CHAPTER 18

Fire Management and Policy Since European Settlement

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Everywhere, and from the earliest times, humans have altered the natural fire regimes they have encountered.

PYNE *et al.* 1996

Since European explorers first touched the shores of California, their activities, shaped by their needs and values, have changed the state's fire regimes. Fire regime changes have resulted, directly and indirectly, from a variety of human activities. At times, these influences have been unintentional consequences of other land management activities; in other instances, they have been well planned and even codified. All of the activities that have affected fire regimes are considered here as fire *management,* but only those that have been intentionally and formally adopted by society are considered fire *policies*.

Formal fire policy since European settlement is a response to society's and institutions' views of fire. These change as human relationships with the land, natural resources, and fire change. Our understanding of the historical relationships between fire and society is greatly enhanced if we review the setting in which that society existed. It is common for us to blame our current fire situation on the shortcomings and lack of perspective of past land managers. But this is rarely the case. The needs and values of society were the driving force of past policies, and those needs and values have changed and will continue to change. In this chapter, we discuss the activities and events that have had the greatest effect on fire in California, why they occurred, and how they influenced fire regimes.

European Exploration Era

The earliest European explorers to visit California came by ship. The "discovery" of Alta (upper) California by European explorers is generally credited to Juan Rodriguez Cabrillo, who sailed up the coast from Baja (lower) California in 1542. Following his death at San Miguel Island in January of 1543, his crew continued to explore northward reaching what is now southern Oregon. They could make no landings north of Point Conception and eventually returned to Mexico. No other European explorers visited the coast of Upper California until Francis Drake and his party landed at Drakes Bay near what is now called Point Reyes in 1579. The first overland journey that extended far into the state was not made until 1769 when Gaspar de Portola's expedition "discovered" San Francisco Bay.

These early explorers were motivated by discovery, conquest, and the pursuit of riches. The voyages were challenging, and landings were difficult and very few. Most of this early discovery was merely a view from off shore. These explorers were not settlers and had little long-term contact with the land, people, or ecosystems that they discovered. So why, as fire ecologists, do we care about their exploits? Because their visits had unintended, long-lasting, and important influences on California fire regimes.

The first significant impacts on fire regimes that the European civilization brought to California actually predate the arrival of large-scale permanent settlers by over a century. The impacts were the introduction of the human diseases that decimated the populations of indigenous peoples and the introduction of plants from other parts of the world. Although both of these impacts involved the expansion of the historic ranges of biological organisms, they had very different mechanisms for influencing fire regimes. Both of these actions were inadvertent but were to have enormous impacts on California ecosystems that continue to the present.

Removal of Native American Fire Use

Manipulation of fire by Native Americans had many important impacts on the character and geographic distribution of California's fire regimes, and greatly modified fire as an ecological process (Anderson 2005). The removal of the Native Americans and their fire use had variable effects on California's ecosystems. Although there was little or no change to ecosystems where fire was very rare, or where fire regimes were not altered by the activities of the Native Americans, there was often a profound change on ecosystems in the areas where they actively managed with fire, including many oak woodlands, montane meadows, coastal grasslands, and coniferous forests. These ecosystems now supported a different burning pattern, replacing the specific pattern of Native American ignitions and lightning with a new combination of settler burning and lightning. Coastal areas experience little lightning, and fire regimes in these areas were dominated by anthropogenic ignitions (Keeley 2005, Stephens and Fry 2005, Stephens and Libby 2006). Removal of anthropogenic fire from these ecosystems has brought about wholesale changes in species composition, by encroachment of invasive species, conversion to other vegetation types, and increased fire hazards (van Wagtendonk 1996; Stephens 1998, 2004, Stephens and Fule 2005, Stephens and Moghaddas 2005).

Introduction of Invasive Non-Native Plant Species

The introduction of non-native invasive plant species began when the explorers visited the California coast during the 1500s and 1600s. The establishment of the Jesuit Missions in the late 1700s with their livestock and horticultural activities greatly accelerated the establishment and expanded the ranges of non-native grasses and forbs in California (Menke et al. 1996).

Cattle ranching in California began on the coast in 1769 when the Spanish brought about 200 head of cattle to San Diego. By 1823, livestock grazing was an established activity, to various degrees, at all 21 missions. At its peak, the missions may have had more than 400,000 cattle grazing one sixth of California's land area. In the Central Valley, grazing by domestic livestock was light until after the gold rush. In 1860, the U.S. Census reported nearly a million beef cattle (not including open range cattle), just over a million sheep, and 170,000 horses in California. As range quality declined, sheep ranching gained in favor with a peak of 5.7 million animals in 1880 (Barbour et al. 1993).

Among the newly introduced plants were several species that were adapted to the rangelands in the mediterranean climates of southern Europe. They had invasive habits and rapidly out-competed the native species in many of the plant communities, especially those dominated by herbaceous plants. Changes in climate over the last centuries could also have influenced plant community responses and composition (Millar and Woolfenden 1999).

Many of California's grasslands and woodlands are currently dominated by invasive species (Menke et al. 1996), and changes in species composition have influenced fire regimes. For example, fuel from introduced annual grasslands cures earlier, recovers faster, and has greater continuity than the native vegetation that previously occupied the sites. This allows the fire season to begin in the late spring, shortens fire-return intervals, and increases fire size. In general, invasive plant species have a greater impact in mesic conditions and at lower elevations than harsher alpine or subalpine ecosystems. Non-native species also aggressively colonize many ecosystems when openings are created by mechanical methods or high-severity fire. Chapter 22 includes an in-depth treatment of invasive species and fire in California ecosystems.

Early Settlement

California Mission Era—Alta California

During the time period from 1769 to 1823, a string of Spanish missions were established as the first permanent outposts of European settlements. These were expansions of the established footholds in Mexico and grew from San Diego northward to as far as Sonoma in northern California (Bean 1973, Watkins, 1983).

