

# Restoring Fire to Southwestern Ecosystems: Is It Worth It?<sup>1</sup>

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## Abstract

The historical record supported by tree ring analysis indicates that fire played a dominant role in pre-settlement southwestern vegetation types within Arizona and New Mexico. Studies within some of these vegetative types have indicated a frequent natural fire interval. As early settlers built homes and businesses adjacent to these forested areas, they quickly recognized fire as a threat to their livelihood. This wildland fire (new terminology from Implementation Procedures Reference Guide) threat has been dealt with effectively for the past 100 years by aggressive fire suppression. Without fire, ecosystem health began changing. Forest fuels have increased that were once recycled by frequent surface fires. As a result fire size and intensity as well as suppression costs have increased. The use of wildland and prescribed fire over time will improve ecosystem health and reduce the suppression costs of unnecessary wildland fire. The cost of returning fire to some areas will be high; therefore, we must evaluate the risk involved if nothing is done.

## Introduction

The role of fire, before European settlement, including fire frequencies, within many ponderosa pine (*Pinus ponderosa* Dougl. ex laws) forests of the Southwest is well-documented (Covington and Moore 1994a, Moir and Deiterich 1988, Moody and others 1992, Swetnam and others 1990). These studies emphasize that fire has maintained an open parklike forest structure with a characteristic herbaceous understory (although some studies have suggested an alternate view [Shinneman and Baker 1997]). Heavy livestock grazing during the late 1800's, followed by aggressive fire suppression and accelerated logging, altered forests from open parks consisting of single-storied stands with a continuous bunchgrass understory cover to multistoried stands with dense downed-woody material and sparse live ground cover (Covington and Moore 1994a). Areas within the Gila Wilderness, on the Gila National Forest in southwestern New Mexico (fig. 1) still maintain these characteristics (Boucher and Moody [In press]).

Before to the late 1800's, these frequent low-intensity surface fires helped to maintain a ponderosa pine and Gambel oak (*Quercus gambelii*) forest on xerophytic sites. Ponderosa pine, Douglas-fir (*Pseudotsuga menziesii*), and Gambel oak occupied moister sites (Moir and others 1997). Ground cover was a continuous grass savanna comprised of Arizona rescue (*Fistula Arizona*) and mountain mule (*Muhlenbergia montana*) on the Mogollon Plateau in Arizona and New Mexico, and screw-leaf muly (*Muhlenbergia virescens*) on pine-covered mesas within the Gila Wilderness. These grasses become dormant during the dry periods of May and June. The accumulated leaf biomass of several fire-free years provided fine fuels to carry low-intensity ground fires with little damage to the parent plant. These grasses recover quickly with the arrival of moisture from the tropics during the summer monsoon period. The herbaceous component was thought to have been fairly continuous, growing up to and against the trunks of trees (Baisan and Swetnam 1990; Barton 1995; Caprio and Zwolinski 1995; Deiterich and Hibbert 1990; Fule and Covington 1994, Grissino-Myers and others 1995; Moir 1992, Swetnam and others 1992, 1995, 1996; Villanueva-Diaz and McPherson 1995).

Tree ring analysis of burn scars has been used to estimate fire frequencies within the mesophytic and xerophytic stands of ponderosa pine in the Southwest (Moir and others 1997, Swetnam 1990). It is generally accepted that fire occurred

