Historical Fire Occurrence in Remote Mountains of Southwestern New Mexico and Northern Mexico

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It has long been held that ponderosa pine forests in the Southwestern U.S. were not subject to crown fires in the pre-settlement era (around 1880). Many authors, including Leopold (1924), Weaver (1951), and Cooper (1960) have convincingly argued this point; they have also discussed the negative consequences of withholding fire from these forests, such as an increasing hazard of stand-replacing crown fires due to excessive accumulation of live and dead fuel. However, it may be that mountainous areas with sharp relief and low lightning ignition rates or poor fuel continuity tend toward unstable disturbance regimes; they may experience an increased incidence of stand-replacing fires in forest types which would not typically support such events. Plant communities in such areas may be relatively transitory compared to communities in areas comprised of large homogeneous blocks and gentle topography. The Basin and Range Province of southern Arizona/New Mexico and northwestern Mexico is populated by numerous isolated mountain ranges of varying size and topography. Fire regimes in these ranges have been little studied and may not be adequately characterized by current models of surface fire versus crown fire regimes.

This paper presents preliminary results and implications of ongoing fire-history research in the borderlands region of southwestern New Mexico and southern Arizona and in the Mexican States of Chihuahua and Sonora. The objective of this study is to document and compare fire regimes in paired island mountain ranges on both sides of the international boundary, a sparsely populated region where fire control has had limited impact. In the first phase of this work we collected and analyzed 68 fire-scarred sections from the Animas Mountains in New Mexico. Results of previous work in the Sierra de los Ajos of Mexico are presented for comparison.

SITE DESCRIPTION

The Animas Mountains, rising to 2,634 m, extend over a 100-square-kilometer area in the Gray Ranch of southern Hidalgo County, NM (Fig. 1). The mountains' proximity to both the Sierra Madre and the Southern Rockies has resulted in a floristically diverse vegetation comprised of both northern and southern elements. Mixed conifer stands similar to those of the Southern Rockies grade into oak-pine forest, oak woodlands, and savannah typical of the Sierra Madre. Topographic complexity interacting with the fire regime has resulted in a mosaic of plant communities largely determined by aspect and elevation with only relatively mesic canyons and northeast facing slopes supporting well-developed coniferous forest. Chaparral, oak scrub, and stands of pinyon-juniper are found on the drier aspects. Foothill areas support grassland and oak savannah. A lightning fire in the second half of June 1989 (the driest year in this area since 1956) burned unrestricted for most of a week and spread over 11,000 ha of the Animas range before it was halted by suppression efforts.

The Sierra Ajos are an isolated mountain range in northern Sonora, Mexico. They rise above 2,600 m and the upper elevations support coniferous forest. The fire chronology presented here was developed from a pine stand near the center of the range. Planned collection efforts will update and extend this chronology.

METHODS

For this portion of the study, 68 fire-scarred cross sections and numerous increment cores were collected in the Animas range. Sections were primarily collected from dead material: logs or snags. A limited number of living trees were sampled by removing partial wedge sections as described by Arno and Sneck (1977). All samples were surfaced to a high polish for examination with a binocular microscope; calendar dates and a seasonal designation were assigned to fire events (Baisan and Swetnam 1990). Fire dates were compiled into a master fire chronology in order to examine their spatial and temporal distribution. Results of the previous study in the Sierra Ajos (Swetnam 1983) were re-compiled and analyzed as well.

RESULTS AND DISCUSSION

The reconstructed fire history of the Animas Mountains (Fig. 2) provides unique insights into the interaction of fuels, vegetation, topography, and land use history in the regulation and perpetuation of fire regimes on an isolated mountain range. Based on dendrochronological (tree-ring) dating of remnant snags and logs in some of our sampled stands, we hypothesize that patchy, stand-replacing fires, similar to the 1989 fire, also occurred in 1707, 1805, 1825,

