THE HISTORICAL ROLE OF FIRE AND ECOSYSTEM MANAGEMENT OF FIRES: GILA NATIONAL FOREST, NEW MEXICO

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ABSTRACT

Prescribed natural fire has been a part of resource management on the Gila National Forest since 1975. The early management plan was conservative and allowed for fire only after the summer rains had become well-established. Recently, in an effort to allow for more aggressive fuel reduction and habitat restoration, the management plan was revised. The new plan takes into consideration the role of fire in ecosystem management and how past natural fires played a critical role maintaining habitats for the native flora and fauna over the 1,335,490 hectares (3,300,000 acres) of the Gila National Forest.

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INTRODUCTION

Planning for the future has involved learning from the past. Prior to European settlement, aboriginal people occupied the lands that are now the Gila National Forest. These inhabitants left their paintings and etchings on steep canyon walls and rock outcrops. Many of these areas are still considered sacred today.

Nature has also left a record of past events in the Southwest. The history of fire is recorded in the tree rings of conifers. This record indicates that fire has been a major factor in shaping and maintaining the Southwest. It is estimated that fire frequencies in ponderosa pine (*Pinus ponderosa*) forests occurred about every 3 years (Swetnam and Baison 1996). Although cultures prior to European settlement used fire to benefit their hunting or agriculture, it is still believed that natural fires were the driving force in forest fuels maintenance. This is further supported by the fact that the Southwest receives some of the highest rates of lightning strikes of any place on earth (Swetnam and Baisan 1996). Fire was also the main source of nutrient cycling in an area where low humidities would make breakdown by other means, such as fungi, too slow to keep up with annual fuels production. Because of the strong evidence for frequent, low-intensity fires, many organisms found within the watersheds of the Gila National Forest are dependent on fire.

The Gila National Forest in southwest New Mexico is comprised of 1,335,490 hectares (3,300,000 acres), including 356,130 hectares (880,000 acres) of wilderness. The Gila Wilderness has been managed as such since 1924 and is considered the first wilderness area in the National Forest System. The Gila Wilderness was set aside 40 years prior to the passage of the Wilderness Act of 1964. Elevation ranges from 1312 meters to 3323 meters (4,300 to 10,895 feet) above sea level.

Vegetation on the Gila National Forest include spruce-fir (*Picea* sp. and *Abies* sp.) and mixed conifer forests along the Black Range and Mogollon Mountains with ponderosa pine the primary species near 2135 meters (7,000 feet). A mixed woodland of evergreen oak, pinyon pine (*Pinus edulis*), and juniper (*Juniperus* sp.) is found below 1983 meters (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 developed 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 resulted in very few acres that were burned. Since 1975, the forest average was 452 hectares (1117 acres) while the average for the last 10 years has been 275 hectares (681 acres), (records on file, Gila National Forest). It was calculated that the forest would have to burn approximately 40,470 hectares (100,000 acres) each year to maintain a 10-year cycle in the ponderosa pine forest.

PLAN DEVELOPMENT AND FIRE HISTORY

Forest and woodland conditions in the Southwest are very different today than they were prior to 1890 (Figure 1). Tree densities were significantly lower at the turn of the last century. (Baisan and Swetnam 1990, Ful and Covington 1994, 1995, 1996, Barton 1995, Caprio and Zwolinski 1995, Grissino-Myer et