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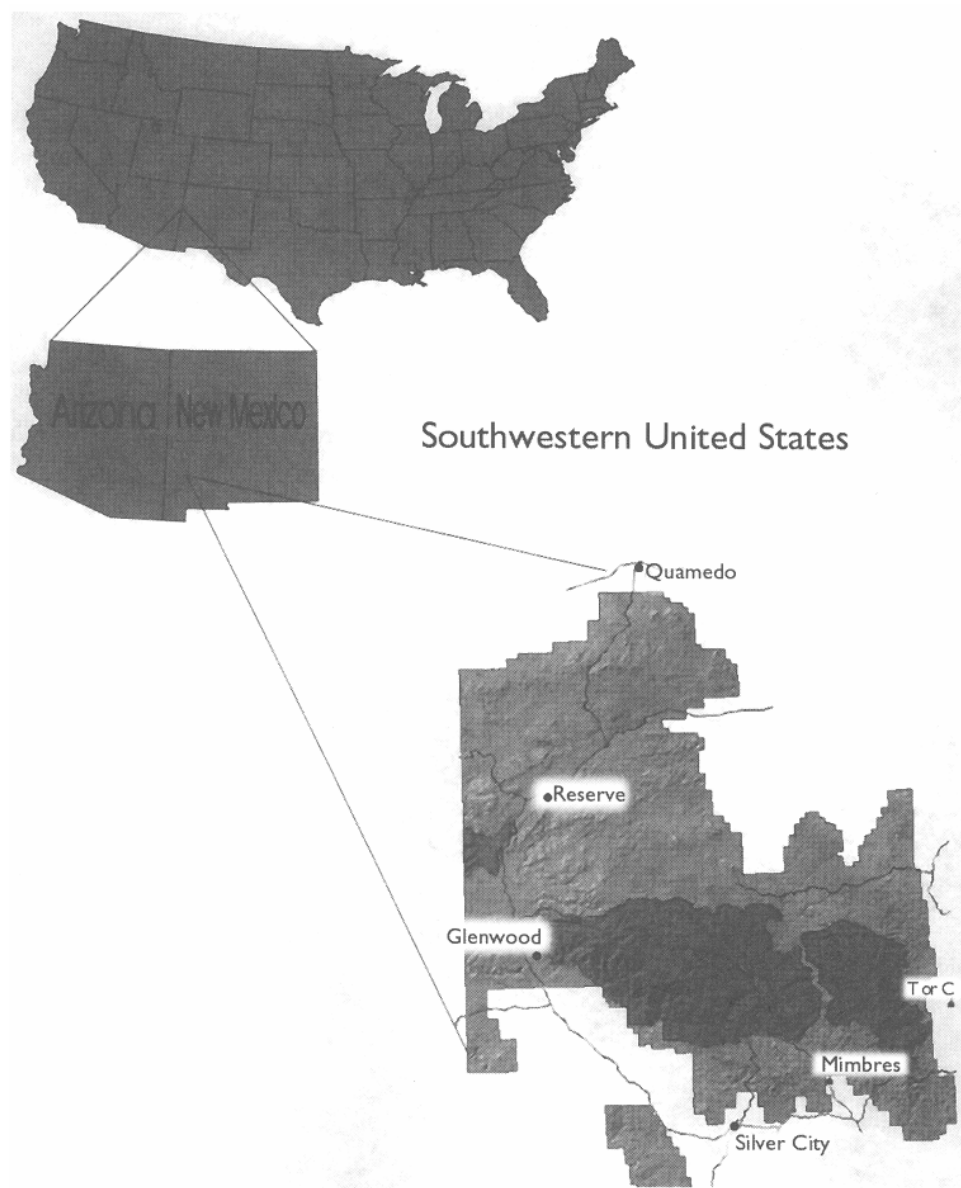
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Figure 1

Gila National Forest and  
Wilderness Area.



on 2- to 12-year intervals for the xerophytic sites and up to 15 years for mesophytic sites (Cooper 1961, Covington and Moore 1994a, White 1985). Stand-replacement crown fires were considered rare and were typically confined to small thickets when they occurred (Pyne 1996, Woolsey 1911). Because of these frequent fire events, it is believed that the species of plants and animals within this vegetation type have evolved with fire. It is also quite possible that they or their habitats require frequent fires to remain viable. Much remains unknown about the soil microbial community and their interdependence with fire (Boucher and Moody 1998, Covington and Moore 1994a, Ganey and others 1996, Moir and Dieterich 1988, Moody and others 1992).

