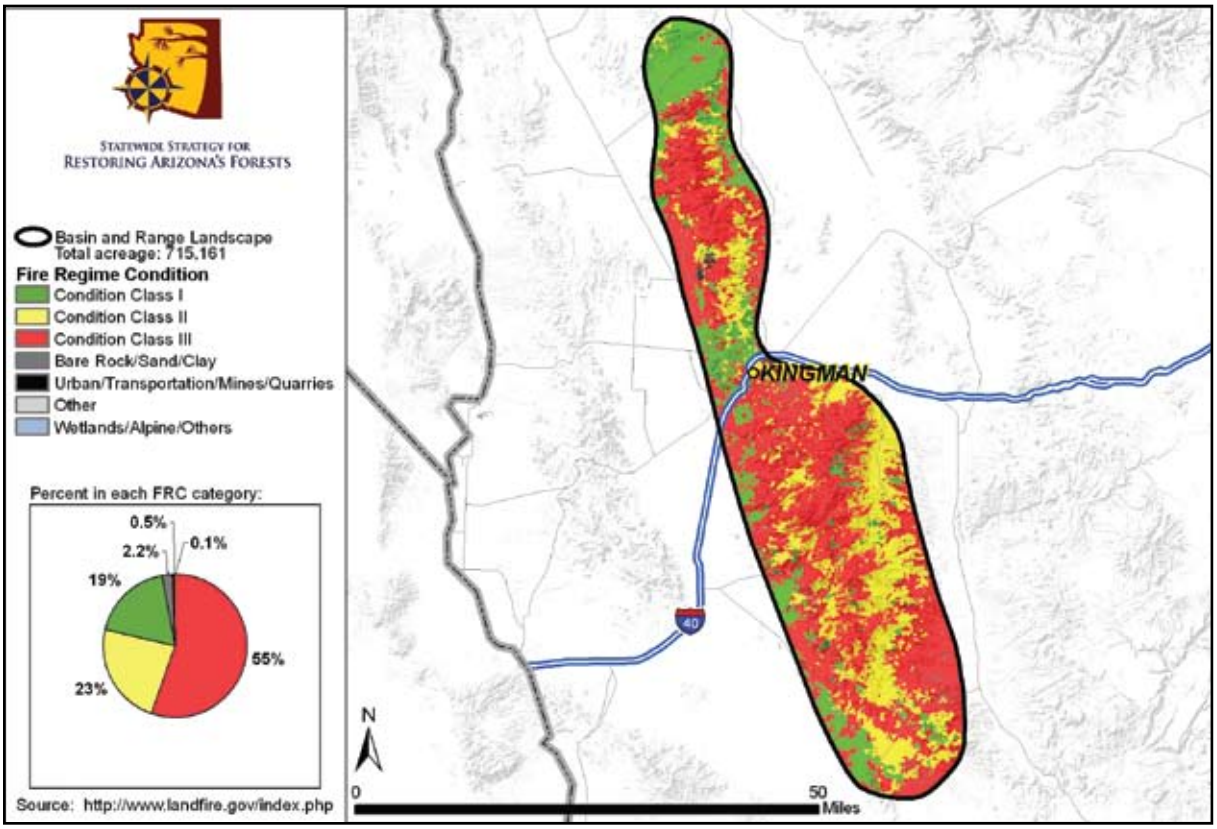


Current Conditions

Fire exclusion during the past century, combined with recent drought, has exacerbated insect and mistletoe infestations in the mixed conifer stands of the Basin and Range landscape. Past fire exclusion has caused overstocking in ponderosa pine stands, and created heavy dead and down fuel loading in some areas, increasing the probability of uncharacteristic wildfire (Figure 9.2.3.).

Pinyon-juniper woodlands in the Basin and Range landscape have not experienced the elevated mortality seen in many other Arizona pinyon-juniper woodlands. Nonetheless, drought and insects have caused significant tree mortality in some areas in recent years, especially across drier, south-facing slopes.

Most interior chaparral has also been affected by fire exclusion. This vegetation type evolved under a regime of infrequent, stand-replacing fires, but fire exclusion has led to heavy fuel accumulations that pose significant fire management challenges. Extensive areas in the Hualapai and Cerbat mountains have been treated with prescribed burning during the last 12 years, and have been successful in creating a mixed age class plant community that is more typical of the pre-suppression era.



▲ Figure 9.2.3. Fire Regime Condition characteristics of vegetation in the Basin and Range landscape.

Communities

Communities located within the forested areas in the Basin and Range area are largely limited to small unincorporated developments around the periphery of the city of Kingman. The developments of Pine Lake, Pinion Pines, Atherton Acres, Lazy Y-U, and Cedar Hills are located at the north end of the Hualapai Mountains. Dolan Springs and Chloride are located on the north and west side of the Cerbat Mountains, surrounded by Mohave Desert vegetation. The city of Kingman, also located in the Mohavean vegetation type, lies between the Hualapai and Cerbat mountain ranges, though rapid growth has spurred exurban development at the north end of the Hualapai Mountains and on the east side of the Cerbat range. Estimated population for the greater Kingman area in 2005 was 43,500 people.

Kingman and Pine Lake are listed in the Federal Register as communities "at risk" (Table 9.2.). Community values to be protected include public safety, aesthetics, and economic viability. A CWPP is currently under development for the communities on the north end of the Hualapai Mountains. A CWPP is also planned for the greater Kingman area.

Critical infrastructure includes transmission lines, roadways, railroads, and water and gas lines, as well as several significant communication facilities, which are located on the highest peaks in the Hualapai and Cerbat mountains. A number of recreational sites in the Hualapai and Cerbat mountains are popular with area residents, providing a cool respite from summer heat. While the Hualapai Indian Reservation is not located in the Basin and Range landscape, areas of the Hualapai and Cerbat mountains are important cultural resources for the tribe and should be considered when making decisions about forest restoration and management in the Basin and Range landscape.

Table 9.2. Communities at risk in the Basin and Range Landscape Area

Community	County	WUI Risk Rating	CWPP
Kingman	Mohave	High	Planned
Pine Lake	Mohave	High	In development

Wildlife

The Hualapai and Cerbat Mountain ranges rise abruptly from creosote bush flats on the Mohave Desert floor, very much like the Sky Islands in southern Arizona. This elevation gradient supports a broad diversity of plant and animal communities from several different western biomes. Wildlife species of particular interest include the endangered Hualapai Mexican vole (*Microtus mexicanus hualpaiensis*) and peregrine falcon (*Falco peregrinus*), along with mule deer (*Odocoileus hemionus*), and the Rocky Mountain elk (*Cervus canadensis*).

The Hulapai Mexican vole lives in the higher elevations of the Hualapai Mountains, where it is associated with ponderosa pine forests. It lives exclusively on grasses and leafy plants that thrive in forest openings and moist sites. Mule deer prefer the shrubs that occur from the interior chaparral at lower elevations into the higher elevation pinyon pine and ponderosa pine stands. Elk tend to prefer those areas where grasses grow. Currently there are an estimated 100 elk residing in the Hualapai Mountains.

Other forest-dwelling mammals identified by the Arizona Game and Fish Department as in need of conservation measures include the spotted bat (*Euderma maculatum*), the greater western mastiff bat (*Eumops perotis californicus*), the California leaf-nosed bat (*Macrotus californicus*), and the big free-tailed bat (*Nyctinomops macrotis*). As in the nearby Arizona Strip landscape, desert tortoises (both Sonoran and Mohave populations) are found in the lower elevation woodlands and chaparral zones of the Basin and Range landscape. The northern goshawk (*Accipiter gentilis*) and Mexican spotted owl (*Strix occidentalis lucida*) are found in the higher-elevation forests and woodlands, as are the Swainson's thrush (*Catharus ustulatus*), olive-sided flycatcher (*Contopus cooperi)*, sage thrasher (*Oreoscoptes montanus*), and red-naped sapsucker (*Sphyrapicus nuchalis*).

Fire

Fires in the Basin and Range country can be hard to control, due to limited access, rugged terrain, and heavy fuel loads. The effects of recent drought, including increased insect mortality, have contributed even more fuel to the readily combustible material in the area's forests. About 70% of wildfires in this area are lightning caused, although human ignitions occur frequently. The largest and most intense fires have occurred primarily in interior chaparral vegetation, which is adapted to infrequent, stand-replacing fire. The Stove Fire burned roughly 11,000 acres in the southern end of the Hualapais in 1995. In recent years, most fires in ponderosa pine and mixed-conifer habitats have burned less than 10 acre. However, the 2002 Wild Cow and Lion Kill fires burned a combined 840 acres in ponderosa pine and chaparral, briefly threatening the communities of Pine Lake, Pinion Pines, Atherton Acres, and Hualapai Mountain Park.

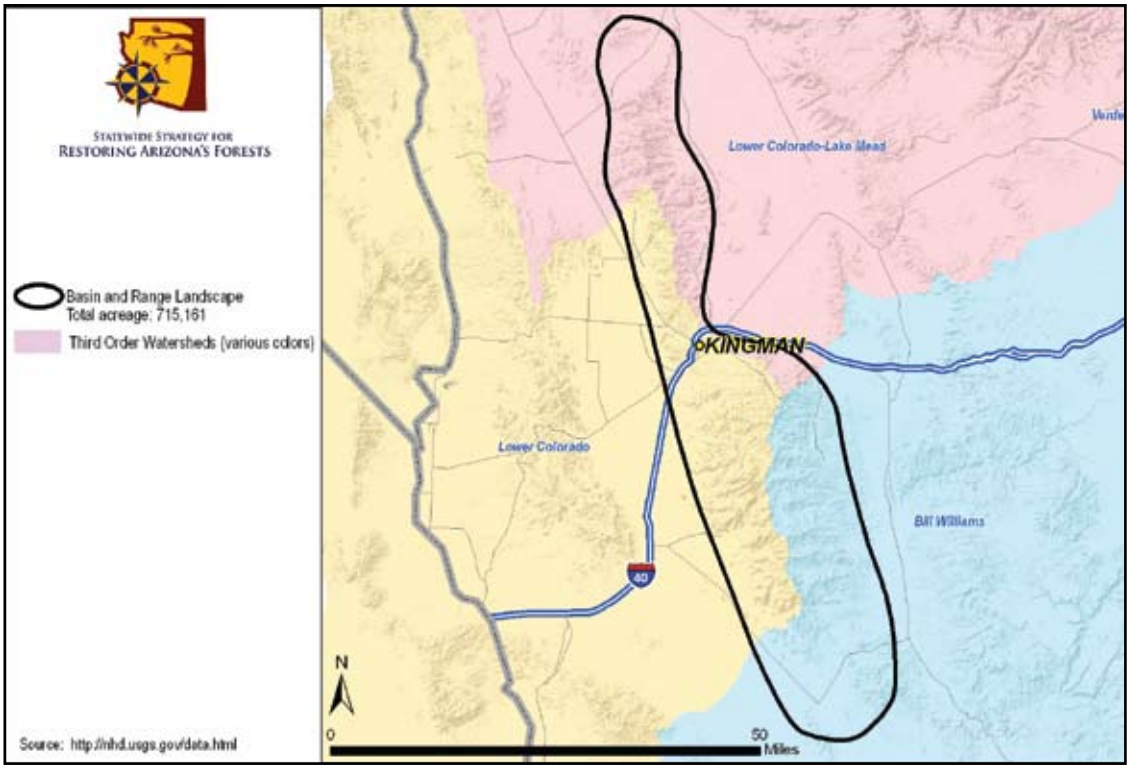
Large fires have been few, primarily due to aggressive fire suppression efforts, the BLM's pro-active prescribed fire program, and efforts to establish defensible space around structures and communities.

Watersheds

The Hualapai and Cerbat Mountain ranges are primarily composed of metamorphic granite that has weathered over millennia to create deep "v" shaped valleys with very steep slopes. The overall alignment of the mountain ridges is north to south with sharply incised valleys running perpendicular from the ridge crest in an easterly or westerly direction. The alignment of these valleys creates a clear difference in vegetation present on the slopes. The south-facing slopes receive more direct sunlight and are warmer than the north facing slopes, which tend to be cooler and moister. The vegetation associated with the southerly slopes is generally interior chaparral with some pinyon pine mixed in at higher elevations. The northerly slopes support forests primarily of ponderosa pine.

In general, soils in the Basin and Range landscape are thin, with granite bedrock very close to the surface. These thin soils have limited water-holding capacity, so precipitation is carried quickly down the steep slopes and collected in the flat valley bottoms, contributing to rapid water movement and powerful erosional events. Even average monsoon rains can generate flooding in the broad valleys to the east and west of the mountains. Maintaining the appropriate amount of vegetative cover on steep slopes is important for reducing the force of erosion. For the interior chaparral, a mosaic of young and old vegetation patches, distributed across the south-facing slopes is desirable, while mixed-age stands of ponderosa pine and pinyon-juniper woodland is appropriate for north-facing slopes and ridge tops at the highest elevation.

Third order watershed basin in the Basin and Range landscape are depicted in Figure 9.2.4.



▲ Figure 9.2.4. Third-order watersheds (basins) in the Basin and Range landscape.

Collaborative Efforts

Collaborative educational efforts have been successful at improving the awareness of the risks associated with living in close proximity to fire-adapted forest and chaparral vegetation. Public education and fire prevention has been the focus of past collaborative efforts within the community of Kingman.

The Pine Lake Working Group was created in 2001 to address fire and fuels management issues in and around the community of Pine Lake. Working group members include the Pine Lake Fire Department, Hualapai Mountain Homeowners Association, Bureau of Land Management, and Mohave County. This group has developed and managed several projects to improve fire safety in the area, including construction of fuel breaks around the communities of Pine Lake, Pinion Pines, and Atherton Acres; maintenance of roads for fire escape routes; disposal sites for hazardous fuel removal; prescribed fire projects; thinning; and increased fire prevention and education efforts. In addition, grant monies have been used to improve defensible space around structures, reduce hazardous fuel accumulations, and upgrade fire department equipment at Pine Lake.

A fuel break has been created around the community of Pinion Pine, and a fuel break is currently being constructed around the Atherton Acres development on BLM-administered lands. Pinion Pine Fire Department has been quite active in assisting property owners in creating and maintaining defensible space around homes in the area.

Pine Lake Fire Department, Pinion Pine Fire Department, Mohave County Emergency Services, Arizona State Land Department, and the BLM maintain an emergency operations plan for fire response in the Hualapai Mountains. This plan outlines the processes and procedures for emergency response, warning and evacuation, incident command and communications, as well as and public information in the event of a wildfire. This plan is reviewed and updated annually.

Economics

Economic utilization of small diameter wood and biomass has been limited in this area. Extremely rugged terrain and restricted access limit the potential for significant biomass utilization. Local businesses that engage in this type of work are limited by the available supply of forest products in the area. In addition, much of the available ponderosa pine habitat occurs on county park lands, where recreational use and value is an important priority.

Modest forest product utilization has occurred with thinning projects in the Pine Lake and Hualapai Mountain Park areas. Careful thinning of hazard trees and insect-killed ponderosa pine has been accomplished by one man with a team of draft horses, and a portable mill. Lumber produced by the mill has been purchased by local residents, ranchers, and businesses. Wood that is not suitable for milling is offered for sale as firewood. Currently about 200 cords of wood are sold to campers and local residents each year.

Implementation & Management

Since 1999, the BLM has conducted prescribed burning on more than 24,000 acres of interior chaparral habitat. The purpose was to reduce fuel loadings and the risk of large wildfires developing in the Hualapai and Cerbat mountains. The BLM's Desired Future Conditions for the Basin and Range landscape is a mosaic of vegetation types and ages that are similar to historic conditions. These conditions are characterized by healthy, vigorous plant communities that are resilient to natural disturbances, fewer dense "dog-hair" thickets prone to uncharacteristic burns, fewer ladder fuels and downed woody debris, and a high percent of large trees. The objective is to maintain these conditions with a combination of prescribed fire and mechanical treatments.

In August 2004, the BLM met with the Mohave County Board of Supervisors and recommended that the county develop a CWPP to address important issues such as wildfire response, hazard mitigation, community preparedness and structure protection, and seeking out new avenues of cooperative funding. The Board of Supervisors decided to develop two separate CWPPs--the Hualapai CWPP and the Kingman CWPP. They did this because they wanted to procure funding for the areas most at risk as soon as possible. The Hualapai CWPP, which includes the communities of Pine Lake, Pinion Pine, Cedar Hills, and the Lazy Y-U, will be developed first. The Kingman CWPP will follow.

Future Restoration Needs

1. Implement prudent use of wildland fire use events in order to reflect the historic range of fire disturbances within the interior chaparral, ponderosa pine, mixed-conifer, and aspen vegetation types of the Basin and Range region.
2. Establish and maintain the appropriate landscape scale diversity of vegetative age classes, densities, and forest structures to create a healthy and resilient range of vegetation types for the long-term benefit of all plant and animal species within the region.
3. Maintain the presence of aspen in the region, remove conifer ingrowth from the aspen stands at higher-elevation sites in the Hualapai Mountains.

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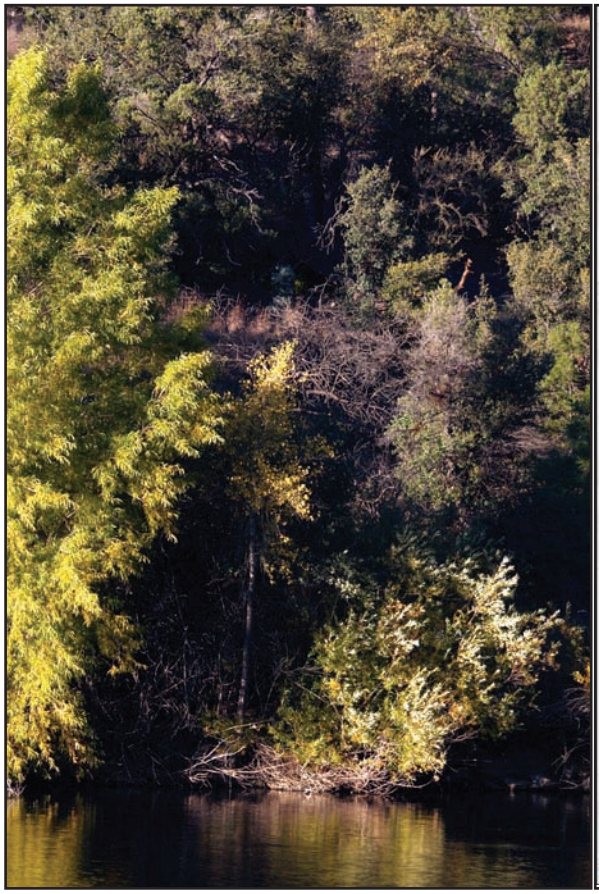
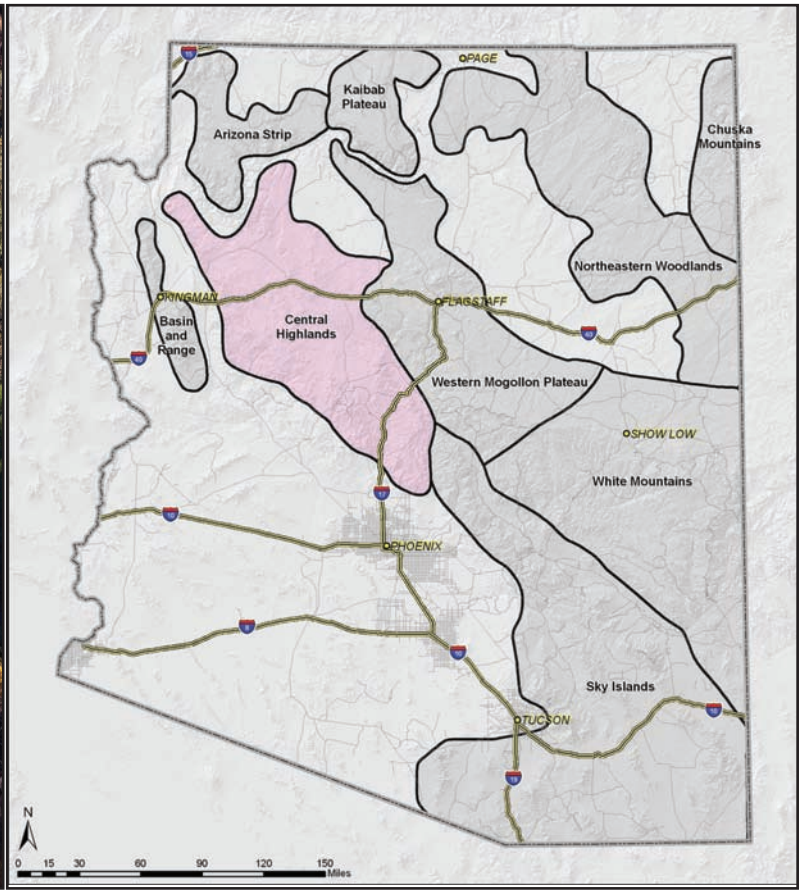
Central Highlands





The Central Highlands region is a transition zone that divides the state of Arizona into two major geologic provinces: the Colorado Plateau to the north and the Basin and Range to the south and west. The region is characterized by numerous mountain ranges separated by several basins including Chino Valley and the Verde Valley. It is a region that offers a wide range of vegetation biomes and geologic landforms.

Elevations range from about 4,400 feet above sea level in the valleys to about 7,800 feet in the highest reaches of the Bradshaw Mountains. Native vegetation varies from high desert grassland in the basin areas to coniferous forest in the surrounding mountains. Ponderosa pine exists at the highest elevations, but most of the landscape is characterized by pinyon-juniper woodlands, chaparral, and Sonoran desert communities at successively lower elevations. Precipitation ranges from about 10 to 35 inches annually, contributing to perennial streams and springs.

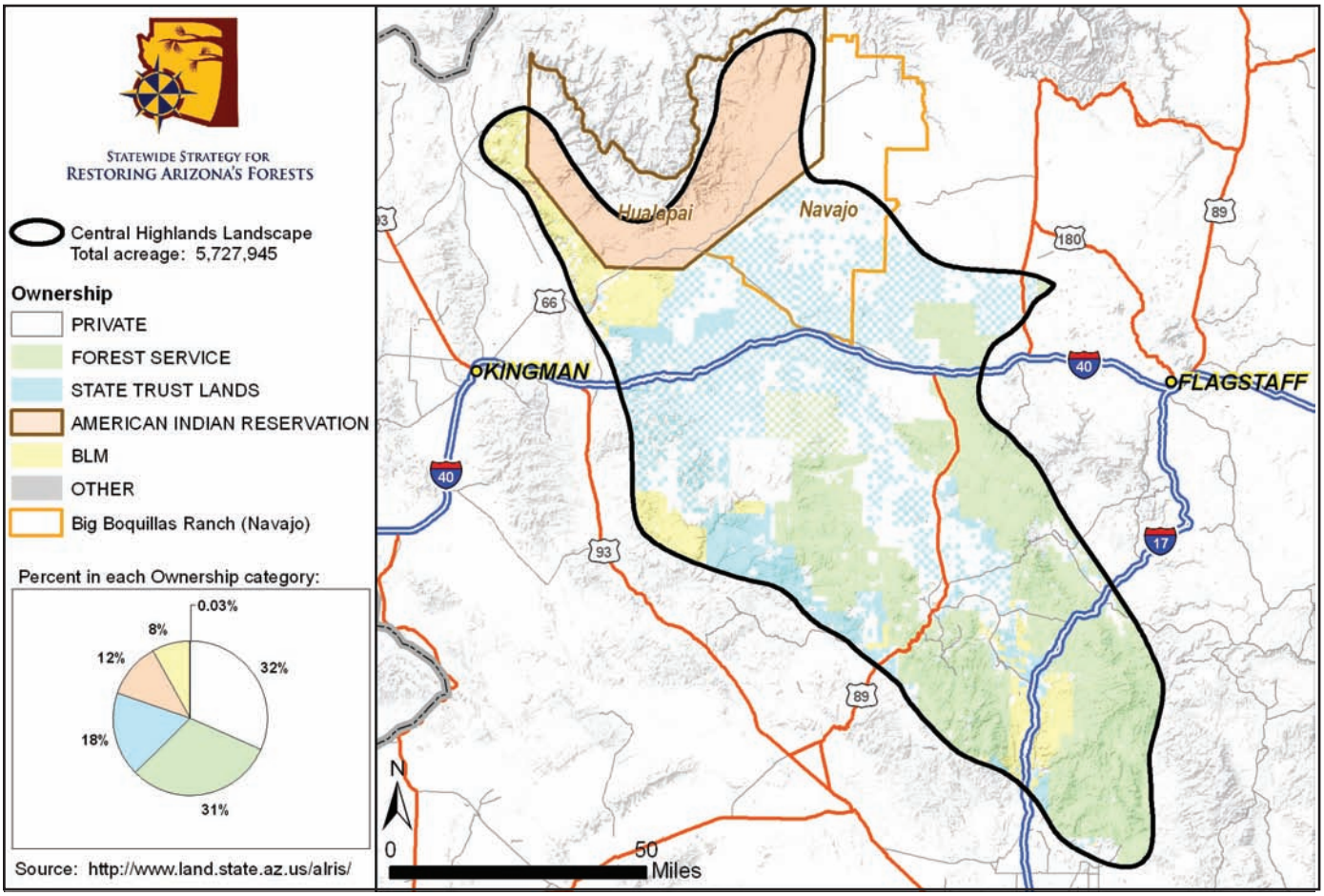
Within the Central Highlands, the Prescott National Forest (PNF) encompasses about 1.41 million acres, almost entirely within Yavapai County. Half of the forested areas lie west of Prescott, in the Juniper, Santa Maria, Sierra Prieta, and Bradshaw mountains. The other half lies east of Prescott in the Black Hills, on Mingus Mountain, and around the headwaters of the Verde River. Two halves are separated by the Chino and Lonesome valleys, and the Agua Fria River corridor.

The Big Boquillas Ranch, north of Seligman, covers roughly 730,000 acres, with more than half of the ranch held privately by the Navajo Nation and the remaining portions comprised of leased state trust land. Pinyon-juniper woodlands predominate, but there are areas of mixed conifer in the region of the Aubrey Cliffs, which run through the center of the ranch.

Occupying part of Coconino, Yavapai and Mohave counties, and hugging the Colorado River, the Hualapai Reservation's topography varies from rolling grassland to forest. Elevations range from 1,500 feet at the Colorado River, to over 7,300 feet at the highest point of the Aubrey Cliffs, located on the eastern portion of the reservation.

Land Ownership

Land ownership status within the Central Highlands landscape is more diversified that across much of Arizona, with 39% under federal ownership--31% managed by the U.S. Forest Service and 8% by the BLM. State Trust Lands comprise 18%, and 12% is under tribal management, either Hualapai or Navajo. The remaining lands (31% of the total) are privately held. Across much of the Central Highlands, the ownership pattern forms a checkerboard mosaic of management authorities (Figure 9.3.1.), making forest planning and management a challenge, particularly with respect to accomplishing restoration treatments on the ground.



▲ Figure 9.3.1. Land ownership status in the Central Highlands landscape.

Communities

Human communities within the forested areas of the Central Highlands landscape are concentrated in the tri-city area of Prescott, Prescott Valley and Chino Valley, where about 110,000 people live, but also include the smaller communities of Yarnell, Crown King, and Seligman. Critical infrastructure at risk includes specific roadways, railroads, overhead utility transmission lines, water and gas distribution systems, and telecommunications sites.

In summer, the population increases dramatically when large numbers of campers, recreationists, and other tourists descend on the Prescott National Forest, and from 4,000 to 10,000 youths spend time in the area's many camps.

The Yavapai Prescott Indian Tribe's 160 members inhabit a 1,395-acre reservation adjacent to and north of Prescott. Further to the northwest, the 1,600-member Hualapai Tribe occupies a reservation of one million acres along 108 miles of the Colorado River, in and adjacent to Grand Canyon. Peach Springs, the tribal capital, is 50 miles east of Kingman on Historic Route 66.

Within the Central Highlands landscape there are 12 communities listed as "at-risk" in the federal Register (Table 9.3). The Yavapai Communities Wildfire Protection Plan is the only collaboratively developed plan in the area, and it encompasses eight of these communities. Four communities--Camp Verde, Cottonwood, Jerome, and Peach Springs--are not included in any Community Wildfire Protection Plan (CWPP). Both the Yavapai Prescott and the Hualapai have developed fire plans for their communities.

Table 9.3. Communities at risk in the Central Highlands region

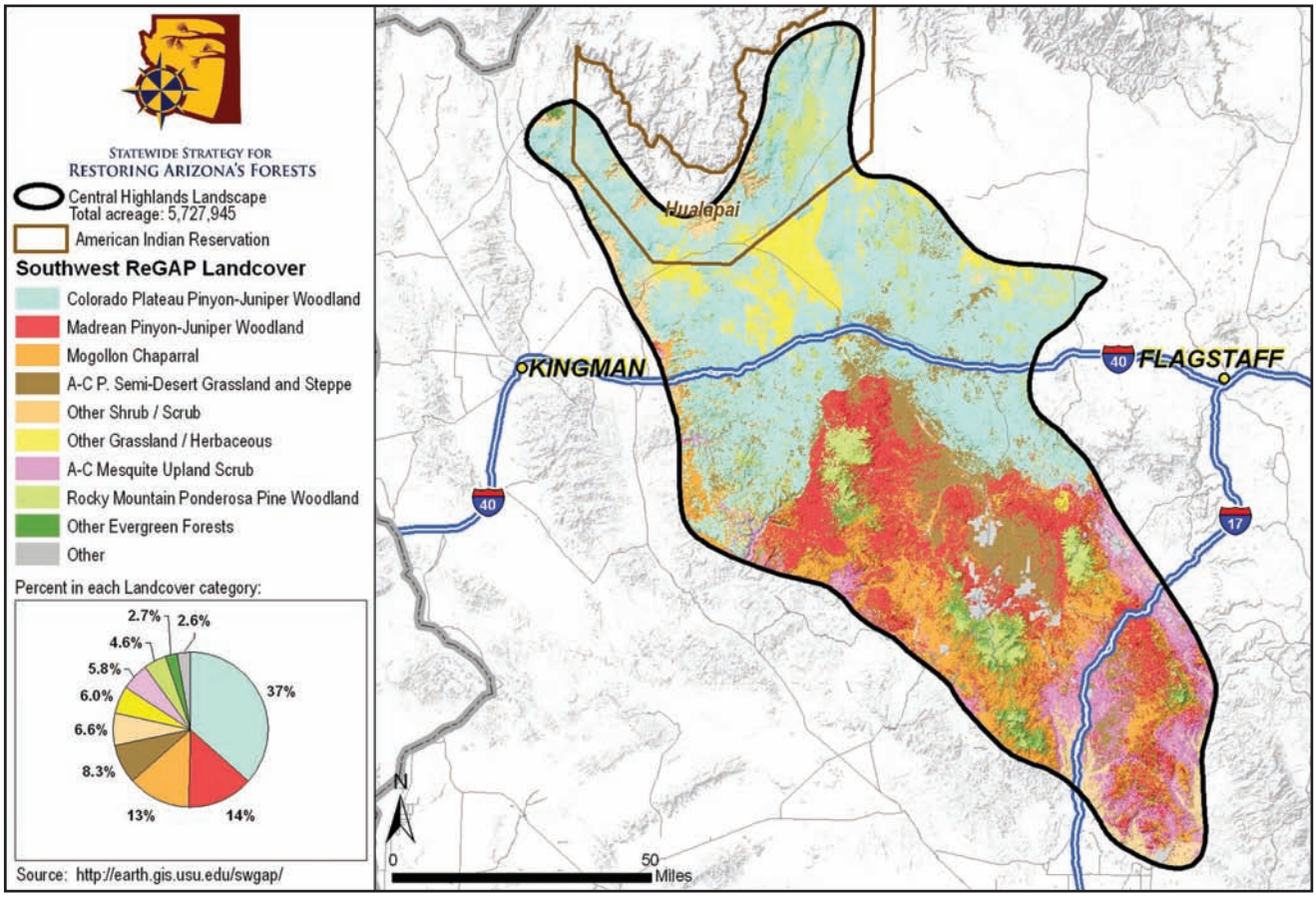
Community	Latitude/Longitude	WUI Risk Rating	County	CWPP
Camp Verde	34.5636 / -111.8543	Moderate	Yavapai	N/A
Cherry	34.5881 / -112.0418	Moderate	Yavapai	Yavapai Communities
Cottonwood	34.7392 / -112.0099	Moderate	Yavapai	N/A
Crown King	34.2056 / -112.3385	High	Yavapai	Yavapai Communities
Groom Creek	34.4756 / -112.4313	High	Yavapai	Yavapai Communities
Jerome	34.7489 / -112.1138	High	Yavapai	N/A
Mingus Mountain	34.6987 / -112.1377	Moderate	Yavapai	Yavapai Communities
Mt Union/Mtn Pine Acre	34.4139 / -112.4125	Moderate	Yavapai	Yavapai Communities
Peach Springs	35.5292 / -113.4255	High	Mohave	N/A
Prescott	34.5400 / -112.4685	High	Yavapai	Yavapai Communities
Walker	34.4558 / -112.3782	High	Yavapai	Yavapai Communities
Yavapai Prescott	34.5622 / -112.3956	High	Yavapai	Yavapai Communities

Forests and Current Conditions

The diverse topography of the Central Highlands landscape, with its many canyons, ridges, and rolling hills, creates an area of high biological diversity. Dominant habitats consist of spruce-fir forests, ponderosa pine forest, pinyon-juniper, chaparral, and semi-desert grassland.

Ponderosa pine forests make up about 5% of the Central Highlands landscape and occur in the higher elevations--6,000 to 8,000 feet. They are found in the areas around Prescott, the Bradshaw Mountains, the Woodchute Mountain Wilderness, and the Juniper Mesa and Apache Creek Wilderness areas (Figure 9.3.2.). Ponderosa pine (*Pinus ponderosa*) is the predominant tree species throughout. White fir (*Abies concolor*) and Douglas fir (*Pseudotsuga menziesi*) may be found in association at the higher elevations, while Gambel oak (*Quercus gambelii*), two-needle pinyon pine (*Pinus californiarum* var. *fallax)*, juniper (*Juniperus* spp.), and chaparral species are intermixed to varying degrees. The Hualapai reservation has 50,000 acres of ponderosa pine forest, intermixed with Gambel oak. It has been 20 years since any thinning was done in this forest.

Ponderosa pine stands are currently stocked at moderately high levels with an age class composition characterized as mostly immature with very little in the young and mature components.



▲ Figure 9.3.2. Vegetation composition in the Central Highlands landscape.

Pinyon-juniper woodlands occur at elevations between 5,000 – 6,000 ft. Colorado pinyon (*Pinus edulis*) is found throughout, with singleleaf pinyon (*P. monophylla*) occurring on limited areas. Other tree species include: Utah juniper (*Juniperus osteosperma*), Rocky Mountain juniper (*J. scopulorum*), and one-seed juniper (*J. monosperma*), which are intermixed with pinyon pine. Annual and perennial grasses and grass-like plants, forbs, half-shrubs and shrubs comprise a highly variable understory. Pinyon-juniper woodlands are generally regarded as having little economic importance, except as fuelwood and for the edible pinyon nuts. Between 2002 and 2003, 40-80% of the pinyon trees in Arizona died, due to drought and high temperatures. Numerous factors, most likely including prolonged livestock grazing, 50 years of fire suppression practices, and changes in climate have resulted in the encroachment of juniper into previously open areas, with the result that many woodlands are subject to the increased likelihood of uncharacteristic wildfire (Figure 9.3.3.).

