AN ABBREVIATED FIRE HISTORY OF THE SOUTHWESTERN UNITED STATES

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Introduction

Fire has been an integral component in the development and maintenance of southwestern U.S. ecosystems. Given the climatic, topographic, and biological diversity of this extensive region, we expect and observe considerable diversity in incidence and intensity with which fires have occurred (Weaver 1974) and the impacts they have imparted on these ecosystems. We define five broad southwest biotic communities, each with historic importance as rangelands, to relate to fire history. Within this context we envision three general fire history eras: 1) natural and pre-European anthropogenic fire contributing to ecosystem development, 2) a period of fire suppression and prevention which began in the late 1800s once Native Americans were extirpated and the region was settled by Anglo-Europeans, and 3) by the 1970s (and in some instances earlier) the reintroduction of fire as an ecosystem management tool.

Principal Biotic Communities

Montane Conifer Forests

Geographically these forests are found on high plateaus and mountains that extend southward from the Rocky Mountains through New Mexico and Arizona and continue into northern Mexico. The Davis Mountains are an example of an isolated range that contains montane conifer forests. Elevations range from 2,000 m to 3,050 m and mean annual precipitation varies from 460 mm to 760 mm. These ecosystems can be subdivided into two major communities based on overstory dominants – a ponderosa pine forest at lower elevations and a mixed conifer forest of Douglas fir, white fir, limber pine, and aspen at higher elevations (Pase and Brown 1994b). Old growth ponderosa pine forests are often park-like, with grassy and herbaceous ground cover (Pase and Brown 1994b). These forests have adapted to frequent periodic burning. There is evidence through tree-ring and fire-scar records that average fire return intervals in ponderosa pine forests can be as low as 6-7 years (Weaver 1974). Grazing by domestic livestock, clear-cut logging, and fire suppression have caused many changes to this forest type (Weaver 1974).

Elevations of mixed conifer forests are generally between 2,450 m and 2,900 m. They are often bordered by more extensive pine forests (ponderosa pine and Mexican white pine) below and boreal spruce-fir forests (true firs and/or Engelman spruce) above (Pase and Brown 1994b). Thorough examination of a montane conifer forest floor usually reveals scattered, suppressed aspen sprouts (Pase and Brown 1994b). This shade-intolerant species increases in dominance once overstory conifers have been removed. Overstocking on recently cutover areas, the western pine beetle depredation of larger pines, growth rate reduction from competition, and an increase in fire hazard are some changes since settlement (Weaver 1974).

Pinyon-Juniper Woodland

This community has been designated as Great Basin conifer woodland by Brown (1994b) and is characterized by unequal dominance of juniper and pinyon. Most of this community is found at elevations between 1,500 m and 2,300 m with annual precipitation from 250 mm to 500 mm. One of the most far-reaching communities in the southwest, this woodland is centered in the Great Basin. Some dominant junipers include Rocky Mountain juniper (higher elevations), Utah juniper, red berry juniper, and oneseed juniper (west Texas, central and southern New Mexico, and southern Arizona). Rocky Mountain pinyon is the most common throughout the southwest. In the far west of this community, Rocky Mountain pinyon is replaced largely by the single needle form. Within the Great Basin, habitats tend to be rocky, and big sagebrush is the dominant understory plant. Further east of the Great Basin, habitats are characterized as savanna-like with a dominant understory of grass. Greatest growth in this community is achieved on mesas, plateaus, slopes, and ridges (Brown 1994b). Within the Trans-Pecos of Texas, Mexican pinyon, papershell pinyon, and red berry juniper are dominant overstory species. Fire has likely been an important factor in the interplay of open grassy areas and the more closed-canopy representations of this community.

Oak Woodland

Evergreen oak woodlands occupy several million hectares in the southwestern U.S. and northern Mexico (McPherson 1992). Brown (1994c) designates this community as Madrean evergreen woodland. This habitat may also be known as pine oak woodland, pinyon-juniper-oak woodland, and/or Mexican oak-pine woodland. It is centered in Mexico and stretches north to the mountains of southeastern Arizona, southwestern New Mexico, and Trans-Pecos Texas (Brown 1994c). The canopy is an unequal proportion of evergreen oaks, deciduous oaks, alligator juniper, oneseed juniper, and Mexican pinyon. Precipitation usually exceeds 400 mm, with 200 mm or more falling between May and August (Brown 1994c). Oak woodlands are very diverse and are generally more open at lower elevations. Some anthropogenic uses of these woodlands include livestock grazing, recreation, and firewood harvest.