The Madrean Sky Island Archipelago, which includes parts of the Gila National Forest, consists of many isolated mountain groups. These mountains are important centers of biological diversity because of the convergence of northern and southern floral and faunal elements (Barton 1995, Felger and Wilson 1995, Warshall 1995). Organisms residing within these forests have evolved with fire as a natural process. Fires of the past were frequent and of low to moderate intensity. Recent fires have been catastrophic as a result of abnormal fuel build-up. These fires are likely to continue without meaningful fuels reduction. If they do continue, they could have far-reaching effects on the local

biota (Barton 1995, Caprio and Zwolinski 1995, Felger and Wilson 1995, Fule and Covington 1994, Ganey and others 1996, Grissino-Mayer and others 1995, Marshall 1957, Warshall 1995). Because stand replacement fires are thought to have been rare in the past, the recent increase of these types of fires is alarming. Localized extinction of isolated, unique populations of plants and animal species or even subspecies are a severe threat (Moir 1995).

## Area Description

The Gila National Forest is comprised of 1,335,490 ha (3,300,000 acres), including 356,130 ha (880,000 acres) of wilderness. The Gila Wilderness has been managed as such since 1924 and is considered the first in the National Forest System. The Gila Wilderness was set aside 40 years before the passage of the Wilderness Act of 1964. Elevation ranges from 1,312 m to 3,323 m (4,300 to 10,895 feet) above sea level.

Vegetation types include spruce-fir and mixed conifer at high elevation along the Black Range and Mogollon Mountains with ponderosa pine the primary species near 2,135 m (7,000 feet). A mixed woodland of evergreen oak, pinyon pine, and juniper is found below 1,983 m (6,500 feet). The desert grassland subtends the woodland. Precipitation is derived from winter frontal systems and from summer thunderstorms generated by a monsoon flow from the tropics.

The Gila National Forest had one of the original prescribed natural fire plans within the National Forest System. This plan was implemented in 1975 and stated that the summer rains had to be well established before a lightning ignition could be managed as a natural fire. Returning fire to the forest under this early plan was treating very few acres. Since 1975, the Forest average was 452 ha (1,117 acres) while the average for the past 10 years has been 275 ha (681 acres).<sup>4</sup> It was calculated that the Forest would have to burn approximately 40,470 ha (100,000 acres) each year to maintain a 10-year cycle in the ponderosa pine forest (Boucher and Moody [In press]).

## Discussion and Conclusion

The perception of many who now live in the Southwest is that the current fire regime and vegetation had remained the same throughout the years, especially over the 100 past years. Photo documentation, in particular the use of historic photo retakes, proved to be most helpful in changing this perception. These photo pairs showed clearly that the number of trees on a given site, at the turn of the past century, was far lower than current conditions. They also gave evidence of heavy forage use by grazing ungulates. Many were unaware that vegetation types and conditions could change in such a short period of time. Although many refer to the change on the watersheds as "invasion" of one species or another, it is more realistically identified as a regeneration event brought on by livestock grazing, timber harvest outside of wilderness, and then fire suppression.

Threats from wildland fire grow each year as long-term effects from past land use and fire management actions become visible in natural vegetation communities. There are additional areas of consideration that fire managers have to deal with while making decisions as they relate to fire and these are clean air, clean water, cultural resources and endangered, threatened, and sensitive species. The 1990 Clean Air Act Amendments, New Mexico State Implementation Plan, and its memorandum of understanding with the Federal agencies maintains that smoke can become a problem after a fire reaches a certain size. During these situations, the New Mexico State Environment Division has requested that the forward spread of these fires be halted.

The Gila National Forest is unique in the Southwest Region of the USDA Forest Service in several ways. It has been using wildland fire with an approved plan since 1975. Before that, even with the attempts to implement the Forest

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<sup>4</sup> Unpublished data on file, Gila National Forest, New Mexico.