Chaparral covers about 13% of the Central Highlands landscape. Predominant species include mountain mahogany (*Cercocarpus montanus*), manzanita (*Arctostaphylos pungens*), silk tassel (*Garrya wrightii)*, scrub oak (*Q. turbinella*), emory oak (*Q. emoryi*), and Arizona white oak (*Q.arizonica*). These vegetation types are arranged as large, continuous stands of chaparral, or can be interspersed with ponderosa pine and in woodland areas. Fire suppression over the last century created stands of greater density and higher fuel loads in this fire-adapted plant community. While stand-replacing fires are characteristic of chaparral, persistent and long-term drought, high temperatures, low humidity, and high winds contribute to extreme fire conditions in this vegetation type.

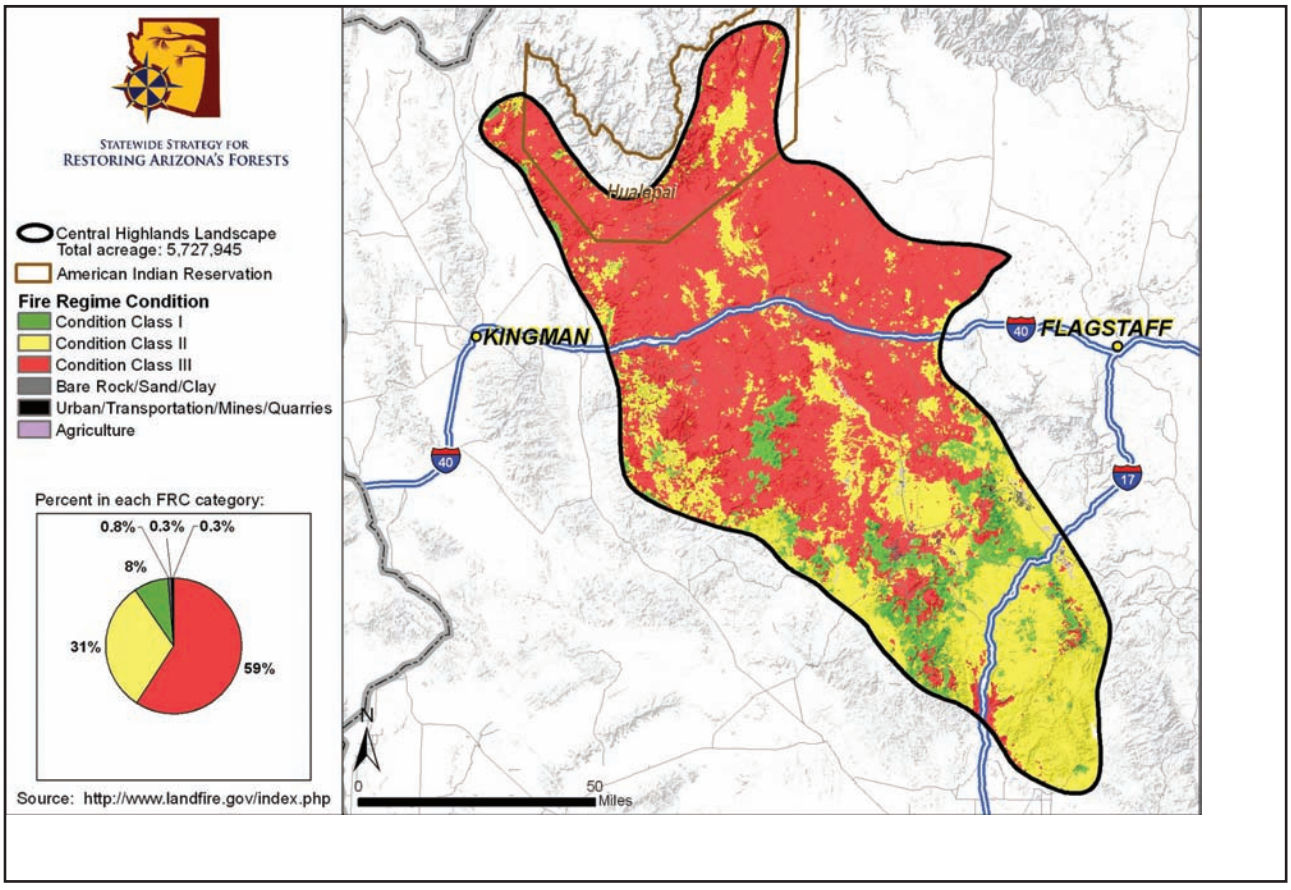


Figure 9.3.3. Fire Regime Condition characteristics of vegetation in the Central Highlands landscape.

Wildlife

Due to its varied topography, the Central Highlands landscape supports a number of different habitat types. Key wildlife species, including the tassel-eared squirrel (*Sciurus aberti)*, Mexican spotted owl (*Strix occidentalis lucida*), Merriam's turkey (*Meleagris gallopavo*), northern goshawk, (*Accipiter gentilis*) white-tailed deer (*Odocoileus virginianus*), Rocky Mountain elk (*Cervus canadensis*), black bear (*Ursus americanus)*, pronghorn (*Antilocapra americana*), black-footed ferret (*Mustela nigripes*), Gunnison's prairie dog (*Cynomys gunnisoni*), and grassland birds such as the western burrowing owl (*Athene cunicularia hypugea*), ferruginous hawk (*Buteo regalis*), Swainson's hawk (*Buteo swainsoni*), and rough-legged hawk (*Buteo lagopus*).

As in many landscapes across the state, ponderosa pine-dominated wildlife habitat in this landscape has become increasingly dense due to fire suppressions, livestock grazing, and large tree logging. Drought during the last two decades appears to be contributing to a retreat of habitat types upslope due to dominant plants dying off in marginal locations at lower elevations. Ponderosa pine and pinyon pine-dominated habitat types have experienced severe losses due to bark beetles. Juniper and manzanita have also perished in more marginal sites. Grassland habitat types have been invaded by shrubs and trees, depleting available moisture and nutrients. Year-long livestock grazing is still prevalent in this region and has eliminated most cool-season grasses and fine fuels for naturally occurring fires. Further, as juniper invasion has progressed, soils have dried out and eroded, forming gullies that further expose grasses to desiccation and diminish the numbers and diversity of plants and wildlife. This conversion of habitat to monotypic stands of juniper trees affects a spectrum of grassland dependent wildlife species – from antelope to burrowing owls.

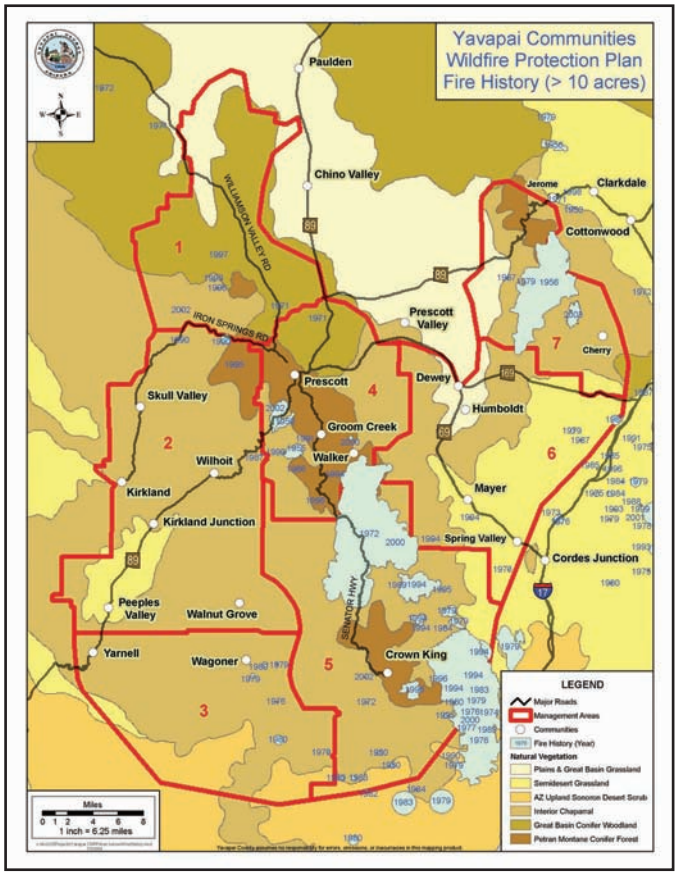
Mexican Spotted Owl

The Mexican spotted owl (*Strix occidentalis lucida)*, a federally-listed threatened species, is considered a species of special concern by the Arizona Game and Fish Department (AZGFD), and a sensitive species by the U.S. Forest Service. They breed primarily in dense, old-growth, mixed-conifer forests located on steep slopes, and especially in deep, shady ravines. In Arizona, they occur primarily in ponderosa, mixed-conifer, pine-oak, and evergreen oak forests. Range size for single owls averages 1,600 acres and combined home ranges for pairs of owls average 2,000 acres.

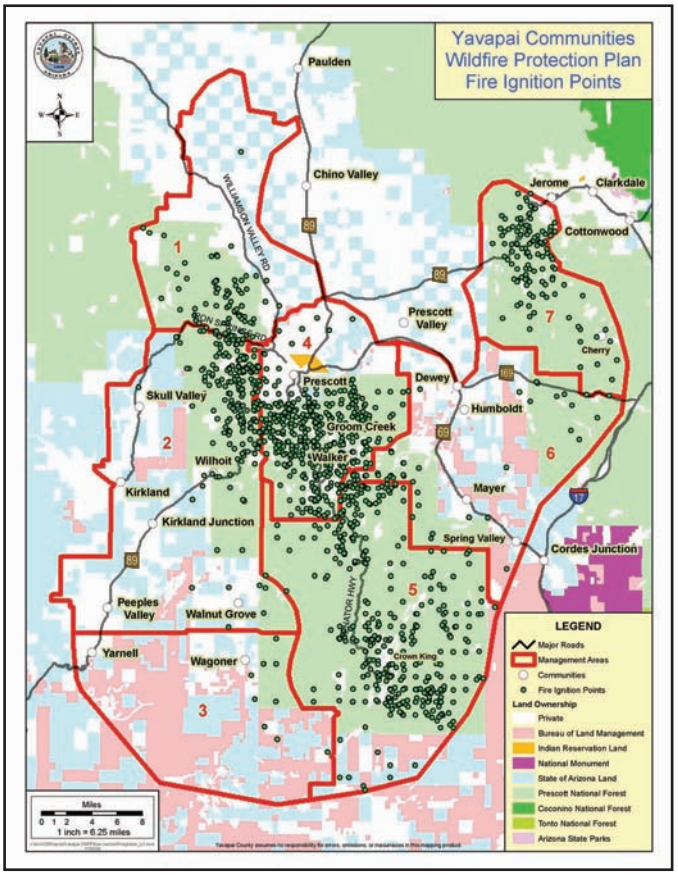
Fire

Fuel hazards include combustible vegetation as well as combustible structures and related improvements. Areas of concern are continuous across Central Highlands forested landscape, except where previous events have reduced hazard, e.g. wildfire, prescribed burns, and vegetation modification through thinning and mowing. Figure 9.3.5. depicts the fire history in the Prescott Basin region of the Central Highlands.

The risk of ignition comes from a combination of human-caused and lightning starts. Concentrations of fire ignition points are often related to human activity around private property and roadways. The Prescott National Forest alone has averaged about 90 fires annually, with more than half of those initiated by lightning (Figure 9.3.6). Almost 30,000 acres burned on the Prescott National Forest between the mid 1980s and the mid 1990s.



▲ Figure 9.3.5. History of fires greater than 10 acres in the Central Highlands region.

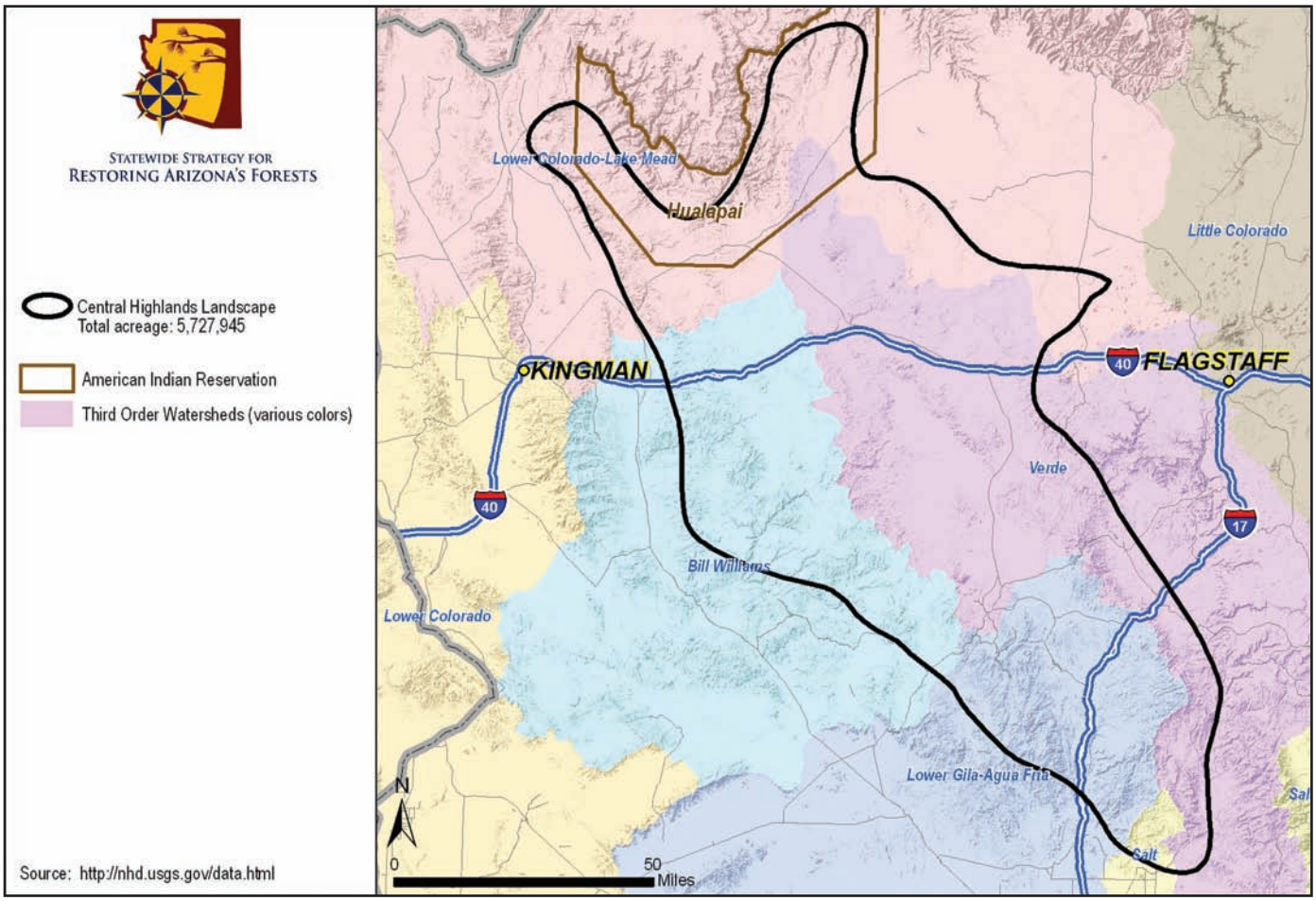


▲ Figure 9.3.6. Fire ignition points in the Central Highlands region.

Watersheds

The Verde River and its tributaries--collectively known as the Verde River Watershed--constitute the principal river system in the Central Highlands. Surface water in the Verde Valley is used mostly for irrigation purposes. The Verde River Basin includes groundwater sources, covers about 5,450 square miles of north-central Arizona, and is divided into the Big Chino, Verde Valley, and Verde Canyon subbasins (Figure 9.3.7.). The northern part of the basin is in the Plateau Upland Province and the southern part is in the Central Highlands Province. Elevation ranges from more than 12,000 feet in the San Francisco Mountains to about 1,600 feet in the south. The Mogollon Rim Escarpment forms a topographic relief of as much as 2,000 feet and trends northwest across the basin.

In 1984, Congress declared most of the Verde River downstream from the headwaters area—from Camp Verde to Sycamore Creek—a Wild and Scenic River.

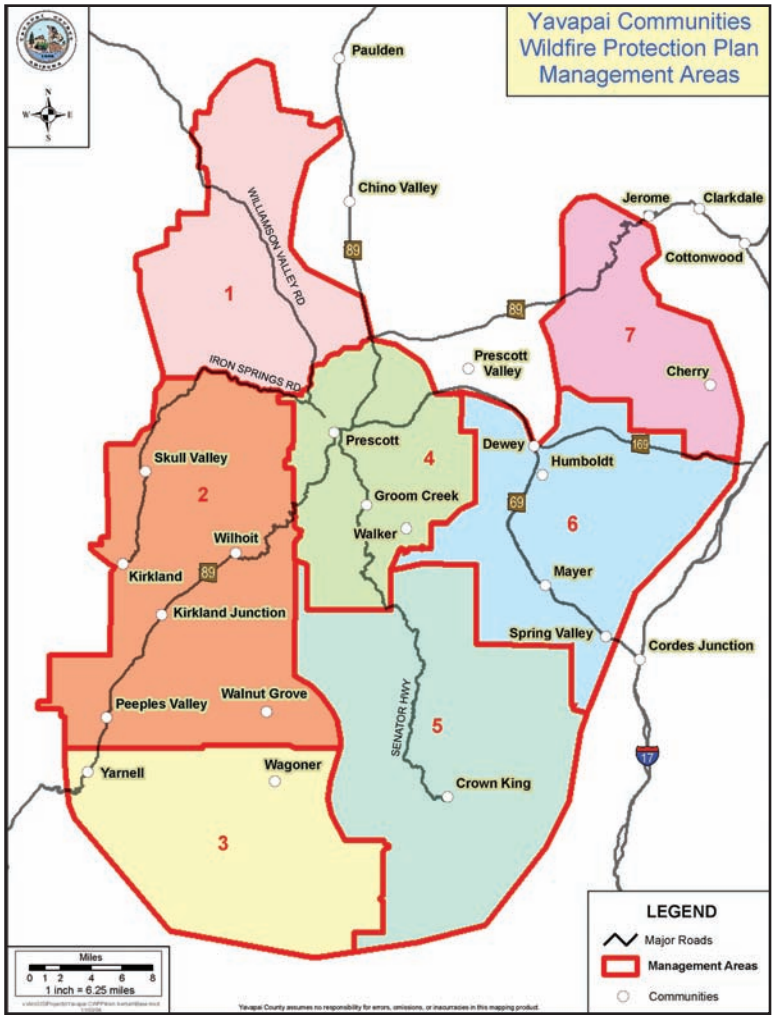


▲ Figure 9.3.7. Third-order watersheds (basins) in the Central Highlands landscape.

Collaborative Efforts

In 1990, the Yavapai County Board of Supervisors and the City of Prescott convened to address the wildfire threat in the Prescott Basin and surrounding areas. They passed a joint resolution, forming the Prescott Area Wildland Urban Interface Commission (PAWUIC). Key cooperating agencies involved in this unfunded, citizen-led commission were, and continue to be, the Prescott National Forest, the Arizona State Land Department, the Bureau of Land Management, the Central Yavapai Fire District, the City of Prescott Fire Department, and the Yavapai County Emergency Management Department. Each of the participating agencies signed on to a Memorandum of Understanding to establish a basis for cooperation and assistance.

The Commission's mission was to identify, develop, and implement wildland/urban interface defensible space, and fire safety awareness programs for the citizens of "at risk" communities in the Prescott area. It is the only such effort in the Central Highlands region (Figure 9.3.8.). PAWUIC has several active committees -- the Interagency Fire and Emergency Management Group (IFEMG), the Healthy Forest Economic Development Team (HFEDT), and the Community Education/Wildfire Awareness. The IFEMG chairman was given the responsibility for developing the Yavapai Communities Wildfire Protection Plan (YCWPP). A core team, consisting of the IFEMG chair, PAWUIC vice-chair, private forester/PAWUIC member, and County Assessor representative, was formed to develop the CWPP.



▲ Figure 9.3.8. Landscape covered by the Yavapai Communities Wildfire Protection Plan.

The IFEMG defined the WUI, or plan area, based on Fire District borders, topography of the region, and fuel types. Wildland-urban interface was defined as the area where houses meet or intermingle with undeveloped wildland vegetation. The total Plan area covers 963,575 acres (over 1,505 sq miles) in Yavapai County, and includes a total of 13 fire organizations (Dept./District/Volunteer). At the BLM's request, the YCWPP boundaries were expanded to include the communities of Crown King, Horsethief Basin, and Yarnell. Funding for work accomplished in the expanded area is largely provided by the BLM.

Economics

The Prescott National Forest is currently seeking authority to enter into a 10-year stewardship contract agreement to assure a steady and predictable supply of harvestable biomass that could be used in a variety of industries (including a waste-to-energy plant). Products of restoration treatments in the YCWPP area are currently converted into firewood (one cord per acre), which is being sold for $125. PAWUIC has been actively working to encourage the development of businesses to utilize forest restoration products. Working with local government and other organizations, the Healthy Forest Economic Development Team (HFEDT) seeks to implement the following recommendations:

- Develop marketing and incentive programs to promote the development of appropriate local businesses and offset the costs of forest treatments.
- Stimulate public education efforts to highlight the restoration solution to existing forest health problems across the landscape.
- Identify treatments that will lower the likelihood of broad-scale factors causing tree mortality due to drought, insect outbreaks, and disease.
- Fuel reduction and community protection have become the overarching focus of forest restoration. We must not lose sight of the fact that forest restoration is also a tool to accomplish forest health objectives.
- CWPPs should include hierarchical silvicultural prescriptions for each vegetation type based on best available science and landowner objectives. They should also include total acres and timelines so that it will be known how much biomass is going to come off the land over time.
- In wildland areas of the PNF, where aggressive prescribed burns have been the primary restoration management tool, we should incorporate mechanical means, selective harvesting, to achieve a more varying stand structure (different age classes and size distribution) and natural regeneration. Prescribed fire alone cannot achieve this.

The timber market for the Hualpai Tribe has completely dried up. There are no longer any operating sawmills in the area, and so for the first time, the Tribe did not advertise a timber sale this year. Currently, in ponderosa pine, they cannot harvest anything larger than 9 inches diameter at breast height. Those they sell as poles for fencing, and other small-diameter wood products. Pinyon-uniper woodlands yield about 100 cords of firewood per acre. They are harvesting about 100 acres per year.

Implementation and Management

The Prescott National Forest (PNF) utilizes tree thinning and harvesting, mechanical brush clearing, and prescribed fire to improve ecosystem health and wildlife habitat, and to reduce the threat and adverse effects of wildland fire. The PNF considers prescribed burning to be one of the most effective, as well as cost-effective, tools for achieving forest ecological restoration. In 2006, more than 15,000 acres were treated in the PNF's Prescribed Fire Program. The PNF is the only agency conducting restoration treatments in the Central Highlands landscape, outside of the YCWPP.

PAWUIC tracks the treatments that are conducted within the YCWPP boundaries. In 2005, nearly 8,900 acres were treated:

Prescott National Forest

Commercial thinning	1,149 acres
Stand Improvement	256 acres
Brush Crushing	274 acres
Indian Fire Salvage	372 acres
Prescribed Burns	6,500 acres

Arizona Bureau of Land Management
Support to Mayer, Peeples Valley and Yarnell Fuels Crews

Arizona State Land Department

Hazard Tree Removal	150 acres
Prescribed Burns	65 acres

Yavapai Prescott Indian Tribe

Defensible Space Thinning	8 acres

Arizona Public Service Company

Brush crushing	100 acres
Tree removal	5,000 trees
Line Protection	1,500 miles

Fire Districts and Departments
Homes treated - 401; Acres treated - 638

Camps and Communities
Properties treated - 132; Acres treated - 190

Ten thousand acres of forest would have to be treated annually to achieve PAWUICs goal of reducing the risk of wildfire within the YCWPP. However, efforts in this region have not reached that level.

The Hualapai manage their ponderosa pine forest for uneven-aged structure, by single tree selection. They used to get National Fire Plan funding for piling, conducting NEPA compliance for prescribed burns, and other activities, but the Bureau of Indian Affairs (BIA) was unable to fulfill its obligation, and the funding has been lost. As a result, the Hualapai have been unable to conduct prescribed burning treatments. They are currently suppressing all wildfires.

Future Restoration Needs

Recommendations

1. Develop marketing and incentive programs to encourage the development of appropriate local businesses to offset costs of forest treatments.
2. Stimulate public education efforts to highlight the restoration solution to existing forest health problems across the landscape.
3. Identify treatments that will lower the likelihood of broad-scale factors causing tree mortality due to drought, insect outbreaks, and disease.
4. Fuel reduction and community protection have become the overarching focus of forest restoration. We must not lose sight of the fact that forest restoration is also a tool to accomplish forest health objectives.
5. CWPPs should include hierarchical silvicultural prescriptions for each vegetation type based on best available science and landowner objectives, and should include total acres and timelines so that it will be known how much biomass is going to come off the land over time.
6. In wildland areas of the PNF, where aggressive prescribed burns have been the primary restoration management tool, mechanical means and selective harvesting should be incorporated, where needed, to achieve a more varied stand structure, protect wildlife habitat, and create the landscape patterns that provide connectivity for wide-ranging wildlife species. In many locations, prescribed fire alone cannot achieve these objectives.
7. Develop better communication and interagency cooperation between Arizona Indian tribes and the BIA.

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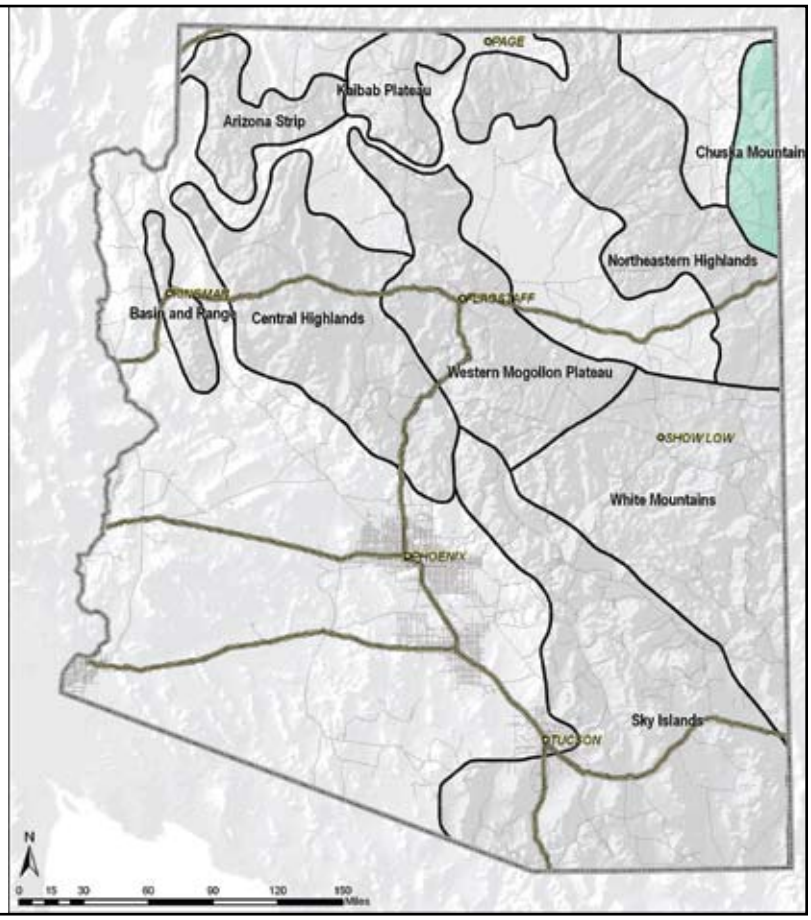
Meetings and interviews conducted with PAWUIC members: Everett Warnock, president, Paul Benner, Ken Iversen, Richard VanDemark, Nick Angiolillo, Jeff Schalau, John Hunter, Carolyn Ladner, Gary Roysdon, Wayne Hultberg, Jeff Whitham, and Bruce Olson (BLM).

Chuska Mountains



The Chuska Mountains and Defiance Plateau comprise the wettest, most verdant terrain of the contemporary Navajo Nation. Two-thirds of the average annual surface water generated within the Navajo Reservation originates in this region's ponderosa pine forests. Although the narrow Black Creek Valley separates the Chuskas from the Defiance Plateau. They are two halves of the same whole--a monocline (upwarp) in the earth's crust that geologists call the "Defiance Uplift." Piggybacked upon the larger Colorado Plateau, the Defiance Uplift has been raised up and worn down repeatedly for hundreds of millions of years.

The harder volcanic and sedimentary rocks that cap the Chuskas have strongly resisted the same forces that have eroded the rocks surrounding them, creating the mountains that we see today. Most of the gently uplifted Defiance Plateau sits between 7,000 and 8,000 feet above sea level, while the more rugged Chuskas reach up to nearly 10,000 feet. Much of the rain and snow that falls in the Chuskas' montane forests drains westward into the spectacular depths of Canyon del Muerto and Canyon de Chelly, eventually emptying into the San Juan River through Chinle Wash.

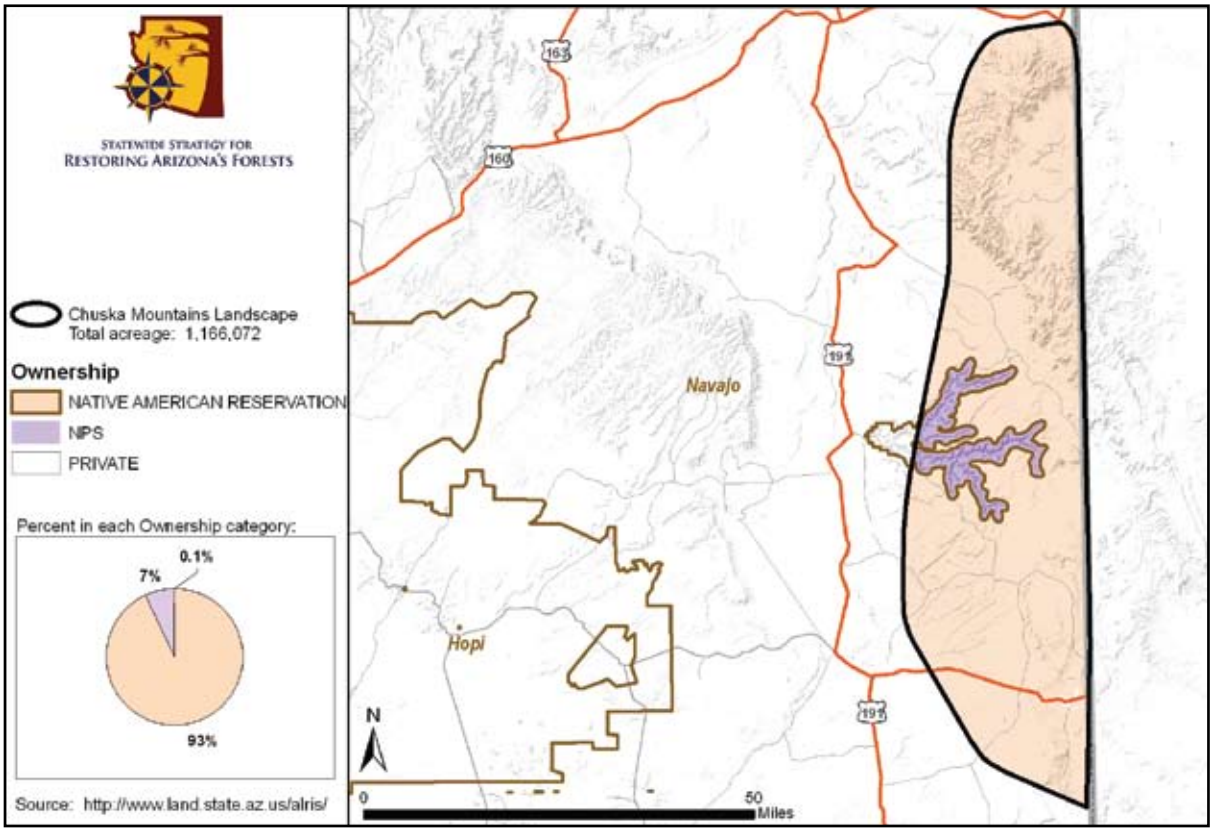
The forests of the Chuskas and Defiance Plateau have been important to the indigenous peoples of the Colorado Plateau for thousands of years. Navajo agropastoralists began moving up into the Defiance Uplift's open, grassy ponderosa pine forests sometime after 1700 A.D., migrating westward out of the tributary canyons of the San Juan River in present-day northwestern New Mexico. These semi-nomadic churro sheepherders and horticulturalists found that the Defiance Uplift's savanna-like forests provided abundant water, forage, building materials, and other "goods of value" for Navajo people and their livestock--the main source of their subsistence. Since the first Navajos claimed these forests as their own, incorporating them into their language and oral traditions, the Chuskas and Defiance Plateau have been vitally important places within the Navajo cultural landscape. From a traditional Navajo view of this landscape, the Chuskas are the "Goods of Value Range," or a "Mountain of Agriculture," as Navajo headman Barboncito referred to them during treaty negotiations with the U.S. military in 1868. They are considered a sacred male deity whose head is Chuska Peak, whose throat is Narbona Pass, and whose legs are the Carrizo Mountains, at the northern terminus of the range. (adapted from Patrick Pynes essay "Chuska Mountains and Defiance Plateau, Navajo Nation").

Land Ownership

All of the Chuskas, and all but the southern tip of the Defiance Plateau, formed a majority of the original 1868 Navajo Treaty Reservation (Figure 9.4.1). The boundary dividing the territories of New Mexico and Arizona had been established five years before, bisecting the Chuskas' main body. Today, the southern half of the Chuskas is located mainly in the New Mexico portion of the Navajo Nation, while the northern half is located in the Arizona portion. The smaller Tunicha and Lukachukai subranges extend outward from the Chuskas' main spine. The Carrizos, Tunichas, and Lukachukais are all considered part of the Chuskas, a transliteration of the Navajo word *choosh'gai*, meaning "white-colored spruce trees."

Canyon de Chelly National Monument, established in 1931, is almost entirely Navajo Tribal Trust Land, which the Tribe and the National Park Service jointly manage. One of the longest continuously inhabited landscapes of North America, Canyon de Chelly sustains a living community of Navajo people, who are connected to this landscape of great historical and spiritual significance.