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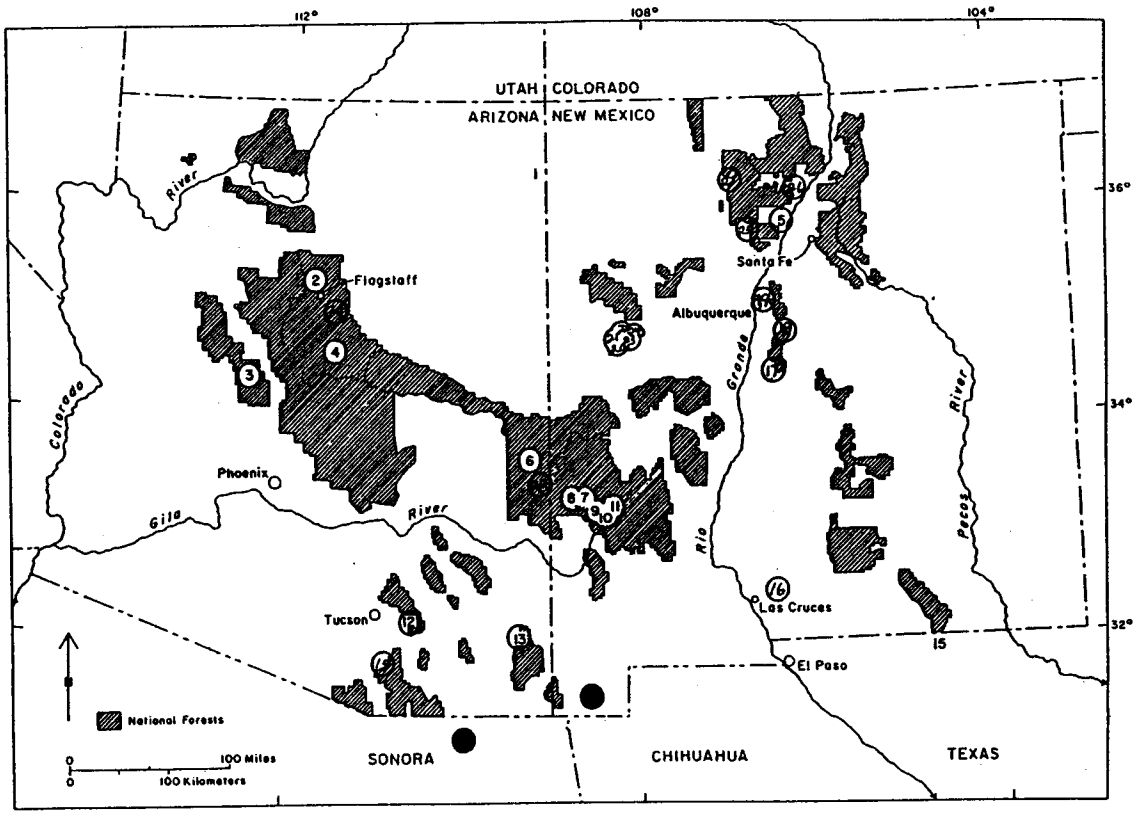

Figure 1—Map of fire history collection sites in Arizona, New Mexico, and northern Mexico. The Animas Mountains and the Sierra Ajos are marked with black dots.

1857, and 1879. Lack of old-appearing individuals in the current canopy of some stands suggests that they regenerated following these events. Portions of these stands sustained crown fire in 1989. A concurrently funded companion study of stand structure may provide additional data for testing this hypothesis.

The Forest Service had jurisdiction of the Animas Mountains from approximately 1909 to 1957. This is clearly evident in the fire chronology as a period of reduced fire activity. Also note the return of spreading fires in 1959, just two years later. Although the lower slopes, grassland, and to a limited extent the high country, have been grazed, probably since the 1890's, it is not clear what impact this land use has had on the fire regime as distinct from the active fire suppression practiced by the Forest Service.

Lightning ignited a fire on June 15, 1989, in the foothills along the north margin of the Animas Mountains (Smith 1993). The fire burned up into the main body of the range and continued to spread for most of a week before suppression efforts were effective. The fire eventually spread over the northern two-thirds of the range and through the whole array of plant communities from grassland to upper-elevation forests. Fire effects varied from light-intensity surface burn to total destruction of the forest canopy and understory vegetation. The final size exceeded 11,000 ha; the fire continued to burn within the controlled perimeter for more than a month. By 1992 the oak brush and chaparral communities were regenerating vigorously while forested areas, including pine, mixed conifer and pinyon-juniper stands, which experienced canopy destruction, remained denuded except for annual forbs. Soil was eroding on some of the steeper slopes in these areas.