Service's "10 a.m. policy," fires within the two large wilderness areas frequently escaped initial attack. Reasons for these escapes included weather patterns, topography, and vegetation types that made early control difficult. The Forest is also isolated from major urban centers, and this has allowed more flexibility in dealing with the smoke problems that have plagued other forests. All of these factors have allowed the Forest to put fire back on most of its acres over the past 20 years. Some areas within the Gila Wilderness have even had multiple fires within the last 75 years.<sup>5</sup>

The economics of fire use have helped direct decisions back towards the natural cycle. The logistics of fighting fire within the Gila and Aldo Leopold Wildernesses make any attempt at full suppression a nightmare. Firefighter safety and the values at risk have generally led the decision process towards confining the fire within topographical features. This has limited the amount of disturbance within the wildernesses and has helped implement the minimum impact suppression tactics outlined in the Forest Wilderness Plan. Generally, fire-fighting personnel are far in front of the main fire, burning out trails and securing the perimeter. This tactic has provided for optimum firefighter safety. It has also limited the number of helicopter landing spots that have been needed as well as the number of safety areas that would have had to have been established for use in the event of an emergency.

Outside of wilderness, past silvicultural treatments have left areas in the ponderosa pine and mixed conifer vegetation zones capable of accepting wildland fire as well as prescribed fire, with minimal risk. The risks associated with burning during the dry periods of May and June are associated with basal and crown scorch. But historically, these risks have been a result of lightning ignited fires. Furthermore, the risks associated with the negative aspects of smoke are limited because of better ventilation and dispersion. The old school of thought that the value of the product would be lowered if the base were black is no longer valid. In reality, the value of timber after a stand replacement fire is far less than that of sawtimber and pulp that has been blackened at the base.

The Forest will continue to have the opportunity to use fire as a tool to reduce fuels and the risk and expense of large-scale wildfires. But fire, even on the Gila, isn't the right tool on every acre. In the future, the rising emphasis worldwide on carbon dioxide emissions and the possible implementation of international treaties may restrict prescribed fire. Restriction placed on the release of green house gasses like carbon dioxide could prevent the use of fire in some sections of the country. Even the restrictions in place with the current Clean Air Act have made it difficult to meet meaningful fuels reduction in some areas adjacent to urban centers. Some of these areas have not seen fire in more than 75 years and are ripe for disaster. Fuels reduction by mechanical means may be the only solution.

There is currently support for the use of fire to reduce fuels, but the removal of wood fiber by commercial means is not in vogue. Some people believe that cutting trees is wrong. That incinerating them through a stand replacement fire is

**Table 1**-Mean estimate "average" cost per acre and planning cost percentage for fuel treatment, in 1994 dollars, USDA Forest Service, Southwestern Region 3.

Region 3	\$/Acre	Pct. in planning
Slash reduction	76.25	13.7
Management ignited	37.81	20.2
Prescribed natural fires	6.75	62.5
Brush, range, and grassland	36.18	18.2
All types	39.25	16.5

<sup>5</sup> Unpublished data on file, Gila National Forest, New Mexico.

acceptable. The cost of various mechanical treatments compared to natural fire is high. This could be offset if a product could be produced (*table 1*).

The urban interface issue and the potential for lawsuits that can result from a fire that escapes the perimeters of public lands during a burn and causes private property damage is a real threat. But this is minimal when one considers the potential loss of private property caused by a catastrophic fire in the future if nothing is done to alleviate the fuel problems that currently exist on those same public lands. What should be done?

We maintain that the public, State and local agencies and the Federal government are all in agreement to the need to accomplish meaningful fuels reduction. The major problems come as a result of the bad press when smoke remains in a community or city for several days; then, negative attitudes begin to develop. Also, do we truly understand how much it will cost and are we ready to repeat the treatment every few years? If natural cycles occur between 2 and 7 years, as with the Gila, one prescribed fire will not be enough. We will have to be committed to return to the same acres with additional dollars to continue the process.

We anticipate that the Gila and its fire reintroduction program will continue to prosper at least into the next decade. As fuels are reduced and the fire cycle approaches historical intervals, fire intensities and the problems with smoke should be lessened. But to accomplish this the Forest will have to burn about 41,000 hectares (100,000 acres) annually (Boucher and Moody [In press]). This is a high goal, and we doubt whether it can be maintained, considering the current political climate. It is too easy for a decision-maker to choose the full suppression alternative and avoid the potential for negative criticism that could come from problems with the use of wildland and prescribed fire. Strict accountability and critical postfire review of decisions should be implemented. This critique should help determine the correct course of action for future ignitions and aid in the decisions of how to best invest the public's money.