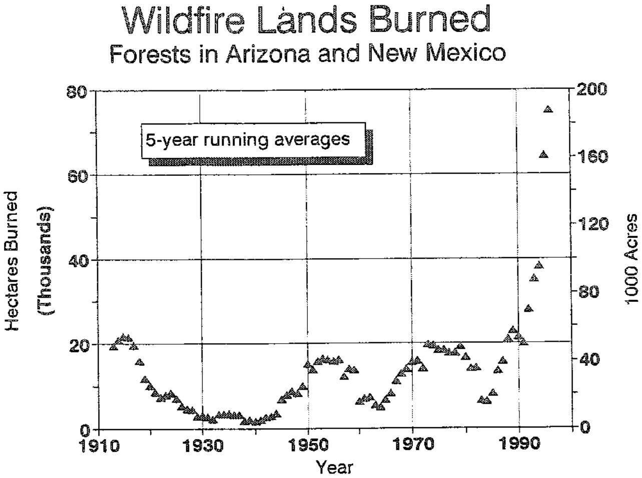

Fig. 1. Boucher and Moody (data from Regional Office, USDA Forest Service, Southwestern Region).

al. 1995, Villanueva-Diaz and McPherson 1995). Fires of the past were frequent and of low intensity. Heavy livestock grazing coupled with fire suppression have allowed fuel loads to increase. Fires today are larger, and more destructive than they were in the recent past (Harrington and Sackett 1990, Swetnam 1990, Covington and Moore 1994, Sackett et al. 1994). The trend in large stand-replacement fires has undergone a sudden increase since 1990 (Figure 2).

The Gila National Forest set out to develop and implement a plan that would allow fires to return to a functional role. It was recognized that any attempt at true ecosystem level management without the use of natural fire was not feasible. The forest planned to allow fires to burn during the spring and early summer periods to more closely resemble historical conditions. Forest officials hoped that this would aid in meaningful fuels reduction and return some stands to a more open presettlement condition.

Forests of the past, prior to domestic grazing and fire suppression, were more open than they are today on the Gila National Forest. Because of the changes brought on by European settlers, trees replaced grasses and forbs on many sites. Topsoil was lost as a result of the unprotected surface as conifer species took advantage of water and nutrients at a deeper level than forbs and grasses could reach (Baker et al. 1994, Carrara and Carroll 1979, Covington and Moore 1994, Sackett et al. 1994). To accomplish the fire plan revision, the public had to be convinced that the present watersheds on the Gila and throughout the West were vastly different than those encountered by early settlers at the turn of the last century, and this change was leading to more destructive fires. The perception of many who now live in the Southwest is that conditions have not changed over the last 100 years. Photo documentation, in particular the use of historic photo retakes, proved to be most helpful. These photo pairs showed clearly that the number of trees on a given site, at the turn of the last century, was far lower than they are today. They also provide evidence of heavy forage use by grazing ungulates. Many people were

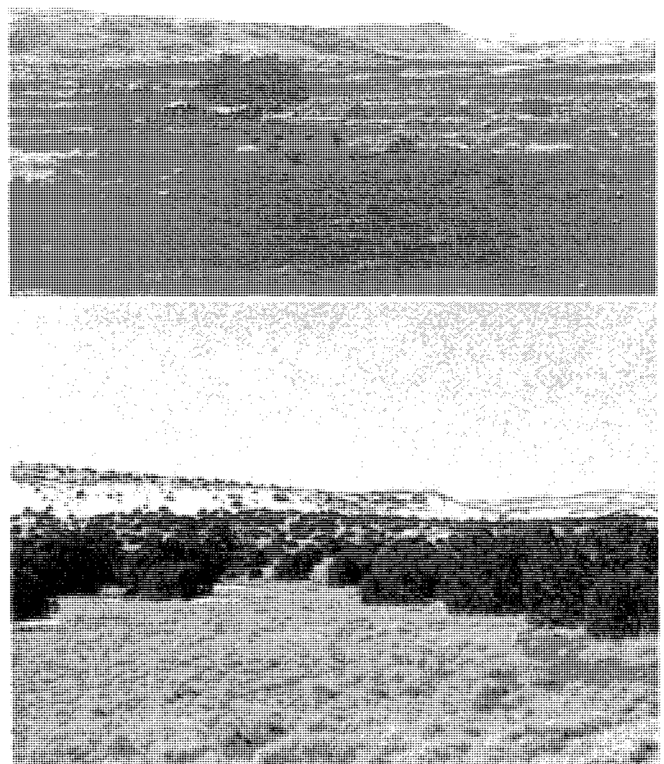

Fig. 2. Photo point in northern Arizona pinyon-juniper woodland, top photo taken in 1901 (photographer unknown); bottom photo taken in 1988 (photograph by P. Boucher).

unaware that vegetation types and conditions could change in such a short period of time. Although people 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.