Private Spanish land grants to establish pueblos or towns were introduced in California starting in 1775 and used extensively beginning in 1784. These grants provided colonists with livestock to establish herds to be grazed on common lands. Each grantee was required to build a storehouse and to stock his holdings with at least 2,000 head of cattle. By 1790, there were 19 private rancheros in California. During the Spanish and Mexican periods, more than 800 large grants of land were given to Hispanics and some European immigrants who settled in California. The effect of these grants was to expand the area of California being utilized by domestic livestock.

The Treaty of Guadalupe Hidalgo explicitly guaranteed that these land grants would be honored by the United States. Several of the land grants were larger than 40,468 ha (100,000 acres). With the beginning of the Gold Rush and the influx of new settlers, Americans complained about the size of such land claims. The U.S. Senate sympathized with the new immigrants, not the rancheros, most of whom were Hispanic, and passed legislation that allowed multiple appeals on land claim decisions. Thus, most claims remained unresolved for years. The Californios had to prove ownership, a difficult task because few accurate surveys had ever been made. The cost of court proceedings often consumed more than the property was worth.

Although fur trappers worked the rivers and streams throughout the state in the 1830s, they did not establish permanent settlements. The missions and small communities such as Monterey and Sutter's Fort near present-day Sacramento were the major European outposts in California until the arrival of settlers from the east in the early 1840s.

Although the missions were small outposts, their establishment represents an important historic and ecological milestone for two main reasons. First, they continued the decline in Native American population and ecological influences, replacing them with influences of European ancestry, who had a different land ethic. Second, they expanded the introduction of domestic livestock and also introduced herbaceous plants from other parts of the world. The domestic livestock served to extend the ranges of the non-native plants in California. Both of these milestones initiated major alterations to California flora and fire regimes that are still important today.

Although no large-scale direct manipulations of the fire regimes were made during this time period, it still resulted in drastic alterations in the role of fire in California's ecosystems. The removal of widespread and often-focused Native American burning was accomplished indirectly by relocating the people and decimating the population by introducing diseases. This was an especially important change to fire regimes where focused, long-term, Native American burning maintained vegetation under conditions that would not persist without them. As detailed in Chapter 17, these ecosystems were often manipulated using fire to increase the reliability of food crops and cordage materials (Anderson 2005). This abrupt halt in the use of fire initiated ecosystem change in many areas of California.

The Gold Rush and Early Statehood

Growth of the non-indigenous population was slow during the years following the establishment of the missions. This changed in a single year with the discovery of gold in January 1848 at Sutter's Mill east of Sacramento in the foothills of the Sierra Nevada. The California Gold Rush of 1849 saw the population explode from about 2,000 non-indigenous people at the time of the discovery to more than 53,000 by the close of 1849 (Shinn 1885, Farquhar 1966). The flood of settlers following the discovery of gold created a need for effective civil government in California. In September 1849, a convention met at Monterey and adopted a state constitution. The constitution was approved by popular vote on November 13, and on December 15 the first legislature met at San Jose to create an official state government. On September 9, 1850, California officially became the 31st state in the Union. The population growth during this time period was not just a growth in numbers, but was a sudden expansion of the population into many remote areas of the state.

The miners and early settlers had several direct and indirect impacts on the fire regimes during this era. Early settlers used fire to clear land for improved grazing and to facilitate the search for gold. Sheepherders often set fires on the way out of the mountains in the fall to improve forage for the next year. The developing railroad system served as a new source of ignitions. Widespread logging occurred in many areas near major mining centers to support both the mines and the population needed to work them (Stephens and Elliott-Fisk 1998, Stephens 2000). Much of the Lake Tahoe basin and areas of the eastern Sierra Nevada were logged to support the mines (Elliott-Fisk et al. 1997). Meanwhile, fire suppression efforts were confined to the immediate protection of structures.

Fire Control Era

Yellowstone and Yosemite were designated as national parks in 1872 and 1890, respectively, but at first no agency was assigned responsibility for their administration (van Wagtendonk 1991). When the United States Army was given the responsibility for managing Yellowstone in 1886, and Yosemite and Sequoia in 1891, the policy of suppressing all fires began (Agee 1974, van Wagtendonk 1991). The National Park Service was established in 1916 and its administration passed into civilian hands.

Federal fire policy was formally started with establishment of large-scale forest reserves during the late 1800s and early 1900s. In 1891, congress authorized President Harrison to establish forest reserves, later to be known as National Forests (Pinchot 1907, Ruth 2000, Stephens and Ruth 2005). The U.S. Forest Service was established as a separate agency in 1905 with Gifford Pinchot as its first chief. Under his direction, a national forest fire policy was initiated and the agency began systematic fire suppression including the development of an infrastructure of fire control facilities, equipment, fire stations, lookouts, and trails. The forest reserves were created partly because Congress believed the nation's forests were being destroyed by fire and reckless cutting (Pinchot 1907). Pinchot declared that one of the objectives of the National Forests was to make sure that "timber was not burnt up."

A policy of fire suppression was not universally supported during this period. One of the most vocal groups that argued for the use of fire in forest management was a group of private foresters from the northern Sierra Nevada and southern Cascades (Clar 1959, Pyne 1982). In the late 1880s, they promoted the concept of "light burning" modeled after earlier Native American uses of fire. The main objective of this burning was to reduce fuel loads and associated damage when the inevitable wildfire occurred. Federal managers disagreed with this policy because of the damage to small trees and problems with fire escapes. Most foresters at this time believed that western forests were understocked and elimination of fire would ultimately produce higher yields of timber (Show and Kotok 1924).