An incident with negative side effects can quickly cause either an agency administrator or fire manager to lose interest in the program. This is especially true when one considers that, currently, the public and politicians provide little criticism when a wildfire is declared, regardless of the cost. Suppression has been advocated, and a particular problem with a wildfire is not likely to jeopardize career aspirations. Unfortunately, the same cannot be said about agencies or individuals and their reputations if they are questioned because of political or public criticism dealing with a wildland or prescribed fire. If the agency is following their plans, then criticism is unfounded. However, if plans are not followed, criticism occurs.

The economic challenges are real. We should be less willing to pay for suppression and more willing to work with the natural process. The sale and removal of excess trees by mechanical means should be encouraged where appropriate. Ignitions that occur at a distance from urban centers need to be carefully evaluated before a full suppression alternative is implemented. After full suppression has occurred, a critical accounting through peer review should be conducted to help determine that dollars spent (cost plus loss) were wisely invested. This process should not become a witch-hunt but rather a method to better support decisions in the future.

The cost of doing nothing has already been well-documented. Are we willing to risk the health and well being of our natural resources? We hope not!

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## References

- Baisan, C. H.; Swetnam, T. W. 1990. **Fire history on a desert mountain range: Rincon Mountain Wilderness, U.S.A.** Canadian Journal of Forest Research 20: 1559-1569.
- Barton, A. M. 1995. **Fire adaptations in pine and oaks: Tree population responses to fire suppression in Arizona's Madrean forests.** In Brown, J. K.; Mutch, R. W.; Spoon, C. W.; Wakimoto, R. H., technical coordinators. Proceedings: Symposium on fire in wilderness and park management. USDA Forest Service. Gen. Tech. Rep. INT-GTR-320. Ogden, UT: Intermountain Research Station; 159-163.
- Boucher, Paul F.; Moody, Ron D. [In press]. **The historical role of fire and ecosystem management of fires, Gila National Forest New Mexico.** Proceedings, annual Tall Timbers fire ecology conference.
- Caprio, Anthony C.; Zwolinski, Malcolm J. 1995. **Fire and vegetation in a Madrean oak woodland, Santa Catalina Mountains, southeastern Arizona.** In: Debano, L.F; Edminster, C. B.; Ffolliott, P. F.; Gottfried, G. J.; Hamre, R. H.; Ortega-Rubio, A., technical coordinators. Biodiversity and management of the Madrean Archipelago: The Sky Islands of southwestern United States and Northwestern Mexico. USDA Forest Service. Gen. Tech. Rep. RM-GTR-264. Ft. Collins, CO: Rocky Mountain Forest and Range Experiment Station; 389-398.
- Cooper, C. F. 1961. **Pattern in ponderosa pine forests.** Ecology 42: 493-499.
- Covington, W. Wallace; Moore, Margaret M. 1994. **Post settlement changes in natural fire regimes and forest structure: Ecological restoration of old-growth ponderosa pine forests.** Journal of Sustainable Forestry 2: 153-181.
- Deiterich, John H.; Hibbert, Alden. R. 1990. **Fire history in a small ponderosa pine stand surrounded by chaparral.** In: Krammes, J. S., technical coordinator. USDA Forest Service. Gen. Tech. Rep. RM-GTR-191. Ft. Collins, CO: Rocky Mountain Forest and Range Experiment Station; 168-173.