Changes can take place in a short period of time, as noted by historic photos. Many areas of the Southwest have been changed from an open savanna to a closed canopy forest and woodlands (Johnson 1994). Livestock grazing removed the forage base of fine fuels, and thus eliminated the ability of fire to spread. Therefore, fires could no longer eliminate the many seedlings that would germinate each year. This has resulted in a dramatic shift in the local biodiversity as savanna-adapted species gave way to plants tolerant of closed canopy forests and woodlands. Topsoil that was once covered by desert grasses and forbs was lost (Baker et al. 1994, Carrara and Carroll 1979). Exposed bare rock has increased the runoff from severe summer storms, and caused damage along fragile riparian corridors.

The Madrean Sky Island Archipelago, which includes parts of the Gila National Forest consists of many isolated mountain ranges. These mountains are important centers of biological diversity due to 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 accumulation. These fires are likely to continue without meaningful fuels reduction. If they do continue, they could have far-reaching effects on the local biota (Felger and Wilson 1995, Fulé and Covington 1994, Barton 1995, Caprio and Zwolinski 1995, Ganey et al. 1996, Grissino-Mayer et al. 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 extinctions of isolated, unique populations of plants and animal species or even subspecies is now more than ever a real threat (Moir 1995).

PLAN DEVELOPMENT AND PUBLIC INFORMATION

During the development of the expanded prescribed natural fire plan, the Gila National Forest personnel took into consideration the two most important factors that shaped the conditions of the southwestern watersheds, historical livestock grazing, and aggressive fire suppression.

Documenting the results of historic fires was an important factor in the revised plan. The Gila Wilderness was established in 1924. Fortunately, some remote areas within the wilderness had burned five times over the last 100 years. The reason for this was the difficulty of getting fire fighting personnel into the remote sites. These areas provided insight about past vegetation conditions. Many ponderosa pine stands in these areas consist of majestic trees with a continuous understory of bunchgrasses. This information was helpful in developing objectives for future conditions.

Most of the fires of the past were understory burns. These fires burned through stands and consumed small seedlings, while reducing pockets of woody debris. The end result, historically, was a ponderosa pine forest of even-sized trees capable of surviving frequent, low-intensity fires. Today, fires in these wilderness areas still remain small, sometimes burning for up to two weeks. Generally after that point, they will experience exponential growth in area burned to the point so that after a month and a half, many thousands of acres have burned. And even though they are called prescribed natural fires, they behave just like wildfire. We have found that committing to a PNF is a full time job. They will burn until a significant moisture event occurs.

Convincing the public that many different fires could be burning in the Gila National Forest was a major task. Frequently, the forest is under campfire and smoking restrictions during the hot dry periods of May and June. This could be the same time the forest has allowed a lightning-ignited fire to burn. An example of this took place during summer of 1995. The HB Fire on Eagle Peak was declared a wildfire after detection, and suppression actions were taken. At the same time, the Bonner fire in the Aldo Leopold Wilderness had grown to 11,330 hectares (28,000 acres) and was a prescribed natural fire. In addition, the Sprite Fire within the Gila Wilderness, because of logistics and personnel shortages, was declared a "confine" strategy wildfire. A confine strategy is where the fire will be controlled as weather conditions change. A further complication came when the Rhett Fire (a prescribed natural fire) crossed the state line from the Apache Sitgreaves National Forest in Arizona. With so many different tactics occuring at the same time, it often confuses the public.