There were many large forest fires in the late 1880s and early 1900s that influenced early federal forest fire policy (Pyne 1982, 1997, 2001). These fires included the Peshtigo (Wisconsin and Michigan, 1871), Michigan (Michigan 1881), Hinckley (Minnesota 1894), Wisconsin (Wisconsin 1894), Yacoult (Washington and Oregon, 1902), and Great Idaho (Idaho and Montana, 1910). Together these fires burned more than 4 million ha and killed approximately 2,500 people (Guthrie 1936). There was some awareness that forest harvesting practices may have contributed to some of these fires in some forest types (Perkins 1900, Stephens 2000), but this was not recognized by many early forest managers.

The Great Idaho fire of 1910 was pivotal in the development of early fire policy (Pyne 2001). In this wildfire, 78 firefighters were killed and over a million hectares of national forest lands were burned. It was time to "do something" about the wildfire threat and the 1910 fires instigated the creation of a national system of wildland fire protection.

Henry Graves, the second chief of the Forest Service was against the "light burning" policy, declaring "the first measure necessary for the successful practice of forestry is protection from fire" (Graves 1910). The earliest comprehensive federal fire control policy was written shortly after Graves was appointed (DuBois 1914). William Greeley, the third Forest Service chief, took over the agency in 1920 and continued the strong endorsement of fire suppression stating, "The conviction burned into me that fire prevention is the number one job of American foresters." (Greeley 1951). During Greeley's nine-year tenure, fire suppression was paramount in federal and private forest management.

A scientific study was initiated in California on the merits of fire suppression versus light underburning, and its conclusions supported a strong fire suppression policy (Show and Kotok 1924). The philosophy that nature could be dominated and controlled contributed to these early policies. Passage of the federal Clarke-McNary Act in 1924 tied federal appropriations to the state first adopting fire suppression and this law effectively created a national fire suppression policy.

The Berkeley fire of September 17, 1923 is a story of wildland fire on the interface with a new and rapidly growing urban area that has become all too familiar to Californians in recent decades. Biswell (1989) describes the progression of the 1923 fire:

> A strong hot, dry northeast wind quickly drove a fire through the grasslands and eucalyptus groves along the crest of the ridge above Berkeley. Firebrands from the eucalyptus allowed the fire to spread out of the wildlands onto the shingle rooftop of the first house at 2:20 pm. Within 40 minutes the fire spread throughout a one-half square mile area. Over a period of just two hours, 625 houses and other buildings were destroyed. At about 4:30 pm the cool moist coastal breeze took over and the firefighters extinguished the blaze.

Perhaps the most effective change that occurred with the industrialization of America and the subsequent scientific revolution was making the philosophy of "taming the wilderness" a possibility. Society was now developing effective tools and strategies for the protection of its valuable timber supply. Fire was seen as a potential threat to that timber supply, and large amounts of resources were committed to the removal of fire from America's forests.

In 1935, federal forest fire policy was updated to incorporate the "10 AM" policy, aimed at increasing suppression efficiency. This policy directed that all fires should be controlled in the first burning period or by 10 AM the following morning. To accomplish this objective, a large labor force and improved access to wildlands were necessary. The newly created Civilian Conservation Corps (CCC) provided thousands of workers to assist in this effort (Anderson et al. 1941, Pyne 1982). Efforts were made to increase the effectiveness of fire suppression by developing better access to further reduce response times, mapping vegetation and fuel hazards, and keeping detailed records of any large fires that occurred (van Wagtendonk 1991).

The first national education campaign designed to influence public behavior regarding forest fire began when the Forest Service created the Cooperative Forest Fire Prevention Program in 1942 (USDA 1995a). This program encouraged citizens nationwide to make a personal effort to prevent forest fires. The campaign was modified three years later to produce the national "Smokey Bear" campaign that is still in existence. Smokey Bear has been one of the most successful public education campaigns in the United States.

World War II had a lasting influence on fire suppression. During the war, fire suppression efforts were modest, due to the war effort. However, after the war there was a new, much more intensive fire suppression effort that included the widespread use of the tools that were developed and refined in the war (Stephens 2005). Aerial retardant drops, helitack crews, bulldozers, and smokejumpers became the new tools of choice and this new firefighting force was very effective in continuing the policy of full fire suppression (USDA 1960, van Wagtendonk 1991).

The public was now well shielded from the history of human–wildland fire relationships and fighting fires had become "The moral equivalent of war" (Pyne 1997). After World War II, firefighting efforts were further intensified. Science and technology were applied to the firefighting efforts and important strides were made toward understanding wildfire and its control. The study of fire concentrated on fire physics, fire behavior, and the relationships between meteorology and fire.

Beginning of Fire Use

The use of fire in the management of California private rangelands was common in the early 1900s to the 1960s (Biswell 1989, McClaran and Bartolome 1989, Stephens 1997). Private ranchers would pool resources and burn rangelands to increase forage for livestock. Fire use was tolerated by the state agencies that had oversight authority on private lands, but the burning was done by private citizens (Biswell 1989).

The effectiveness of fire protection was partly responsible for the beginnings of a shift in policy from fire control to fire management (van Wagtendonk 1991). Research was indicating that exclusion of fire caused shifts in species composition and forest structure, and increased fuel accumulations. Harold Biswell advocated the use of prescribed fire to reduce fuel accumulations in Sierra Nevada ponderosa pine forests (Biswell 1959). Hartesvelt and Harvey (1967) considered the greatest threat to giant sequoia *(Sequoiadendron giganteum [Lindley] Buchholz)* groves was not trampling by humans, but catastrophic fire burning through understory thickets and unnaturally high fuel accumulations.

In 1951, the first use of fire by the National Park Service occurred in Everglades National Park in Florida (Kilgore 1974). Several vegetation types in the park were fire adapted, including pine and mixed hardwood forests. The initial burns were designed to reduce understory vegetation and to promote pine regeneration (Robertson 1962).