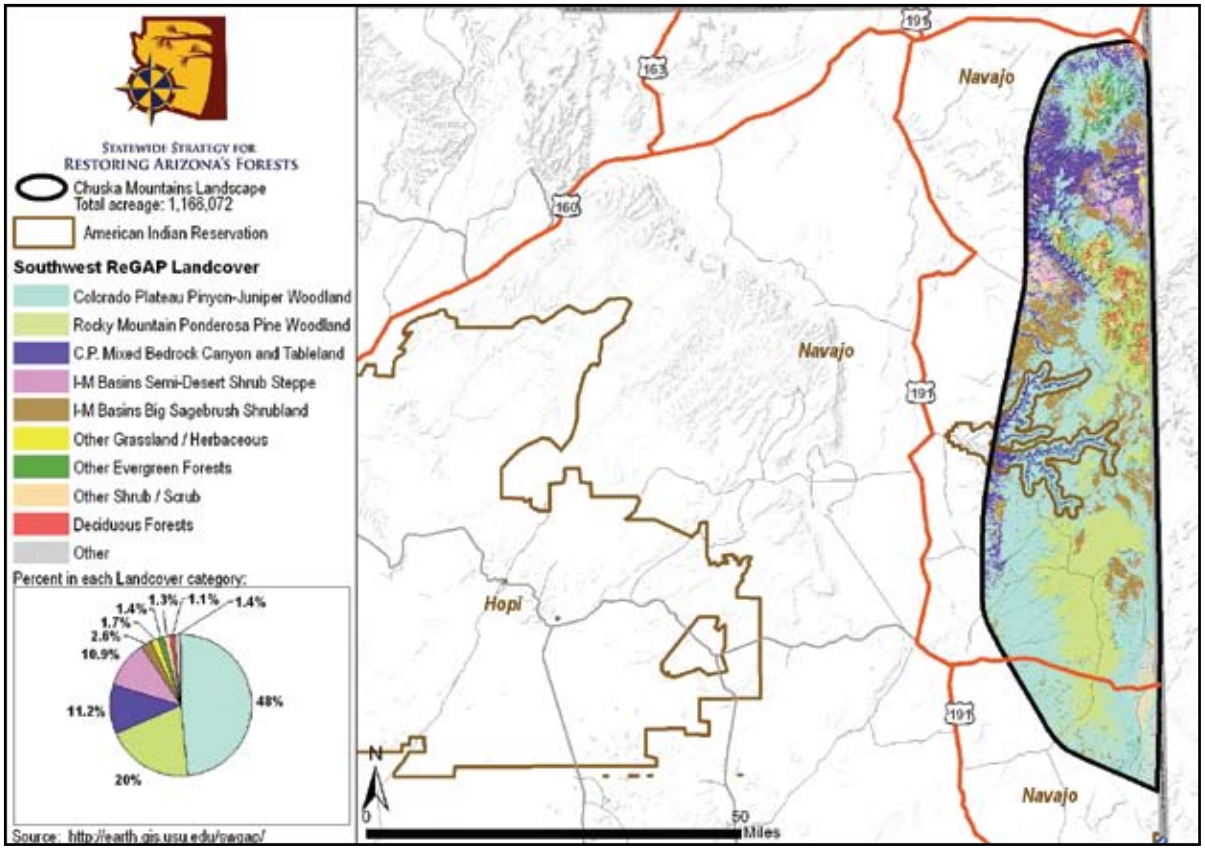
Canyon de Chelly National Monument



▲ Figure 9.4.1. Land ownership status in the Chuska Mountains landscape.

Forests

The forests of the Navajo encompass about 596,725 acres of the Chuska Mountains and the Defiance Plateau, and include commercial timberland that are predominately ponderosa pine (*Pinus ponderosa*) with minor acreages of other commercial species, such as Douglas-fir (*Pseudostuga menziesii*), and Engelmann spruce (*Picea engelmannii*) (Figure 9.4.2). Atop the Chuska Mountains, at an elevation of 9,780 feet, is a spectacular upland ponderosa pine forest. Mixed conifer stands of blue spruce (*Picea pungens*), subalpine fir (*Abies lasiocarpa*), Douglas-fir and aspen (*Populus tremuloides*) are found on the north-facing slopes of the canyons and ridges. Along the flanks at lower elevations, Gambel oak (*Quercus gambelii*) accompanies the ponderosa pine. This latitudinal belt gives way below (5,500-7,000 feet) to pinyon pine (*Pinus edulis*)-juniper (*Juniperus spp.*) woodlands with a sage brush (*Salvia spp.*) community intermixed. The Chuska landscape encompasses roughly 250,000 acres of the commercial timber landscape of the Chuska Mountain and Defiance Plateau.



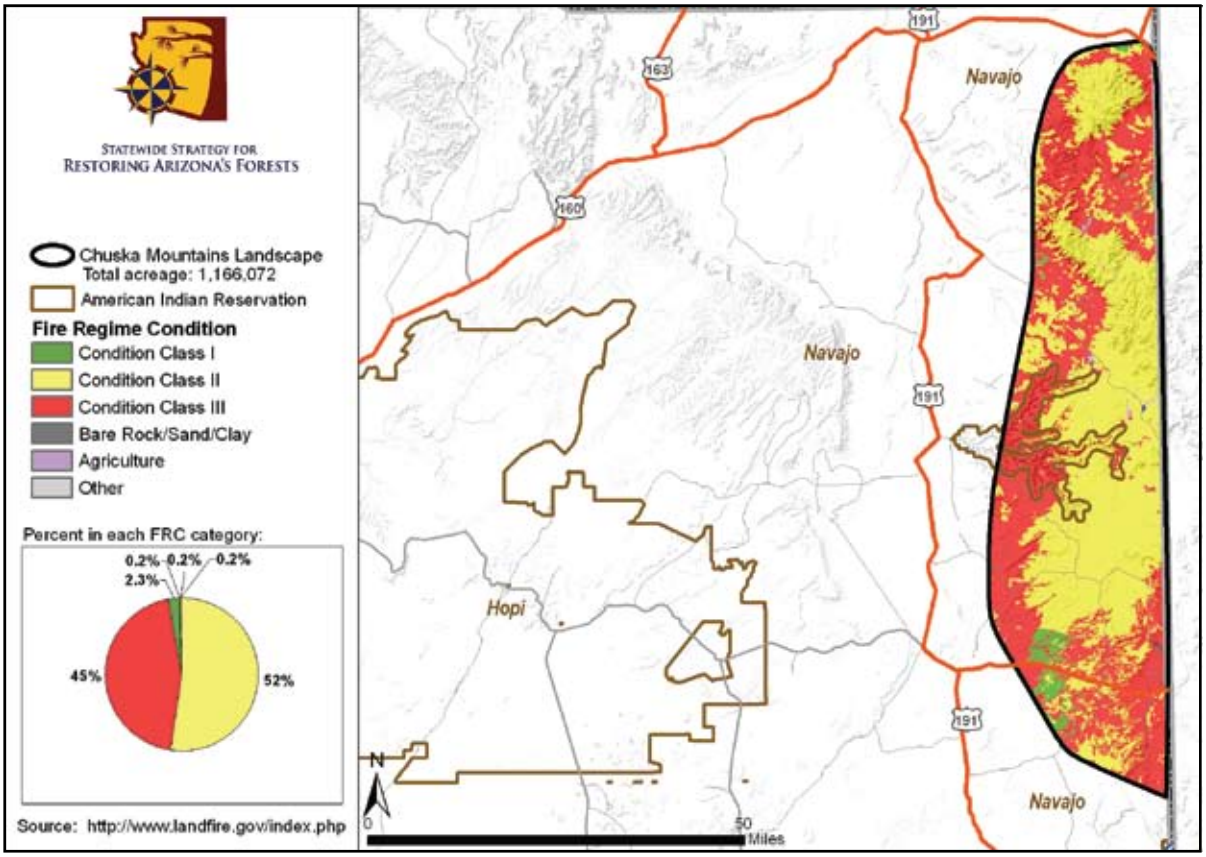
▲ Figure 9.4.2. Vegetation composition across the Chuska Mountains landscape.

Current Conditions

Like the other ponderosa pine forests of Arizona, the structure of the Chuska Mountain-Defiance Plateau ponderosa pine forest has undergone changes during the past century, similar to other ponderosa pine forests of the Southwest. These changes in structure and the landscape-scale disruption of natural ecological processes due to a history of intense livestock grazing and fire-exclusion policies have contributed to increases in the extent and density of the forest. Increases in tree density tend to increase tree susceptibility to insects, diseases, and pathogens; increase the risk of catastrophic stand replacement fire events; and cause an overall decline in forest health.

With the building of the first modern sawmill on the Navajo Nation in 1958, timber harvesting quickly reduced the old-growth stands of ponderosa pine. In general, stand structure analysis of ponderosa pine in the Chuskas indicates significantly greater forest density, and a shift in structure from uneven to even-aged stands due to new recruitment coupled with the logging of old-growth pines.

Fire exclusion in forests adapted to low-intensity, frequent-fire regimes severely alters vegetation structure, fire hazard, and wildlife habitat over time. Figure 9.4.3. illustrates how much forests in the Chuska Mountains landscape have diverged from their natural range of variability.



▲ Figure 9.4.3. Fire Regime Condition characteristics of vegetation in the Chuska Mountains landscape.

Communities

Navajos continue to use the Chuskas and Defiance Plateau for grazing livestock, gathering medicinal herbs and building materials, hunting, fishing, farming, and as a place for conducting sacred ceremonies. With increasing population pressures, permanent (as opposed to seasonal) homesites within the Navajo forest increased significantly, prompting the Navajo Tribal Government to issue a moratorium on new homesites within the forest during the mid-1990s.

The major communities within the Chuska Mountains landscape include the Navajo Nation capital of Window Rock (population 3,059 – 2000 census), Fort Defiance (population 4,061), and St. Michaels (population 1,295). Other Navajo communities are scattered throughout the landscape. Several of these communities are listed in the Federal Register of Communities at Risk, including: Tsaile and Oak Springs, which have a Wildland Urban Interface (WUI) risk rating of low; and Hunters Point and Pine Springs, which have a moderate WUI risk rating.

Portions of Canyon de Chelly National Monument exist within the Chuska Mountains landscape area. In addition to visitation by tourists, which was more than 881,000 in 2004, the Monument, which has been inhabited by indigenous peoples since about 300 A.D., continues to sustain a small Navajo community.

Wildlife

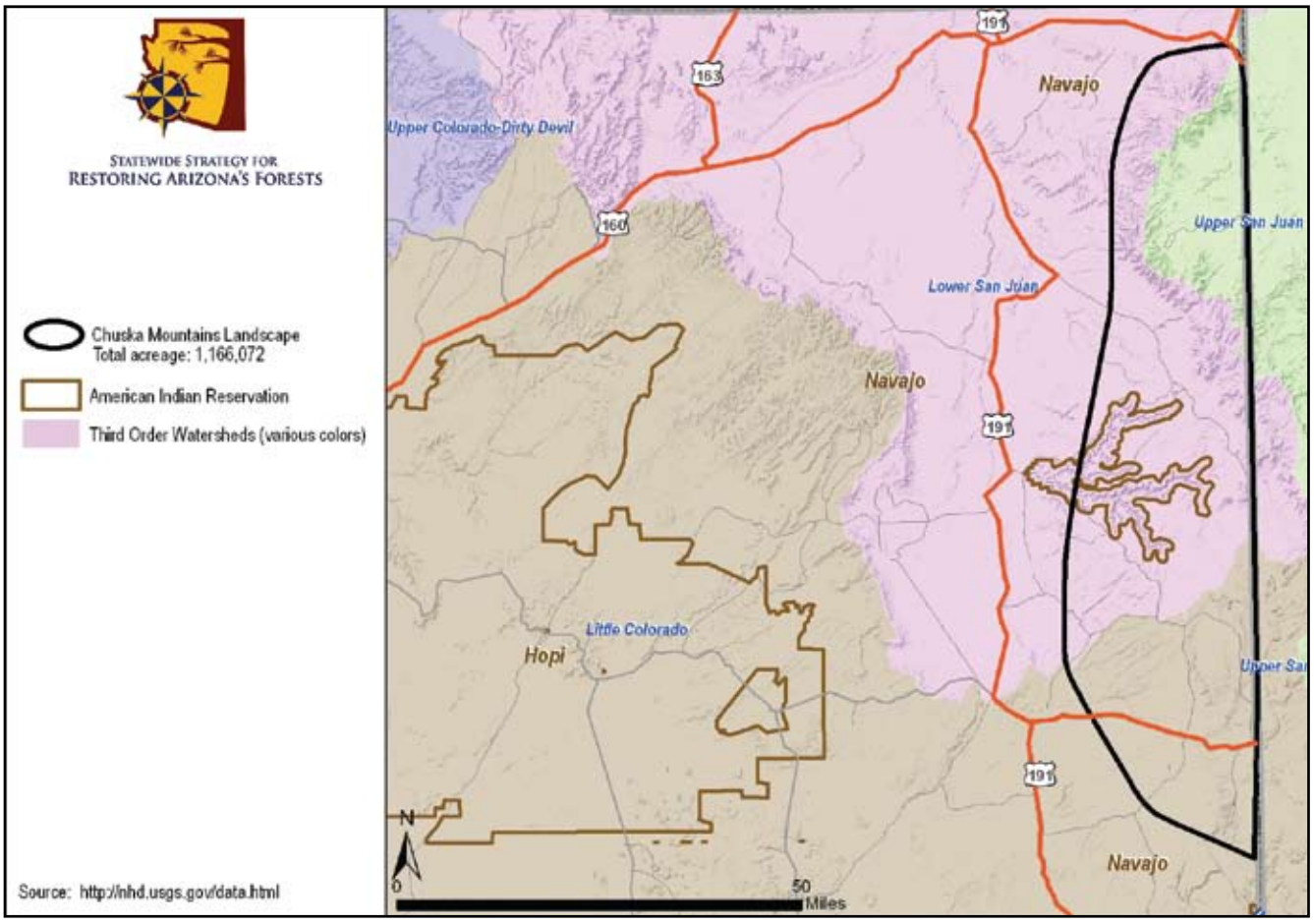
The Mexican spotted owl (*Strix occidentalis lucida*) is listed as a threatened species by the U.S. Fish and Wildlife Service, and by the Navajo Fish and Wildlife Department. This species is generally found in ponderosa pine forest and mixed-conifer forests, and has also been associated with steep canyons. The Navajo Nation has designated critical habitat and developed a management plan for this species. Other significant avian species found in the Chuska Mountains and Defiance Plateau include the northern goshawk (*Accipiter gentilis*), ferruginous hawk (*Buteo regalis*), northern saw-whet owl (*Aegolius acadicus*), mountain plover (*Charadrius montanus*), and peregrine falcon (*Falco peregrinus*).

Mammalian species of concern include pronghorn (*Antilocapra americana americana*) and the Chuska tassel-eared squirrel (*Sciurus aberti chuscensis*). Mountain lion (*Felis concolor*), and mule deer (*Odocoileus hemionus*) are also found within this landscape. The principal threat to wildlife species in this region is the alteration or destruction of habitat by humans or by natural forces such as drought and insect infestations.

Fire

Because forest management treatments were halted in 1993, forests in the Chuska Mountains are dense with small trees. Competition for nutrients and water and a prolonged drought has weakened tree resistance to bark beetle infestations. The resulting mortality has significantly increased the amount of hazardous fuels in the forest. The Kinlichii Two Fire that started on June 6, 2006, and burned 1,665 acres of pinyon-juniper woodlands, jumped Highway 264, and caused the evacuation of 66 people before it was controlled. Several people had to be treated for smoke inhalation, Highway 264 was shut down for a time, and the Navajo Nation declared a state of emergency. Fires like the Kinlichii Two Fire highlight the need for treatments to reduce the threat of fire to Navajo communities.

Watersheds



▲ Figure 9.4..4. Third-order watersheds (basins) in the Chuska Mountains landscape.

Collaborative Efforts

The Navajo Nation Ten Year Forest Management Plan was developed under the direction of the Navajo Forestry Department (NFD) by an interdisciplinary team consisting of natural resource specialists from the Navajo Nation and the Bureau of Indian Affairs. Public scoping to solicit issues and concerns of stakeholders was used to guide planning regarding forest management activities. Management themes developed from the initial scoping were presented in six public meetings. Stakeholders must be educated about the dangers associated with current forest conditions and the benefits of ecological restoration.

Economics

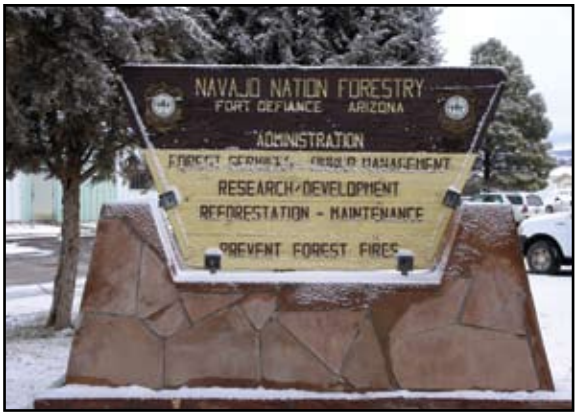
The Navajo Forest Products Industry (NFPI) was formed in 1958. In the years between 1962 and 1992, NFPI cut and processed an average of 40 million board feet of lumber each year from the Chuskas and Defiance Plateau's forests. The NFPI was operating the largest lumber mill in the Southwest and in the process, created thousands of good-paying jobs and produced millions of dollars in tribal revenues. However, the rate of timber harvest was unsustainable, raising concerns about forest health in the Navajo Forestry Department, and criticism from some within the Navajo community about the effects of timber harvest on traditional subsistence and spiritual uses of the forest. In the end, timber sales were halted until a new forest management plan was completed, which closed the mill and put hundreds of tribal members out of work.

Unemployment rates are high on the Navajo Nation. While natural resources are an important part of the Navajo economy, the current economic focus is on the industrial, retail, and tourism industries. Tourism produces 48% of the Navajo Nation's income. The Navajo Nation Division of Economic Development (DED) has been somewhat successful in recruiting businesses to the area. Two wood-based businesses are presently operating on the Navajo Nation--a cabinet company and a housing panel manufacturer, although neither uses local wood for their operations.

Currently the only wood-harvesting activity taking place on the Navajo Nation is through personal use permitting for forest products. The Navajo Nation DED has been working on a project to build a 10-megawatt power plant that will run on biomass fuel on the former NFPI mill site. The fuel to power this plant will come from bark beetle-infected trees and small-diameter wood, as well as from two invasive tree species—salt cedar and Russian olive. The project is anticipated to generate about 25 jobs. It will also encourage Navajo residents to clear the areas around their homes because the wood that is cleared from home sites will be purchased and stockpiled for use by the power plant.

The major challenge to implementation of the biomass power plant will be environmental opposition. Past over harvesting of the forests in the Chuska Mountains landscape resulted in opposition to harvesting by vocal residents. Harvesting of small-diameter wood looks the same as full-scale harvesting to these people, and opposition may still persist. Educating people about the benefits of ecological restoration--community protection and restoring the ecological health of the forests--will help to overcome existing opposition and allow restoration projects to move forward.

Implementation and Management



All Indian forestlands in the United States have been classified into categories related to commercial timber productivity by the BIA. This classification is used as the basis for forest management planning and federal funding appropriations. (Commercial timberland is a forest classified by the BIA-BOFRP as being capable of producing 15 cubic feet of timber/acre/year.) The regulatory jurisdiction of the Forest Management Plan is defined by BIA, by the Code of Federal Regulations and by the National Indian Forest Resources Management Act (P.L. 101-630). These regulations define procedures for: timber harvesting, timber stand improvement (planting, thinning), forest protection (fire prevention and suppression, disease and insect control, enforcement against trespass, permitting for personal use (firewood, fence post, poles) and access for development for these activities. In addition to these actions, the NFD and BIA must ensure compliance with all applicable federal and Navajo Nation laws.

In 1991, the Resources Committee of the Navajo Nation Council directed the NFD and an interdisciplinary team of natural resource specialists from the Navajo Nation and the BIA to develop forest management alternatives for the 596,725 acres of forest of the Defiance Plateau and Chuska Mountains. These alternatives were to be compared, and a preferred alternative would be incorporated into the Navajo Nation's Ten Year Forest Management Plan.

In July 2001, the Resources Committee of the Navajo Nation Council selected Alternative 4 as the preferred alternative that will best protect the Navajo forest against damaging insects, disease, timber trespass, and wild fire. Alternative 4 describes the desired future conditions of the forests as a mosaic of even-aged and uneven-aged stands, intermixed with areas of special management or no management. Special Management Areas (SMAs) were designated to create favorable wildlife habitat, and for the benefit of threatened and endangered species, water, soil, recreation and traditional/cultural resources. This alternative designates 74,735 acres from accessible commercial forest areas as SMAs, and will implement Best Management Practices and monitoring programs.

Future Restoration Needs

The Navajo Nation faces many challenges in implementing its forest management plan and fuel reduction treatments, and developing sustainable industries based on by-products of forest restoration treatments. The Navajo Nation currently receives $169,000 from the federal government to treat 4.2 million acres of forests and woodlands on the entire Nation. This amounts to 3¢ an acre, which is wholly inadequate when the actual cost of forest restoration ranges from $300-$1,000 per acre. Furthermore, the U.S. Forest Service has little interest in participating in fuel reduction/restoration projects with the tribes because they can't claim the acreages treated in their budgets.

Other challenges include: Lack of adequate training for NFD personnel; limited accurate, up-to-date spatial data; and resistance and opposition from local groups and residents; and interagency cooperation with the BIA. Some recommendations to address these challenges are listed below:

1. Provide training for NFD personnel for pinyon-juniper treatments, Wildland Urban Interface treatments, and the use of prescribed and wildland fire.
2. Obtain most recent accurate spatial data describing Navajo Nation forests and woodlands.
3. Design and implement forest treatments that minimize associated impacts on forests.
4. Educate Navajo Nation residents and environmental groups about the need for forest restoration.
5. Educate Navajo Nation residents about the need to reduce fuel loads around their homes.
6. Improve communication and cooperation with the Bureau of Indian Affairs.

References

Note: The Chuska Mountains landscape analysis was developed in cooperation with the Navajo Nation Forestry Department and is printed here with their permission.

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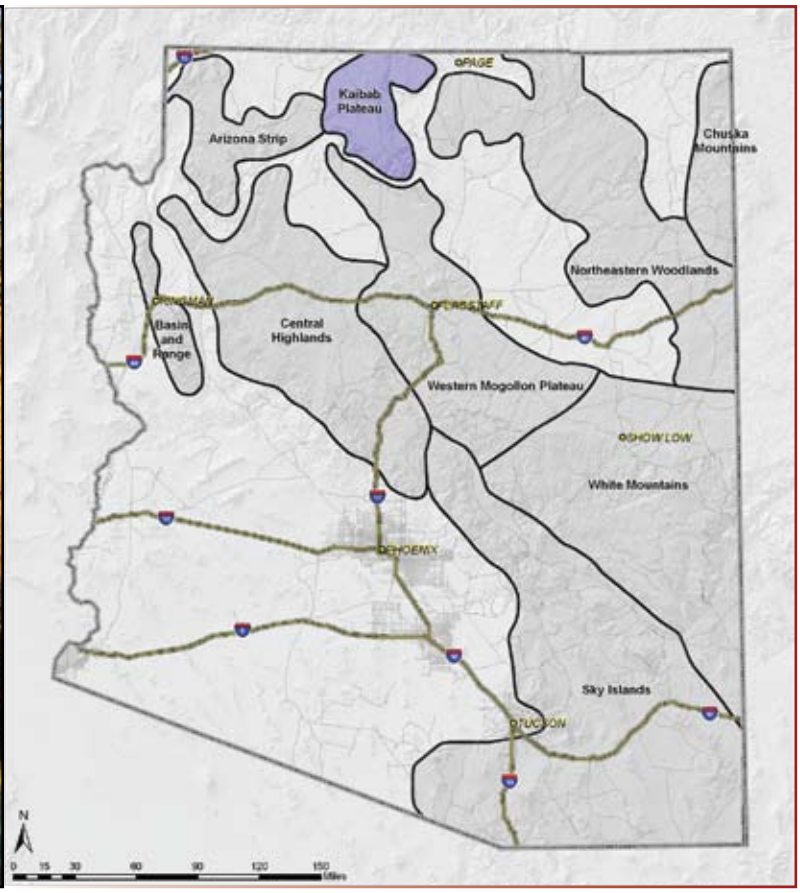
Personal Interviews conducted December 18-19, 2006 with Navajo Forestry Department and the Bureau of Indian Affairs: Alexious C. Becenti Sr.- Forest Manager, Navajo Nation; Eddie Sam, Woodland Forester, Navajo Nation; Frankie Thompson, Program Manager/Forester, Navajo Nation; Theresa Nallick – GIS analyst, BIA-Fort Defiance Agency.

Phone Interview conducted January 18, 2007 with Allan Begay, Director of Navajo Nation Division of Economic Development

Kaibab Plateau

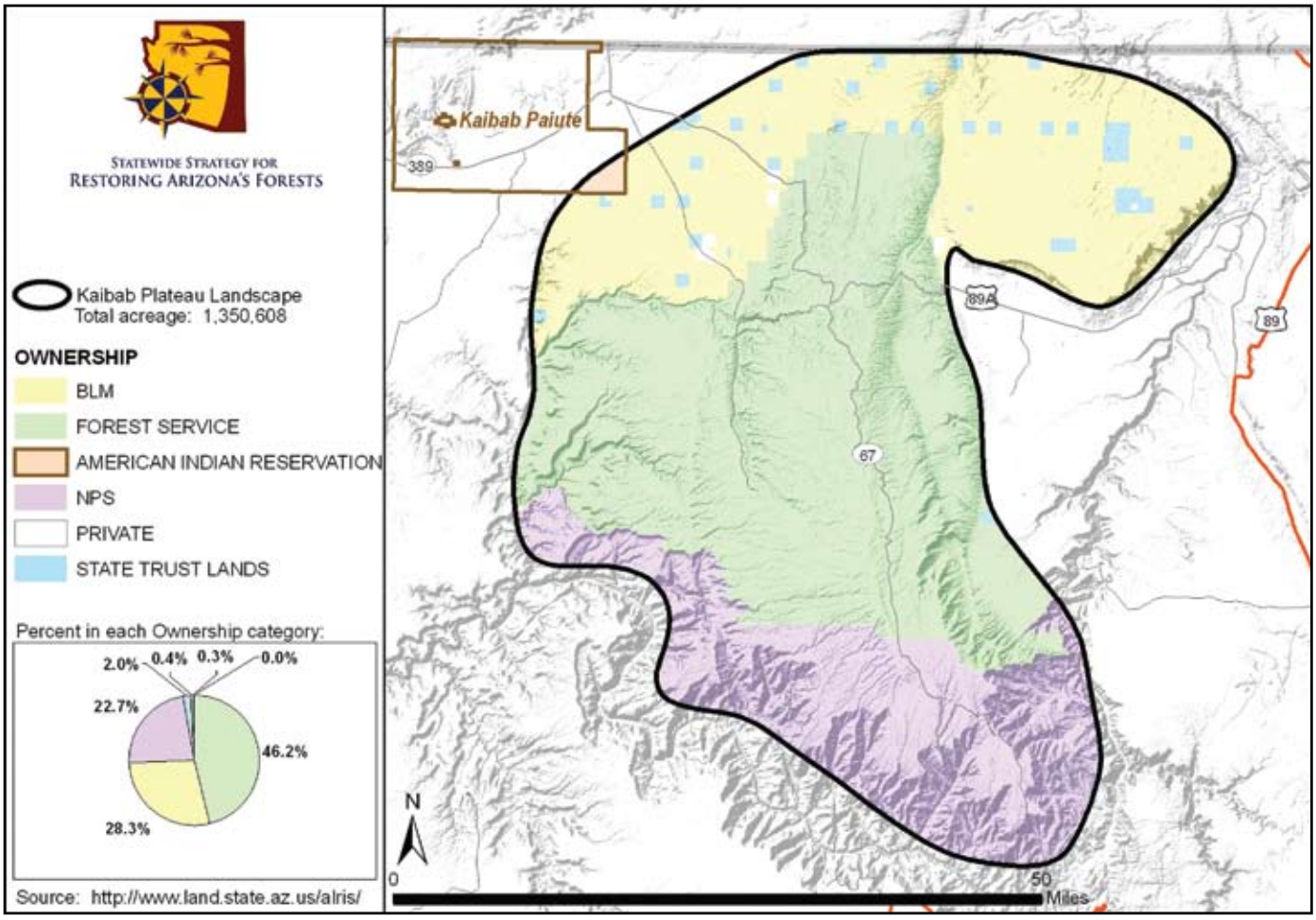


The Kaibab Plateau landscape encompasses an area 1,350,608 acres in size, extending west to east from Kanab Creek to the confluence of the Paria and Colorado rivers, and north to south from the Arizona-Utah state line to the North Rim of the Grand Canyon. This landscape actually includes both the Kaibab Plateau and the lower elevation Paria Plateau to the east. Each is a sky island rising dramatically from lower elevations with grass and shrublands on all sides. The entire area is one of dramatic topographic and ecological contrast, with elevations ranging from 4,000 feet near Kanab Creek to more than 9,200 feet atop the Kaibab Plateau. It is one of the most remote landscapes within the state, with very little infrastructure development occurring within its boundaries.

The North Rim of the Grand Canyon of the Colorado River lies atop the broad upwarp of the Kaibab Plateau. The plateau supports a rich mix of plants and animals. Sufficiently high to capture occasional heavy winter snows and far enough south to garner significant summer monsoonal moisture, the Kaibab Plateau is surprisingly lush. Despite the cool temperatures and moisture, surface water is not common due to the porous nature of the Kaibab Limestone that caps much of the plateau.

Land Ownership

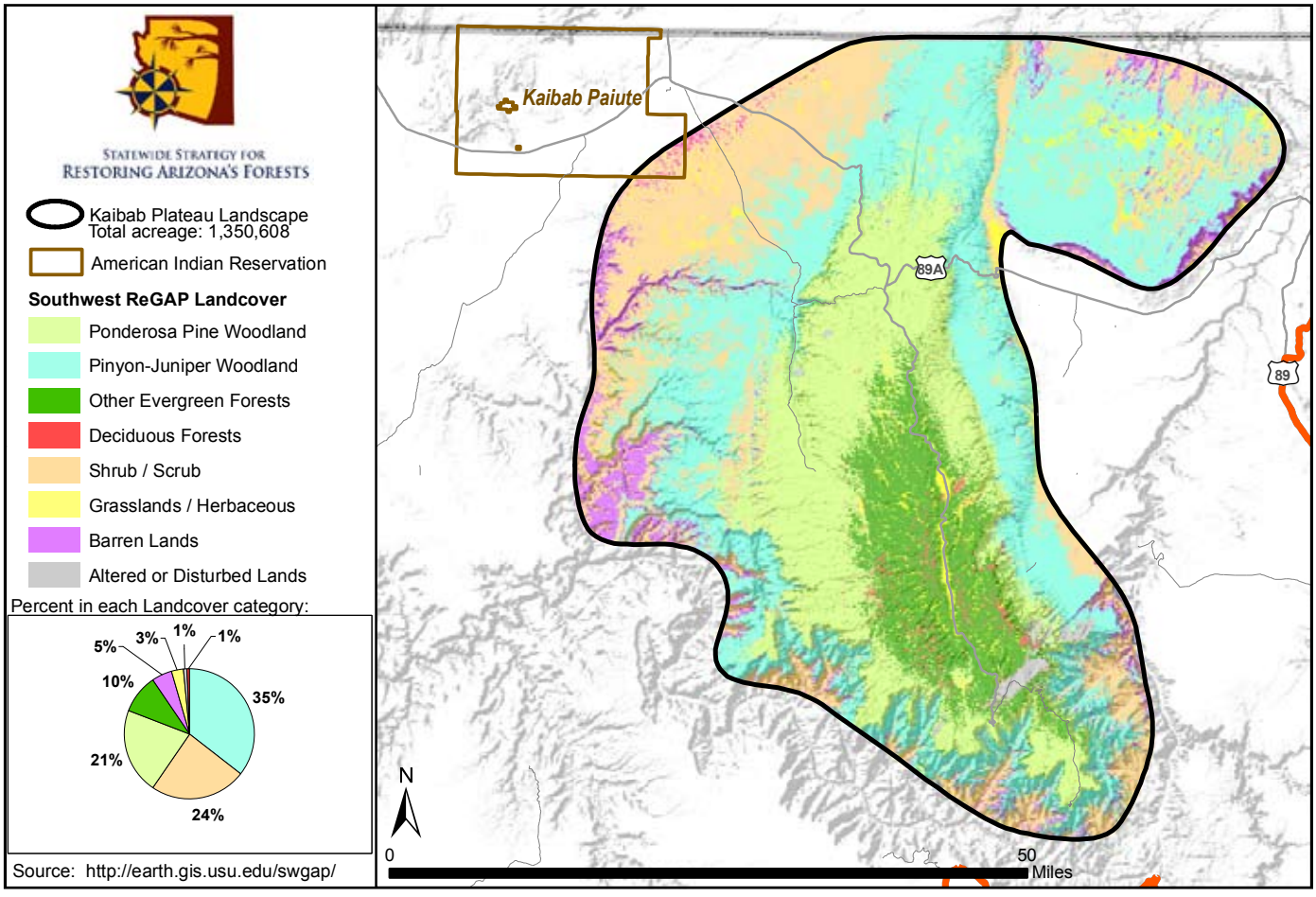
A majority of the Kaibab Plateau landscape is on federal land. (Figure 9.5.1.). About 46% of the area is managed by the U.S. Forest Service, 28% by the Bureau of Land Management, and 23% by the National Park Service. State and private lands are scattered throughout, but comprise a very small portion (less than 1%) of the total area. The landscape also includes a portion of the Kaibab Paiute Reservation. Historically, the Kaibab Paiutes utilized all of the lands across the Kaibab Plateau and the Arizona Strip. Challenges presented by ownership status across the Kaibab Plateau landscape include coordination of restoration activities between the three federal agencies and developing a greater sensitivity to the cultural and subsistence values of the Kaibab Paiute Tribe.



▲Figure 9. 5.1. Land ownership status in the Kaibab Plateau landscape.

Forests

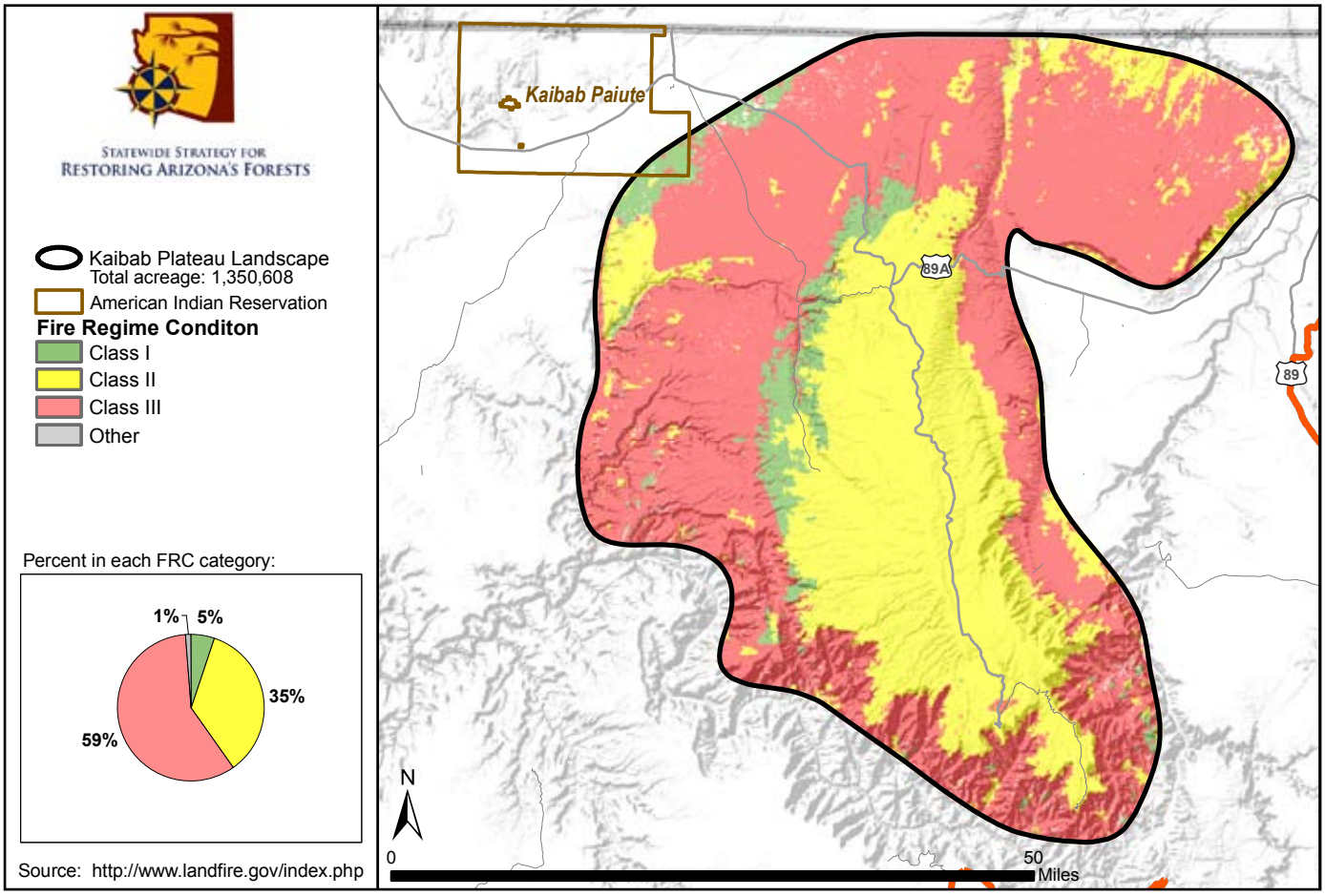
The crest of the Kaibab Plateau is heavily forested with spruce-fir, aspen, and mixed-conifer forests (Figure 9.5.2.). Occasional subalpine grassland parks are scattered throughout the forests, generally above 8,500 feet. Stands of ponderosa pine and pinyon-juniper woodlands at lower elevations stretch from about 8,000 feet down to about 5,500 feet. The logging of large trees throughout much of the century has diminished the abundance of old growth trees, although the Kaibab Plateau is still widely regarded as holding some of the best remaining old growth ponderosa pine in the Southwest. Vegetation cover on the Paria Plateau, which ranges from 5,500 to 7,000 feet, consists principally of pinyon-juniper woodlands, interspersed with grasslands and sagebrush communities.