It is important for the Gila to keep the public informed about the fire program and the reasons behind the decision to use fire as a management tool. Some groups feel that we should now let all fires burn. Others are still reluctant to use fire at all and would rather we remained in the business of total suppression.

There are additional areas of consideration that forest personnel have to deal with while making decisions as they relate to fire. These are clean air, clean water, cultural resources, and endangered, threatened and sensitive species. These concerns were not a major factor at the time of the first plan. Issues like the Clean Air Act come into play when smoke problems arise after a fire attains a certain size in conjunction with early morning inversion. An example of this was the Torres prescribed natural fire during the fall of 1995. Because of continued smoke within the Silver City airshed, the State Environment Division requested that the forward spread of this fire be halted.

Other problems arise after a typical high-intensity rain event hits a freshly burned watershed during the start of the summer monsoon. The effects on water quality have taken center stage through the implementation of the Clean Water Act. An example of this was the ash flow that entered the East Fork of the Gila River after the Bonner prescribed natural fire. Historic and prehistoric cultural resources are widespread throughout the Gila National Forest and influence every ignition. And even though the Endangered Species Act was a factor in 1975, it has truly become a focal point with some noteworthy new additions to the list including the spotted owl (*Strix occidentalis*).

The forest had to get public and media support for the program. Historically, the media has been involved with wildfire because of the interest it has with the public. This interest is centered around the threats fire poses to life and property. Many people seem to thrive on tales of disaster, burning houses and, in some cases, loss of life during fire fighting efforts. Prescribed fires, on the other hand, burn with less intensity and are designed to eliminate many of the traditional threats. The major complaint of a prescribed fire at present is the smoke. The public often times is very supportive of the program during the planning phase, but will often turn against it after several days of smoke in their community.

Aspen (*Populus* sp.) is a component of the higher elevation mixed conifer forests in the Southwest. The public overwhelmingly supported aspen as a stand component when comments were solicited for the Forest Land Management Plans. Unfortunately, when people are told that aspen is a result of fire, support is lost. Public sentiment has waxed and waned over the years in favor and against natural fires, depending upon the types of smoke and water quality problems that they have been exposed to in the past. Gila National Forest fire information personnel have found through experience, that the public will tolerate smoke for about 20 days. After that length of time they don't care what the benefits are, they want the fire suppressed. The future of the program depends on close communication with the communities involved. It may also depend on allowing fires to burn toward the end of the spring-summer fire season when the probability of summer moisture is high. This direction, however, would move us back to the level we were in during the 1975 plan.

WHERE DO WE GO FROM HERE?

Large ponderosa pine with basal fire scars are still common within the Gila and Aldo Leopold Wildernesses. These fire scars have given researchers an excellent record of past fire history (Swetnam 1990). Because of suppression activities outside of wilderness, fires no longer scorch the base of these trees. As a result, many of these scars have closed as the trees continue to grow. These closed scars should also be a warning sign to resource managers throughout the West. As the trees continue to grow and cover over the old burn marks they indicate that fire has been eliminated from the system. The result has been a steady increase in high-intensity, stand-replacement fires (Baisan and Swetnam 1990, Ful and Covington 1994, 1995, 1996, Barton 1995, Caprio and Zwolinski 1995, Grissino-Mayer et al. 1995, Villanueva-Diaz and McPherson 1995).

What managers are faced with at present is indeed an area of concern. Fuels continue to accumulate, and fires continue to grow in size and intensity. Current trends indicate that the Southwest has a narrow window of opportunity to reduce fuels on our forest lands. Research predicts that fires are going to increase in intensity and acres burned if current trends continue (Swetnam 1990). The situation may get to the point that, regardless of the amount of personnel and money spent on suppression, fires are going to be difficult to control without seasonal change; i.e., rain or snow. Additionally, the cost to the taxpayers to suppress fires during this current decade has been enormous.