In 1962, the Secretary of the Interior requested a wildlife management report, and it identified fire suppression as a policy that was adversely impacting wildlife habitats (Leopold et al. 1963). In 1968, the Leopold Committee report was incorporated into National Park Service policy, and for the first time since 1916, the National Park Service viewed fire as a natural process rather than a menace (van Wagtendonk 1991). Shortly after the report was commissioned, the first western federal prescribed fire occurred in California at Sequoia-Kings Canyon National Parks (1968) and two years later in Yosemite National Park (USDI 1968, van Wagtendonk 1991). This was the beginning of the use of fire on federal forested lands in the western United States. Creation of the national Wilderness System in 1964 also advanced the idea of wildland fire use in remote forested areas (Pyne 1982).

In 1968, the first experimental prescribed natural fire program (managed lightning fires to meet resource objectives) in Sequoia-Kings Canyon National Parks was created (USDI 1968, Kilgore 1974, Parsons et al. 1986). This program became possible because of earlier research on the fire ecology of mixed-conifer forest in the Sierra Nevada (Biswell 1961, Hartesveldt and Harvey 1967, Kilgore and Briggs 1972) and because of the recent change in National Park Service fire policy. The era of wildland fire use in the National Park Service had begun; the long era of total suppression that began in the early 1900s had ended (Agee 1974, Kilgore 1974, van Wagtendonk 1978).

Prescribed fire in the California State Park system was initiated in 1972 at Montana de Oro State Park on the Central Coast and then Calaveras Big Trees State Park in the Sierra Nevada. The program was initially the target of high levels of political and academic criticism, but persistent efforts to evaluate the biological impacts of fire and fire exclusion have supported the need for prescribed fire to maintain ecosystems (Biswell 1989). The prescribed fire program expanded to treat more than 4,000 acres a year by 1996. Today the program is coordinated on a statewide basis and focuses on restoring the natural role of fire in California (Barry and Harrison 2002).

Forest fire policy in the Forest Service changed from fire *control* to fire *management* in 1974. Henry DeBruin, Director of Fire and Aviation Management for the Forest Service, stated: "we are determined to save the best of the past as we change a basic concept from fire is bad to fire is good and bad" (DeBruin 1974). This was a major policy shift for the Forest Service, but fire suppression was still to dominate for the coming decades. Some Forest Service Wilderness areas such as the Selway-Bitterroot Wilderness in Idaho and Montana, and the Gila Wilderness in New Mexico began a program of prescribed natural fire but areas with similar management philosophies were few in number (Stephens and Ruth 2005). During this change, some Forest Service managers believed suppression would have to be increased to meet the demand of the new fire management policy (Sanderson 1974). In 1978, the Forest Service abandoned the 10 AM policy in favor of a new one that encouraged the use of prescribed fire. No Forest Service Wilderness areas in California adopted a prescribed natural fire program until the mid 1990s and areas with this type of management are still rare today.

In 1978, the National Park Service further refined its fire management policy to describe the conditions under which fire could be used and specified that any management fire would be suppressed if it posed a threat to human life, cultural resources, physical facilities, threatened or endangered species or if it threatened to escape from predetermined zones (van Wagtendonk 1991). In 1986, the National Park Service issued Wildland Fire Management Guidelines that detailed procedures and standards for managing wildfires, prescribed natural fires, and prescribed burns. These guidelines required that condition limits under which naturally ignited fires could be allowed to burn, the maximum size and boundaries, and daily monitoring and evaluation must be preplanned (USDI National Park Service 1986). In 1988, a series of very large fires in the Greater Yellowstone Area again brought federal fire policy under review. Whereas fire policy was generally reaffirmed, greater emphasis was placed on the development of fire management plans (van Wagtendonk 1991).

Although management of fire on many jurisdictions is changing, protection of people and property is still the top priority. The State Board of Forestry and the California Department of Forestry (CDF) drafted a comprehensive update of the fire plan for wildland fire protection in California entitled "California Fire Plan—A Framework for Minimizing the Costs and Losses from Wildland Fires" (CDF 1996). This approach to management of wildland fire is focused on the reduction of the damage caused by wildfire and does not generally emphasize the role of fire in wildland natural resource management. This difference in perspective is explained by the fact that CDF is primarily a firefighting organization tasked with fire prevention and suppression on private and state lands. In contrast, the Forest Service, Bureau of Land Management, and National Park Service are primarily land management agencies tasked with land management as their primary mission.

In the last decade, CDF has increased the size and scope of their Vegetation Management Program, which encourages partnerships between private land owners to reduce fire hazards, primarily in the urban-wildland interface. Although this program has been successful in a relatively small number of communities, CDF still emphasizes fire suppression. Without a well-funded program of fuels management to complement their already strong fire suppression capability, it will be difficult or impossible to reduce fire losses in lands overseen by CDF. Certainly the added complexity of CDF not owning the majority of the lands where it has fire responsibility makes it difficult to initiate fuels management programs, but they are as essential as strong suppression programs. Without investments in both suppression and prevention, large, expensive, and destructive wildfires will continue on CDF-administered lands.

One area in which the state and counties can significantly improve fire management is by passing and enforcing laws that mandate the use of combustion-resistant construction materials and defensible space for every structure in the urban–wildland interface. Presently, counties have the majority of the jurisdiction in this area, but in most cases, they have been unwilling or incapable of providing this essential oversight. Losses of life and property in the urban–wildland interface will only be reduced when both private homeowners and adjacent wildland managers take steps to reduce fire hazards and risks. If only one side of the interface (private homeowners or adjacent wildland managers) takes steps to reduce its vulnerability to wildfire, the result will be continued large losses in this expanding area of California.

Fire science and management continue to change. Starting in the late 1960s and continuing today, the emphasis of fire research has become more focused on natural resource values and the influence of fire as an ecosystem process. There has been widespread acceptance of the idea that fire is an important part of many ecosystems, and that changes in the patterns of occurrence of fire have had many large-scale ecosystem impacts. Today, fire management has become the central issue in land management throughout the state.