Visual observations of stand structure, combined with dates of death of canopy trees and the reconstructed fire chronology, provide evidence of a mixed surface fire/crown fire disturbance regime for the Animas range. The combination of rugged topography, heterogeneous vegetation (including large areas of oak brush and chaparral which support fires only infrequently), and relatively low ignition rate resulted in relatively long fire-free periods for individual stands. A pattern of infrequent surface fires was evidently punctuated by a canopy-replacement fire in some stands every century or two, especially areas within the interior of the range and those occupying relatively mesic sites. Thus, viewed in historical context, the 1989 fire was not an unprecedented event, but reflected the continuation of a long-term pattern. Although the fire regime of the Animas Mountains was disrupted by a 50-year period of fire suppression, the continued occurrence of surface fires in some stands during this century clearly diminished the overall impact of a fire which occurred during an exceptionally dry year. We suspect that mixed surface fire/crown fire regimes may have occurred in other mountain ranges with similar rugged topography in the Southwestern United States, northern Mexico, and perhaps the Great Basin. Further research may begin to

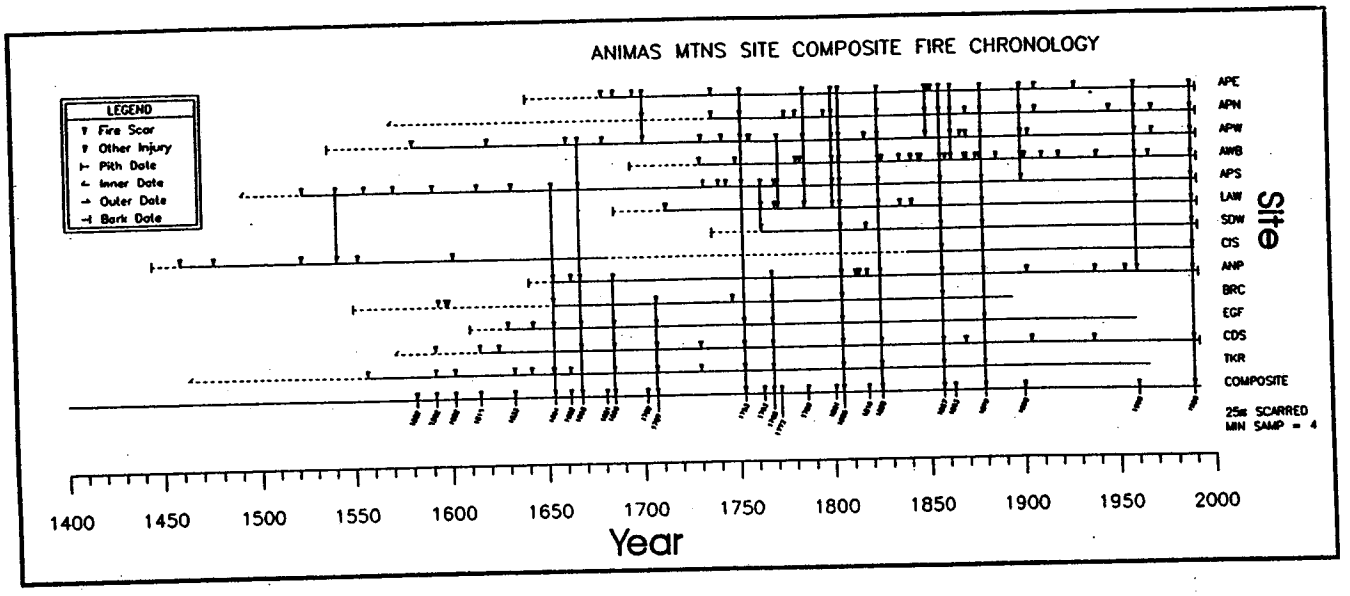

Figure 2—Composite fire chronology chart for the Animas Mountains. Horizontal lines represent sampled life spans of trees at each site, and arrowheads denote fire dates recorded at each site. Note the evidence for episodic spreading fires in the vertical alignment of arrowheads in 1668, 1753, 1805, 1825, and 1879.

clarify and define relationships between fire regimes and landscape factors.

By contrast, the fire regime of the Sierra Ajos has not experienced the disruptive influences of fire control and intensive grazing (Fig. 3). The uninterrupted occurrence of fires during this century is not found north of the border except in a few areas completely isolated from management and utilization. Additionally, the fire regime at this site is more representative of those typically studied in the ponderosa pine type. The mean fire interval here was 5.4 yr, well within the range reported for ponderosa pine in the Southwest. Ongoing work will more completely characterize the range of variability in this location and determine whether this stand is representative of this mountain range.