A good case study of those predictions is the Rattlesnake Fire of 1994 that was located in the Chiricahua Wilderness on the Coronado National Forest. Because of the number of large fires throughout the West, resource shortages were widespread. Crews necessary for containment of this fire were unavailable, and for the better part of 3 weeks the fire did just about what it would have done had no personnel been assigned to control the blaze. The cost to suppress this fire was approximately $7,600,000 (data on file, Region 3 Office, Albuquerque, NM). In contrast, the Bonner Fire (June-July 1995) in the Aldo Leopold Wilderness of the Gila was managed as a natural fire. Both fires eventually reached approximately the same size 11,330 hectares (28,000 acres), and both fires were extinguished by rain. However, the total cost for the Bonner Fire was $100,000 (data on file, Gila National Forest Supervisor's Office, Silver City, NM). The funding for PNF is limited by the budget on each forest. Wildfire suppression budgets at present are virtually unlimited.

The Rattlesnake Fire incurred some additional costs. When flames reached the top of the ridge behind Rustler Park, they were 240 meters (800 feet) in length. The fire was burning in pure ponderosa pine at that point. The smoke column was over 15,250 meters (50,000 feet). The amount of particulates produced by the fire storm most likely violated the Clean Air Act. Because the fire destroyed some stands of mixed conifer, it destroyed habitat for the spotted owl, a listed threatened species. This is a violation of the Endangered Species Act as it relates to destruction of a species habitat or the killing of a listed species. The fire was also responsible for the loss of rare plant habitat (Moir 1995). The amount of ash that was washed into South Fork Creek after the first rain event likely violated the total mean daily load restrictions of the Clean Water Act. All of this was acceptable because the Rattlesnake was a declared wildfire. Had this fire been declared a prescribed natural fire, all of the above mentioned laws would have come into play. It is interesting to note that the Rattlesnake Fire would have been within the prescription parameters of the expanded Gila National Forest Fire Management plan. This assessment is based on the burn intensity and percent age of canopy removal in all vegetation types.

I used the Rattlesnake Fire as an example of how far we have come, and how far we still have to go. It shows the challenges we face as we attempt to accomplish fuel reduction using fire. Many of the laws passed to protect the environment may appear to hamper efforts to use fire as a management tool. We have found that this is not the case. These laws strengthen our decision by helping us to take into consideration all possible known consequences of our actions. The Rattlesnake Fire is similar to many fires that have occurred on the Gila.

Each ignition poses different challenges. Every ignition is different and conditions change daily, if not hour by hour. Burn intensities need to be closely monitored to help ensure that we are meeting our objectives. The public needs to be aware that this powerful force will sometimes leave undesirable conditions on the watershed. This will happen as a result of a drying trend or wind condition brought on by a change in the weather. The forest must try to manage within the parameters of the natural system. This will involve burning during those times of the year that historical fires burned. We will also have to acknowledge the uncertainty involved with fire and that it will not always work the way we would like and that there is risk involved when working with this natural force. The eventual outcome, it is hoped, will be a return to a fire cycle that will more closely mimic the past.

The Gila National Forest is in a unique position. Other forests in the Southwest are adjacent to major urban areas. The center of the Gila National Forest is more than 160 kilometers (100 miles) from El Paso, Texas to the southeast and Albuquerque, New Mexico to the northeast, the directions smoke would normally drift. Other forests have limited opportunity to burn because of smoke issues. The Gila National Forest, because of its isolation, has been able to develop and implement an expanded prescribed natural fire plan. The large wilderness areas have benefited from frequent fires. It is anticipated that future fires will produce less smoke and ash runoff as fuels are reduced and grasses and forbs return as the understory component. The Gila National Forest through the Challenge Cost Share Program has undertaken research projects to monitor the effects of fire on air quality, watershed conditions, and water quality. Finally, we are learning as we implement. It is not practical to assume that we could ever return the watersheds on the Gila National Forest to the condition they were in presettlement times. We do feel, however, that with the implementation of this expanded plan on the Gila National Forest we will limit the intensity and severity of future fires.

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