▲ Figure 9.5.2. Vegetation characteristics in the Kaibab Plateau landscape.

Current Conditions

As has been the case throughout forested landscapes across Arizona, frequent fire regimes across the Kaibab Plateau were disrupted in the late 19th century. By 1920, land managers had almost completely excluded fires across higher elevations of the Plateau dominated by ponderosa pine and mixed conifer. Fire exclusion across much of the Plateau has likely resulted in denser forest stands, more prone to high intensity crown fires. These unnatural conditions are partially reflected in the Fire Regime condition of the forests and woodlands (Figure 9.5.3.).



▲ Figure 9.5.3. Fire Regime Condition characteristics of vegetation in the Kaibab Plateau landscape.

Communities

Development is sparse across the Kaibab Plateau. Three areas of developed visitor facilities are listed as at-risk in the Federal Register: Jacob Lake (high risk), Kaibab Lodge (moderate risk), and the developed area on the North Rim of Grand Canyon National Park (high risk). The North Rim of the Grand Canyon attracts about 500,000 visitors per year, and dispersed camping occurs across the Kaibab National Forest. The cities of Page and Fredonia in Arizona, and Kanab in Utah, are the nearest incorporated communities.

Part of the Kaibab Paiute Reservation falls within the Kaibab Plateau landscape. While not included within the landscape at this time, two communities on the reservation are listed as “at-risk” in the Federal Register: Juniper Village (low risk) and Kaibab (moderate risk). Nomadic ancestors of the Kaibab Paiute tribe have lived on the Kaibab Plateau since around 1100 A.D. Both the Kaibab Plateau and the Arizona Strip hold natural resources of important cultural value to the tribe, for food, water, medicines, and for ceremonial purposes.

Wildlife

Current Wildlife Habitat Characteristics

On the Kaibab Plateau, ponderosa pine forest wildlife habitat structure has become more homogeneous over time because of fire suppression, timber harvest strategies, and grazing pressure on the understory vegetation. The Kaibab Plateau retains a higher proportion of old trees, a more balanced tree age and size structure and better understory conditions than most ponderosa forest in Arizona. This forest is also one of only two designated National Game Preserves in the Forest Service.

Wildfires have drastically altered wildlife habitat on the Plateau. Wildfire burned 54,000 acres of ponderosa and pinyon-juniper habitat on the west side of the Plateau in 1996 and an additional 60,000 acres of the ponderosa, mixed conifer, and pinyon – juniper habitat on the east side in 2006. Some of the pinyon–juniper woodlands that have been burned are critical wildlife winter ranges.

In the mixed conifer, wildlife habitat structure has also become more homogeneous largely due to fire suppression. These habitats are very important for wildlife on the Plateau.

Selected Wildlife Species

Given its topographic and elevational diversity, the Kaibab Plateau provides habitat for a wide array of species. The Kaibab Plateau is particularly known as providing habitat for the highest concentration of northern goshawks *(Accipiter gentilis*) in the Southwest. Northern goshawks are considered a Sensitive species by the Kaibab National Forest (KNF), as well as an indicator species for late-seral, ponderosa pine forests. Late-seral, mixed-conifer habitat is also important to this species. Goshawks are dependent on a continuous flow of habitat structural types over time to provide the necessary habitat characteristics for nesting and to support a wide variety of prey species, which include small mammals and medium-sized birds.

The Kaibab squirrel (*Sciurus aberti kaibabensis*) is a subspecies of the tassel-eared squirrel, and is found only on the Kaibab Plateau. It is considered an indicator species for early seral, ponderosa pine habitat by the KNF. Kaibab squirrels forage, in part, on the forest floor and are associated with tree litter, roots, and mycorrhizal fungi, which is associated with Ponderosa pines. They also depend on mature trees to provide cones as a food source and arboreal travel routes as protection against predators.

The Kaibab Plateau is also known for its world-famous mule deer (*Odocoileus hemionus*) herd, Merriam's turkey (*Meleagris gallopavo*), and the California condor (*Gymnogyps californianus*), though it also provides critical habitat for numerous additional wide-ranging species, such as black bear, mountain lion (*Puma concolor*), and numerous forest-dependent song birds, as well as Species of Concern such as the dwarf shrew (*Sorex nanus*), peregrine falcon (*Falco peregrinus*), and Paradine Plain's cactus (*Pediocactus paradinei*).

Fire

Recent fires on the Kaibab Plateau highlight the need for and the complex challenges associated with returning natural fire through landscape-scale fire management and restoration. Fires across the plateau historically burned most intensely and least frequently across lower elevation pinyon-juniper woodlands, and least intensely and most frequently across intermediate elevation ponderosa pine forests. Higher elevation mixed conifer forests burned less frequently and more intensely than frequent fire-adapted ponderosa pine forests. Analysis of relatively recent fires across the Kaibab Plateau shows dramatically different post-fire responses in low, middle, and high elevation forests.

At lower elevations, the effects of stand-replacing fire have been significant and largely negative. The Bridger Knoll Complex Fire, which burned about 51,000 acres in 1996, affected a majority of the transition zone between ponderosa pine forests and pinyon-juniper woodlands on the west side of the plateau--a critical zone for Kaibab mule deer, as well as other wildlife species. Shrub regeneration in the area has been slow, and cheatgrass (*Bromus tectorum*) has invaded tens of thousands of acres within the burn perimeter. Several noxious weed species such as musk thistle (*Carduus nutans*), Scotch thistle (*Onopordum acanthium*), Canada thistle (*Cirsium arvense*), leafy spurge (*Euphorbia esula*), Russian knapweed (*Acroption repens*), and spotted knapweed (*Centaurea maculosa*) have invaded smaller site-specific areas.

At middle elevations, fire impacts have been mixed, depending in large part on fire intensity. Within relatively low intensity burn areas, such as those caused by the Powell, Big, and Rose fires (2003), fires have thinned smaller coniferous trees, and moved burned areas incrementally closer to their natural range of variability. Within higher intensity burn areas, such as those caused by the Outlet Fire (2000), fuels have been reduced more substantially, and coniferous trees have been largely replaced by more fire-resistant early successional species such as quaking aspen which are generally in decline throughout the Southwest.

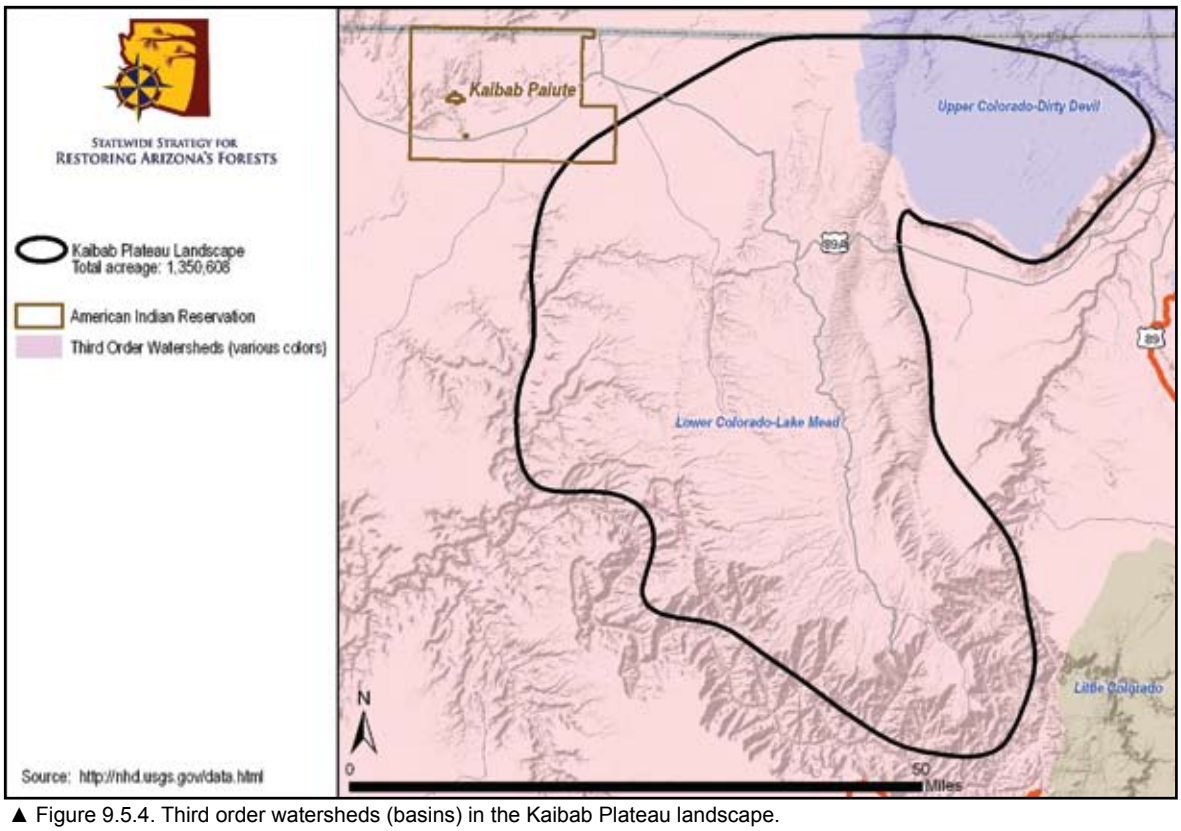
At high elevations, fire intensities have generally been more severe. For example, within the Poplar Complex burn area (8,500-8,800 ft. elevation) of 2003, fire killed more trees, reduced canopy cover, and reduced forest floor fuel loading more than fires at lower elevations. Longer fire return intervals in higher elevation coniferous forests are considered the natural fire regime, and so high-severity fires are considered more natural at higher elevations than fires in lower-elevation ponderosa pine forests.

The Warm Fire (2006) burned 60,000 acres and was one of the most intense and largest fires to have burned across the Kaibab Plateau in recorded history. It burned across a broad elevation zone, affecting pinyon-juniper woodlands, ponderosa pine, and mixed conifer forests. Long-term monitoring will help to clarify the costs and benefits of the Warm Fire, while analysis of historical fire impacts across the plateau should help guide post-fire response and future fire management strategies.

Watersheds

The Kaibab Plateau spans both the Kanab and the Paria groundwater subbasins and encompasses portions of the Upper Colorado/Dirty Devil and the Lower Colorado/Lake Mead basins (Figure 9.5.4.). The Kaibab Plateau is uniformly dry except for small sinkhole lakes and localized springs and streams. Snowmelt and precipitation typically percolates into the Plateau and eventually exit at springs and seeps in the Grand Canyon. However, some sinkholes can capture runoff and hold it throughout the year. The Paria Plateau is similarly dry, with runoff percolating through Navajo Sandstone until it encounters the Chinle shale layer and is conveyed laterally to springs at the base of the Vermillion Cliffs.

In part due to the dry nature of the Kaibab Plateau, the North Canyon watershed stands as one of the most valuable watersheds in the region, with challenging but pressing restoration and fire management needs. North Canyon Creek is a small perennial stream that flows approximately 1.2 miles from its emergence points in upper North Canyon Wilderness Area, Crystal Springs on the East Rim, and various unnamed springs along the canyon floor. It disappears after flowing into the lower Hermit Shale Formation. North Canyon provides abundant habitat for forest wildlife. The stream is an important habitat for Apache trout (*Onchorhynchus apache*), which was introduced there during the past century. This species is federally threatened and is regarded as an Arizona Species of Special Concern. It is endemic to Arizona, and is restricted to streams of Upper Salt, Blue, and Little Colorado drainages in the White Mountains. Forest conditions throughout the North Canyon watershed are generally conducive to high intensity crown fire, the effects of which could be significant and negative for North Canyon Creek.



▲ Figure 9.5.4. Third order watersheds (basins) in the Kaibab Plateau landscape.

Collaborative Efforts

Over the past decade, the U.S. Forest Service has facilitated collaborative discussions regarding old growth ponderosa pine conservation across the Kaibab Plateau, and livestock management across the Kane Ranch, which includes large parts of the Kaibab Plateau. However, due to the remoteness and minimal Wildland urban interface of the region, larger-scale community-based collaborative forest management has not occurred across the Kaibab Plateau to the degree it has elsewhere in the state. Given the concern recently generated by the Warm Fire, it is likely that local community members and stakeholders from across the region will participate in collaborative post-fire planning and long-term restoration and fire management planning discussions, especially if the recommendations from those discussions feed into land management planning across the Kaibab Plateau landscape.

Prescribed fire on the Kaibab Plateau

Economics

Opportunities for economic utilization of restoration products are limited in this remote region, due to long distances to markets and domination of the region by low-value species such as sagebrush, pinyon, and juniper. Past utilization of forest and woodland species has consisted mostly of fuelwood, juniper posts, and Christmas tree sales. Other vegetative products such as pinyon nuts and ponderosa pine cones have been permitted. Current economic utilization (within the past ten years) has included these same products with the addition of several small ponderosa pine timber sales for sawlogs and poles. In shrub and grasslands there has been a demand for collection of seed by seed companies.

Future Restoration Needs

Despite its remoteness, Despite its remoteness, the Kaibab Plateau landscape has been dramatically altered during the past century by livestock overgrazing, large-scale timber harvest, and aggressive fire suppression. Modern fire control efforts have reduced fire frequency, while creating conditions that favor high-intensity burns atypical in the paleoecological record. As discussions about forest restoration and fire management progressively shift from concerns about WUI areas to the management of wildland areas, they highlight the immediate need to develop and test adaptive and integrated landscape-scale restoration and conservation strategies. Given its isolation, high conservation value, and measurable legacies associated with historic wildlife, forest, fire and non-native invasive species management initiatives, the Kaibab Plateau stands as a compelling showcase for testing emerging science-based approaches to restoration and fire management at extensive spatial scales.

The Warm Fire, which burned almost 60,000 acres in 2006, stands as a reminder that fire hazard reduction will and should be an important objective guiding forest management across the Kaibab Plateau. However, such fire hazard reduction must occur within an explicit and comprehensive restoration context that recognizes the essential ecological role played by mixed severity fire –one that provides long-term strategic direction for maximizing the positive benefits of fire while minimizing the associated risks. In this vein, collaborative, cross-jurisdictional (especially BLM, U.S. Forest Service, and National Park Service) and science-based fire management planning is essential. This fire management planning should provide long-term guidance that establishes priorities and strategies, and directs treatment (thinning, prescribed burning, and Wildland Fire Use) aimed at preparing the Kaibab Plateau landscape for the reintroduction of natural fire. It should account for the potentially negative consequences of fire, especially those related to post-fire cheatgrass invasion and sensitive watershed degradation. It should recognize and account for the effects of alternative fire management and restoration strategies on forest-dependent wildlife habitat characteristics.

Despite the Kaibab Plateau's relative remoteness, restoration activities in ponderosa pine forests are likely to support, and be supported by, appropriately scaled industry in northern Arizona and/or southern Utah. The analysis of available supply characteristics within a restoration and long-term fire management context will provide local industry necessary certainty and stability, and as such should be an integral part of any restoration and fire management planning process.

Recommendations

1. Prioritize the North Kaibab landscape as one in which science-based collaborative "wildland" approaches to fire management and forest restoration can be tested and demonstrated at landscape scales. Beyond its inherent value in restoring the Kaibab Plateau, the demonstration and testing of such approaches would complement community protection-based approaches to forest management currently being implemented in Wildland Urban Interface areas, and inform the development of integrated community protection / wildland restoration strategies across the state.

2. Collaboratively develop a spatially and temporally explicit long-term restoration and fire management plan that supports the reintroduction of natural fire across the Plateau, and the restoration of the full range of natural variability in diverse and unique forest ecosystems, while protecting critical watersheds, wildlife habitat areas, and other critical landscape features. Such a plan would consider, at a minimum, the following management needs and approaches:
   - Analysis of current landscape-scale forest, fire, watershed, wildlife habitat, recreation, and infrastructure characteristics across the Plateau.
   - Development of explicit strategies for simultaneously protecting critical landscape features from high intensity crown fire, and strategically modifying fire behavior at multiple scales, including the landscape scale. Landscape-scale fire behavior modification would likely involve strategically placed restoration treatments that might also serve as fuel breaks, and appropriately-scaled and sequenced application of prescribed burning and Wildland Fire Use strategies.
   - Development of coordinated cross-jurisdictional forest restoration and fire management plans.
   - Consideration of post-fire rehabilitation strategies and priorities within a landscape-scale restoration context.
   - Control of invasive non-native species within a landscape-scale post-fire rehabilitation and restoration context. Such control will require identifying invasion characteristics and trends (especially that of cheatgrass) across the Plateau, including in surrounding lower-elevation invasive non-native species "source" areas within which invasion has already occurred, or is likely to occur.
   - Identification of fire management and forest restoration strategies that protect and restore connectivity and habitat quality for wide-ranging species (ie, mule deer), and habitat quality for threatened, endangered, and sensitive species (ie, northern goshawk).
   - Integration of forest and livestock management strategies, considering especially appropriate livestock management within the context of natural fire reintroduction and post-fire recovery.
   - Development of an access management plan that is consistent with long-term forest health restoration goals.
   - Development of a long-term implementation and effectiveness monitoring plan.
   - Analysis of long-term restoration by-products supply characteristics, and recommendations regarding initiation of appropriately-scaled industry designed to support restoration and fire management implementation.

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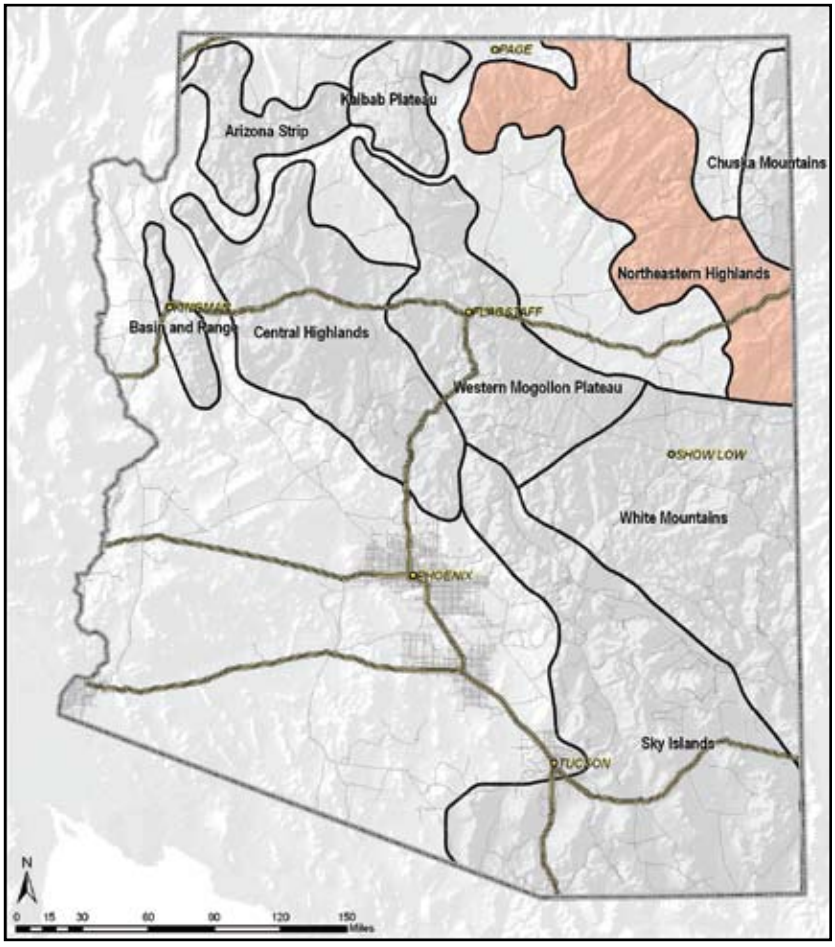
Northeastern Woodlands



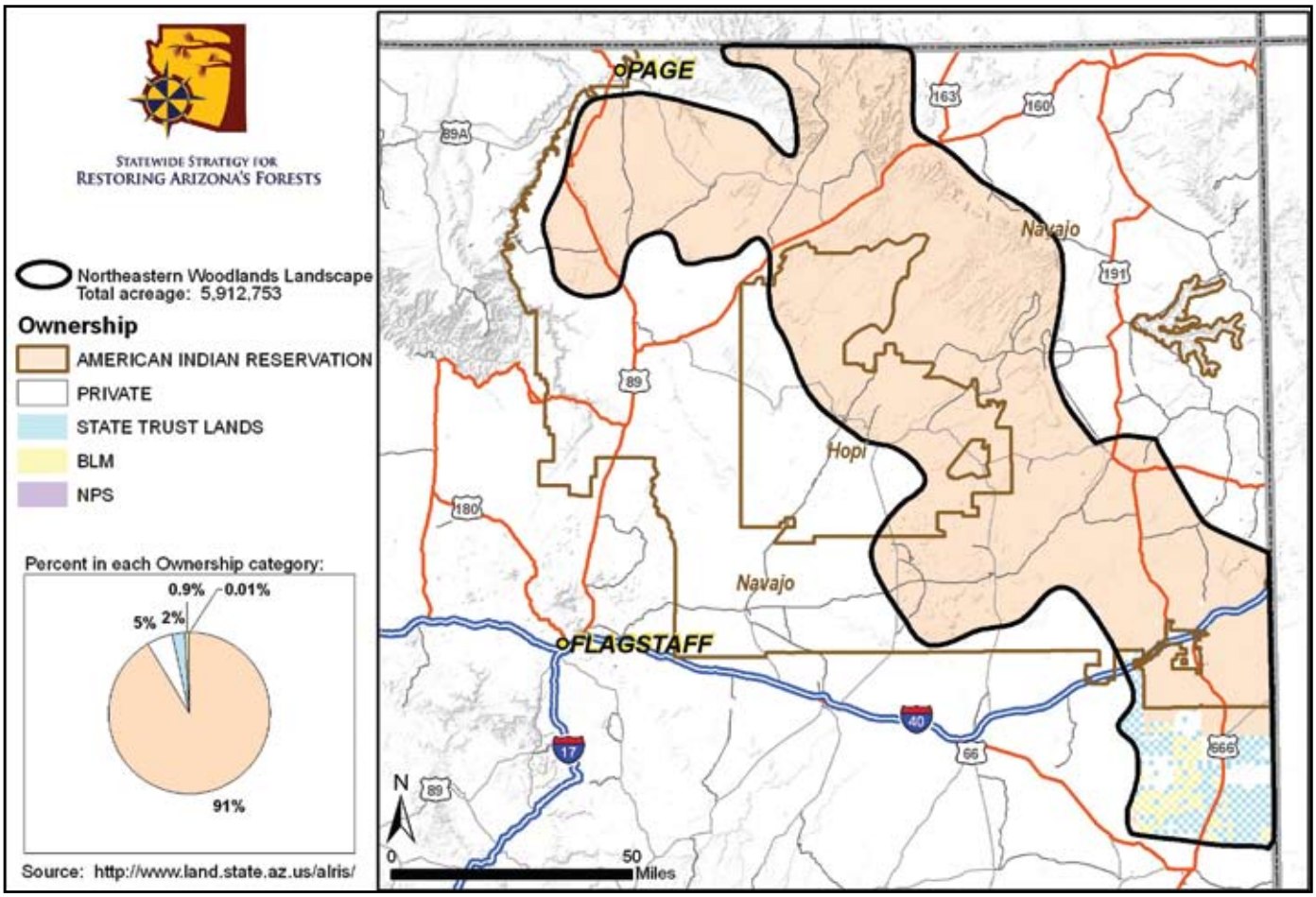
The region covered by the Northeastern Woodlands landscape covers nearly 6 million acres in northeastern Arizona. It is a land of broad mesas, arid valleys and deep canyons. Most of the area is over 5,000 feet in elevation. Extensive tablelands average 6,000 – 7,000 ft. in elevation, with high points just under 8,000 ft. Some of these tablelands include Kaibito Plateau, Grey Mesa, Rainbow Plateau, and Shonto Plateau in the north; Black Mesa, Hopi Buttes, and Balakai Mesa in the central region; and the Defiance Plateau in the southeastern region.

Precipitation and temperature in this landscape are largely a function of elevation. Precipitation at lower elevations is about 4 inches/yr, and about 20 inches/yr at the highest elevations. Most of the woodlands get 8-12 inches/yr, in the form of summer monsoonal rain and winter snow. Generally snow, when it occurs, is intermittent and melts quickly, so that many woodlands do not have a continuous cover of snow through the winter.

Northeastern woodlands have undergone significant changes in extent and in vegetation composition due to changes in land use. For example, woodlands have been cleared for agriculture, mining, and development. Grazing also has had a considerable effect on woodlands—altering the vegetation composition and reducing grasses that carried natural frequent fire. This, in turn has promoted the expansion of pinyon-juniper woodlands into grasslands.

Land Ownership

The majority of the Northeastern Woodlands landscape is composed of Indian trust lands—roughly 4,394,000 acres of Navajo Nation lands and 878,000 acres on the Hopi Reservation. A checkerboard of private, State Trust, BLM and National Park lands comprises the extreme southeastern portion of the landscape and covers approximately 473,000 acres (Figure 9.6.1.). Most of the Hopi Partitioned lands are included in the landscape as well as the North Oraibi, Hardrock, Upper Polacca, Toreva and Five Houses units of District Six of the Hopi Reservation. While a lengthy controversy over the boundaries of the Hopi and Navajo reservations hampered cooperation between the two tribes in the past, they now work together to improve conditions of the woodlands on both lands.



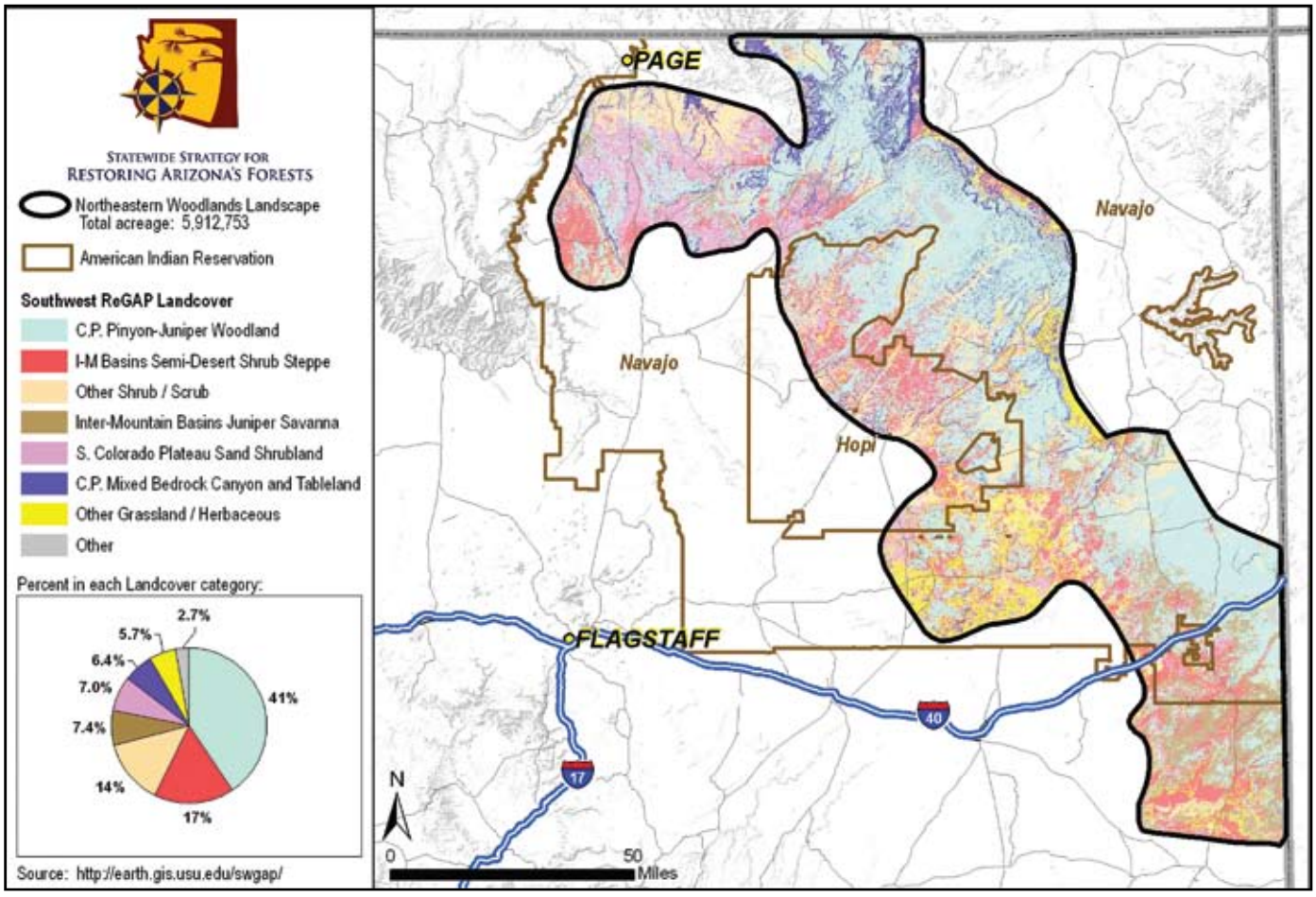
▲ Figure 9.6.1. Land Ownership status in the Northeastern Woodlands landscape.

Forests

Pinyon-juniper woodlands are widespread on the Colorado Plateau between 5,000 and 7,000 ft. The dominant trees in the Northeastern Woodlands landscape are Colorado pinyon pine (*Pinus edulis)* and one or more species of juniper which can include Utah juniper (*Juniperus osteosperma*), one-seed juniper (*J. monosperma*) and Rocky Mountain juniper (*J. scopulorum*). Proportions of the trees vary, and pure stands of either pinyon pine or juniper can be found (Figure 9.6.2). Typically, as elevation increases, pinyon increases, juniper decreases, total tree density increases, and trees grow larger.

Gambel oak and mountain mahogany (*Cercocarpus spp.*) can be intermixed in woodland areas, generally at higher elevations. These provide forage when other forage is scarce. Mixed conifer and pine are found at the highest elevations

Riparian forests are found along washes and streams, and can include the following native species: Box elder (Acer negundo), cottonwood (*Populus spp*), willow (*Salix spp*) and quaking aspen (*Populus tremuloides*). Two invasive introduced species have become problematic in riparian and other areas—Tamarisk (*Tamarix chinensis*) and Russian olive (*Elaeagnus angustifolia*).



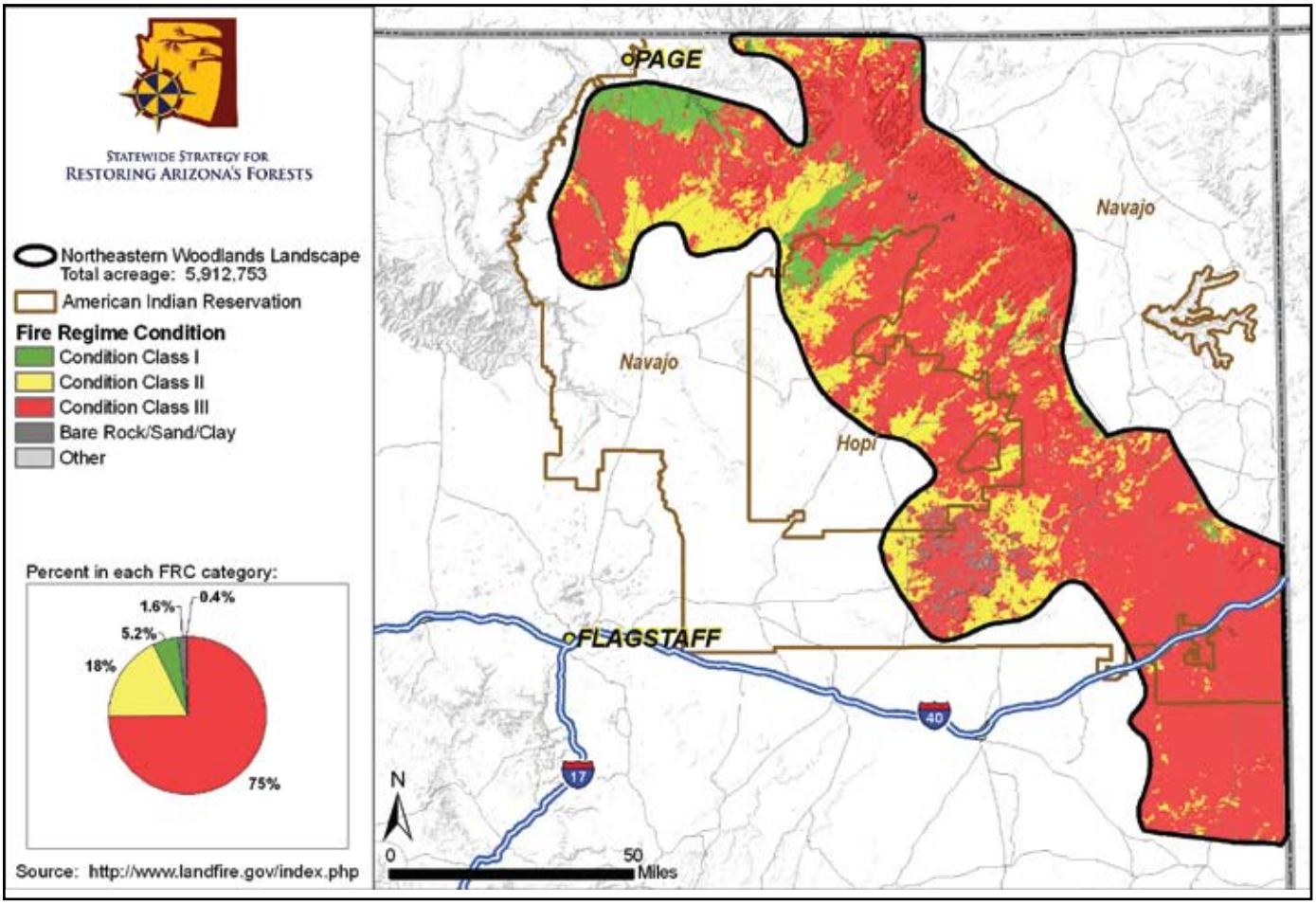
▲ Figure 9.6.2. Vegetation composition characteristics in the Northeastern Woodlands landscape.