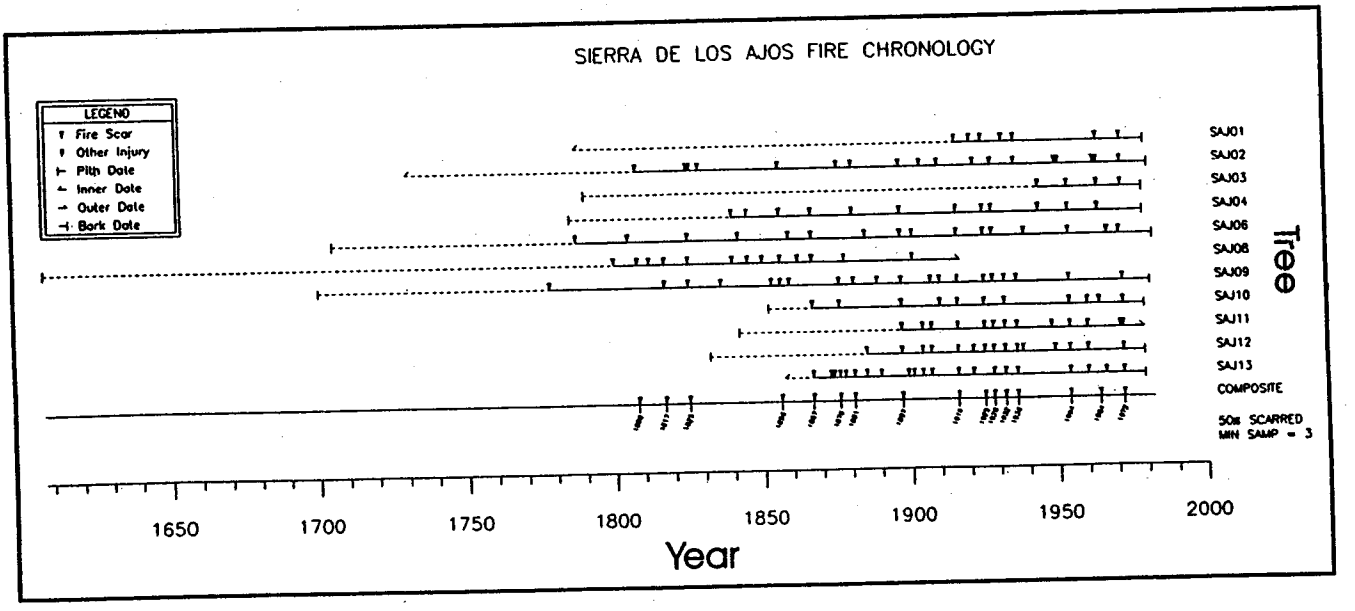

Figure 3—Fire chronology chart for the Sierra de los Ajos. This mountain range is 30 km south of the United States-Mexico border. Fire frequency here was more typical of southwestern pine forests, but the continuous history of episodic fires throughout the twentieth century is rarely observed on the northern side of the border. Nearly all Southwestern United States surface fire regimes were initially impacted around the turn of the century by intensive livestock grazing, and subsequently, fire suppression (see papers by Touchan and Swetnam, and Grissino-Mayer and Swetnam).

SUMMARY

The Animas Mountains appear to have maintained a meta-stability resulting from this mixed surface/canopy fire regime for at least the past four to five centuries. Although individual stands of conifers and shrubs were intermittently destroyed by crown fire, in the larger context of the mountain range, many other stands survived. In between the infrequent, intense fires, lower intensity fires served to reduce fuels in some stands, affording them long-term resistance to crown fires. This example provides hope that the current situation in semi-arid western wilderness areas with large amounts of woody fuels and excessive regeneration due to eight decades of fire suppression can be successfully managed by a strategy of planned ignition under moderate climatic conditions coupled with the tolerance for heterogeneous burning including some canopy loss. This tolerance is a prerequisite for planning and successfully treating any sizeable area (larger than 500 ha), given the reality of budgetary and manpower constraints.

CONCLUSIONS

This historical analysis provides some historical perspective and recommendations for land managers of these rugged, isolated mountain ranges of the Southwest.

- Despite the occurrence of high-intensity fires in the past, the overall community structure of the Animas Mountains appears to be stable; loss of individual stands apparently has not resulted in loss of species or communities.
- Pre-treatment by planned ignition of areas of some reasonable size (larger than 500 ha) will help break up fuel continuity and provide buffering for wildfires occurring under extreme conditions.
- Creating a mosaic of burned and unburned areas may provide sufficient refugia to maintain existing diversity through natural regeneration, even if large wildfires subsequently occur under extreme conditions.

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