- Felger, Richard S.; Wilson, Michael F. 1995. **Northern Sierra Madre Occidental and its Apachian outliers: A neglected center of biodiversity.** In: Debano, L.F; Edminster, C. B.; Ffolliott, P. F.; Gottfried, G. J.; Hamre, R. H.; Ortega-Rubio, A., technical coordinators. Biodiversity and management of the Madrean Archipelago: The Sky Islands of southwestern United States and Northwestern Mexico. USDA Forest Service. Gen. Tech. Rep. RM-GTR-264. Ft. Collins, CO: Rocky Mountain Forest and Range Experiment Station; 36-59.
- Fule', Peter Z.; Covington, W. Wallace. 1994. **Fire-regime disruption and pine oak forest structure in the Sierra Madre Occidental, Durango, Mexico.** Restoration Ecology 2: 261-272.
- Fule', Peter Z.; Covington, W. Wallace. 1995. **Changes in fire regimes and forest structure of unharvested Petran and Madrean pine forests.** In: Debano, L.F; Edminster, C. B.; Ffolliott, P. F.; Gottfried, G. J.; Hamre, R. H.; Ortega-Rubio, A., technical coordinators. Biodiversity and management of the Madrean Archipelago: The Sky Islands of southwestern United States and Northwestern Mexico. USDA Forest Service. Gen. Tech. Rep. RM-GTR-264. Ft. Collins, CO: Rocky Mountain Forest and Range Experiment Station; 408-415.
- Fule', Peter Z.; Covington, W. Wallace. 1996. **Conservation of pine oak forests in northern Mexico.** In: Covington, W.; Wagner, P. K., technical coordinators. Conference on adaptive ecosystem restoration and management: restoration of cordilleran conifer landscapes of North America. USDA Forest Service. Gen. Tech. Rep. RM-GTR-278. Ft. Collins, CO: Rocky Mountain Forest and Range Experiment Station; 80-88.
- Ganey, Joseph L.; Block, William M.; Boucher, Paul F. 1996. **Effects of fire on birds in Madrean forests and woodlands.** In: Allen, L. S.; Baker, M. B. Jr; Debano, L. F.; Edminster, C. B.; Ffolliott, P. F.; Gottfried, G. J.; Hamre, R. H.; Neary, D. G.; Solis-Garza, G., technical coordinators. Effects of fire on Madrean province ecosystems. USDA Forest Service. Gen. Tech. Rep. RM-GTR-289. Ft. Collins, CO: Rocky Mountain Forest and Range Experiment Station; 146-154.
- Grissino-Mayer, Henri D.; Baisan, Christopher H.; Swetnam, Thomas W. 1995. **Fire history in the Pinaleno Mountains of southeastern Arizona: Effects of human related disturbance.** In: Debano, L.F; Edminster, C. B.; Ffolliott, P. F.; Gottfried, G. J.; Hamre, R. H.; Ortega-Rubio, A., technical coordinators. Biodiversity and management of the Madrean Archipelago: The Sky Islands of southwestern United States and Northwestern Mexico. USDA Forest Service. Gen. Tech. Rep. RM-GTR-264. Ft. Collins, CO: Rocky Mountain Forest and Range Experiment Station; 399-407.
- Marshall, J. T., Jr. 1957. **Birds of the pine oak woodland in southern Arizona and adjacent Mexico.** Pacific Cost Avifauna 32: 1-125.
- Moir, William H. 1992. **Ecological concepts in old-growth forest definition.** In: Kaufmann, M. R.; Bassett, R. L.; Moir, W. H., technical coordinators. Old-growth forests in the Southwest and Rocky Mountain Regions: proceedings of a workshop. USDA Forest Service. Gen. Tech. Rep. RM-GTR-213. Ft. Collins, CO: Rocky Mountain Forest and Range Experiment Station; 18-23.
- Moir, William H. 1995. **Persistence of uncommon cryopedic plants in the Chiricahua Mountains spruce forest island.** In: Debano, L.F; Edminster, C. B.; Ffolliott, P. F.; Gottfried, G. J.; Hamre, R. H.; Ortega-Rubio, A., technical coordinators. Biodiversity and management of the Madrean Archipelago: The Sky Islands of southwestern United States and Northwestern Mexico. USDA Forest Service. Gen. Tech. Rep. RM-GTR-264. Ft. Collins, CO: Rocky Mountain Forest and Range Experiment Station; 214-218.