In 1989, Harold Biswell asked, "Is fire management on a collision course with disaster?" and answered, "Perhaps, because wildfires continue to become more intense and destructive of resources, and expenses in fire control are increasing at an astronomical rate" (Biswell 1989). Today, the practice of managing wildland fuel to modify future fire behavior has become an important land management activity (Stephens and Moghaddas 2005). The wildland–urban interface has become one of the focal points for the application of fuel management in California. Although society as a whole continues to value the suppression of wildfire, and we continue to negatively affect ecosystems by reducing fire's impact as an important ecosystem process, there is an increasing recognition among land managers that the long-term exclusion of fire has changed fuel dynamics and is changing the patterns of uncontrollable wildfires.

Overview of Some Key Historic Fires, 1923–2005

Human interaction with fire during the period since European settlers first set foot in California is defined by the struggle to reduce the negative impacts of wildfire on society. Throughout this period, there have been efforts to remove fire from California's ecosystems. Even to this day, in which fire is widely recognized as an important ecosystem process, the efforts to restore and manage fire in the state's wildlands are dwarfed by the efforts to suppress unwanted fire. As technology develops and resources become available, they are continuously used to *control* wildfire. Despite our intensive efforts over several decades to remove fire as a threat to society and natural resources, large-scale fires continue to occur at an alarming rate. Although we have often altered its pattern, we have not eliminated fire from California ecosystems, nor have we eliminated fire as a threat to human life and property.

Although fire suppression is very effective over most of California, there are a few situations in which very large fires still occur despite the intensive effort and resources applied to suppressing them. These are settings and conditions in which fire intensity is extremely high over large areas. It is a relatively rare, but predictable, set of circumstances that leads to conditions that can produce the largest and most destructive fires in California.

Tables 18.1 and 18.2 list the 20 largest fires, in terms of area burned and structure loss, that occurred in California between 1923 and 2005. The fires are located on Maps 18.1 and 18.2. The entire 2002 Biscuit fire is included in this table although only a portion of it burned within California. Several important patterns are evident in these tables. The largest and most destructive fires have occurred in relatively few settings under a small number of weather conditions and continue to occur during those conditions in the same ecosystems.

Chaparral and Woodland Fires in the Central and South Coastal Mountains

The current pattern is for large chaparral fires to occur in the south and central California Coastal Mountains, or the Sierra Nevada foothills in two distinct scenarios. During the extended periods of hot dry summer conditions that are common in these ecosystems, fires occur that can burn for several weeks or even months in very steep inaccessible terrain. The 1999 Kirk and 1977 Marble Cone fires in the Central Coast and portions of the McNally fire in the Southern Sierra Nevada are examples. The second type of very large chaparral fire occurs in the fall and early winter during short periods of extreme fire weather characterized by foehn winds, locally known as Santa Ana, Sundowner, or North Winds (Keeley et al. 2004, Moritz et al. 2004). These winds are characteristically gusty, strong, dry, and warm and drive the fires rapidly over very large areas in periods of time lasting from a few hours to a few days. The intensity of the winds coincides with the period of time when the live fuel moistures are the lowest, thereby producing explosive fire conditions. Because there is virtually no lightning activity during this part of the year, these fires historically may have started with holdover fires burning in from higher-altitude vegetation types, but are now almost universally human caused. The 2003 Cedar and 1970 Laguna fires are examples of this type of fire. These fires are responsible for most of the highest structure loss fires since 1923, including the 2003 Cedar fire (2820 structures lost), 1991 Tunnel fire (2843 structures lost), Old (1,003) fires, 1990 Paint fire (641) and 1923 Berkeley fire (584). Both the 1991 Tunnel fire and the 1923 Berkeley fire burned through urban forest landscapes occupied by Eucalyptus and other urban trees, and were driven by foehn winds.

Forest and Chaparral Fires in the Sierra Nevada and Klamath Mountains

A second type of very large fire occurs in the Klamath Mountains and Sierra Nevada foothills and mountains. These fires can be human caused, or started by numerous lighting strikes over a large area, overwhelming fire suppression forces. The fires burn over a relatively long period of time with fire

TABLE 18.1

The 20 largest fires (by area burned) in California from 1923 to 2005

		Bioregion(s)	*Hectares*	*(Acres)*
Biscuit	July 2002	Klamath Mountains	202,328	(499,965)
Cedar	October 2003	South Coast	110,579	(273,246)
Matilija	September 1932	South Coast	89,031	(220,000)
Marble Cone	July 1977	Central Coast	71,980	(177,866)
Laguna	September 1970	South Coast	70,992	(175,425)
McNally	July 2002	Sierra Nevada	60,985	(150,696)
Stanislaus Complex	August 1987	Sierra Nevada	59,076	(145,980)
Big Bar Complex	August 1999	Klamath Mountains	57,040	(140,948)
Campbell Complex	August 1990	North Coast	50,947	(125,892)
Wheeler	July 1985	South Coast	47,753	(118,000)
Simi	October 2003	South Coast	43,789	(108,204)
Highway 58	August 1996	Central Coast	43,167	(106,668)
Clampitt	September 1970	South Coast	42,578	(105,212)
Wellman	June 1966	South Coast	37,879	(93,600)
Old	October 2003	South Coast	36,940	(91,281)
Kirk	September 1999	Central Coast	35,086	(86,700)
Refugio	September 1955	South Coast	34,305	(84,770)
Fork	August 1996	North Coast	33,581	(82,980)
Scarface	August 1977	Northeastern Plateaus	32,336	(79,904)
Las Pilitas	July 1985	Central Coast	30,206	(74,640)

NOTE: Data from California Department of Forestry and Fire Protection. Area for the Biscuit fire includes California and Oregon.