Interior Chaparral

Chaparral is the term applied to the broad-sclerophyll (hard, leathery, evergreen foliage) scrub or brushland dominated by many species belonging to unrelated genera (Biswell 1974). Woodland-grass chaparral, as defined by Biswell (1974), is considered successional in development and most closely matches the Interior Chaparral community defined by Pase and Brown (1994a). This habitat was subjected to frequent fires and was originally maintained as grassland. With the onset of fire suppression, shrubs increased in density and converted to a chaparral vegetation cover (Biswell 1974). Mean annual precipitation in this community ranges from 380 mm to 635 mm. Most precipitation falls during the summer monsoon, which often follows dry springs. Mature stands are between 1 m and 2-2.5 m in height and have dense crowns. These features make areas of chaparral very susceptible to fire (Biswell 1974). Some adaptations to fire include seed production within 5 years post-fire, a plant's ability to stump-sprout, and high flammability. Most species sprout readily and quickly regenerate for about 15 years after burning (Biswell 1974). Slowed growth after this time suggests a fire return interval of around 15 years may be necessary to maintain this habitat (Biswell 1974). Lower elevation interior chaparral sites were primarily used for grazing by domestic livestock, especially between 1880 and 1920 (Pase and Brown 1994a).

Grasslands

The most extensive grasslands in the Southwest fall under the divisions of cold-temperate and warm-temperate grasslands as defined by Brown (1994a). Subdivisions under these categories include: 1) montane meadow grassland, 2) plains and Great Basin grassland, and 3) semidesert grassland. Montane meadow grasslands are found in natural, flat openings of montane conifer forests where, on poorly drained soils, forbs are more dominant than grasses (Brown 1994a). The plains grasslands (from the northeast) and the Great Basin grasslands (from the northwest) reach their southern limits in the American Southwest. There is a large area where these two grassland types overlap. The most obvious difference among them is their mean annual precipitation. The plains receive between 300 mm and 460 mm annually whereas the Great Basin receives between 180 mm and 300 mm. Most of the plains, considerably altered by grazing, are composed of mixed or short-grass communities, and dominant grasses are perennial sod-forming species (Brown 1994a). Palatable forbs constitute a small component throughout most of the grasslands (Brown 1994a). The third subdivision, semidesert grassland, is a perennial grass-scrub dominated landscape that adjoins and largely surrounds the Chihuahuan Desert. Annual average precipitation is between 250 mm and 450 mm and elevation ranges between 1,100 m and 1,700 m. Enclosed drainages, within the desert dominated by tobosagrass and sacaton, also constitute semidesert grassland. Reproduction of the perennial bunch grasses is primarily by seed. Heavy grazing has reduced the dominance of these grasses and increased low growing sod grasses, especially in areas of heavy to moderate rainfall (Brown 1994a). The ranges of many shrubs, such as tarbush and creosote, have extended from the desert into the grassland and are replacing native grasses, similar to mesquite encroachment. Two native shrubs, burrowweed and snakeweed, have now replaced grasses on millions of acres (Brown 1994a).

Historical Perspective

The climate of the Southwest changes greatly with elevation. It is arid at lower elevations, semiarid along mountain flanks and rims, and more mesic within higher mountains (Pyne 1982). The Southwest possesses one of the highest concentrations of lightning fires in the world, which results in frequent low-intensity fires (Pyne 1982). Lightning comes with summer storms, and fires are abundant when the monsoon season arrives, usually in July or August. The Mogollon Rim is a geological feature running across Arizona and defines the southwestern edge of the Colorado Plateau. It is known for its stands of ponderosa pine and for the density of its annual lightning fires. Lightning has also been the source of fires in the intermountain grasslands.