Current Conditions

Areas of historic pinyon-juniper woodlands in the Northeastern Woodlands landscape have been removed to make way for agricultural uses, mining and residential areas. In other areas, drought and grazing have contributed to pinyon-juniper woodlands encroaching on grasslands and savannas.

Recent extended drought conditions have facilitated bark beetle and mistletoe damage throughout the region. By some estimates, more than 22% of trees have been affected in this way, creating unnaturally high fuel loads in pinyon-juniper woodlands.

Figure 9.6.3. illustrates that as much as 75% of woodlands in the Northeastern Woodlands landscape could be far removed from their natural range of variability.



▲ Figure 9.6.3. Fire Regime Condition of Vegetation in the Northeastern Woodlands landscape.

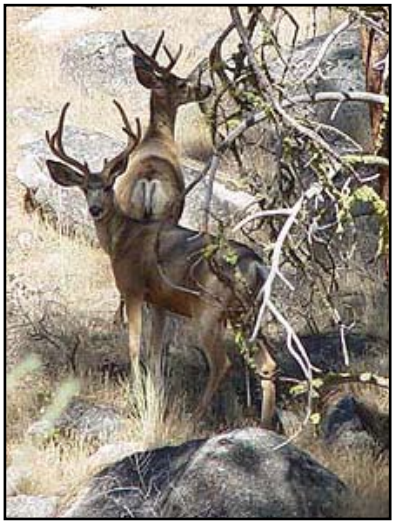
Communities

The Northeastern Woodlands is a sparsely populated landscape. The town of Kayenta, Arizona (population ~5,000) is the largest in the landscape. Numerous Navajo communities and Chapter Houses are scattered throughout the region.

The Hopi population in the Northeastern Woodlands landscape is concentrated in eleven villages situated atop three mesas that extend from the larger Black Mesa. Old Oraibi on Third Mesa is listed in the National Historic Register. First inhabited in 1050, it is one of the oldest continuously inhabited communities in North America.

Five communities in the Northeastern Woodlands landscape are classified as communities at risk:

- Second Mesa - Moderate
- Third Mesa - Moderate
- Polacca - Low
- Jeddito - Moderate
- Keams Canyon - Moderate



Wildlife

On the Hopi Reservation, the Wildlife and Ecosystems Management Program (WEMP) is responsible for protecting wildlife, including culturally sensitive species, and wildlife habitat. The program focuses on the protection of wildlife, such as raptors, large and small game animals, migratory birds, reptiles and amphibians that have inhabited areas of the Hopi Reservation throughout its history. The Hopi have benefited from wildlife through hunting harvests and spiritual connections, and feel that wildlife play an important role in healthy ecosystems. One of the goals of woodland management for the Hopi is to protect threatened and endangered species. However, most of the Hopi woodlands are considered marginal to unsuitable habitat for most of the species listed by the USFWS.

On Navajo lands, big game species, especially mule deer (*Odocoileus hemionus*), provide subsistence food for many Navajo residents, and recreational hunting opportunities. Other important woodland game animals include elk (*Cervus elaphus nelsoni*), pronghorn (*Antilocarpa americana*), black-tailed jackrabbit (*Lepus californicus*), quail (*Callipepla gambelkik)* and turkey (*Meleagris gallopavo*). Woodlands provide winter range for deer and elk populations, and cover from predators and extreme winter weather.

Evidence indicates that the Mexican spotted owl (*Strix occidentalis lucida*), a threatened species, lives in the mixed conifer forests of the Northeastern Woodlands landscape. Feathers of molting individuals and nests have been found in Pinyon-juniper woodlands that include narrow, shady, cool canyons in sandstone slickrock.

Fire

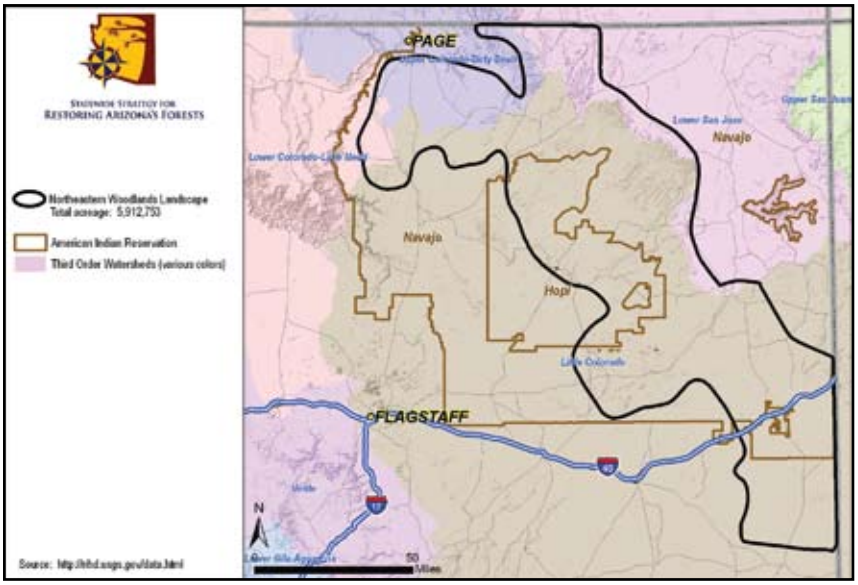
With the post-settlement reduction in fire frequency, introduction of grazing by livestock, and shifts in climate, the vegetation structure of pinyon-juniper woodlands shifted. As trees, especially pinions, became dominant, shrubs and herbaceous vegetation declined. Dense tree canopies are now becoming susceptile to intense crown fires, which, in turn, can lead to dominance by exotic species.

A large number of fires have historically been caused by land clearing, the burning of weeds and trash, and the burning of fields prior to planting in the spring. While there are lightning strike caused fires, historically, the majority of fires reported in this zone were human-caused.

Because of the obvious risk associated with the use of prescribed fire, planning and implementation will require a prescribed burn plan, review of the plan by the public, review by a competent fire management professional, review by the Water Resources Program (to assure that soil erosion is not accelerated), and approval by the Department of Natural Resources and BIA officials. The prescribed burn plan shall be consistent with the land useobjectives outlined in the Tribal plans such as the Hopi Integrated Resources Management Plan, the Hopi Wildand Fire Management Plan and others such as specific Range Unit Management Plans. A qualified burn specialist must carry out the prescription.

On the Navajo Nation, fire management is addressed under the Programmatic Wildland Fire Plan developed for the Navajo Nation by the BIA-Fore and Aviation Management Program.

Watersheds



▲ Figure 9.6.4. Third order watersheds in the Northeastern Woodlands landscape.

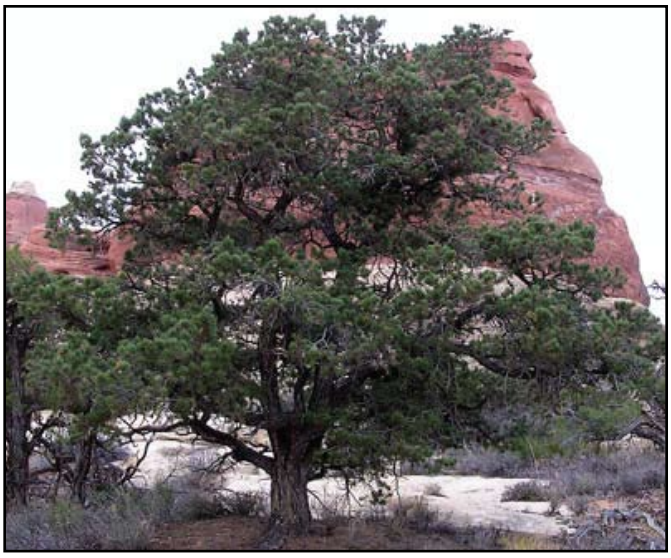
The Northeastern Woodlands landscape is part of the Little Colorado Watershed Figure 9.6.4). Water is a precious resource in this area due to its scarcity. Hopi farmers depend on seasonal rains and diversions of water from the washes to successfully grow their corn and other crops. Black Mesa is a source of water for this region, and can be visualized as a broad, hand-shaped mesa across whose “wrist” runs a pine-covered rim of generally 8,000 foot elevation. Along its “fingers” extending to the southwest lie the Hopi villages and the headwaters of the Polacca, Wepo, Oraibi, and Blue Canyon drainages. Precipitation percolates into porous sandstones far back on the mesa, feeding the springs that give the Hopi villages a permanent supply of drinking water. Precipitation can also be delivered directly through the washes, but high volume flushes during extreme rain events can be destructive to farm fields and diversions. Land management in the highlands and washes can either improve or aggravate the effects from rain events.

Water flowing through the washes eventually flows into the Little Colorado River.

Collaborative Efforts

The National Indian Forest Resources Managment Act (Public Law 101-630 requires that American Indian Tribes develop a plan for forest development, maintenance, and enhancement. In keeping with this act, the BIA requires a forest management plan to assure wise-use and sustained yield of forest resources. Both the Navajo and Hopi Tribes worked with their respective BIA agencies to develop their Forest Management Plans.

Economics



Resources derived from Pinyon-Juniper woodlands by the Navajo Nation include:

- Fuel for heating and cooking, both for personal use, as well as for barter or sale.
- Posts and poles
- Christmas trees for sale
- Pinyon nuts for personal consumption and sale and barter
- Recreational and subsistence hunting
- Tourism and other recreational uses

The Navajo Nation Division of Economic Development is currently working on building a 10-megawatt power plant that will run on biomass. At the present time, there are no plans for other uses of small diameter wood.

Resources derived from Pinyon-Juniper woodlands by the Hopi Tribe include:

- Fuel for cooking and heating homes
- Posts, poles, for fencing and building
- Juniper for ceremonial uses
- Pinyon nuts
- Gathering plants for medicinal or ceremonial purposes
- Recreation

The Hopi Tribe is interested in investigating opportunities to develop businesses that utilize small diameter wood, however, they are using most of the wood that is cleared from their lands.

Implementation and Management

The BIA plays a significant role in the management of Indian forests. All reservation timber-harvest plans must be approved by the agency, which is also responsible for monitoring the cuts.

The Hopi Integreated Woodlands Management Plan was adopted by the Hopi Tribal Council in June 2006. The management goals reflected in this document are to protect cultural and traditional resources, wildlife habitat, watersheds, threatened and endangered species (as identified by the USFWS), and culturally sensitive species. Implementation steps include ecological assessments of specific range units, woodland areas, and special management areas, to determine current status of natural resources, and identify desired conditions and proposed actions. Implementation also includes monitoring of program impacts and effectiveness.

Currently, the Hopi Tribe is only harvesting dead and downed wood, including beetle-killed trees. The Tribe is also working to eradicate invasive Russian olive and tamarisk trees from riparian areas, and to plant native trees in their place.

Management of the Woodland area on the Navajo Nation is under the jurisdiction of the Navajo Forestry Department, with some local control by chapters. The goal of woodlands management is the integrated management and use of woodlands to encompass both the harvest and use of wood and tree products, as well as consideration of important habitats for wildlife, forage for grazing and the protection of woodland areas for ceremonies and other cultural uses, recreation and tourism.

Future Restoration Needs

Below are recommendations for accomplishing restoration goals in the Northeastern Woodlands landscape developed through conversations with the Navajo Department of Forestry and the Hopi Department of Natural Resources.

Navajo:

1. Provide training for Navajo Forestry Department personnel Pinyon-uniper treatments, Wildland Urban Interface treatments, and the use of prescribed and wildland fire.
2. Obtain most recent accurate spatial data describing Navajo Nation forests and woodlands.
3. Design and implement forest treatments that minimize associated impacts on forests.
4. Educate Navajo Nation residents and environmental groups about the need for forest restoration.
5. Educate Navajo Nation residents about the need to reduce fuel loads around their homes.
6. Improve communication and cooperation with the Bureau of Indian Affairs.

Hopi:

1. Participate in the Firewise Communities program: Do community assessment, obtain training, and obtain public education materials.
2. Obtain the equipment to become self-sustaining – e.g. mulchers, and splitters, which are currently being rented from Flagstaff.
3. BIA should expedite the development of site specific burn plans. Hopi have been unable to implement prescribed burn treatments.

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Note: The Northeastern Woodlands landscape analysis was developed in cooperation with the Navajo Nation Forestry Department and the Hopi Tribe's Department of Natural Resources; and is printed here with their permission.

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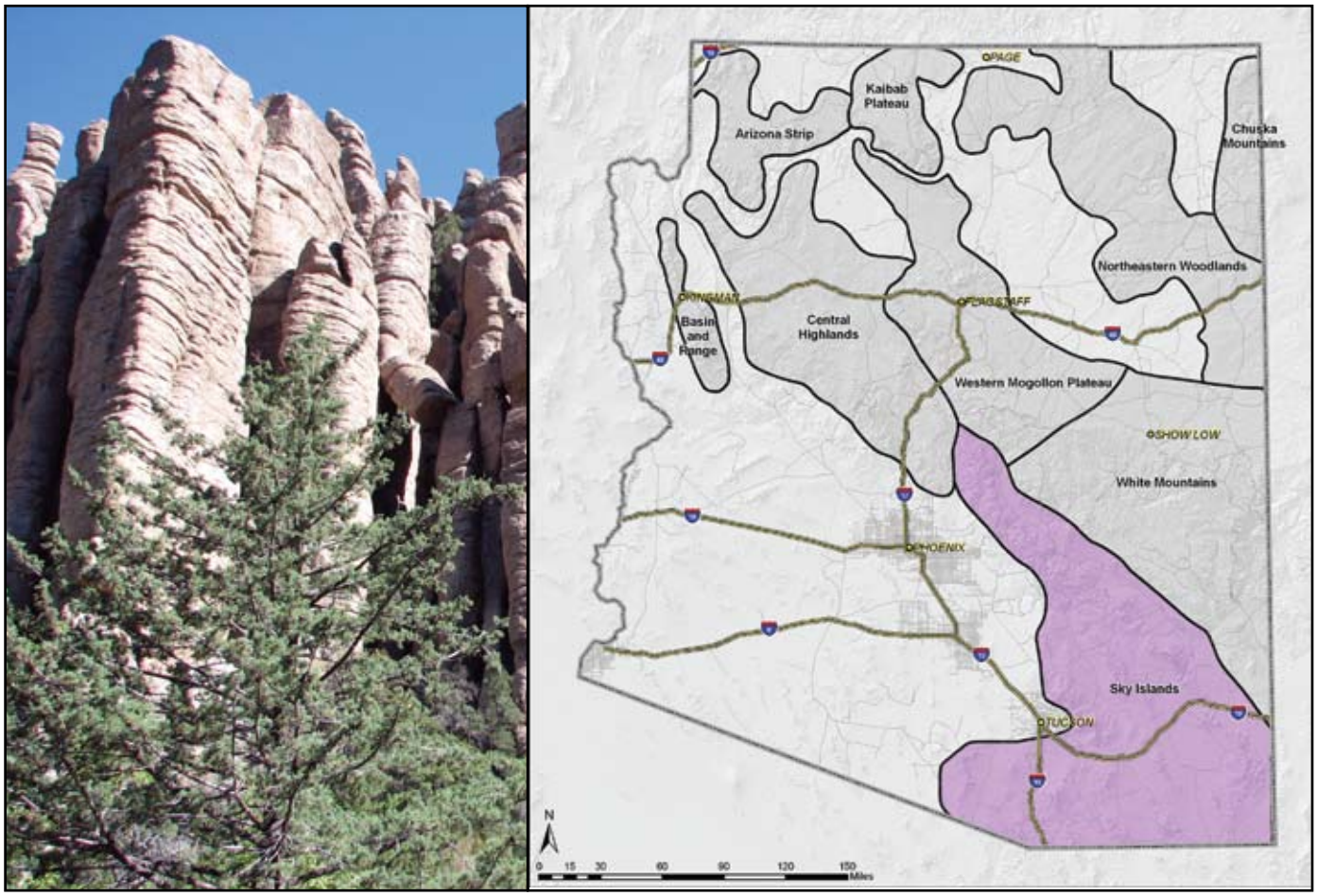
Personal Interviews conducted December 20, 2006 with Hopi Department of Natural Resources: Arnold Taylor, Director; Donna Anderson, Hopi Wildlife; Woody Shattuck, Wildland Fire Use manager.

Sky Islands



The Madrean Archipelago is a group of sky islands surrounded by desert grasslands. These sky-islands are located at the confluence of four major bioregions--the Southern Rocky Mountains, the Northern Sierra Madre Mountains, the Sonoran Desert, and the Chihuahuan Desert. Plant and animal inhabitants of many of the mountains in this area have been isolated from one another for at least 11,000 years. Evolutionary processes during this period of isolation have created a region of great biological diversity, with high numbers of species native only to a particular area and/or sky island. This area also constitutes the historic ranges of the Chiricahua and Mescalero Apache tribes.

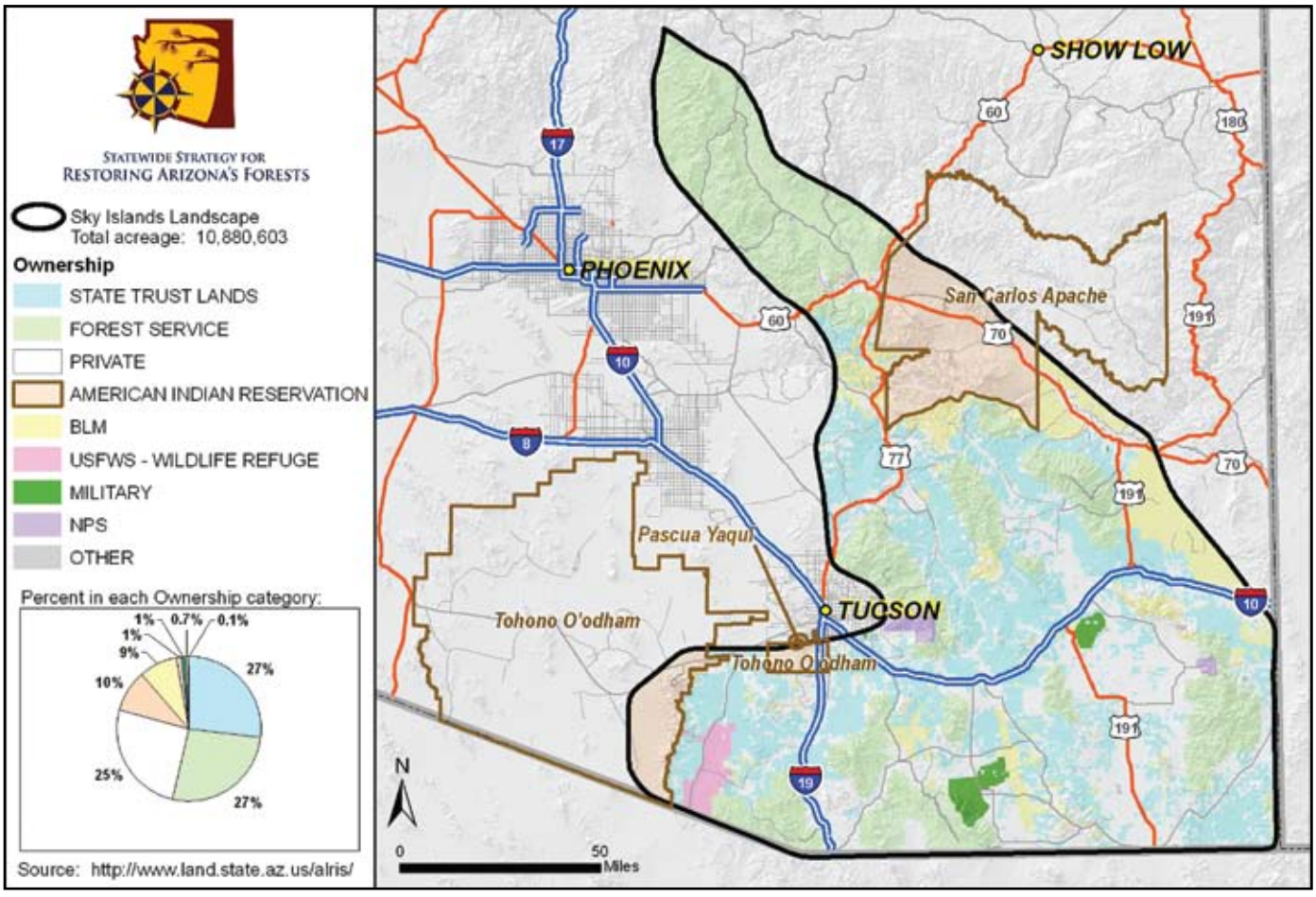
In Arizona, the Sky Island region of the Statewide Strategy is circumscribed by the Gila Mountains to the north, the Baboquivari Mountains to the west, and the Mexican border to the south. Major mountains within the region include the Chiricahua, Pinaleño, Catalina, Rincon, Tumacacori, Santa Rita, Whetstone, and Galiuro ranges. Geographically, the forested Sky Island ranges of southeastern Arizona span the North American continent's two major mountain spines--the Rocky Mountains and Colorado Plateau to the north, and the Sierra Madre Occidental to the south. In addition, the Sky Island region spans North America's two largest desert biomes--the Sonoran to the west, and the Chihuahuan to the east. Due to latitudinal extent, as well as elevational range, plant and animal diversity derives from both temperate and tropical origins, contributing to the unusually high levels of biodiversity in this landscape.

Madrean oak woodlands are the defining feature of the Sky Islands mountains and are the most prevalent vegetation type. The Sky Island region of the southeastern Arizona hosts the northern extension of Madrean-radiated oak woodland and savanna, which are dependent on the wet summer, mild winter climate associated with the subtropical Sierra Madre Occidental mountain range in western Mexico. This biotic community supports a relatively rich assortment of wildlife and plant species, generally absent in other forest types across Arizona. Because of its floristic and geographic connection to the Madrean continental spine to the south, bird, mammal, and reptile diversity is unparalleled in relation to other forest associations. Low-intensity, relatively frequent fire events are a natural component of this vegetation zone, and are fueled largely by a significant fine-fuel (grass) understory.

Sky Islands

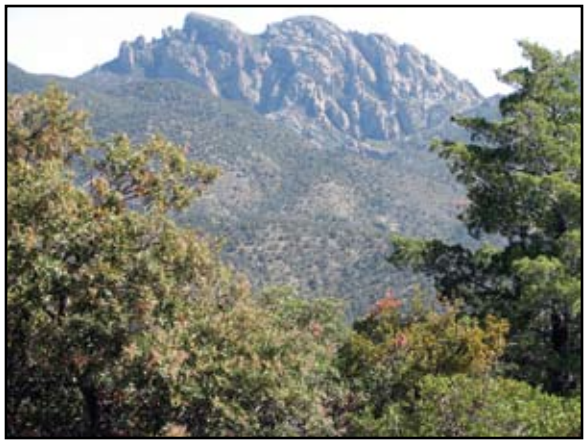
Land Ownership

Land ownership patterns within the Sky Island region comprise a relatively complex mosaic of different jurisdictions and private landowners (Figure 9.7.1.). Separated by wide valleys (10-20 miles), the upper elevations are generally managed by the Coronado National Forest, which oversees 1.8 million acres of land within 13 distinct Ecological Management Areas. Valleys within the region are managed largely by the Arizona State Land Department, BLM, and private land owners. Ex-urban development with the region currently threatens landscape connectivity between mountain ranges. Fire events are invariably localized to individual mountain ranges today, although historically may have stretched across grassland valleys to adjacent ranges.



▲ Figure 9.7.1. Land Ownership status in the Sky Islands.

Forests



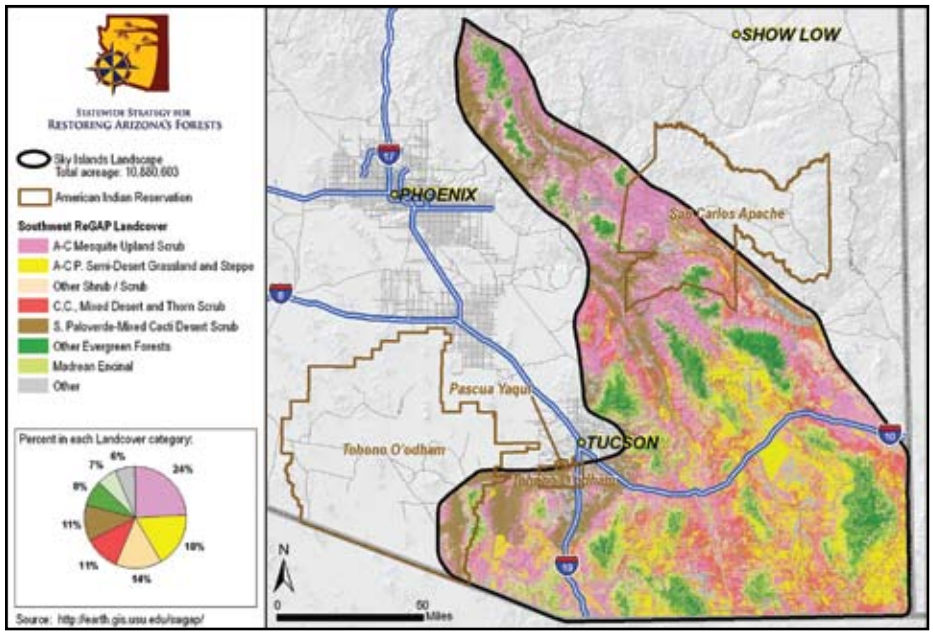
At the highest elevations (8,000 – 10,000 feet), the sky islands are capped with cold, wet spruce-fir forests (Figure 9.7.2.) that receive an average of 25-40 inches of precipitation annually. Engelmann spruce (*Picea engelmannii*) predominate, and can be interspersed with subalpine fir (*Abies lasiocarpa*), blue spruce (*Picea pungens*), Rocky Mountain maple (*Acer glabrum*), Bebb willow (*Salix bebbii*), Scouler willow (*S. scouleriana*), blueberry elder (*Sambucus caerulea*), or bitter cherry (*Prunus emarginata*).

Below the spruce-fir level, a discontinuous belt of mixed-conifer forests leads downward to the warmer, drier pine forests. Douglas fir (*Psuedotsuga menziesii*), white fir (*Abies concolor*), ponderosa pine (*Pinus ponderosa*), Mexican white pine (*P. ayacahuite*) and blue spruce can be found at this level.

Ponderosa pine forests make up the lowest elevation of coniferous forests (6,500 – 8,000 feet), and typically receive 18-26 inches of precipitation annually. Aspen (*Populus tremuloides*) is the principal successional species in conifer forests, forming dense stands of trees that shelter and promote the growth of young conifers. Fire suppression and intense browsing by deer and other herbivores threaten aspen populations, and have resulted in dense stands of conifers, which pose a risk of wildfire.

Below the conifer forests lie the pinyon-juniper woodlands or, depending on aspect and micro-climate, Madrean oak woodland. Grasses dominate the understory, which also includes shrubs, such as mountain mahogany(*Cercocarpus* spp.), Gambel oak, snakeweed (*Gutierrezia arizonica*), and threadleaf groundsel (*Senecio longilobus*). Pine-oak woodland forms a transitional zone between oak woodland and higher-elevation montane conifer forests.

Madrean encinal, or oak woodlands, are found at elevations ranging from 3,600 to 6,500 feet, and are bordered by semidesert grassland and plains at lower elevations. Emory oak (*Quercus emoryi*) is present throughout the oak woodlands range, with Mexican blue oak (*Q. oblongifolia*), Arizona white oak (*Q. arizonica*), and gray oak (*Q. grisea*) also occurring discontinuously. Understory is often composed of grasses and scrubland species.



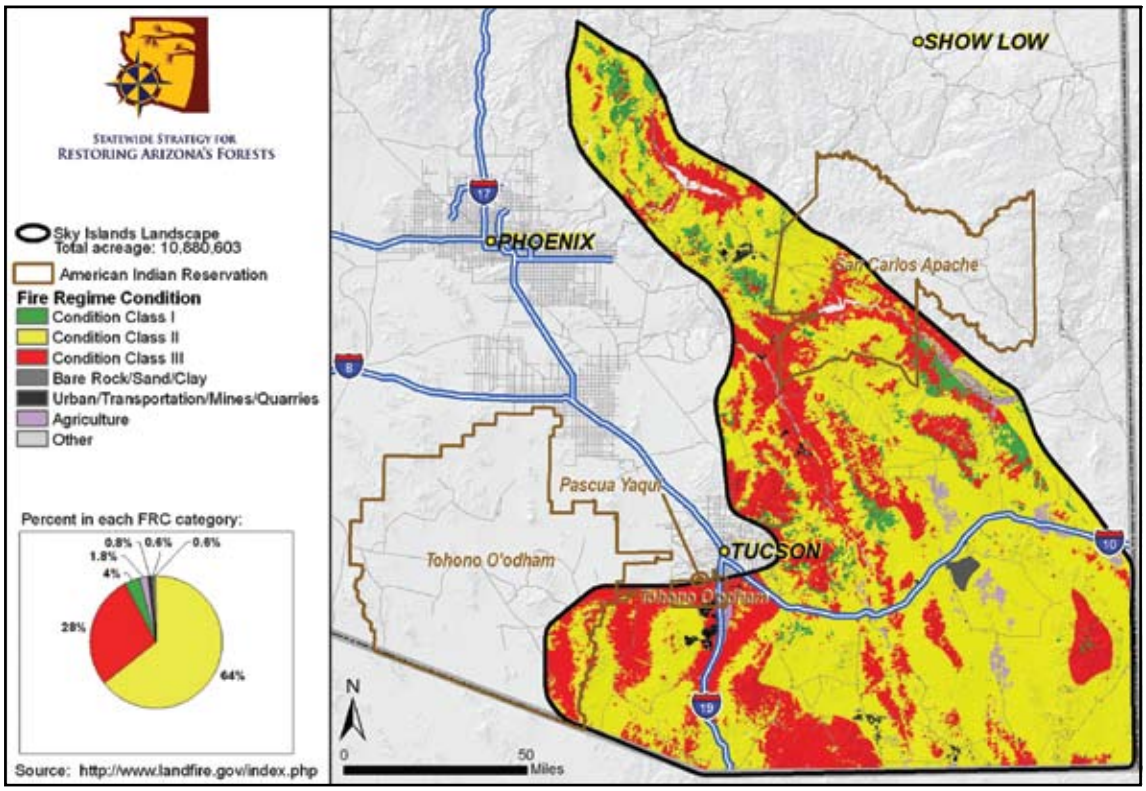
▲Figure 9.7. 2. Vegetation characteristics in the Sky Islands landscape.

Current Conditions

More than 30 mining centers operated in the Sky Islands landscape in the 1880s. Wood was extensively used in the mines for fuel and construction. To supply these mines with wood, significant saw timber logging occurred in the Chiricahua, Huachuca, Santa Rita, and Santa Catalina mountains. The management of the Sky Islands forests by U.S. Forest Service included fire exclusion, beginning around 1906, to encourage overstocking of the forests in order to maximize tree growth for fiber production. In addition, overgrazing by cattle and sheep eliminated grasses that carried natural, cool, ground fires. Fires could no longer run through the valleys and move through the mountains, resulting in unnaturally high fuel loads in nearly all forest types. Further more, the elimination of grasses has been instrumental in the spread and increased density of pinyon-juniper woodlands. As illustrated by the Fire Regime Condition characteristics in Figure 9.7.3., almost all of the forested areas in the Sky Islands landscape have significantly diverged from their historic range of variability.

Spruce-fir forests are normally insulated from fire by cool temperatures and soggy ground, but drought has created drier than normal conditions. Below the spruce-fir zone, in the mixed conifer zone, fire exclusion has created a forest that is overstocked with woody fuel. The downward migration of shorter spruce and fir has contributed to the fire threat by providing ladder fuels.

About 34,000 acres of the Coronado National Forest are in Wildland Urban Interface areas In the Tucson area alone, there are 60 miles of interface. The mix of houses, fuels and brush fields adds significantly to the challenge of reintroducing natural wildland fire in forest restoration.



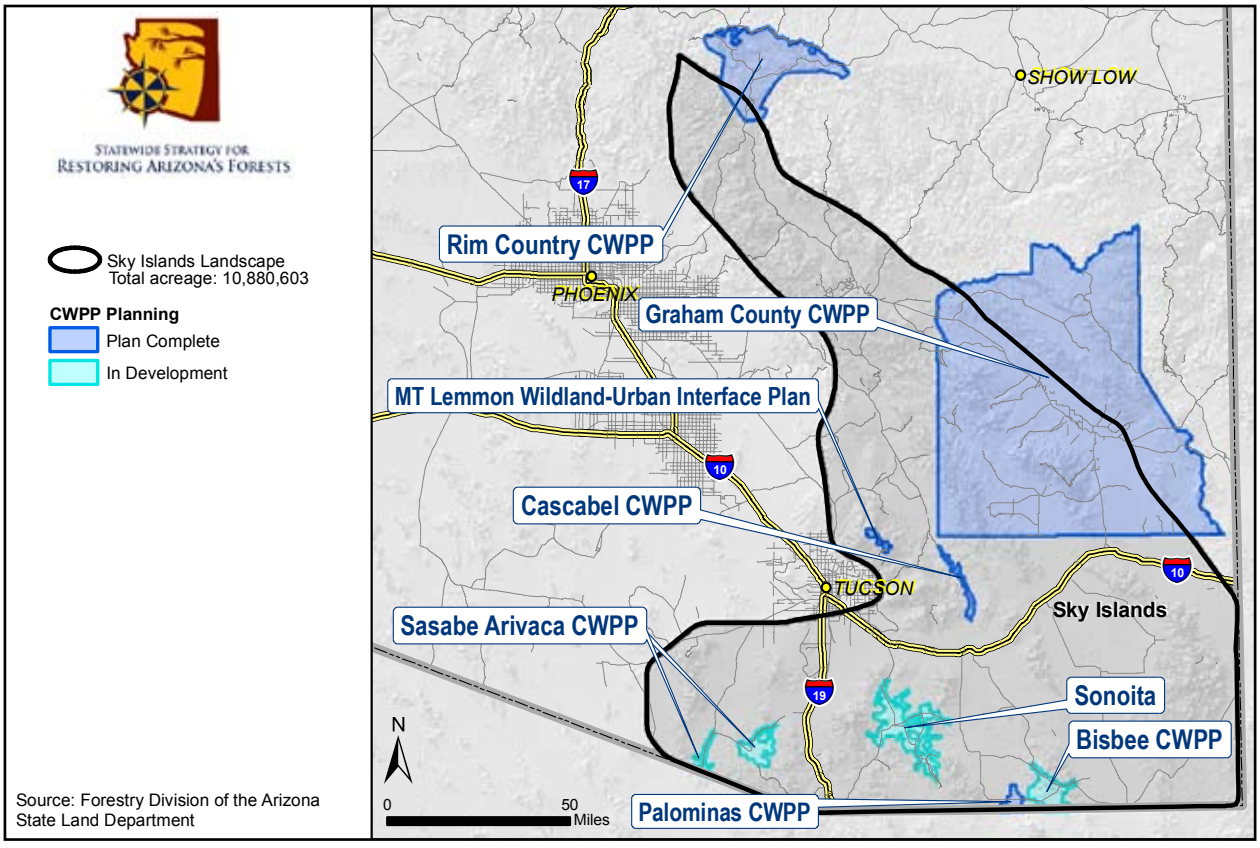
▲Figure 9.7.3. Fire Regime Condition of vegetation in the Sky Islands landscape.