TABLE 18.2

The 20 most destructive wildland fires (by number of structures lost) in California from 1923–2005

		Bioregion	*Structures Lost*	*Hectares*	*(Acres)*
Tunnel	October 1991	Central Coast	2843	647	(1,600)
Cedar	October 2003	South Coast	2820	202,328	(273,246)
Old	October 2003	South Coast	1,003	36,940	(91,281)
Jones	October 1999	Central Valley	954	10,603	(26,200)
Paint	June 1990	South Coast	641	1,983	(4,900)
Fountain	August 1992	Southern Cascades	636	25,884	(63,960)
Berkeley	September 1923	Central Coast	584	53	(130)
Bel Air	November 1961	South Coast	484	2,465	(6,090)
Laguna	October 1993	South Coast	441	5,842	(14,437)
Laguna	September 1970	South Coast	382	70,992	(175,425)
Panorama	November 1980	South Coast	325	9,551	(23,600)
Topanga	November 1993	South Coast	323	7,284	(18,000)
49er	September 1988	Sierra Nevada	312	13,638	(33,700)
Simi	October 2003	South Coast	300	43,789	(108,204)
Sycamore	July 1977	South Coast	234	326	(805)
Canyon	September 1999	Central Valley	230	1,044	(2,580)
Kannan	October 1978	South Coast	224	10,273	(25,385)
Paradise	October 2003	South Coast	223	22,946	(56,700)
Kinneloa	October 1993	South Coast	196	2,220	(5,485)
Old Gulch	August 1992	Sierra Nevada	170	7,036	(17,386)

NOTE: Data from California Department of Forestry and Fire Protection.

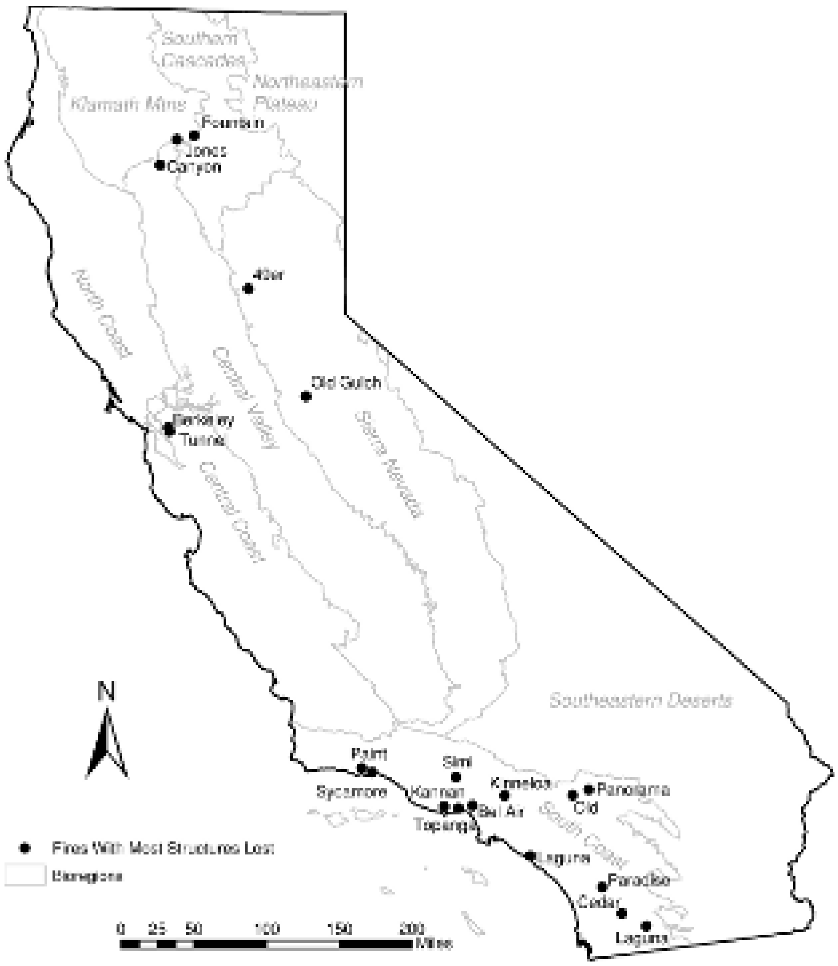
MAP 18.1 Location of the 20 fires burning the largest area between 1923 and 2005.

behavior highest in areas where the fire can make long uphill runs, through many vegetation zones, and over steep terrain and canyons. The 1987 Stanislaus Complex, 2002 Biscuit, and 1999 Big Bar Complex fires are examples of these lightning-ignited fires. The 2002 McNally fire is similar but was human caused. Although most of these fires burn in uninhabited landscapes, they can cause a great deal of structure loss when they occur in landscapes with numerous developments mixed into the wildlands. The 1988 49er (312) and 1992 Old Gulch (170) fires are examples of fires that burned numerous structures.

Patterns of Large Fires

The 20 fires burning the largest area in California from 1923 to 2005 (Table 18.1) are illustrated by decade in Figure 18.1 and by month in Figure 18.2. In the 81 years of record, 90% of the largest fires have occurred in the last 39 years after 1966. The 1990s and 2000s were the decades with the most large fires (with five). The first six years of the 2000s have produced more of the largest fires than there were in the first half of the recorded period. Nine of the 12 largest fires have occurred since 1985. All of these largest fires occurred in steep inaccessible terrain. The fires were well distributed during the four-month period from July to October with one occurring in June. Increasing fuel continuity and fuel loads from successful fire suppression have probably contributed to the increase in large fires since 1970.

The 20 fires burning the most structures in California since 1923 (Table 18.2) are illustrated by decade in Figure 18.1 and by month in Figure 18.2. Although there were a variety of specific causes, all of the ignitions were human caused. Thirteen of the 20 fires occurred since 1990, including those causing the six highest structure losses. Eighteen of the 20 fires occurred since 1970. Nearly half of the fires occurred in October, including the top four that combined to burn more than 7,600 structures. Nineteen of the 20 largest structure-loss fires occurred between July and November. There is an increasing rate of occurrence of the state's largest and most destructive fires. This is despite increasing efforts, effectiveness, and expenditures for fire suppression. All of the fires occurred during extreme fire weather conditions, and all were actively suppressed.