Sources of fire are either natural and primeval or cultural and anthropogenic. Artifacts of a paleo-Indian culture of big game hunters possibly dating back 30,000 years have been found in Arizona and New Mexico. This is notable because of all the uses for fire. The most widespread among indigenous cultures is also probably the most ancient – fire for hunting (Pyne 1982). Examples of fire use for hunting include torches for spotlights, smoke to flush wildlife, encircling or driving wildlife with fire, and pasture improvement for domestic and nondomestic animals (Pyne 1982). Broadcast burning was another practice used by Native Americans for purposes such as harvesting firewood, flushing enemies from heavy grass, increasing the ease of travel, and assisting with harvesting certain vegetation. These practices were not uniform in intent or technique, but there were repeated, controlled surface burns on a regular cycle, interrupted only occasionally and during droughts (Pyne 1982).

Native Americans helped cultivate ecosystem development. Periodic fires promoted herbaceous vegetation by reducing debris that may have inhibited growth. Woody shrubs burnt to the ground produce more tender, nutrient-rich shoots. Some types of vegetation (such as quaking aspen and deerbrush) are fire dependent and require fire to regenerate. Recurrent fires assure continued dominance of fire-resistant species, such as ponderosa pine, and gradually reduced snags and wind-felled trees to ash beds, creating seedbeds necessary for seedling establishment while releasing surviving trees from competition which allows increased growth (Weaver 1974). Periodic fires resulted in less intense fires than we witness today.

The records of Native American occupation in the Southwest are abundant with multiple civilizations disappearing and others arising through time. More recently, three groups are distinguished: 1) the Mogollon along the Mogollon Rim, 2) the Hohokam of the desert and riparian habitats, and 3) the Anasazi on the Colorado Plateau. The next peoples to occupy this region were the Spanish from the south and the Athebascan-speaking people (Navajos and Apaches) from the east. Within 300 years of the Spanish arrival, the Apache became sovereign residents (Pyne 1982). Here they preserved an economy of hunting, gathering, and semi-nomadism, which included the use of broadcast fire, and began to stalk domesticated animals introduced by the Spanish. Apache raids were so widespread that they depopulated portions of the Southwest, retarded Spanish settlement, and kept livestock herds from overgrazing for nearly 300 years (Pyne 1982). Because Native Americans recognize their natural and cultural past and continually try to preserve it, Pyne (1982) asserts that anthropogenic fires have played a large role in shaping the environment that was described during the time of European discovery.

Changes in the Last 200 Years

The adoption of Native American fire practices by frontiersmen was short-lived. The Apaches were subdued in the late 1870s permitting mining and livestock interests to expand over what had been their former lands. Livestock reached unprecedented numbers by the 1880s (Pyne 1982), and the conservation movement began in North America in the late nineteenth century. Several causes contributed to the influx of settlers in the Southwest. Land laws were reformed, which helped close the open range. Military forts, Indian reservations, and mining camps created a market for goods and services. Landscapes were cleared for farming, ranching, and mining purposes using light burning. These fires frequently grew large and often involved the loss of lives and structures, primarily because there were inadequate means to control fires (Martin and Sapsis 1995). These conflagrations led people to believe that they needed to control fires. Timber became more important at the beginning of the 1900s and forestry professionals claimed that any fire in the forest was bad (VanWagtendonk 1995). The suppression period, along with prevention efforts, began around 1910 and lasted about 50 years. The campaign against fire often took on aspects of a religious crusade, labeling fire as evil (Martin and Sapsis 1995).

Overgrazing in the early 1900s, a practice used to reduce fire hazard and promote savannah like tree distributions, helped to prevent fires, which led to brush encroachment (Wright and Bailey 1982) in various communities in the Southwest. Fire suppression and grazing (among other factors) seems to have accelerated a general trend towards decreased grass cover, increased soil erosion, and increased shrubbiness (Keller 2005). When it was established in 1905 the Forest Service had a strict policy of fire exclusion. The remoteness of national forests created by the Land Revision Act of 1891 led to unsuccessful experiments in the 1920s with "take a chance" fire management policies, but subsequently resulted in a national drive for better initial fire attack in the backcountry (Pyne 1982). Increased success in fire control on the public domain occurred when cattle replaced sheep and goats. The consequence of these actions was a dramatic increase of woody vegetation and an associated decline of the semidesert grassland over the entire region. Exotic plant species more easily invaded landscapes with altered fire regimes and may have simultaneously inhibited native plant growth (Wolf 2008).