Communities

The socioeconomic setting for the Sky Islands landscape is rural, with average incomes much lower than the national average. The population density in the region is typically less than five people per square mile, except for suburban or urban areas. In Arizona, seven counties are wholly or partially contained within the region. The only major urban area in the Sky Islands region is Tucson, Arizona. Other towns include Douglas, Benson, and Sierra Vista in Cochise County; Safford in Graham County; and Nogales and Patgonia in Santa Cruz County. The community of San Carlos on the San Carlos Apache Reservation, is also within the landscape area, and listed on the Federal Register of communites at risk.

The scientific community has several research sites in the Sky Islands landscape, including the world-renowned Large Binocular Telescope Observatory on Mt. Graham, which was threatened by the Nutall Fire Complex in the summer of 2004.

Population in the Sky Islands region has been increasing steadily during the last few years. The mild climate and comparatively low cost of living draws large numbers of retirees from other parts of the country. The resulting sprawl has increased Wildland Urban Interface with wildlands and wildlife. Currently, five Community Wildfire Protection plans are in place in the Sky Islands landscape area (Figure 9.7.4): Graham County, Mt Lemmon, Cascabel, Palominas, and a small region of the Rim Country CWPP.



▲Figure 9.7. 4. Community Wildfire Protection Plans within the Sky Islands Landscape area.

Wildlife

The Sky Islands landscape is a biodiversity "hotspot," and this is reflected in the wide array of wildlife species, many of them rare or sensitive, that are found within this landscape. More than 240 butterfly species and at least 468 bird species have been identified in southeastern Arizona in the last 50 years. The Sky Islands contain a large number of threatened and endangered species, many of them reliant on streams, springs, and other water sources in this mostly arid, hot environment. Several other species are restricted to unusual habitats, such as spruce-fir and moist mixed-conifer forests on moist talus slopes.

The Madrean pine-oak woodlands in the higher elevations are home to species, such as the white-bellied long-tailed vole (*Microtus longicaudus leucophaeus*), the violet-crowned hummingbird (*Amazilia violiceps*), and the threatened New Mexico ridge-nosed rattlesnake (*Crotalus willardi obscurus*). Very high elevation spruce-fir and moist mixed-conifer forests in the Pinaleño Mountains contain the only population of the endangered Mount Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*). Populations of this species have suffered in recent years from fire and insect infestations due to declining forest health in the Pinaleño range. Other rare and sensitive species found in Sky Islands forested habitats include the Mexican spotted owl (*Strix occidentalis lucida*), Chiricahua leopard frog (*Rana chiricahuensis*), and occasional sightings of jaguar (*Panthera onca*).

Several plant and wildlife species are restricted to a single, or a few isolated mountain ranges, such as the Pinaleño, Huachuca, and Patagonia mountains. For many forest-dwelling species, each mountain range is indeed an isolated "island" surrounded by an inhospitable sea of treeless desert. Because migration is often difficult, if not impossible, many wildlife populations are especially vulnerable to forest health declines in their local regions.

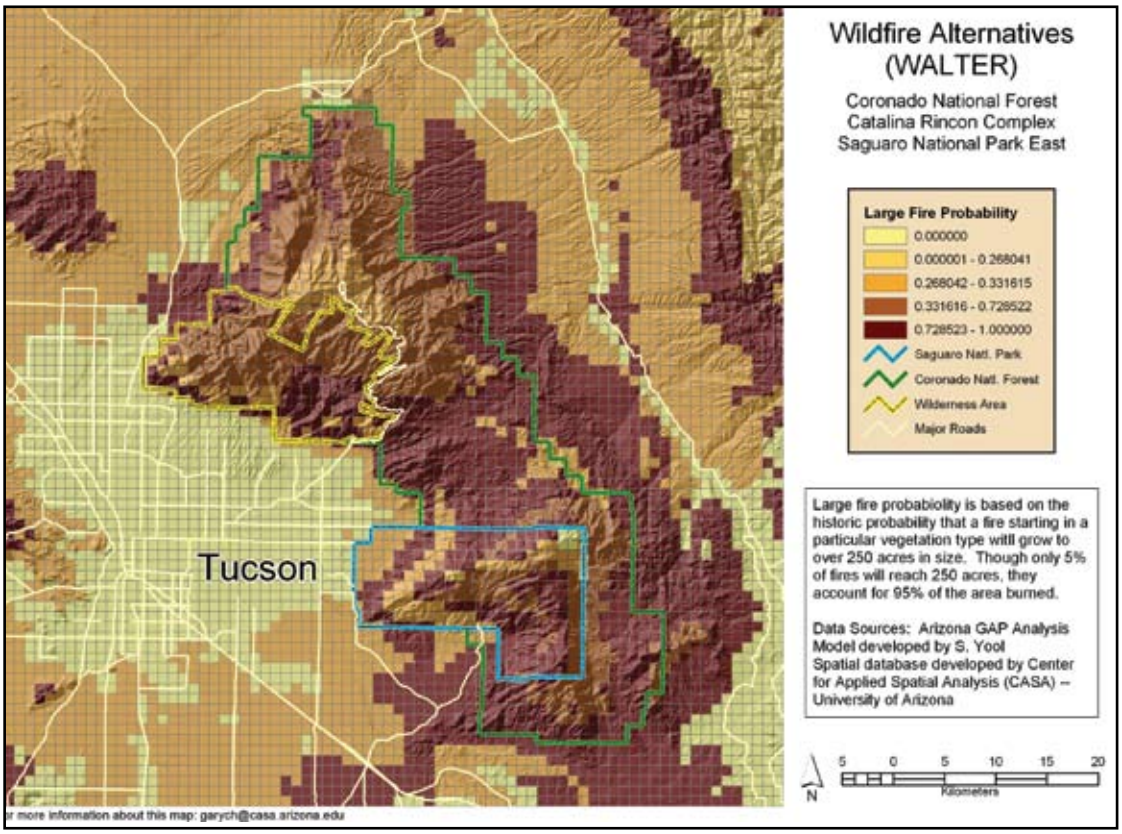
Other significant species in the Sky Islands landscape include: black bear (*Ursus americanus*), wild turkey (*Mealeagris gallopavo*), buff-breasted flycatcher (*Empidonax fulvifrons*), and white-tailed deer (*Odocoileus virginianus*).

Fire

Due to high levels of topographical complexity and gradient within each Sky Island, fire characteristics are variable across the region. Single fires will often cross multiple vegetation zones due to the relatively small distances between different associations. Wooded canyons may carry fire below traditional burn areas of ponderosa pine, pine-oak, and oak woodland into chapparal or semi-desert grassland, and, conversely, traditionally lower frequency burn areas, such as mixed-conifer and spruce-fir associations, may burn more frequently with ignition sources in lower elevations.

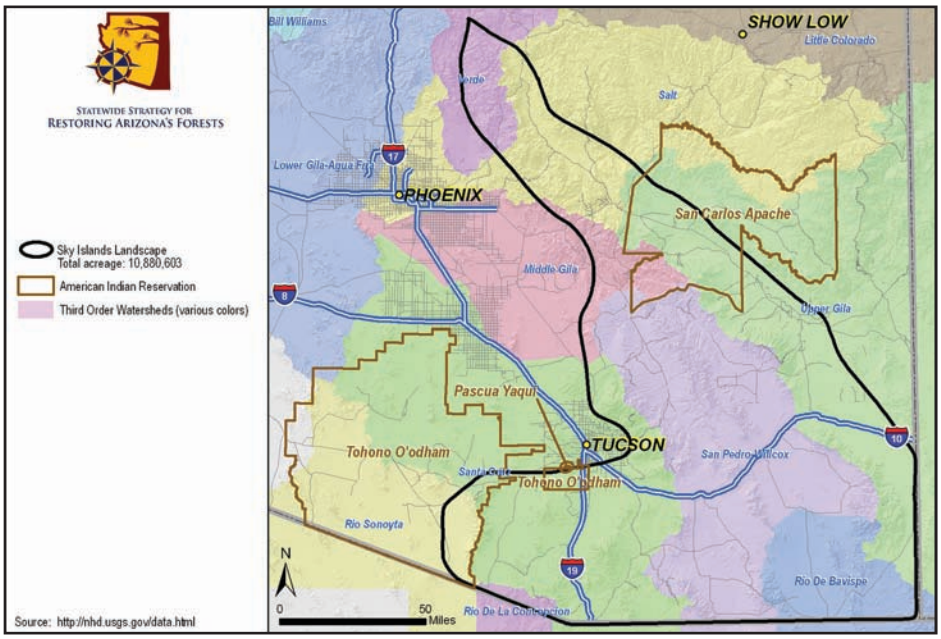
Unnaturally high fuel loads and drought have contributed to a series of major wildfies in the Sky Islands ranges since 1994:

- Rattlesnake Fire - Chiricahuas, 1994, 27,500 acres burned
- Bullock Fire - Santa Catalinas, 2002, 30,000 acres
- Aspen Fire - Santa Catalinas, 2003, 87,000 acres and 333 structures burned
- Nuttall Fire - Pinalenos, 2004, 29,000 acres
- Florida Fire - Santa Ritas, 2005, 23,000 acres



▲Figure 9.7.5. Large fire probability in the Catalina Rincon Complex and Saguaro National Park East, near Tucson, Arizona. Source: WALTER

Sky Islands



▲Figure 9.7.6. Third order watersheds within the Sky Islands landscape.

Watersheds

Annual precipitation in the high elevation, mixed-conifer forests (above 9,500 feet) ranges from 30 to 45 inches and is normally in excess of potential evapotranspiration—the amount of water required by plants to grow normally. As a result of this excess precipitation, streams originating in this area are often perennial and contribute significantly to Sky Island watersheds. The Sky Island region contains the only watersheds apart from the Colorado River drainage system in Arizona. West of Nogales, the upper reaches of the Rio Magdelena are represented by Sycamore Canyon, California Gulch, Warsaw Canyon, and other minor tributaries. The Rio Magdelena flows south from Cibuta, Sonora westward directly into the Gulf of California. In the extreme southeastern portion of the state, the Whitewater Draw and Hay Hollow watersheds flow south into the Rio San Bernardino, and together represent the northern reaches of the Rio Yaqui River, which flows south for several hundred miles to finally reach the Gulf of California near Obregon, Sonora. Third order watersheds are depcited in Figure 9.7.6.

Collaborative Efforts

A number of collaborative efforts have developed in the Sky Islands landscape that focus on reducing the risk of undesirable or uncharacteristic fire and forest restoration. The Pinaleño Partnership is a collection of agency, conservation, and local stakeholders working together on monitoring and restoration work throughout the mountain range. Specifically, attention is currently devoted to monitoring effects of the Pinaleños Ecosystem Restoration Project – a series of thinning projects in the range's higher elevations, and additional thinning near the cabins at Columbine.

The Huachuca Area Fire Partners (HAFP), is an example of collaborative fire management planning in the Sky Islands landscape. The group culminated years of collaborative information gathering and processing with the release of the HAFP Fire Management Plan of 2005. The Fire Management Plan covers approximately 500,000 acres. The HAFP include National Audubon Society, Arizona State Land Department, Babocomari Ranch, Coronado National Memorial (National Park Service), Fort Huachuca (U.S. Army), San Pedro Riparian National Conservation Area (Bureau of Land Management), San Rafael Ranch, Arizona State Parks, USDA Forest Service, and The Nature Conservancy. The group developed and implemented the Firescape concept, which works to restore fire-adapted ecosystems by:

- Working at a landscape scale
- Applying current science to establish goals
- Involving partner land managers
- Sharing resources in creative ways
- Streamlining compliance and other paperwork to focus more on implementation.

Future Restoration Needs

Recommendations

1. Conduct educational outreach to stakeholders that will highlight the ecological and socio-economic benefits of ecological restoration.
2. Provide incentives and assistance for restoration of privately owned forests.
3. Integrate restoration planning with long term planning and zoning processes, which will require outreach and education to planning and zoning commissions.
4. Encourage Firewise landscaping and building in communities.
5. Encourage the restoration-based harvesting of firewood as opposed to importing firewood from Mexico.
6. Work to reintroduce natural fire regime in the remote Sky Islands mountains before that option is precluded by development, specifically in Galiuro Wilderness and Galiuro/Winchester Mountain Complex.

Madrean oak woodlands are the defining feature of the Sky Islands mountains.

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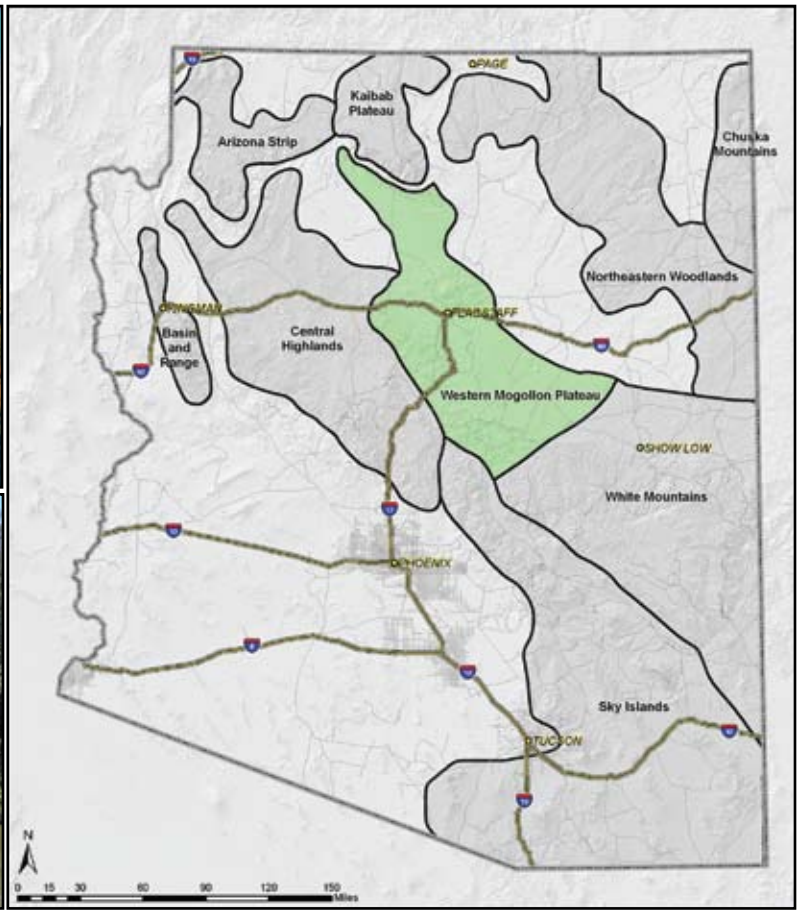
Western Mogollon Plateau



The Western Mogollon landscape spans more than four million acres of north-central Arizona between the Grand Canyon and the White Mountains. It encompasses the communities of Flagstaff, Williams, Blue Ridge, and Payson. Its most extensive feature, the Mogollon Plateau, is a northwest-southeast trending plateau capped by Tertiary volcanic formations and extensive forests and woodlands. The Mogollon Rim forms a steep scarp along the southwestern edge of the Mogollon Plateau, dividing two major geologic provinces: the Colorado Plateau to the north and the Basin and Range to the southwest. Near Flagstaff, the San Francisco Peaks volcanic field forms the landscape's most prominent feature with more than 600 volcanoes and Arizona's highest point, Humphrey's Peak (12,633 ft).

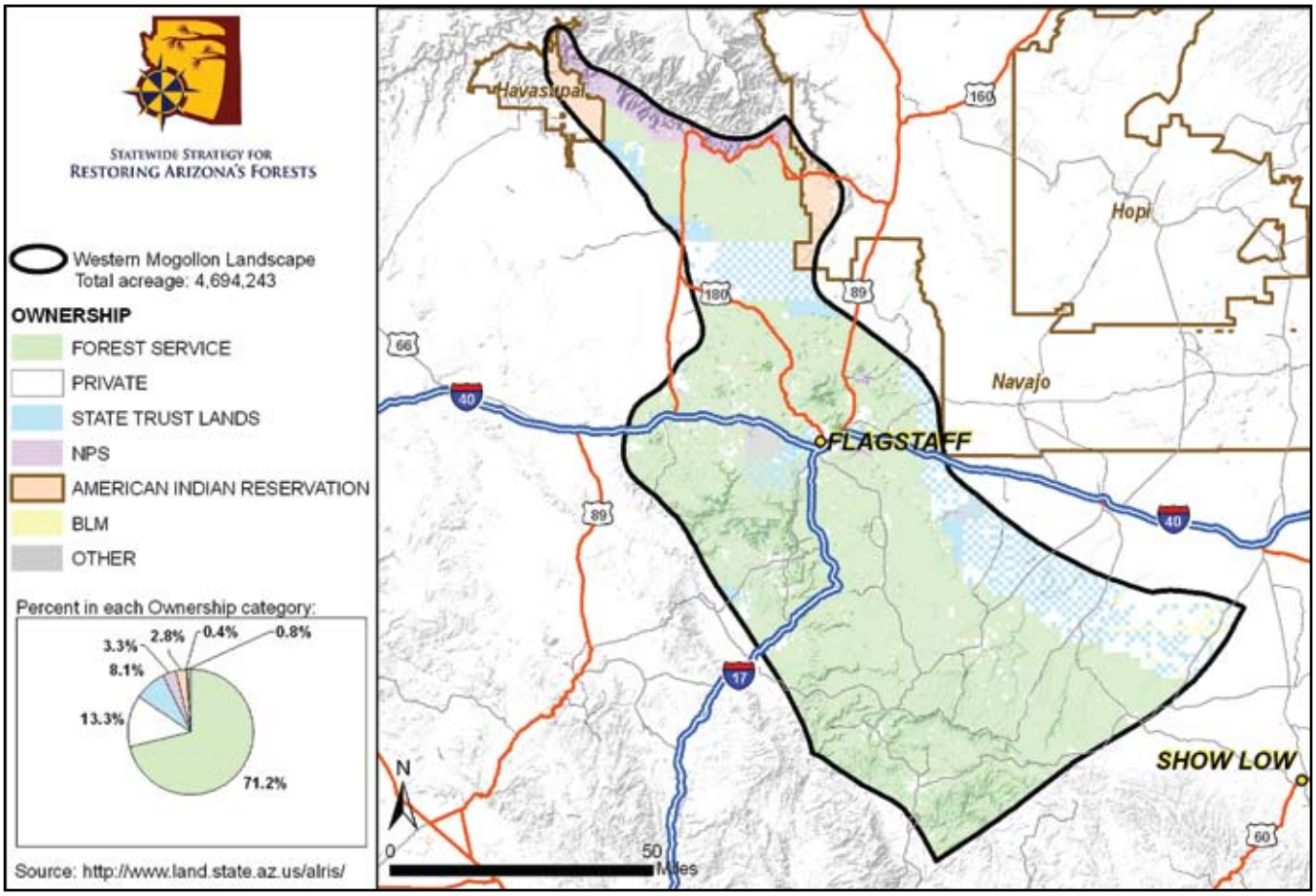
Drainages to the southwest and northeast of the Mogollon Plateau form deep tributary canyons of the Verde and Little Colorado rivers, respectively. Exposing Permian and Pennsylvanian formations, these canyons contain the landscape's only natural perennial water. From peak to canyon bottom, the Western Mogollon landscape spans more than 6,000 vertical feet, with most of the landscape above 6,000 feet. Cooler and wetter than the surrounding lowlands, precipitation occurs as summer thunderstorms and winter rain and snow. Varying widely with sea surface temperature cycles, annual precipitation ranges from more than 35 inches on portions of the San Francisco Peaks and Mogollon Plateau to less than 10 inches in the Little Colorado River Valley.

Land Ownership

Land ownership patterns consist of large tracts of National Forest land with embedded communities and dispersed private and state land Land ownership allocations are as follows (Figure 9.8.1.):

- 71% United States Forest Service,
- 13% private,
- 8% State Trust,
- 3% National Park Service,
- 3% Tribal and
- less than 1% BLM management and other.

Because each ownership has a unique suite of applicable laws and policies, jurisdictional differences can cause problems for fire and wildlife management, smoke management, access and treatment funding, and implementation. These challenges, unless overcome, may impede forest restoration, community protection, and wildlife conservation. Collaborative interjurisdictional planning and implementation can help to identify and resolve such problems, bridge interagency barriers, and bolster public involvement and support. Contiguous National Forest ownership in many parts of the Western Mogollon landscape, especially in areas distant from communities, provides an excellent opportunity for collabroative fire management and restoration planning.



▲Figure 9.8.1. Land ownership status in the Western Mogollon Plateau landscape.

Forests

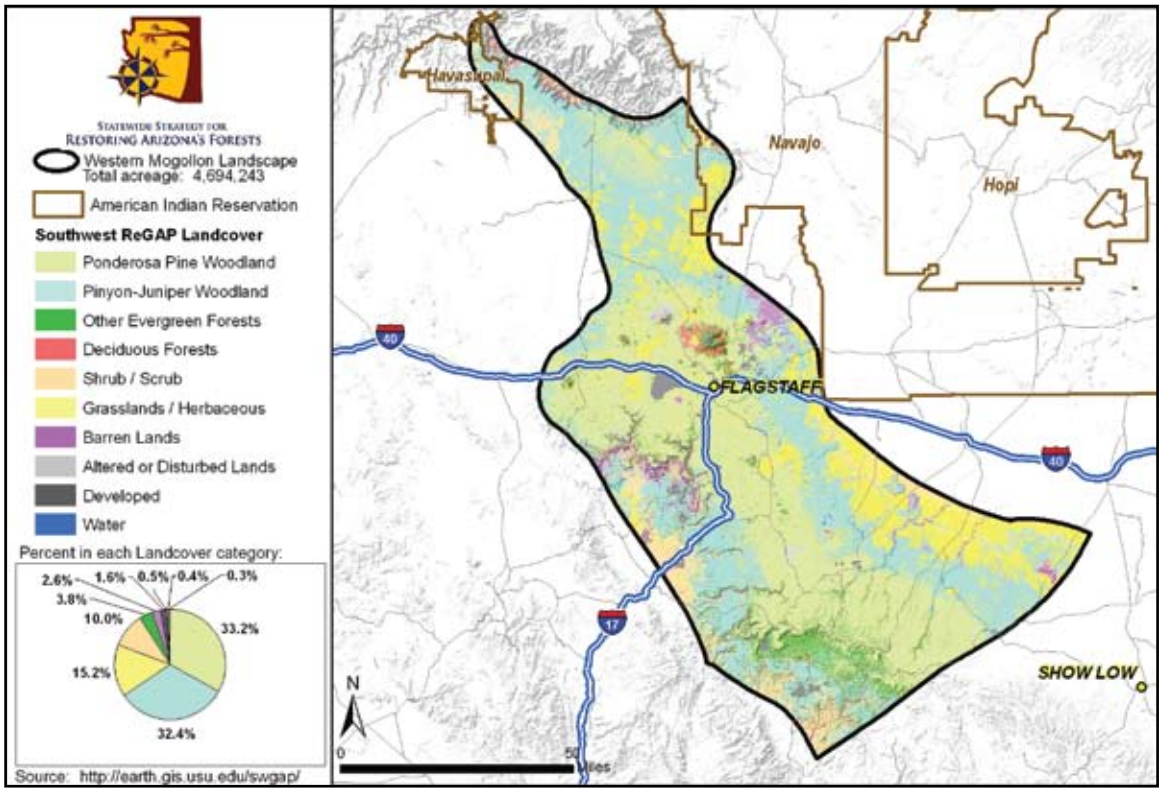
With its variable climate and topography, the Western Mogollon Plateau is one of the state's most ecologically diverse forested landscapes (Figure 9.8.2.). At the highest elevations, spruce-fir forests are co-dominated by Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*). Under natural conditions, spruce-fir forests are constantly changing mosaics of stands in varying stages of recovery from natural disturbances.

Mixed conifer forests (8,000 - 10,000 ft) are closed-canopy, multi-layered forests that vary from site to site. Douglas fir (*Pseudotsuga menziesii*) and ponderosa pine dominate lower, drier sites while white fir (*Abies concolor*), blue spruce (*Picea pungens*) and Southwestern white pine (*Pinus strobiformis*) are found elsewhere.

Aspen (*Populus tremuloides*) forests (8,000 - 10,000 ft) grow interspersed with mountain meadows, mixed-conifer, and spruce-fir forests. Aspen can form stable stands for long periods, or can occur as a "temporary" forest that gives way to conifers after several decades.

Ponderosa pine forests (6,000 - 8,000 ft) span the entire Mogollon Plateau, comprising about 33% of the the Western Mogollon landscape. In their natural condition, these forests are characterized by clumps of large trees, and often abundant and diverse grass and forb communities. Interspersed with mixed-conifer forests at upper elevations and pinyon-juniper woodlands at lower areas, ponderosa pine forests are frequently dotted with grasslands and meadows. Gambel oak (*Quercus gambellii*) is often found within ponderosa pine forests and provides valuable wildlife habitat.

Pinyon-juniper woodlands (4,000 - 6,000 ft) occur throughout the Western Mogollon landscape. Mixing with ponderosa pine forests at upper elevations and desert scrub, grasslands and shrublands at lower elevations, these woodlands may include Colorado pinyon pine (*Pinus edulis*), Utah juniper (*Juniperus utahensis*), one-seed juniper (*Juniperus monosperma*), Rocky Mountain juniper (*Juniperus scopulorum*) and alligator juniper (*Juniperus deppeana*). The woodlands' dynamics are tied to climate, with tree mortality occurring during droughts, and recruitment during wet periods.



▲Figure 9.8.2. Vegetation characteristics across the Western Mogollon Plateau landscape.

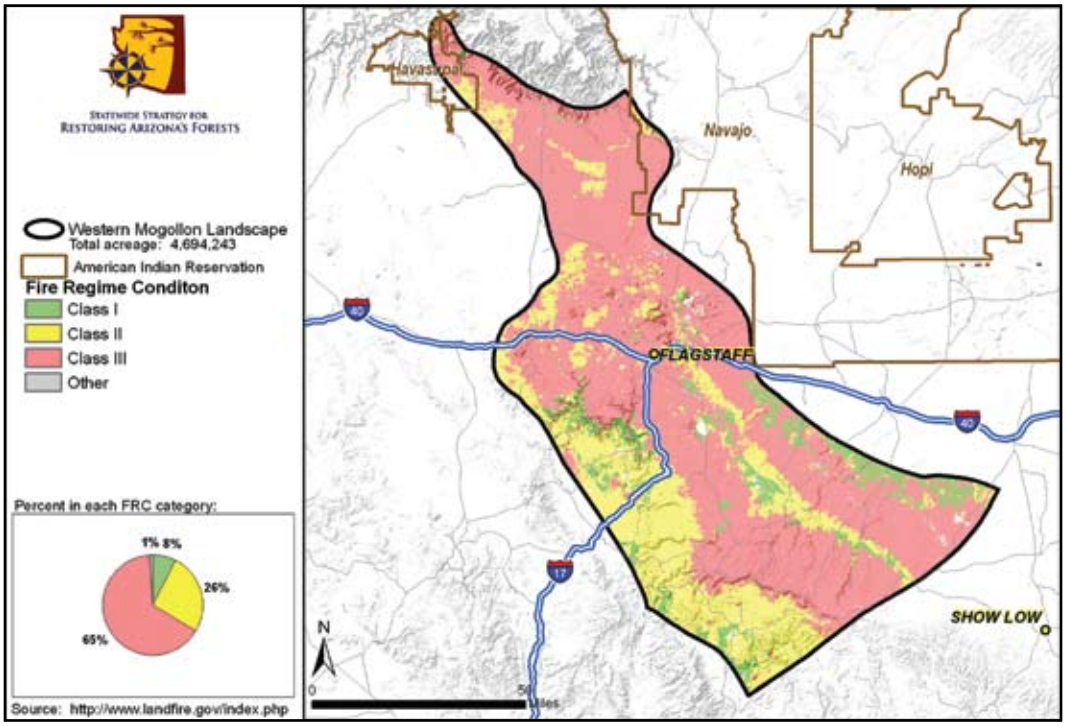
Current Conditions

The Western Mogollon landscape has undergone significant environmental change during the past 120 years, due to both human and natural forces. These include domestic livestock grazing, fire suppression, industrial logging, development, predator extermination, and climate variability. Resulting changes include extirpation of wildlife species, increased abundance of exotic species, and encroachment of urban areas into wildlands.

Past management has most affected ponderosa pine forests. By removing grasses that carried frequent fires, livestock grazing and fire suppression helped to increase tree densities, and ladder and surface fuels. This has increased the threat of uncharacteristic crown fire--threatening human and ecological communities alike. Industrial logging has contributed to declines in old-growth conditions and associated biodiversity. Natural resource values at risk include forest and woodland communities, watershed function, soil productivity, stream erosion and flooding, aquatic systems, air pollution from wildfire, and wildlife and endangered species habitat.

The past decade's drought caused die-off in pinyon-juniper, ponderosa, aspen and mixed-conifer forests, contributing to increased fuel loads in the forests. The build-out of communities into forests has compounded these problems, increasingly putting human values at risk. At the same time, significant efforts are underway in the Western Mogollon Plateau landscape to implement ecological restoration projects, especially in the ponderosa pine forests. Limitations are primarily the result of insufficient resources to treat the extensive public lands in the area, and the lack of utilization opportunities for the forest products produced and harvested during treatment activities.

Figures 9.8.3 shows the potential fire conditions in the Western Mogollon landscape. Class III represents conditions that are highly departed from natural variability, as is the case for 65% of the Western Mogollon Plateau. Much of the mixed-conifer and ponderosa pine forests in this region fall in either Fire Regime Condition Class II or III, with increased surface and ladder fuels on sites formerly dominated by large, resilient trees. Forests that naturally experience infrequent, severe fires, like spruce-fir forests or some pinyon-juniper woodlands, are generally not in need of ecological restoration, at least from a fire standpoint, and would be considered as Class I, within the range of natural variability.

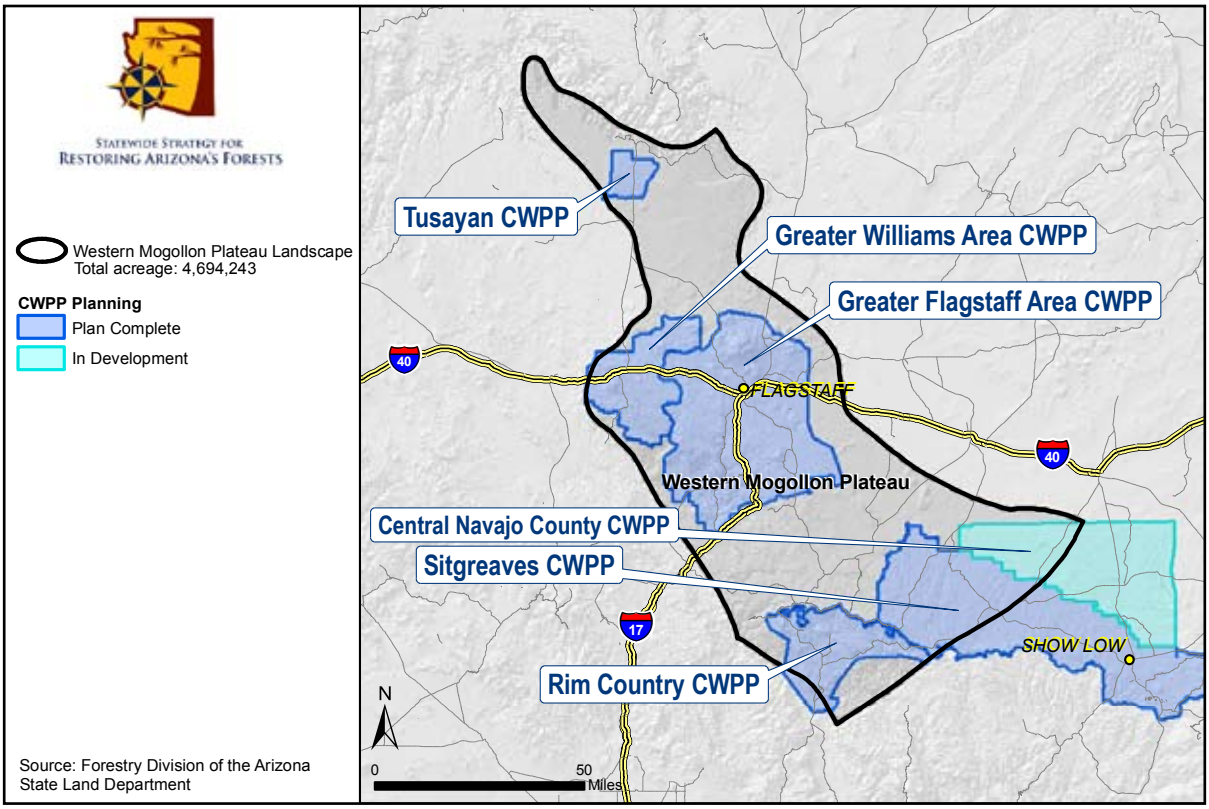


▲**Figure 9.8.3**. Fire Regime Condition characteristics of Vegetation in the Western Mogollon Plateau landscape.

Communities

The Greater Flagstaff area is the hub of activity for the Western Mogollon Plateau region, with Flagstaff the largest urban area within the landscape (population 65,000). Other communities include Williams, Parks/ Bellemont, Winslow, Sedona, Munds Park, Happy Jack and the Blue Ridge developments, Payson, Pine/Strawberry, and Forest Lakes. The edge of the Navajo Nation abuts the northeast edge of the landscape, but there are no major communities in thay area. However, on the Hualapai Reservation, which is included in the northwest edge of the Western Mogollon landscape, the community of Supai has been assigned a high risk rating (Arizona State Land Department).

Four Community Wildfire Protection Plans (CWPPs) have been developed within the Western Mogollon Plateau region (Figure 9.8.4.), covering 43 communities, including the Greater Flagstaff area, Williams, Tusayan, and Rim Country (Payson). The Sitgreaves (Heber/Overgaard area) CWPP spans the Western Mogollon Plateau and the White Mountain regions. Each of these plans identifies community values at risk and suggests strategies and actions necessary for living safely within fire-adapted landscapes. However, 20 communities and recreation sites designated as at-risk, including four in the Grand Canyon South Rim area, are not included in any CWPP, although the communities in the Blue Ridge area are reported to have begun developing a CWPP. The Central Navajo County CWPP, which spans the Western Mogollogn Plateau and White Mountains landscape is currently being developed. Increased community fire preparedness will decrease risks associated with unwanted fires while making it safer and easier for managers to use beneficial fires in surrounding forests.



▲Figure 9.8.4. Community Wildfire Protection Plans in the Western Mogollon Plateau landscape.

Wildlife

In southwestern ponderosa pine forests, wildlife habitat structure has become more homogeneous over time because of fire suppression, timber harvest strategies, and grazing pressure on the understory vegetation. These pressures have caused a reduction in large old trees, an increase in pole size trees, reduced age and size class diversity, more even spacing of trees, and a simplification of the understory.

In the pinyon – juniper woodlands, wildlife habitats have undergone a reduction in both structural diversity and vegetation species diversity as a result of a reduction in wildfire and grazing. These factors have often resulted in woodlands that are largely not very productive for wildlife. In the mixed-conifer wildlife habitat structure has also become more homogeneous due to fire protection and the lack of aspen regeneration.

The lowered diversity in structure and vegetation composition has had a major effect on wildlife habitat in these vegetation communities. The relative lack of habitat features, such as snags, hollow trees, downed logs, and shrub/oak understories, reduces the overall density and diversity of wildlife using the forest.

Given its topographic diversity and resulting vegetation diversity, the Western Mogollon Plateau landscape provides habitat for a wide array of forest-dependent species. The Mexican spotted owl (*Strix occidentalis lucida)* a federally-listed threatened species, is considered a species of special concern by the Arizona Game and Fish Department (AZGFD), and a sensitive species by the U.S. Forest Service. They breed primarily in dense, old-growth, mixed-conifer forests located on steep slopes, and especially in deep, shady ravines. In Arizona, they occur primarily in ponderosa, mixed-conifer, pine-oak, and evergreen oak forests.