MAP 18.2. Location of the 20 fires burning the most structures between 1923 and 2005. Berkeley and Tunnel are two separate fires.

Current Fire Policies, Initiatives, and Direction

In recent years, societal concerns for managing natural resources have shifted to include the role of fire as a dynamic and predictable part of wildland ecosystems. This has served to thrust fire management into the forefront of wildland management. It is now widely recognized that fire plays an important role in the functioning of natural ecosystems. It is also recognized that if we value ecosystem components such as plant and animal species and their habitats, water, and air, then fire must be managed rather than eliminated from ecosystems. The focus of fire policy and management has shifted away from the overall goal of removing fire toward the much more complex goal of managing fire.

In response to 14 firefighter fatalities at the South Canyon fire in Colorado in 1994, and the growing recognition that fire problems are caused by fuel accumulation, the Bureau of Land Management, Forest Service, National Park Service, Fish and Wildlife Service, Bureau of Indian Affairs, and the National Biological Service released a joint Federal Wildland Fire Management Policy and Program Review in 1995 (USDI-USDA 1995, USDA 1995b). The key findings of this policy and program review are as follows:

1) The protection of human life is reaffirmed as the first priority in wildland fire management.
2) The second priority is the joint protection of property and natural and cultural resources.
3) "Wildland fire, as a critical natural process, must be reintroduced into the ecosystem. This will be accomplished across agency boundaries and will be based upon the best available science."
4) Treatment of hazardous fuel buildups, particularly in the wildland-urban interface, and approved fire management plans are needed.

It concluded, "Agencies and the public must change their expectations that all wildfires can be controlled or suppressed." For the first time, the federal land management agencies jointly took responsibility for managing fire as a natural process in America's wildlands.

The 1995 fire policy was reviewed and updated in the aftermath of the Cerro Grande fire. This incident started with an escaped prescribed fire that eventually burned 235 structures in and around Los Alamos, New Mexico, and threatened the Los Alamos National Laboratory in May of

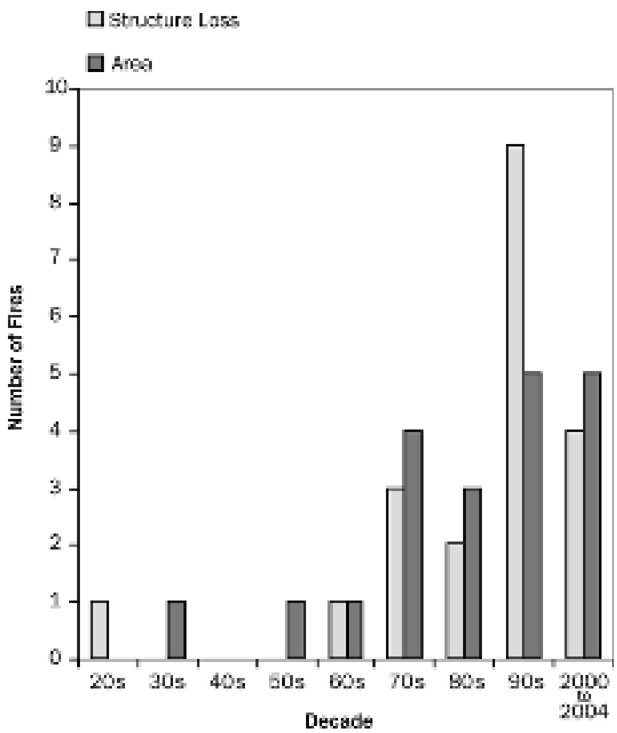


FIGURE 18.1. Distribution of the 20 fires burning the most structures and largest areas between 1923 and 2003, by decade.

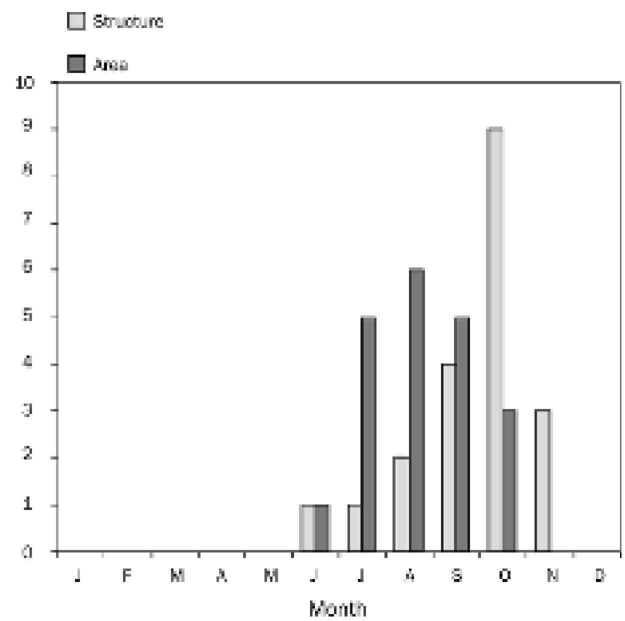


FIGURE 18.2. Seasonal distribution of the 20 fires burning the most structures and largest area between 1923 and 2005.

2000 (USDI 2001). The review supported the 1995 fire policy and fine tuned its implementation. The key findings of the review are as follows:

1) The 1995 policy is generally sound and continues to provide a solid foundation for wildland fire management activities and for natural resources management activities of the federal government.
2) As a result of fire exclusion, the condition of fire-adapted ecosystems continues to deteriorate; the fire hazard situation in these areas is worse than previously understood.
3) The fire hazard situation in the wildland-urban interface is more complex and extensive than understood in 1995.