The reemergence of the Apache in fire history of the Southwest was in part the product of the Bureau of Indian Affairs (BIA) creation of a forestry branch in 1910 (Pyne 1982). In 1934 the practice of conservation in forest and range management was made mandatory through the Indian Range Management Act. In 1948, the BIA, under the direction of Harold Weaver (southwest area forester), began an official broadcast burning program on reservations in the region, and by 1952 approved controlled burning as a suppression measure (Pyne 1982).

The ranch and game range burning program was created to improve forage for livestock and habitat for wildlife. It was active in the 1940s and 1950s, but as more homes were built on adjacent wildlands, concern about the liability for an escape increased and the program deteriorated (VanWagtendonk 1995). The Forest Service conducted broadcast fire experiments along the Mogollon Rim between 1950 and 1958. They concluded that in comparison with intensive silvicultural practices, the value of fire was marginal (Pyne 1982). As long-term effects of overgrazing and fire control became apparent, many parties wanted some form of prescribed fire put onto the land.

Dawn of A New Era

In 1962, the Department of the Interior asked Dr. Starker A. Leopold, the son of Aldo Leopold, to head a committee to examine wildlife management concerns in the National Parks. The Leopold report (1963) recommended that fire should be included in ecosystem management, and this was incorporated into National Park Service policy in 1968 (VanWagtendonk 1995). The change in policy allowed fires to run their courses as long as they stayed within a prescription (VanWagtendonk 2007). The next nine years are referred to as the experimental years. Multiple national parks began establishing natural fire management programs, and the Forest Service soon followed. In 1978, Forest Service national policy changed to encompass total fire management including fire use (VanWagtendonk 1995). Between 1978 and 1988 three events occurred which contributed to a major policy review in 1989. The first event was the Ouzel fire in Rocky Mountain National Park in 1978. After burning in a low risk zone for more than a month, it threatened a community outside the park's boundary. After it was controlled, a review board criticized the park and suspended its fire program pending revision (VanWagtendonk 2007). Second, in 1988, a $120 million fire season consumed 562,310 ha, 67 structures and killed a firefighter in the greater Yellowstone area (Schullery 1989). Third, also in 1988 in the Lewis and Clark National Forest, a fire that had been allowed to burn escaped the Bob Marshall Wilderness area and burned more than 100,000 ha. This fire did not receive much media coverage because most of the attention at that time was on Yellowstone National Park (VanWagtendonk 2007). Following revisions and updates to the federal wildland fire management policy, and program review, fire as a management tool was reaffirmed as a legitimate program. The National Park Service and the Forest Service began to allow fires to burn once again without suppression (VanWagtendonk 2007). The policy was again reviewed and updated in 1995 and 2001 following concerns raised by the South Canyon fire in Colorado, which claimed 14 firefighters, and the Bandelier National Monument fire, which burned into the town of Los Alamos destroying 255 homes (VanWagtendonk 2007).

Concerns with Reintroducing Fire

Fire is important to maintain productive ecosystems and mitigate severe wildfires. At the same time, there are valid public concerns about smoke management, escaped fire, damage to structures and developments, loss of current forage resources, aesthetics, and erosion, to name a few. Furthermore, habitat fragmentation from urbanization, burn bans, liability issues, and introduction and spread of exotic plant species has further complicated the already complex logistics of prescribed burning. Prescribed fire as a management tool has encountered uncertain funding compared with open-ended expenditures for "emergency" wildfire suppression reflected in congressional authorizations for many years (Botti 1995). In fiscal year 1994, the Department of the Interior budgeted $221.5 million for suppression and suppression preparedness, while only $12 million was set aside for prescribed fire and fuels management (Botti 1995). Fire has been recognized as a cost effective tool for resource management compared with other options (e.g. chemical and mechanical treatments), but concerns about its safe use remain a factor.

There are inherent risks associated with using fire as a management tool, and reputations and careers can be adversely affected if something does not go as planned. Loss of homes and structures to fire continue to rise as more people strive to live closer to natural areas without means to manage fuels (Martin and Sapsis 1995). Many ancestral ties with fire have been broken in recent history. There seems to be a slow awakening as more organizations publicly support the need to integrate prescribed fire to sustain certain ecosystems (Wade and Brenner 1995). The ecological rationale for allowing wildland fires to burn, and the cost effectiveness of using prescribed fire when appropriate, continue to attract manager's attention despite the inherent risks.

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