The northern goshawk (*Accipiter gentilis)* is listed as a management indicator species by the U. S. Forest Service, and is considered highly sensitive to management. Avian communities have been well-studied in the area, and several species, including the pygmy nuthatch (*Sitta pygmaea*) and hairy woodpecker (*Picoides villosus*), are considered management indicator species by the U.S. Forest Service.

Tassel-eared squirrels (*Sciurus aberti*) are a specialist in ponderosa pine, being dependant on pine seeds, terminal buds, and mycorrhizal truffles as food sources. They play a key role in dispersing spores from mycorrhizal fungi symbionts of ponderosa pine, are an important prey species for the goshawk, and are considered a management indicator species in national forests.

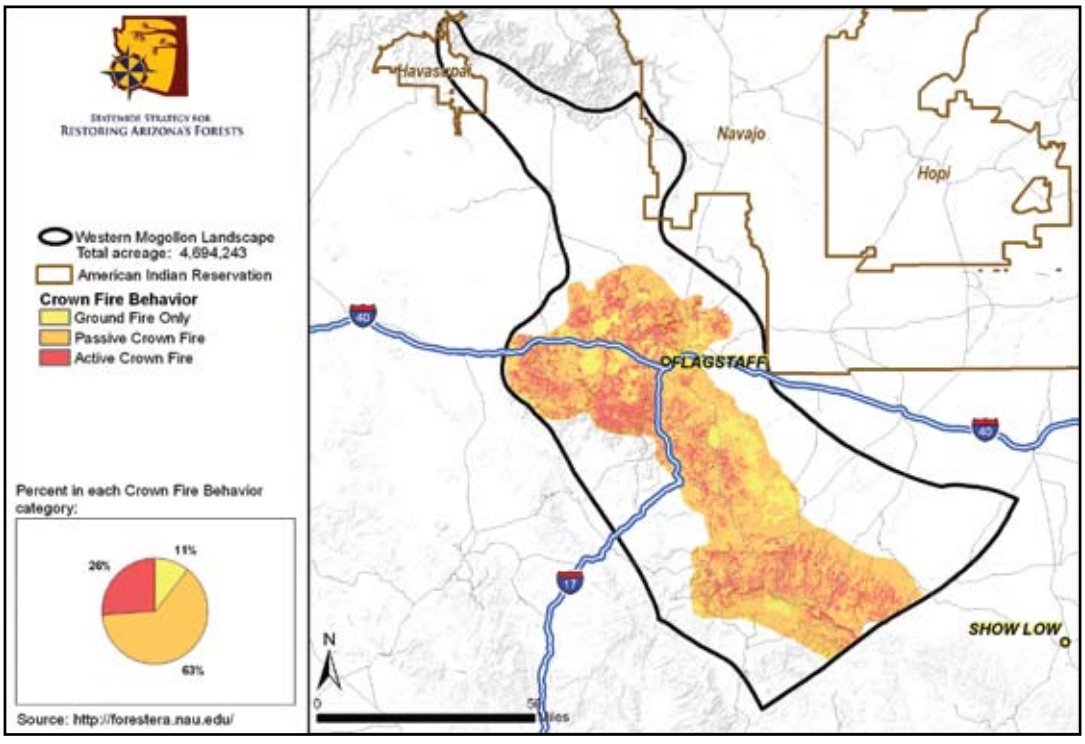
Pronghorn (*Antilocapra americana*) habitat exists throughout the area, especially in montane grasslands. Pronghorn are considered sensitive to management and are listed as a management indicator species by the U.S. Forest Service. The mule deer (*Odocoileus hemionus*) is an indicator species of early-seral stages of aspen and pinyon-juniper woodlands. Early-seral stages of ponderosa pine, mixed-conifer, and chaparral habitats are also important for this species. Mule deer typically summer at higher elevations in aspen and ponderosa pine forests, and winter in pinyon-juniper woodlands found at lower elevations. They are browsers and prefer herbaceous, green shoots and fruits of shrubs and trees, but also feed on grasses.

Additional species with significant habitat across the Western Mogollon Plateau that have been identified as important within the context of forest management include Merriam's wild turkeys (*Meleagris gallopavo merriami*), western bluebird (*Sialia mexicana*), black bear (*Ursus americanus*), and American elk (*Cervus elaphus*).

Fire

Fire is a keystone ecosystem process, meaning it regulates a wide range of other ecological factors, including structure, composition, pattern, soil development and retention, insect and other animal populations, nutrient cycling, hydrology, and carbon storage. The natural variability of fires differs across ecosystems. In high-severity fire forests, like spruce-fir forests, infrequent, high-severity crown fires are typical. Climatic variation, through its effects on the moisture content of live fuels and larger dead fuels, is the principal influence on fire frequency and severity. In mixed-severity fire forests, like mixed-conifer forests, the historical fire regime includes both low-severity surface fires and high-severity crown fires. Both fuels and climate influence the frequency, severity, and size of fires in these forests. In low-severity fire forests, like ponderosa pine forests, frequent, low-severity surface fires characterized the historical fire regime, which was regulated by the variation in fine fuels over space and time. Periodic fire is also important for restarting aspen forests which may be dominated by mixed conifer forests in the absence of fire.

Droughts are prolonged periods of below normal precipitation. They last from a few years to a several decades. Prolonged drought results in less water for plants, animals, and people. Fire activity increases during droughts as forest vegetation dries and dry, hot, and windy weather helps fires spread. Drought can change the makeup and structure of forests and shift boundaries between them. These changes may last for decades and affect populations of wildlife that depend on certain types of vegetation. Droughts also affect the availability of natural resources, including snow pack, spring and stream flows, lake and reservoir levels, and growth and availability of timber and forage.



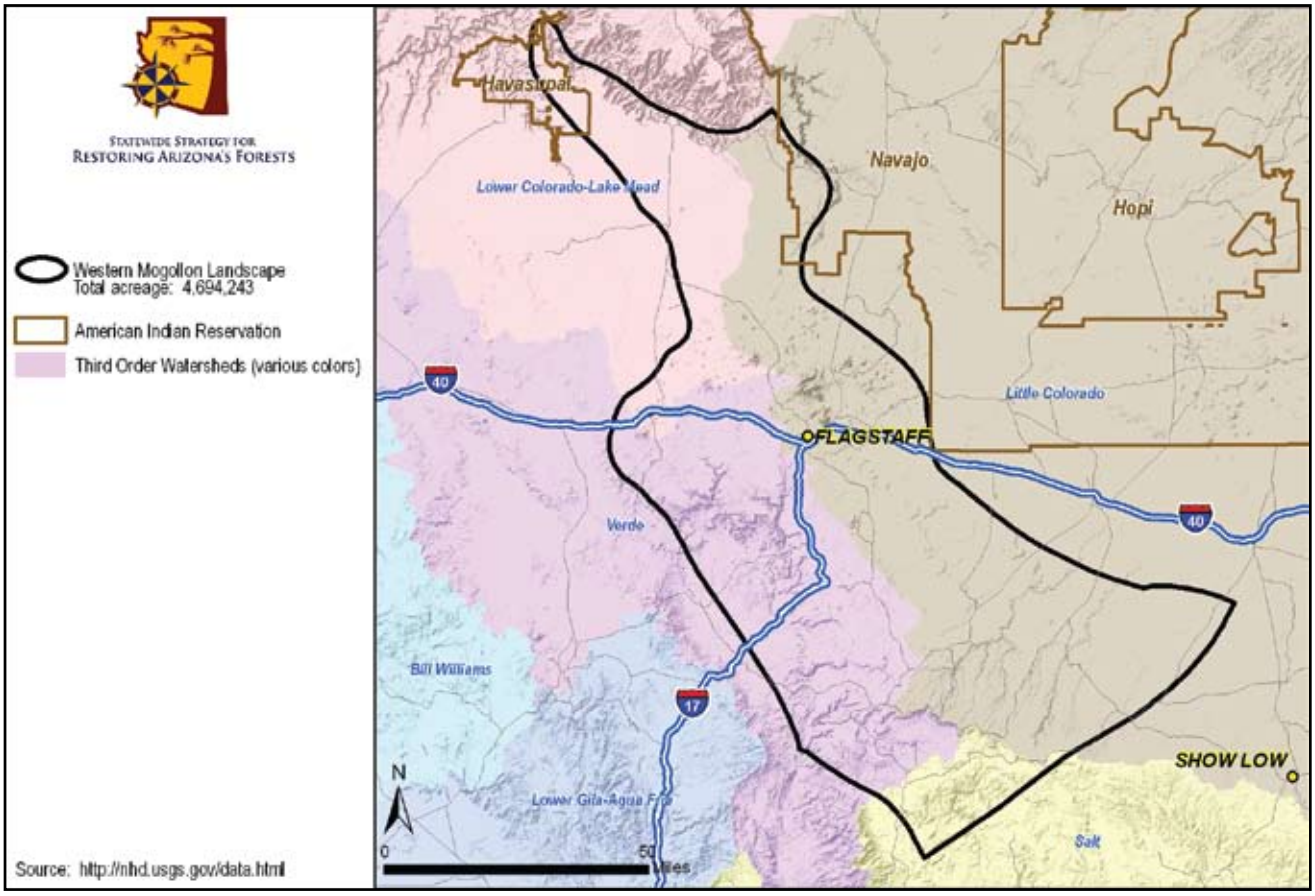
▲Figure 9.8.5. Predicted fire behavior in the Western Mogollon Plateau landscape.

Figure 9.8.5. describes predicted fire behavior under 90th percentile fire weather conditions. Under these conditions, most (63%) of the landscape is predicted to experience passive crown fire behavior, while active crown fire is predicted across 26% of the landscape, and ground fire across 11%.

Watersheds

The Western Mogollon landscape contains the boundary separating two major Arizona watersheds (Figure 9.8.6.): the Verde River watershed to the south and the Little Colorado River watershed to the north. Volcanic soils and fractured base rock allows the sparse rainfall and snowmelt (averaging from 10–25 inches annually) to percolate through to deep aquifers, which also feeds occasional surface springs and springs along slopes with exposed geologic strata.

These highlands are the headwaters for numerous water courses that feed the Verde River and the Little Colorado. Some streams in the area discharge to closed basins and percolate into the substrate. Tributaries of the Little Colorado are mostly gently sloping washes and ravines with intermittent flow, while those feeding the Verde typically follow steeper gradients through deep canyons. Sycamore, Oak, Beaver, Clear, and Fossil creeks are examples of the latter. Several communities get drinking water from surface water features (Lake Mary and Blue Ridge Reservoir), where the watersheds are subject to potentially negative impacts from wildfire.



▲ Figure 9.8.6. Third-order watersheds (basins) in the Western Mogollon Plateau.

Collaborative Efforts

Several collaborative efforts exist in the Western Mogollon landscape. Some of these were formed expressly for the purpose of developing CWPPs. The Greater Williams Area CWPP is a collaborative effort between the City of Williams, Coconino County, Parks-Bellemont Fire District, Sherwood Forest Estates Fire District, Kaibab National Forest, Arizona State Land Department, and concerned citizens.

The collaborative process for developing the Tusayan Community Wildfire Protection Plan began May 5, 2004 at a Tusayan/Grand Canyon Chamber of Commerce Board meeting in Tusayan. Five committee members, representing various interested parties, were appointed that day. Other state and federal representatives were then invited to participate. Federal, state, county, local and Tribal governments, public utilities, local private businesses, and individual citizens joined together to develop the Rim Country Community Wildfire Protection Plan.

In the Flagstaff area, The Grand Canyon Forests Partnership was created after the 1996 wildfire season, when the Hochderffer, Horseshoe, and Bridger-Knoll fires burned more than 75,000 acres in the Coconino and Kaibab National forests near Flagstaff and the Grand Canyon. These devastating wildfires revealed the need to return the forests surrounding Flagstaff to a more natural tree-density level. Later renamed the Greater Flagstaff Forest Partnership (GFFP), the organization has a 25-member Partnership Advisory Board, which reaches decisions through consensus. The partners include the Coconino County Farm Bureau and Cattle Growers Association, Coconino Natural Resource Conservation District, Cocopai Resource Conservation and Development District, Ecological Restoration Institute, Flagstaff Chamber of Commerce, Flagstaff Native Plant and Seed, Grand Canyon Trust, Greater Flagstaff Economic Council, Highlands Fire Department, Indigenous Community Enterprises, Northern Arizona Conservation Corps, Northern Arizona University, Perkins Timber Harvesting, Ponderosa Fire Advisory Council, Practical Mycology, The Nature Conservancy, Society of American Foresters-Northern Arizona Chapter, Southwest Environmental Consultants, The Arboretum at Flagstaff, U.S. Fish and Wildlife Service, and city, county and state officials.

GFFP has three primary goals:

- Restore natural ecosystem functions in ponderosa pine forests surrounding Flagstaff;
- Manage forest fuels to reduce the risk of catastrophic wildfire; and
- Research and test key ecological, economic and social dimensions of restoration efforts.

Economics

Planning and implementing forest restoration and community protection efforts is expensive. A factor limiting these efforts is inadequate public funding. Opportunities for maximizing the benefits of limited public funding exist both in planning treatment types and sequencing, and private sector utilization of small trees and biomass. Strategic planning of treatment types and sequencing can reduce per-acre costs by positioning relatively costly mechanical treatments in a way that facilitates wildland fire use, which is comparatively less expensive than mechanical treatments, across broader landscapes. While wildland fire use can cost as little as $10 per acre, mechanical treatments can exceed $1,000. The goal is to increase acres treated, while decreasing unit costs.

Where mechanical treatments are warranted, there is an opportunity to reduce treatment costs by increasing the value of small trees thinned. However, capacity to utilize small-diameter trees is limited. While the Western Mogollon Plateau region supported a thriving timber business for decades, the last local pulp mill closed in the mid 1990s. Although logging contractors continue to treat forests and remove material, end uses for restoration products are limited to fire wood, mulch, occasional poles and cants for dimension lumber, etc. The largest consumer of material removed from the forest is a pallet manufacturer and mulch producer in Phoenix, who recently built an additional processing plant in Ash Fork. Attempts to locate biomass energy plants in the region have been unsuccessful to date. Potential large users that have looked at the area have not moved forward with investment in operations due to limited guaranteed supply of wood from public lands.

The Greater Flagstaff Economic Council works to recruit small-diameter timber users. Prospects are usually concerned about their ability to procure a predictable, long-term supply of small-diameter wood. Most in the region agree that it will take business enterprises that use large amounts of wood to keep pace with the need for forest restoration and fuel reduction treatments.

Implementation and Management

The Western Mogollon Plateau is a microcosm of issues facing many of the forested areas of the state. These issues include degraded forests, communities at risk of wildfire, limited small diamter utilization opportunities, established collaborative processes, and lack of a cohesive landscape-scale strategy for comprehensive fire management and restoration. Despite these challenges, collaborators are moving forward with the most critical actions and continue their efforts to reach lofty goals.

Tens of thousands of acres of community protection and restoration treatments are planned or being implemented in the Western Mogollon landscape. Many of these treatments, including efforts to protect and safeguard homes from fire, and treatments occuring on non-federal lands, are tied to CWPPs. While continued implementation of CWPPs is a critical priority, integrating these into a broader landscape strategy is necessary to develop an ecologically sound, socially viable, and maximally efficient landscape-scale strategy for managing fire, restoring forests, and protecting communities.

Successful restoration will require that the entire landscape be zoned and assigned spatially explicit fire management and restoration objectives. Implementation activities can and should be prioritized, sequenced, and coordinated within and between zones. Given the critical ecological, social, and economic role played by fire across the entire landscape, collaborative and science-based fire management planning should provide an adequate starting point for zoning, delineation of management objectives, and sequencing of implementation activities. As such, fire management should be considered a critical landscape context for ecological restoration.

With ongoing fire management planning, forest plan revisions underway, and a seemingly insurmountable challenge before us, the need to coordinated, strategic landscape-scale planning and implementation has never seemed greater. As is reflected in recommendations herein, successful restoration will require a comprehensive approach that considers communities, ecosystems and landscapes together.

Future Restoration Needs

From a restoration standpoint, current conditions in the Western Mogollon landscape warrant placing the highest priority on community protection treatments in and around at-risk communities, and on restoration treatments in degraded ponderosa pine forests. The costs of inaction are greatest in these areas. Facilitating treatments will require significant public and private resources, viable, appropriately scaled utilization capacity for small trees and biomass, and a coherent and broadly supported restoration strategy that, building upon CWPPs, spatially defines fire management and restoration objectives, treatment strategies and sequencing across the entire landscape.

Recommendations

1. Collaboratively define and map fire management and restoration objectives, treatment strategies and treatment sequencing strategies to inform Fire Management and Forest Plan Revisions for the Western Mogollon landscape.
2. Prioritize treatments to maximize efficiency and return on investment--CWPPs, U.S. Forest Service, community collaborative plans, FIREMAP.
3. Rapidly complete work in the wildland/urban interface zone to protect communities and infrastructure and allow greater flexibility in treatments for wildland ecosystems--CWPPs.
4. Increase public education about the need for, and benefits of, large-scale treatment, prescribed fire, and wildland fire use.
5. Enhance the use of prescribed and natural fire as a treatment tool and address the impacts of associated smoke.
6. Build appropriately scaled economic capacity to accelerate treatment implementation and produce higher value-added benefits from large volume of material removed during mechanical thinning.
7. Coordinte supply across multiple forests to assure efficient utilization and limit transportation costs.
8. Assure stakeholder involvement in the collaborative processes addressing these issues.
9. Expand planning horizons to address longer-term and restoration-based sustainable supply.
10. Expand monitoring and research activities to assess potential and real impacts of various projects and programs.
11. Implement more structured application of adaptive management to assure lessons learned are applied to future management programs and actions.
12. Enhance integration of forest restoration and fuel reduction treatments on public land and requisite Firewise and defensible space actions on private land.
13. Develop appropriate statutes, ordinances, and codes to allow governmental entities to address the causes and results of wildland/urban interface conflicts.
14. Increase funding across the board (federal, state, local and private) to achieve targeted treatment priorities and longer-term goals.

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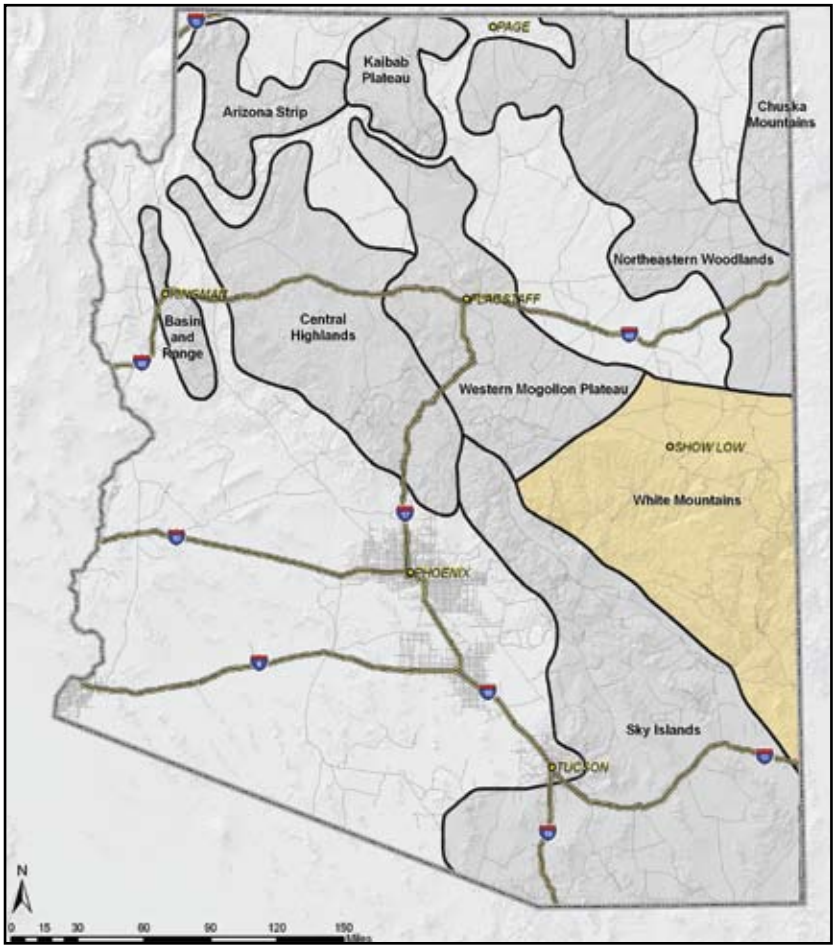
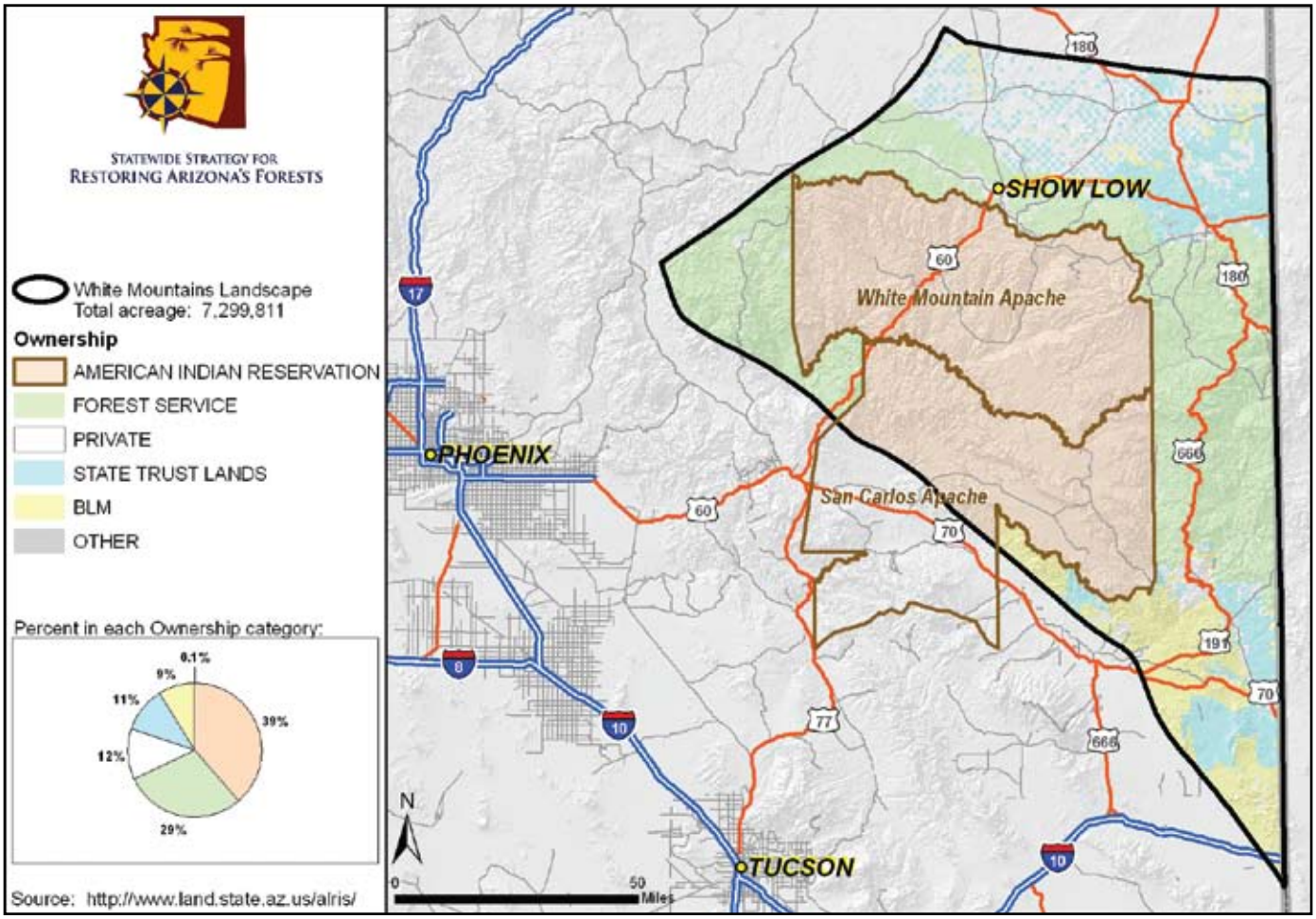
White Mountains



The White Mountains landscape encompasses 7.3 million acres, and includes the Apache-Sitgreaves National Forests, White Mountain Apache tribal lands in the Fort Apache Reservation, portions of the San Carlos Apache Reservation, and scattered BLM, state, and private lands. From desert grassland at 3,000 feet to the summit of Mt. Baldy at more than 11,400 feet, this landscape is large and diverse. It contains both rural hubs such as Show Low, and large remote regions like the Blue Range Primitive Area. Occasional heavy winter snows and summer monsoon rains give rise to numerous perennial streams and lakes in the high country, a notable feature in a state where surface water is not common. Because of the cool temperatures and abundant precipitation, much of the region is thickly forested with spruce-fir, aspen, mixed conifer, and ponderosa pine forest types. Subalpine grassland parks, some of them quite large, are scattered throughout forests above about 9,000 feet. Pinyon-juniper woodlands and semi-arid grasslands are found throughout much of the lower elevations. The White Mountains landscape is ecologically, culturally, and economically diverse.

Land Ownership

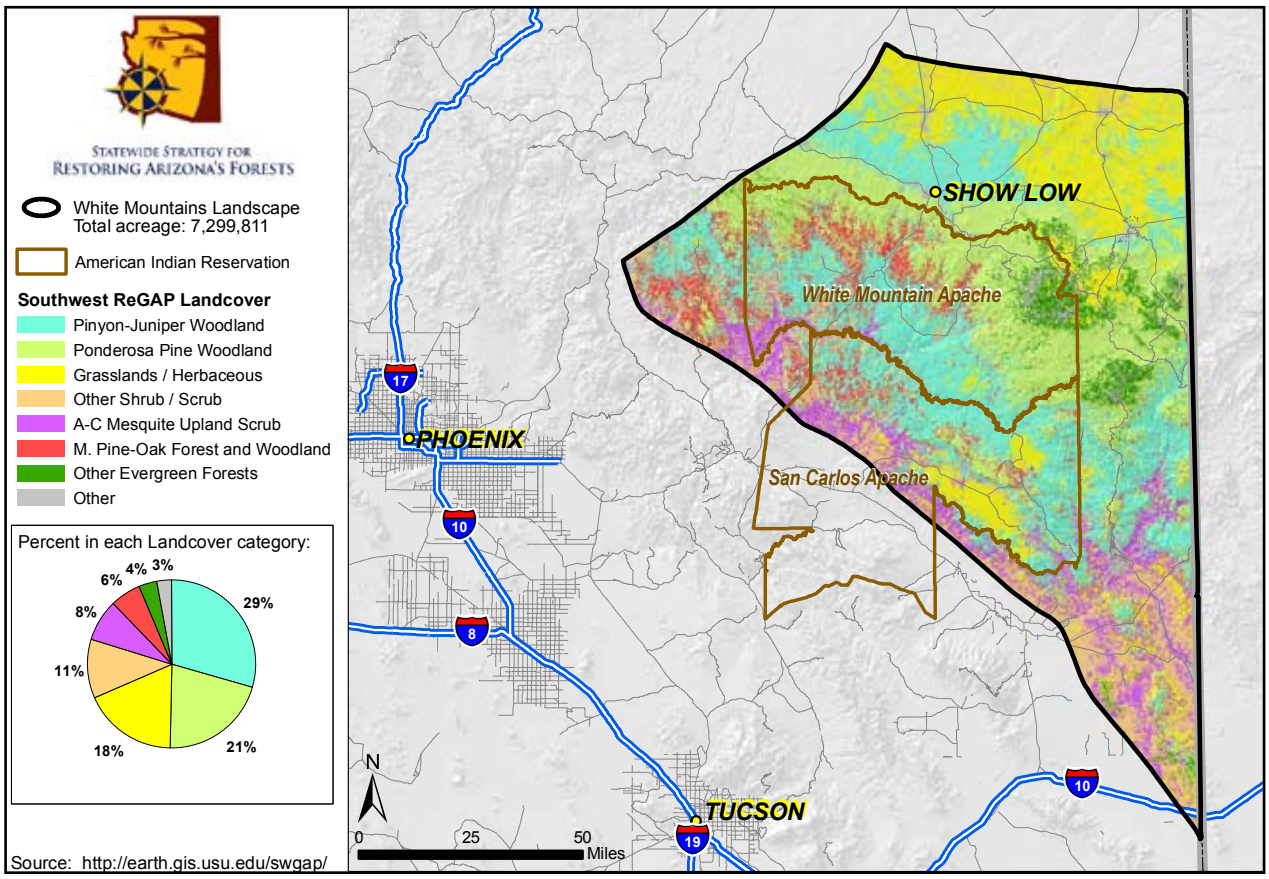
In much the same manner as other forested landscapes throughout the state, the White Mountains landscape spans several large land ownership and management units (Figure 9.9.1.). The White Mountain Apache Reservation is wholly contained within this landscape, as is about half of the San Carlos Apache Reservation. Together, these reservations occupy 2.85 million acres of the White Mountains landscape. Tribal lands are bordered to the north, east, and west by national forest lands, which are in turn bordered to the north by a checkerboard of state and private lands, and to the south by private and BLM lands. Private lands, primarily found in or near the Sitgreaves portion of the Apache-Sitgreaves National Forests, are embedded within a public lands matrix, and account for about 12% of the landscape.



▲ Figure 9.9.1. Land ownership status in the White Mountains landscape .

Forests

The forests of the White Mountains region are diverse, due to the great elevational and topographic diversity in the region (Figure 9.9.2.). Along and above the Mogollon Rim, forests include a vast portion of Arizona's famous ponderosa pine belt, primarily within the Apache-Sitgreaves National Forests. These forests are largely overstocked, stressed, and susceptible to landscape-scale, stand-replacement fire, as was demonstrated in the Rodeo-Chediski Fire of 2002. The higher terrain contains mixed conifer, aspen, and spruce-fir forests, particularly in the vicinity of Mount Baldy and the Alpine Ranger District of the Apache-Sitgreaves National Forests. Ponderosa pine forests continue below the rim until pinyon-juniper becomes more predominant with decreasing elevational and moisture gradients. Due to the diverse topography in White Mountain Apache tribal lands and within the Clifton District of the Apache-Sitgreaves National Forests, chaparral, pinyon-juniper, ponderosa pine, and dry mixed-conifer forests are found in close proximity to one another. Mountainous terrain on San Carlos Apache tribal lands contains ponderosa pine, pinyon-juniper, and pine-oak woodland forests, along with chaparral. Pinyon-juniper and semi-arid grassland ecosystems are found at the lowest elevations, such as the gently rolling terrain north of the Apache-Sitgreaves National Forests and portions of the Gila River drainage near the New Mexico border and within the San Carlos Apache Reservation.

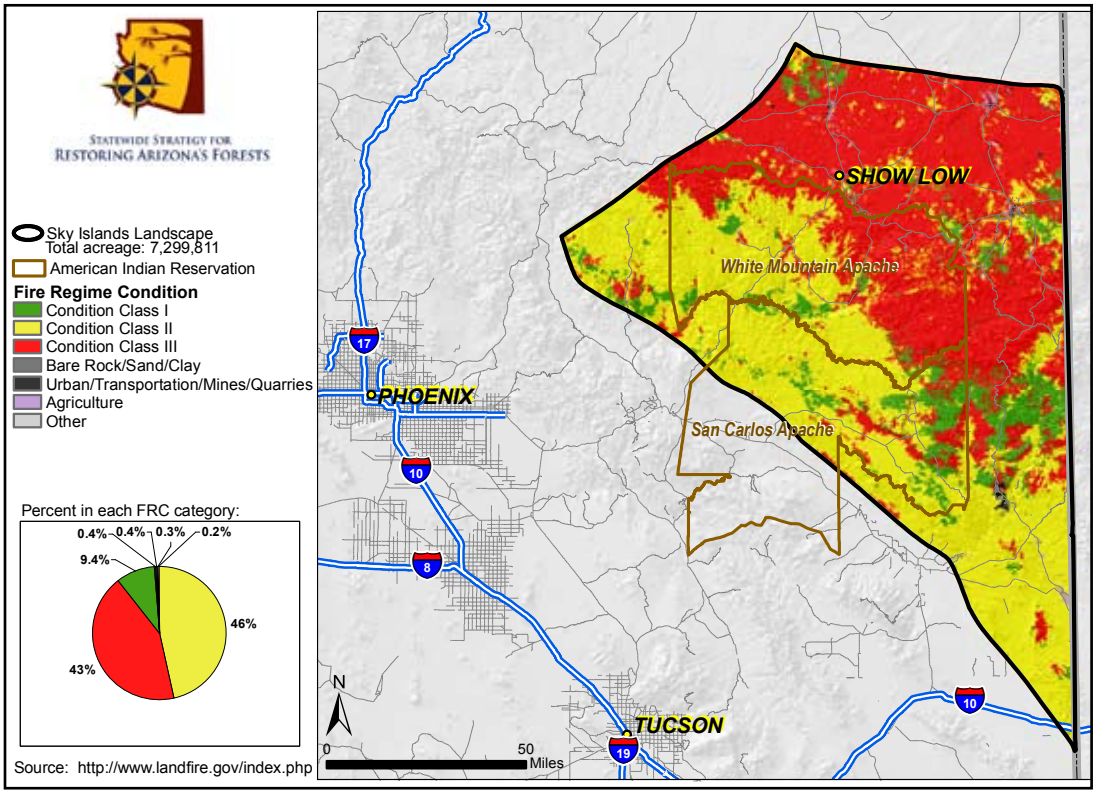


▲Figure 9.9.2. Vegetation characteristics in the White Mountain landscape.

Current Conditions

Forest conditions in the White Mountains landscape are like those throughout Arizona: most forests are unhealthy due to past land use practices, alterations of natural processes, and recent natural phenomena, such as drought and insect outbreaks. Ponderosa pine and mixed-conifer forests are both denser and more homogenous compared to their natural historic conditions. This makes the trees more stressed and the forests more susceptible to uncharacteristic stand-replacing wildfire. Abundance and diversity of understory plant species in these forest types are also diminished, leading to degraded habitat suitability for many wildlife species. Pinyon-juniper systems also contain greater tree densities and less understory than occur under natural conditions, and many grassland ecosystems are degraded. Many of the region's communities are at risk of damage from wildland fire, as the 2002 Rodeo-Chediski Fire illustrated. Forty-three percent (3.14 million acres) of the landscape is classified as Fire Regime condition class III (Figure 9.9.3.), largely in the ponderosa pine, mixed-conifer, and pinyon-juniper forests types, with another 3.34 million acres (46%) in condition class II.

A number of programs and initiatives have developed to address forest health issues in the White Mountains. These include the White Mountain Stewardship Project (WMSP), the nation's largest and first 10-year stewardship contract. Collaborators in the WMSP are working to treat about 150,000 acres in the Apache-Sitgreaves National Forests, much of it in the Wildland-Urban Interface. The Clifton Ranger District (the southernmost district of the Apache-Sitgreaves National Forests) has implemented landscape-scale management and restoration programs in recent years that include a large component of prescribed fire and wildland fire use, combined with mechanical treatments and other activities. The White Mountain Apache Tribe has used prescribed fire and an active timber management program to reduce forest fuels and improve unhealthy stand conditions, with the possibility of using wildland fire in the future. Current Tribal forest management programs include a hazardous fuel reduction program and a WUI program tasked with creating defensible space around all human habitations. However, funding for these programs, and creating markets for the small-diameter wood removed as part of them, are ongoing challenges to full implementation.