- Moir, William H.; Benoit, Mary Ann; Geils, Brian; Sculock, Dan. 1997. **Ecology of the southwestern ponderosa pine**. In: Block, W. M.; Finch, D. M., technical coordinators. Songbird ecology in southwestern ponderosa pine forests. USDA Forest Service. Gen. Tech. Rep. RM-GTR-292. Ft. Collins, CO: Rocky Mountain Forest and Range Experiment Station, 3-27.
- Moir, William H.; Dieterich, John H. 1988. **Old-growth ponderosa pine from succession on pine-bunchgrass habitat types in Arizona and New Mexico**. *Natural Areas Journal* 8: 17-24.
- Moody, Ron; Buchanan, Les; Melcher, Ron; Wistrand, Hunter. 1992. **Fire and forest health**. USDA Forest Service. Albuquerque, NM. Southwestern Region; 23p.
- Pyne, Stephen J. 1996. **Nouvelle Southwest**. In: Covington, W. W.; Wagner, P. K., technical coordinators. Conference on adaptive ecosystem restoration and management: restoration of cordilleran conifer landscapes of North America. USDA Forest Service. Gen. Tech. Rep. RM-GTR-264. Ft. Collins, CO: Rocky Mountain Forest and Range Experiment Station; 10-16.
- Shinneman, D. J., Baker W. L. 1997. **Nonequilibrium dynamics between catastrophic disturbances and old-growth forests in ponderosa pine landscapes of the Black Hills**. *Conservation Biology* 11:1276-1288.
- Swetnam, Thomas W. 1990. **Fire history and climate in the southwestern United States**. In: Krammes, J. S., technical coordinator. USDA Forest Service. Gen. Tech. Rep. RM-GTR-191. Ft. Collins, CO: Rocky Mountain Forest and Range Experiment Station; 6-17.
- Swetnam, Thomas W.; Baisan, Christopher, H.; Caprio, Anthony C.; Brown, Peter M. 1992. **Fire history in a Mexican pine-oak woodland and adjacent montane conifer gallery forest in southeastern Arizona**. In: Ffolliott, P. F.; Bennett, D. A.; Gottfried, G. J.; Hernandez, V. M. C.; Ortega-Rubio, A. H., technical coordinators. Ecology and management of oak and associated woodlands: perspectives in the southwestern United States and northern Mexico. USDA Forest Service. Gen. Tech. Rep. GTR-RM-218. Ft. Collins, CO: Rocky Mountain Forest and Range Experiment Station; 165-173.
- Villanueva-Diaz, J.; McPherson, Guy R. 1995. **Forest stand structure in mountains of Sonora, Mexico and New Mexico, USA**. In: DeBano, L.F.; Edminster, C. B.; Ffolliott, P. F.; Gottfried, G. J.; Harare, R. H.; Ortega-Rubio, A., technical coordinators. Biodiversity and management of the Madrean Archipelago: The Sky Islands of southwestern United States and Northwestern Mexico. USDA Forest Service. Gen. Tech. Rep. RM-GTR-264. Ft. Collins, CO: Rocky Mountain Forest and Range Experiment Station; 416-423.
- Warshall, Peter. 1995. **The Madrean Sky Islands Archipelago: A planetary overview**. In: DeBano, L.F.; Edminster, C. B.; Ffolliott, P. F.; Gottfried, G. J.; Hamre, R. H.; Ortega-Rubio, A., technical coordinators. Biodiversity and management of the Madrean Archipelago: The Sky Islands of southwestern United States and Northwestern Mexico. USDA Forest Service. Gen. Tech. Rep. RM-GTR-264. Ft. Collins, CO: Rocky Mountain Forest and Range Experiment Station; 6-18.
- White, A. S. 1985. **Presettlement regeneration patterns in a southwestern ponderosa pine stand**. *Ecology* 66: 589-594.
- Woolsey, Theodore S. Jr. 1911. **Western yellow pine in Arizona and New Mexico**. Bulletin 101. Washington DC: USDA Forest Service; 64p.