One of the main objectives of the 1995 policy was to reduce fire hazards annually on 1,200,000 ha (3,000,000 acres) of forests using mechanical and prescribed fire treatments by 2005. Re-introducing fire and restoring large areas of forests is a formidable management challenge for both political and ecological reasons (Cole and Landres 1996, Ruth 2000, Stephens and Ruth 2005). Progress has been slower than forecasted (GAO 2003), because of constraints on smoke production, difficulties in plan preparation, possible effects on rare and endangered species, and budgetary procedures that have delayed the implementation of fuel management projects.

The National Fire Plan, established in "A Report to the President in Response to the Wildfires of 2000" (USDA-USDI 2000), is now being implemented using the "Collaborative Approach for Reducing Wildfire Risks to Communities and the Environment: Ten-Year Comprehensive Strategy" (WGA 2001). The Plan and the Strategy state: "Unless hazardous fuel is reduced, the number of severe wildland fires and the costs associated with suppressing them will continue to increase." Implementation of the National Fire Plan is designed to be a long-term, multibillion-dollar effort (GAO 2003). The Ten-Year Comprehensive Strategy recognizes that key decisions in setting priorities for restoration, fire, and fuel management should be made collaboratively at local levels. As such, the Strategy requires an ongoing process whereby the local, tribal, state, and federal land management, scientific, and regulatory agencies exchange the required technical information to facilitate the decision-making process.

Today's complex land management objectives will be achieved by the long-term incorporation of fire as an ecosystem process as a part of a broadly based wildland management program. Fire management includes a combination of methods that are used individually or in combination to meet different objectives (Stephens 1998, Stephens and Moghaddas 2005). Methods include the general categories of fuel management, using naturally occurring fire to achieve natural resource objectives (wildland fire use), modifying future fire behavior and home construction in the wildland–urban interface, and restoration of historic fire regimes.

Fire management has developed from a relatively simple straightforward suppression program, tasked with protecting lives, property, and natural resources, into an immensely complex program of land management, tasked with the additional needs to maintain plant and animal species and their habitats, air, soil and water quality, and visual, recreational, and residential landscapes. Fuels management must be applied in appropriate ecosystems (Stephens and Ruth 2005) at necessary spatial scales and arrangements (Finney 2001) before it will have the ability to reduce losses from large high-severity wildfires.

In October of 2003, a group of 10 fires burned more than 303,514 ha (750,000 ac) of chaparral, woodlands, and forest in and around the cities of the greater San Diego and Los Angeles areas. More than 4,000 structures were burned and 22 lives were lost over a one-week period. This was a dramatic demonstration of several points that define our current place in the history of fire ecology, management, and policy:

1) High-intensity wildland fires continue to operate on large landscapes. Removal of smaller and low- to moderate-intensity fires in forests by effective fire suppression serves to greatly increase the proportion of the burned area that experiences extreme fire behavior.
2) Fire management can be effective in modifying fire behavior in certain ecosystems. However, in ecosystems characterized by very high-intensity fire, such as chaparral and some forest types, management of wildlands as natural ecosystems is not likely to reduce the threat to adjacent urban areas. In such cases, it is likely that we must rely on the design of structures and the development of buffers between the wildlands and urban areas. These buffers may consist of unnatural vegetation that can reduce fire intensity and result from the modification of urban area designs.
3) Fire policy must continue to focus on three primary areas: promoting the restoration of the role of fire in natural ecosystems, moderating the impacts of wildland fire on society, and producing better building codes and wildland management in and adjacent to the urban–wildland interface.
4) Fire management is a very important part of wildland management. Despite great effort over several decades, we have not managed to remove fire from ecosystems, even in wildlands adjacent to the nation's largest population centers. In fact we have had little impact on the frequency or intensity of fire in these ecosystems. Fire is a very basic part of these ecosystems and will not likely be removed in the near future. We must continue to improve our understanding of the natural role of fire in ecosystems, how fire can be a threat to society and how to co-exist with fire in California's wildlands.

Fires in a Changing Climate

Despite the complexity inherent in local fire regimes, regional fire activity often oscillates in phase with year-to-year climatic variability (Clark 1988, Swetnam 1993, Stephens and Ruth 2005). For example, the area burned annually across the southwestern United States tends to decrease in El Niño years and increase during La Niña years (Swetnam and Betancourt 1990). In northern California, the impact of climatic change on wildland fire and suppression effectiveness is projected to change in the inland regions of the state (Fried et al. 2004). Despite enhancement of fire suppression efforts, the number of escaped fires (those exceeding initial containment limits) is projected to increase by 51% in the south San Francisco Bay area and 125% in the Sierra Nevada; no increase in the number of escaped fires is projected in the wet coastal forests of northwestern California. In addition to the increased suppression costs and economic damages, changes in fire severity of this magnitude would have widespread impacts on vegetation distribution, forest condition, and carbon storage, and greatly increase the risk to property, natural resources, and human life.

Conclusion

Industrialization and urbanization of America from the late 1800s to the mid 1900s generated an increasing need to manage wildlands for commodity production to supply an increasingly urban population. Protection of forests and rangelands from wildland fire was a central part of this evolution in management philosophy. The application of a fire-protection philosophy that was developed to protect European forests was applied to every plant community in North America during this period (Wright and Bailey 1982).

The challenge today is to develop fire policies, management actions, and budgets that recognize the need for both fire suppression and the management of fire as an ecosystem process and hazard reduction tool. Fire will continue as an important agent of change in many western ecosystems but we must strive to produce conditions where fire can become a positive force in most of California. This is a challenge of magnitude and complexity that is unprecedented in the history of wildland resource management. The stakes are extremely high and the future of both the relationship of wildlands to society and the integrity of natural ecosystems are at risk.

Global climate change may further complicate fire management in California (Torn and Fried 1992, Karl 1998, Fried et al. 2004). Climate change may lead to differences in plant distributions (Bachelet et al. 2001), lightning frequency (Price and Rind 1994), and the length of fire season, which could increase ignitions and further exacerbate wildfire effects. Changing climates may necessitate creation of fire policies that are easily adaptable because of large uncertainties (Stephens and Ruth 2005).

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