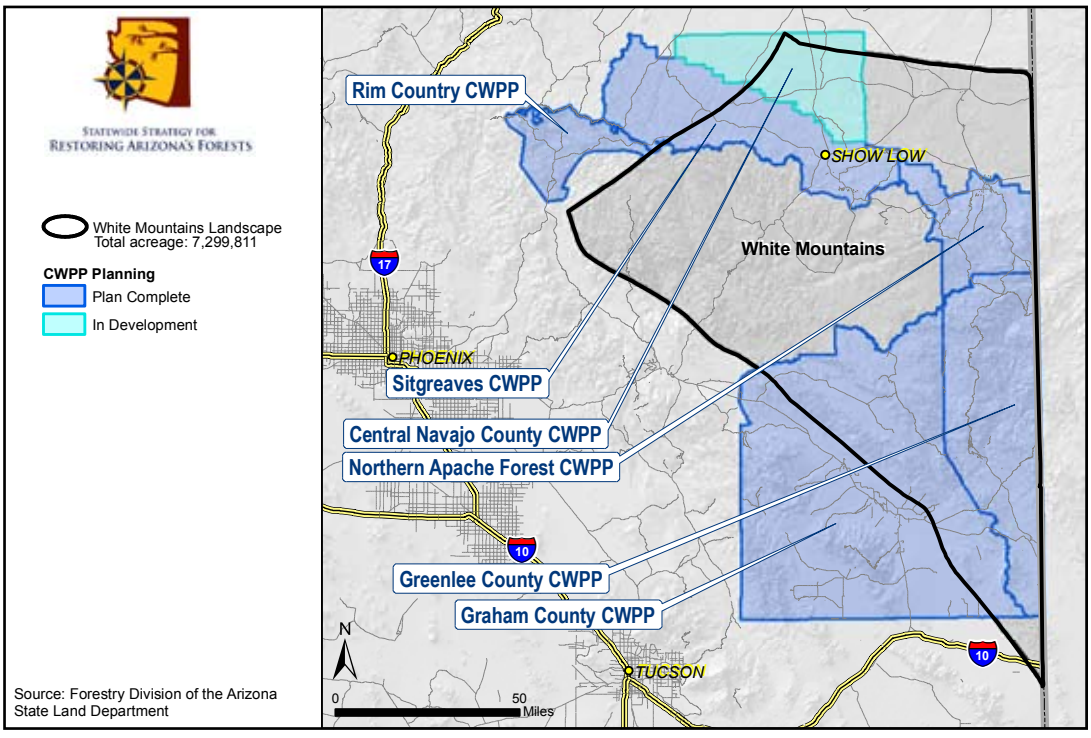


▲Figure 9.9.3. Fire Regime Condition characteristics of vegetation in the White Mountains landscape.

Communities

The White Mountains landscape contains a number of human communities, many of which have strong cultural and economic ties to the surrounding forests. The northern portion of the landscape contains some of the region's largest communities: Show Low, Snowflake, Taylor, Pinetop-Lakeside, Springerville, and Eagar, as well as smaller communities such as Pinedale, Clay Springs, Heber, Overgaard, Greer, Alpine, Nutrioso, and others. Many of these communities were greatly affected by the 2002 Rodeo-Chediski Fire. Both the Fort Apache and San Carlos Reservations contain several communities within or near forests, including Whiteriver, Fort Apache, McNary, Bylas, and San Carlos. The mining communities of Clifton and Morenci are found in the southeast portion of this landscape. Many of the aforementioned communities currently rely or relied historically on wood products from surrounding forests; several communities currently rely on forests for tourism and amenity income.

A large number of the communities in the White Mountains landscape are considered to be at risk of wildland fire. Many of these communities have participated in the development of CWPPs (Figure 9.9.4.), and some have begun work implementing their plans. Other at-risk communities have yet to develop wildfire protection plans, and some have limited capacity to respond to wildfire emergencies. The White Mountains landscape in general, and the Sitgreaves Forest region in particular, is currently experiencing rapid residential and vacation/resort development, nearly all of it taking place in close proximity to fire-prone forests. Indeed, it is the forested environment itself which is a major draw for tourists, retirees, second-home owners, residents of Arizona's urban centers, and others. At the same time, even some of the most desirable destination communities contain areas of rural poverty. Preparing for, and responding to, wildland fire emergencies is likely to be a particularly great challenge for those living on limited incomes.



▲Figure 9.9.4. Community Wildfire Protection Plans in the White Mountain landscape.

Wildlife

Wildlife issues in the White Mountains landscape are closely related to the degradation of habitat in all forest types, particularly ponderosa pine, mixed-conifer, and pinyon-juniper systems. Tassel-eared (Abert's) squirrel (*Sciurus aberti*), mule deer (*Odocoileus hemionus*), forest songbirds, and Merriam's turkey (*Meleagris gallopavo merriami*) are species of particular importance. Mexican spotted owls (*Strix occidentalis lucida*) and northern goshawks (*Accipiter gentilis*) are found in denser forest habitats across all ownerships, particularly on White Mountain Apache Tribal lands and on the Apache-Sitgreaves National Forests. In addition, the southwest willow flycatcher (*Empidonax traillii extimus*), Chiricahua leopard frog (*Rana chiricahuensis*), Apache trout (*Oncorhynchus gilae apache*), Gila trout (*O. gilae gilae*), Little Colorado spinedace (*Lepidomeda vittata*), Loach minnow *(Rhinichthys cobitis*), spikedace (*Meda fulgida*), razorback sucker (*Xyrauchen texanus*), and Gila chub (*Gila intermedia*) are all listed as threatened or endangered under the Endangered Species Act. Most of these sensitive species rely in part or entirely on the region's surface water and associated riparian zones, which make up a small portion of the total area in the White Mountains landscape, but account for a large proportion of its biological diversity.

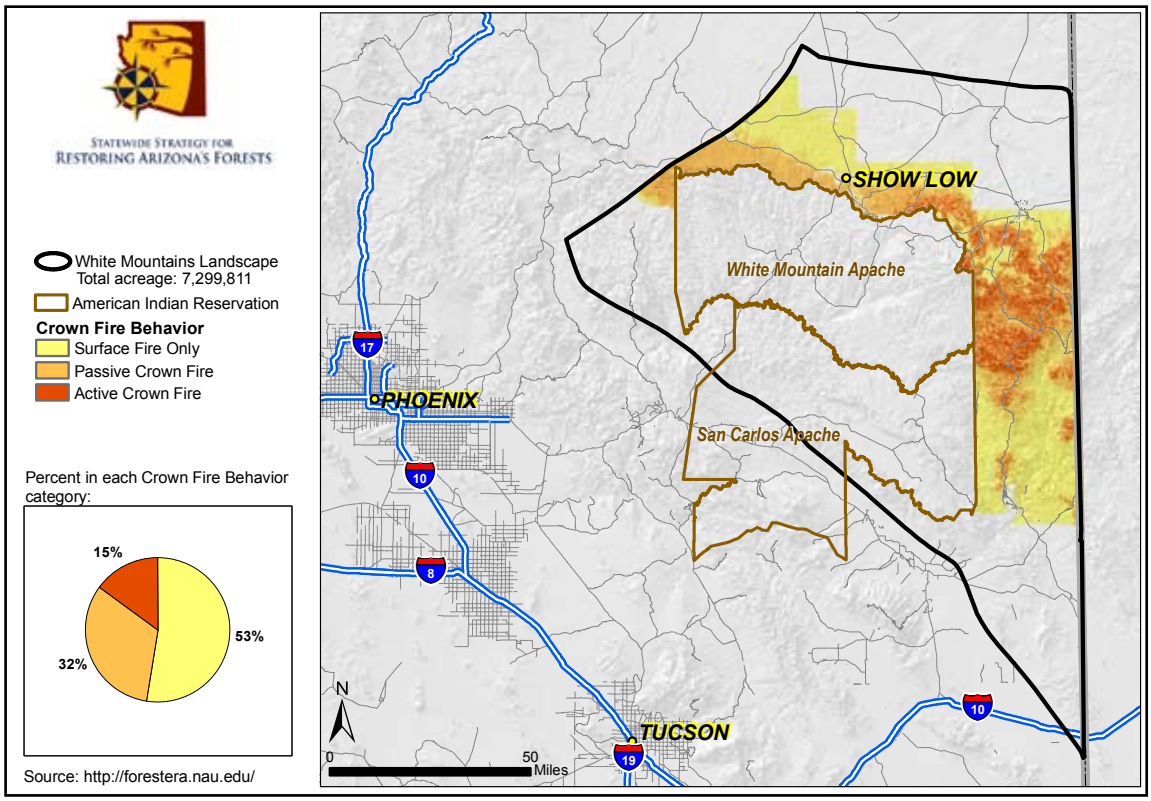
The Mexican gray wolf (*Canis lupus baileyi*), a subspecies of the gray wolf, is a wildlife species of concern in the White Mountains landscape. Largely exterminated from the United States and Mexico by 1970, the Mexican wolf was listed as endangered under the Endangered Species Act in 1976. In 1998, 11 captive-reared Mexican wolves were released to the wild in the Blue Range Wolf Recovery Area. A Memorandum of Understanding has been established to oversee the recovery process in Arizona and New Mexico. Participating cooperators include the Arizona Game and Fish Department, New Mexico Department of Game and Fish, U.S. Forest Service, U.S. Fish and Wildlife Service, White Mountain Apache Tribe, New Mexico Department of Agriculture, and Greenlee County.

A major challenge of wildlife management in the White Mountains landscape is protecting and enhancing wildlife habitat while improving forest health and reducing catastrophic fire risk. Past forest management has resulted in a deficit of large, old trees and led to current overstocked, homogenous forest conditions across much of the landscape. Fire risk reduction treatments, particularly in the WUI, can conflict with wildlife habitat needs, particularly when those treatments produce even tree spacing and relatively even-aged or even-sized distributions. Other wildlife issues include herbivory on aspen regeneration and on fine fuels, and competitive conflicts between introduced game species, such as rainbow trout, and the native species, such as Apache trout.

Fire

Discrete fire regimes vary significantly across the varied vegetation types found in the White Mountains landscape, and are further complicated in areas of intermixing and ecological transitions. Due to the unnaturally dense and high fuel load conditions found in many of the region's ponderosa pine, mixed-conifer, and even some pinyon-juniper forests, the potential for unnaturally severe fire is high. Figure 9.9.5. shows the unnatural fire conditions of forests in the White Mountain landscape. The Rodeo-Chediski Fire burned across nearly a half million acres of White Mountain Apache tribal lands and the adjacent Apache-Sitgreaves National Forest in 2002, displaying some of the most extreme fire behavior ever recorded in ponderosa pine forests. The fire resulted in the loss of 426 structures, many of them residential, and the evacuation of thousands of White Mountains area residents. The Rodeo-Chediski, along with other major fires in the White Mountains in recent years, illustrates the potential result of continued declines in forest health in the region. Although both the Rodeo and Chediski components of the burn were human-caused, the White Mountains region receives heavy lightning activity. The combination of high ignition potential, overstocked forest conditions, and extensive WUI development makes the White Mountains landscape a region of high concern for community protection.

Both the Apache-Sitgreaves National Forests and the White Mountain Apache Tribe have prescribed fire programs, although the White Mountain Apache prescribed fire program has been curtailed in recent years. Wildland Fire Use has been used successfully in more remote regions of the Clifton District in the Apache-Sitgreaves National Forest, and may also be a future option available on White Mountain Apache tribal lands.

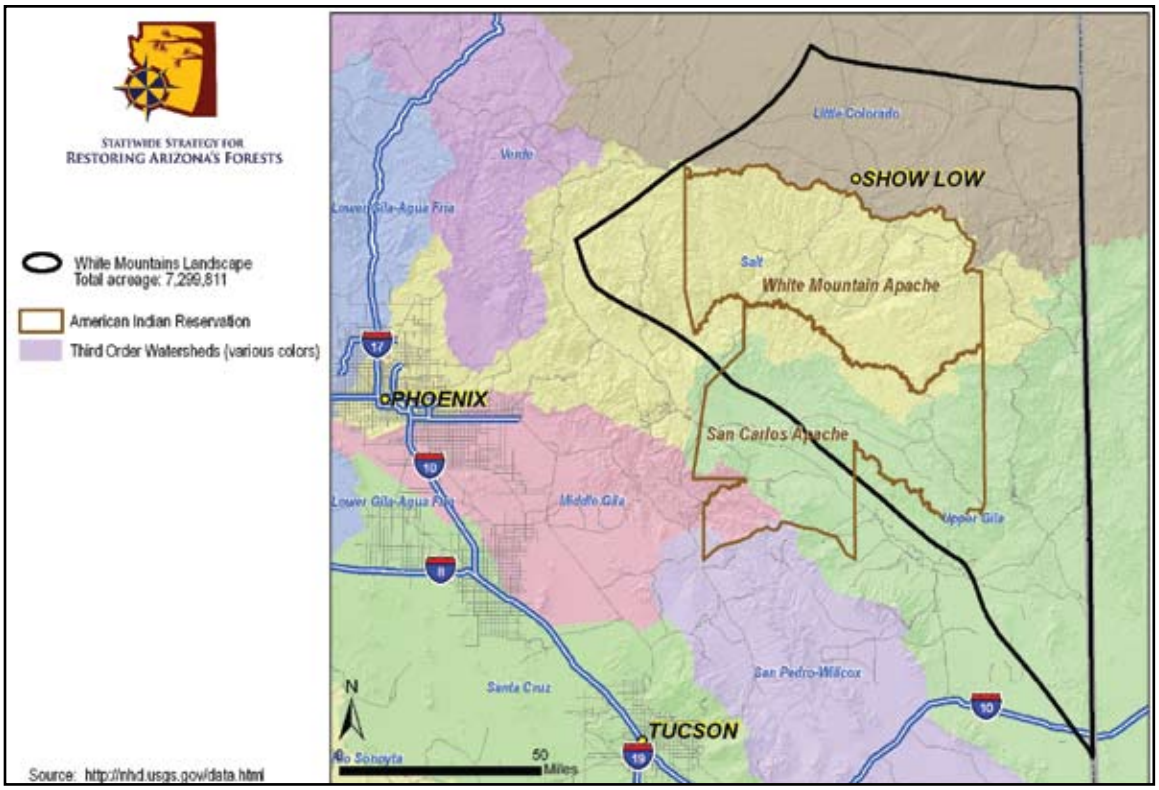


▲Figure 9.9.5. Potential crown fire behavior in the White Mountains landscape, excluding tribal lands.

Watersheds

The White Mountains landscape is the source area for three major watersheds (Figure 9.9.6.) To the north, the Little Colorado River has its head waters on Mt. Baldy, draining northward through many of the White Mountains' more populated areas. Major tributaries originating in this portion of the White Mountains are Nutrioso Creek, Carnero Creek, and Silver Creek. Show Low Creek, and the Cottonwood/ Mortenson Wash Complex are critical components of the Silver Creek drainage. The San Francisco River originates in the eastern and southern portion of the White Mountains landscape, flowing east into New Mexico, then south and west back into Arizona where it meets the Blue River and becomes a major tributary of the Gila River. The Black River originates along the eastern slopes of Mt. Baldy, on White Mountain Apache Tribal lands and Apache-Sitgreaves National Forest. Along its southern reaches, it marks the boundary between the White Mountains and the Sky Island landscape to the south. Reservation Creek, Pacheta Creek, and Bonita Creek drain the entire southern area of the White Mountains feeding the Black River. On the north, Paradise, Trout, and Diamond creeks are major contributors to the North Fork White River. The White River confluences with the Black River 20 miles from White River, marking the beginning of the Salt River. Further to the west. Carrizo and Cibeque creeks feed into the Salt River, representing the rest of the watershed system associated with the White Mountains area.

Surface water is one of the most important elements of the White Mountains landscape, and is relied upon by wildlife and human populations for a variety of uses. Massive watershed sedimentation following landscape-scale crown fire is a real threat in this region.



▲Figure 9.9.6. Third-order watersheds (basins) in the White Mountain landscape.

Collaborative Efforts

Local collaboration has been a defining characteristic of the White Mountains landscape. Community Wildfire Protection Plans have been developed for Greenlee County, Graham County, the "Rim Country" area northwest of the Fort Apache Reservation, communities of the northern portion of the Apache National Forest, and communities of the Sitgreaves National Forest. The Sitgreaves CWPP received a 2005 National Fire Plan award for Excellence in Collaboration, in part due to its cross-boundary collaboration between private lands, National Forest System lands, and tribal lands within the Fort Apache Reservation. A CWPP is currently under development for central Navajo County, north of the Sitgreaves National Forest. In addition, a number of longer-term collaborative efforts exist in the area, including the Natural Resources Working Group of the White Mountains, Upper Eagle Creek Watershed Association, Upper Little Colorado River Watershed Partnership, Show Low Creek Watershed Enhancement Partnership, and the Little Colorado River Watershed Coordinating Council. The Southwest Sustainable Forests Partnership has been instrumental in encouraging and helping to develop local wood products businesses capable of utilizing small-diameter timber.

Local collaboration within the Natural Resources Working Group has been a key component in the planning and implementation of the White Mountain Stewardship Project. The contract includes funding for monitoring of the project's effects, and the coordination of this monitoring is being led by the Multiparty Monitoring Board, a collaborative body composed of various scientists and stakeholders from the region. In 2005, local stakeholders participated in the White Mountains Landscape Assessment project--a collaborative, science-based approach to restoration planning at the landscape scale using GIS layers and tools developed by the Forest Ecosystem Restoration Analysis project at Northern Arizona University.

Economics

Economic dependence on the natural resources of the White Mountains landscape is complex and multifaceted. On one side there are community economic structures dependent on the extraction, processing, and sale of products from the national and tribal forests. On the other side, there are communities whose economic structures are based on the forests' amenity values, which means that forest access for a multitude of recreational activities is of primary importance. Additionally, there are communities which represent a combination of both types. Communities on the east (Apache County), south (Greenlee County), and in parts of both Apache Reservations are primarily extraction- and processing-based, while communities in the western and northern areas (Navajo County) are largely amenity-based with significant numbers of second homes and retirement dwellings.

The White Mountains area was one of the few regions in Arizona that did not completely lose its forest products infrastructure during the 1980s and early 1990s. This was due entirely to the White Mountain Apache Tribe, which maintained an active forest products extraction and processing effort throughout that period. While economic capacity is still a major barrier to effective forest stewardship and restoration, having the basis for a credible economic prospect was essential to developing the current level of activity experienced throughout the area. Wood products created by local businesses include lumber, posts and poles, molding, pellet heating fuel, bioenergy, mulch, animal bedding, and other applications. The recent growth in wood products businesses can be attributed to both the persistence of a wood products economy through the lean years of the 1990's and to the level of supply predictability that accompanied the announcement of the White Mountain Stewardship Project.

Increased utilization opportunities and marketing efforts have acted to reduce somewhat the cost per acre of restoration treatments implemented under the White Mountain Stewardship Project, but these treatments still operate at a net loss. Even with the relatively large number and variety of wood products businesses in the White Mountains, there is still a need for greater utilization capacity to deal with the by-products of restoration treatments. Opportunities for locating wood products businesses have become more limited in recent years as some communities have wholly embraced amenity-based economies where milling and processing infrastructure is either unwelcome or is excluded due to land and real estate prices.

Implementation and Management

Implementation of the White Mountain Stewardship Project has been steady, though at times constrained by weather-related factors, such as drought or excessive precipitation. To date, close to 16,000 acres have been mechanically treated under the contract. Stewardship contract implementation has been aided by the expansion of utilization opportunities in the local area, but the need exists for continued funding of the contract as well as expanded economic utilization opportunities to offset treatment costs.

Implementation of Community Wildfire Protection Plans within the White Mountains Landscape has benefited from state and federal community protection grants, but treatment needs far exceed available funding. Some locales have hired CWPP coordinators to oversee implementation. As of yet, the federal dollars that were supposed to be prioritized to communities with CWPPs have not materialized, leaving many communities with viable plans but little means of implementing them. Forest management activities on White Mountain Apache and San Carlos Apache tribal lands are continuing, but a lack of funding is slowing hazardous fuel reduction work, including defensible space creation in the WUI.

Like all other Region 3 forests, the Apache-Sitgreaves National Forests are currently revising the Forest Plan guiding the management of these federal lands over the next ten year period. This presents a unique opportunity to address some of the most pressing issues related to declining forest health and the threat of unnaturally severe wildfire.

White Mountains Stewardship Contract

Conceived in 2004, White Mountains Stewardship Contract opened the door for large forest restoration and fuels reduction projects on the Apache-Sitgreaves National Forests. It involves a local coalition of forest-related industries organized as Future Forests LLC in Pinetop, Arizona. The contract calls for the removal of excess small-diameter biomass from a minimum of 5,000 acres annually up to a maximum of 25,000 acres. The excess biomass is then used by local industries. To date, 16,000 acres have been treated. The major factor contributing to the lower levels of treatment are the costs and the lack of processing and marketing opportunities for the product. Currently the U.S. Forest Service subsidizes the project at the level of $400+ per acre.

The initial focus of the contract has been interface and priority watershed restoration related wildland treatments. Future priorities will be in the wildland and focus on wildlife guidelines as an additional consideration and model to meet the desired, ecosystem, social, economic, watershed, and wildland fire mitigation outcomes.

According to Dr. Lay Gibson of the University of Arizona, in 2006, the White Mountain Stewardship Contract supported 15 firms with total annual expenditures of almost $16 million. These firms employ 245 full-time equivalent employees (FTE) with an additional 85 FTE created through the multiplier process.

White Mountain Apache Tribe (WMAT)

The WMAT landscape is managed for recreation, fuel wood, cultural preservation, wildlife, aesthetics, livestock, and the economics gained by the removal of merchantable timber. Two plans exist to provide for long-term resource objectives and to ensure the development, maintenance, and enhancement of ecosystems on White Mountain Apache tribal land: the Forest Management Plan (2005 to 2014) and the Fire Management Plan (2005 to 2009). Input was gathered from tribal members, the BIA, and WMAT staff during the development of this plan. Federal, tribal and state laws are followed in regards to protecting cultural heritage resources when implementing both the Forest and Fire Management Plans.

Management of fuels on the WMAT forests is conducted throughout logging, thinning, and Hazard Fuel Reduction projects. There have been several wildlife habitat and range improvement burns conducted on the WMAT landscape. Another fuel reduction program implemented on the WMAT reservation is the Wildland Fire Use (WFU) program, which may be conducted from about mid-July to April, as long as certain criteria are met.

Future Restoration Needs

Some of the major restoration needs in the White Mountains landscape include:

- Protecting communities efficiently and strategically. A combination of high hazardous fuel loads and extensive WUI development creates a high-risk situation.
- Integrating community and tribal lands protection with wildland restoration strategies. Much of the recent attention and activity has been in the wildland-urban interface, but as the Rodeo-Chediski Fire illustrated, wildland areas and remote watersheds remain at high risk due to degraded forest ecological health.
- Development of utilization opportunities. While the White Mountains landscape stands out for its number and variety of wood products businesses, local capacity is still not sufficient to meet restoration needs. Potential cost savings on restoration treatments will not be realized without expanded markets for low-value restoration by-products.
- Increased funding for implementation. A number of restoration and community protection plans have been developed at local, tribal, and forest levels. Funding in the form of grants and cost-share assistance is needed to successfully implement these plans. Low-income rural populations are in particular need of wildfire protection assistance.
- Support for long-term, large-scale restoration plans. The White Mountain Stewardship Contract is the first of its kind in the nation, and has the potential to serve as a demonstration of the ways restoration, community protection, and economic development can complement each other. This stewardship contract and others like it need ongoing federal financial and political support.
- Monitoring of restoration and community protection activities. The Multiparty Monitoring Board for the White Mountain Stewardship Project has taken the lead on monitoring important indicators within the project area. Further monitoring is needed for other activities outside the project area, including on some of the more remote regions of the Apache-Sitgreaves National Forest and on non-federal lands.
- Support for collaborative enterprises. Communities in the White Mountains landscape have shown that locally driven, grassroots collaboration is a viable model for comprehensive forest and watershed management across jurisdictions. As these collaborative enterprises continue to work effectively, their guidance must be supported by relevant state, federal, and local land and resource managers.
- A focus on watershed protection. The White Mountains landscape contains more surface water than any other region of the state. Active forest restoration is needed to lower the risk of irrevocable watershed damage following a wildfire event.

Some more specific recommendations include:

1. Federal government should ensure the White Mountain Stewardship Project is fully funded and supported.
2. Local entities should develop requirements regarding building materials, defensible space, and other FireWise activities to be met before new development is approved.
3. Funding is needed to help accelerate WUI fire protection. Primary needs include cost-share funding and grants for fuel reduction and funding to support outreach and educational efforts.

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Meeting with the Natural Resources Working Group, August 8, 2006

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Appendix

Appendix 1: Recommendations and Action Items

Appendix 1: Strategies, Recommendations and Action Items

STRATEGY #1: Increase the human and financial resources available for forest restoration and community protection in Arizona.	
Recommendations	**Action Items**
1.1. Congress should increase funding to federal and tribal land management agencies and the state to furnish the capacity essential for collaboratively planning, implementing and monitoring restoration treatments.	1.1.1. Vegetation and fuel treatment funding should be increased to a minimum of $30 million/year for 3 years for the Forest Service; and $10 million/year for 3 years for Department of Interior agencies (BLM, NPS, BIA, and F&WS). Funding should increase by 15% per year for 20 years. 1.1.2. Funding for CWPP implementation should be increased to $5 million per year, and the dollars should be allocated to local communities through the State Forester. (1.1.2.) 1.1.3. Program funding should be provided to federal land management agencies to ensure adequate human resources are available to facilitate treatment action. This includes capacity for all facets of developing and applying treatments including: environmental review, contracting, community collaboration and implementation. 1.1.4. Funding should be provided to the USFS research stations to cooperate with universities, land managers, organizations with applicable expertise, and other stakeholders in identifying practical multi-scale monitoring approaches. 1.1.5. Congress should maintain funding to complete the White Mountain Stewardship Contract on the Apache Sitgreaves National Forest.
1.2. Congress should restore funding to enable communities, stakeholder groups and tribes to collaborate in utilization and marketing of small-diameter wood and biomass.	1.2.1. Congress should revitalize the Economic Action Program or create a new source of funds dedicated to assisting local communities throughout the West in their efforts to develop utilization and marketing opportunities for small-diameter wood and biomass.
1.3. Congress and the Arizona State Legislature should increase funding for developing and translating best available biological, biophysical, and social science into forms needed by land managers and stakeholders.	1.3.1. The Arizona State Legislature should provide financial support to universities, state agencies and other organizations with applicable expertise to conduct applied research, translate scientific information and serve as neutral conveners within collaborative processes. 1.3.2 Congress should fund applied biophysical, social science, ecological, and economic research in universities, colleges, research stations, and other organizations with applicable expertise, that informs and improves forest health and the vitality of rural communities.

1.4. The Arizona State Legislature should provide funding for restoration treatments, community protection, and fire management on non-federal lands.	1.4.1. The Arizona State Legislature should allocate $5 million per year to community protection activities identified in Community Wildfire Protection Plans (CWPPs). Activities to be supported would include completion of CWPPs and funding for community collaboration.
STRATEGY #2: Coordinate and implement action at the landscape scale.	
Recommendations	**Action Items**
2.1. Federal land management agencies should collaboratively develop and implement integrated landscape-scale restoration, community protection and fire management for forests across the state.	2.1.1. The Forest Service should support collaborative planning and implementation of integrated restoration, community protection, and fire management strategies across the state within the Forest Plan revision process. 2.1.2. The Forest Service should develop, revise, and/or update Annual Forest Fire Management Plans using the best available science and in a transparent and collaborative fashion. 2.1.3. National forest plans should provide clear performance measures that allow the agency and public to evaluate progress toward meeting restoration, community protection, and fire management objectives.
2.2. The Arizona State Legislature, county and local governments and state agencies should develop land-use policies and practices that support forest restoration, community protection, and fire management efforts.	2.2.1. Counties and local governments should classify undeveloped lands based on relative fire hazard. 2.2.2. The State Fire Marshall should adopt and enforce an Urban Wildland Interface Code to protect communities and property from wildfire. 2.2.3. Counties and local governments should adopt and enforce building and Wildland Urban Interface fire codes to minimize communities' exposure to fire danger. 2.2.4. Planners should work with developers to incorporate appropriate buffer zones, based on anticipated fire hazard, into the design of new developments to allow for maintaining conditions in adjacent forests where natural or prescribed fires may continue or be reintroduced. 2.2.5. The Arizona State Legislature should delegate authority to counties to manage development in the Wildland Urban Interface to enhance protection from wildfire, and to protect public safety. 2.2.6. The Arizona State Legislature, counties and local governments should develop incentives to encourage landowners to maintain defensible space. 2.2.7. The Arizona State Legislature should work with local governments to revise planning requirements under Growing Smarter legislation to deal with fire risk at the landscape scale. 2.2.8. The Arizona State Land Department should develop long-term forest restoration and fire management plans for state lands.

2.3. All federal, state,tribal, and local governments should increase coordination of forest restoration, fire management, and community protection planning and implementation across jurisdictional boundaries.	2.3.1. The State Forester should work with the Arizona Interagency Wildland Fire Prevention Team or a similar organization to improve coordination between all agencies and tribes on treatment implementation as well as fire preparedness. 2.3.2. The State of Arizona should provide adequate financial support to Arizona Fire Map. This tool provides the foundation for sharing treatment information across jurisdiction boundaries. 2.3.3. Federal land management agencies, counties and local governments should provide treatment data to update the Arizona Fire Map. 2.3.4. The federal land management agencies should actively collaborate with the state, local governments and the tribes to revise Forest Plans. 2.3.5. Federal land management agencies and the Arizona Department of Transportation should prioritize treatments to protect important infrastructure, e.g., telecommunication installations, power lines, and transportation corridors.
2.4. The federal land management agencies, counties and local governments should use Community Wildfire Protection Plans to inform and prioritize treatments in their jurisdiction.	2.4.1. Local governments in communities at risk should complete Community Wildfire Protection Plans. 2.4.2. Federal agencies should place priority on implementing projects identified within CWPPs.
2.5. State and federal land managers should design forest management practices to integrate wildlife habitat and biodiversity conservation protection with restoration, community protection, and fire management.	2.5.1. The Arizona Game and Fish Department should work with the Arizona Forest Health Council, federal agencies and other stakeholders with applicable expertise to develop a set of principles and strategies for integrating wildlife habitat and biodiversity conservation with restoration, community protection, and fire management. This should include educating the public about these strategies.
STRATEGY #3: Strategically increase efficiency of restoration, fire management, and community protection activities.	
Recommendations	**Action Items**
3.1. Federal and state land management agencies should collaboratively and strategically place treatments in order to increase efficiency and maximize benefits.	3.1.1. Federal land management agencies should develop short-term (2-5 year) and longer-term (10-20 year) treatment plans based on priorities developed at the landscape scale. 3.1.2. State land management agencies should develop restoration, fire management, and community protection performance standards that measure progress toward objectives and can lead to refinement of strategies as necessary. 3.1.3. Federal land management agencies should complete and implement plans for using prescribed fire and Wildland Fire Use where and when appropriate. 3.1.4. Federal land management agencies should initiate treatments where a collaborative process has preliminarily identified and prioritized landscape attributes at risk.

	3.1.5. A national forest in Arizona should take a landscape-scale approach that systematially evaluates existing ecological conditions and then identifies, applies, and monitors the effectiveness of strategically placed treatments that in theory should modify extreme fire behavior and reduce the probability of large, unnaturally severe wildfire. 3.1.6. State and federal authorities should work collaboratively with stakeholders to identify and develop restoration and fire management strategies for watersheds of critical importance across the state. 3.1.7. The state should ensure that all state-identified communities at risk have completed a Community Wildfire Protection Plan, or equivalent plan (e.g. Grand Canyon North Rim.
STRATEGY #4: Support ecologically sustainable forest-based economic activities.	
Recommendations	**Action Items**
4.1. Land managers should work with stakeholders to clarify the amount, availability, and location of restoration, community protection, and fire management-generated wood and biomass across the region.	4.1.1. The Forest Service and other land management agencies should fund and participate in a collaborative and objective evaluation of the amount and characteristics of the wood and biomass available for utilization across Arizona. 4.1.2. Local governments should ensure that wood utilization opportunities and challenges are clearly identified in CWPPs.
4.2. Federal, state, and local governments should identify and enhance opportunities for utilizing small-diameter wood and biomass generated from forest treatments.	4.2.1. The Forest Products Lab of the US Forest Service, the U.S. Department of Energy, and the U.S. Department of Agriculture should conduct studies to identify utilization and marketing opportunities for products created from pinyon-juniper as well as ponderosa pine. 4.2.2. Arizona state agencies should use treatment-generated material whenever possible. Specifically, the State of Arizona should actively apply Arizona Executive Order 2005-05, which calls for all new state-funded buildings to derive their energy from renewable sources, such as woody biomass. 4.2.3. State agencies should encourage retrofitting of existing heating systems in public and private buildings to promote greater use of wood biomass. 4.2.4. The Arizona State Legislature should work with the Arizona Department of Commerce to identify incentive programs that encourage the use of restoration-generated materials by businesses across the state. 4.2.5. The Arizona Department of Transportation should use restoration treatment by-products generated in Arizona for guard rails and other transportation or highway maintenance applications.
4.3. All levels of government should work together to support wood products industries capable of utilizing small diameter wood and biomass.	4.3.1. The Forest Service should continue to use, and other land management agencies should initiate, best-value contracts and other tools that ensure continuous wood flow, where such contracts support collaborative and science-based forest management, and promote economic and social stability in rural communities.

	4.3.2. The Arizona State Legislature should fund a position that is designed to assist rural communities to convene, recruit, and support forest and wood-products enterprises. This poosition would reside either in within the State Forester's office or the Dept. of Commerce 4.3.3. Local governments should develop and use policies, planning, and tax incentives to encourage businesses that will diversify the economy, are appropriately scaled to the amount of material available from the forest, and keep jobs and dollars in rural Arizona. 4.3.4. Congress and the Arizona State Legislature should fund recruitment and training programs for forest and wood-products workers in cooperation with forest and wood-products employers and educational organizations.
STRATEGY #5: Build public support for accomplishing necessary restoration, community protection, and fire management work across the state.	
Recommendations	**Action Items**
5.1. The Arizona State Legislature should fund public education, and work with the State Forester and local governments to educate the public about restoration, sustainable forest and wood products businesses, fire management, and community protection needs and responsibilities.	5.1.1. County, local and tribal governments should create and/or promote education programs to help residents of forest communities understand the risks inherent in living in fire-prone areas, and to educate developers and the community about steps that can be undertaken to reduce exposure to fire hazard and to improve forest health. Much has been done already under the FIREWISE, USA program. 5.1.2. The Arizona State Legislature should fund an education coordinator position under the State Forester to coordinate and promote public education about restoration, sustainable restoration-based businesses, fire management, and community protection needs and responsibilities.
5.2. Citizens should take actions to protect their properties and communities from fire.	5.2.1 Citizens should seek assistance from their local fire district, fire department, homeowners association or visit http://www.firewise.org/usa/ to learn what they can do to protect their home and property.
5.3. The Governor's Forest Health Council, working closely with the State Forester, the U.S. Forest Service and other federal agencies, should develop and administer annual "Forest Health Scorecard" based in part upon the Western Governor's Association's 10-Year Strategy Implementation Plan.	5.3.1. In 2007, the Forest Health Councils should develop a scorecard based on the 20- Year Strategy to measure progress.

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