

Southern California Wildfires 1984–2007: Burn Severity Trends and Ecological Implications

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Description of Southern California Biophysical Setting, Fire Ecology, and Management Issues

The Southern California environment is known for its volatile fuels, rugged topography, recurrent droughts, and foehn (Santa Ana) winds (Pyne, 1996). The vegetation can be divided into grasses (lowlands), Chaparral shrublands (slopes), and forests (mountain summits). In the Chaparral shrublands, crown fires generally cause 100 percent mortality in the aboveground vegetation; however, these shrublands are resilient to a range of fire frequencies. The rugged topography favors upslope burns; adding foehn winds to the volatile fuels results in large wind-driven fires. Southern California winds commonly exceed 60 mph with relative humidity less than 10 percent and are capable of spreading fires more than 24,000 acres in an hour (Keane and others, 2008). This environment supports explosive fire behavior as demonstrated in the high intensity events such as the 2003 Cedar Fire and the 2007 Witch Fire. The poster compares the 2003 Cedar Fire and 2007 Witch Fire using burn severity data from the Monitoring Trends in Burn Severity project (figs. 1, 2).

With increasing urban populations encroaching on the Southern California wildlands, there is a growing need for fire prevention and planning. Past fire management practices, in particular fire exclusion and lack of effective fuels management, have been suggested by scientists, fire managers, and legislators in California as a key reason for the size of the Cedar Fire (Keane and others, 2008). Adding disturbances, such as prescribed burning and other fuel manipulations, however, allow non-native opportunistic species to become established on the landscape. Management agencies are now recognizing the potential conflicts between control of non-native species and fuel manipulations (Keeley and others, 2005).

Monitoring Trends in Burn Severity (MTBS) Project



Figure 3. The Southern California study area includes the selected Landsat path/rows.

The Monitoring Trends in Burn Severity (MTBS) project, sponsored by the Wildland Fire Leadership Council (WFLC), has the fundamental requirement to create nationally consistent burn severity assessment for all large fires that have occurred in the United States since 1984. Sharing that responsibility and beginning in 2006, the U.S. Geological Survey Earth Resources Observation and Science (EROS) Center and the USDA Forest Service Remote Sensing Applications Center (RSAC) have been using Landsat imagery and the differenced Normalized Burn Ratio (dNBR) approach to map the extent and burn severity for all fires greater than 500 acres in the eastern United States and 1,000 acres in the West. MTBS can help answer the following questions: 1) Are Southern California fires becoming larger, and 2) are they becoming more severe? MTBS data can be used to show historical fire activity.

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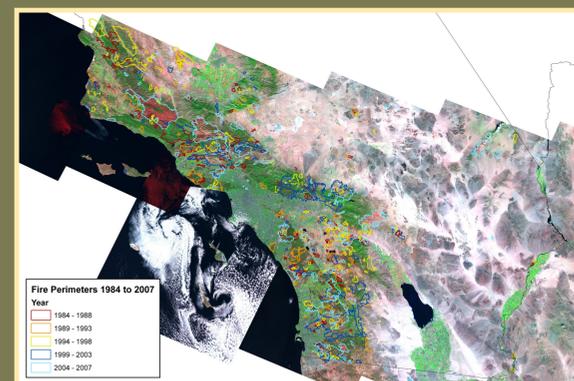


Figure 4. Southern California fire history from 1984 to 2007 displayed by 5-year intervals. From 1984 to 2007, 464 fires have burned in southern California.

Historical Trends for Southern California (1984–2007)

For this study, Southern California is defined by the selected Landsat path/rows in figure 3. From 1984 to 2007, a total of 464 fires greater than 1,000 acres were mapped by the MTBS project (fig. 4). To better understand the historical fire trends in Southern California from 1984 to 2007, fires were grouped into 5-year intervals. The interval from 2004 to 2007 represents a 4-year time interval.

Grouped years with the most reported fires are 1994–1998 followed by 1984–1988 (fig. 5). Figure 6 shows the number of fires by individual year, demonstrating the range of variation within each timeframe. Grouped years with the most acres burned were 2004–2007, even with only a 4-year time interval, followed by 1999–2003 (fig. 7), highlighting that the number of fires doesn't necessarily correlate to number of acres burned. Figure 8 shows individual fire years by area burned, again demonstrating the range of variation within each timeframe. More than 750,000 acres burned in both 2003 and 2007. Burn severity by grouped years seems to be fairly consistent (fig. 9). The grouped years that had the highest percentage of high severity was 1999–2003.

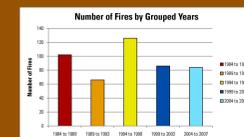


Figure 5. Number of Southern California fires by grouped years from 1984 to 2007. Years 2004 to 2007 only depict a 4-year interval.

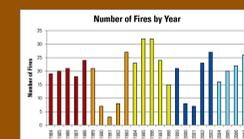


Figure 6. Number of fires that burned each year from 1984 to 2007. Years are color-coded by grouped years.

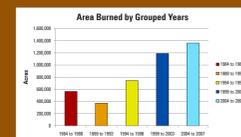


Figure 7. Southern California area burned by grouped years from 1984 to 2007. Area is recorded by number of acres burned. Years 2004 to 2007 only depict a 4-year interval.



Figure 8. Area burned in Southern California each year from 1984 to 2007. The years are color-coded by group years.

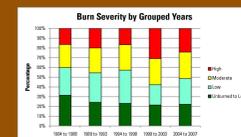


Figure 9. Burn severity by grouped years for Southern California fires from 1984 to 2007.

Ecological Implications/Issues of Higher Fire Frequencies in Southern California



Figure 10. The Witch Fire burned north of the 2003 Cedar Fire and reburned 43,706 acres of the Cedar Fire.

In Southern California, recent examples of short interval fire disturbance are the 2003 Cedar Fire and the 2007 Witch Fire (fig. 10). According to the 2001 National Land Cover Database (<http://www.mrlc.gov/>), the dominant land cover within the perimeters of the Cedar and Witch Fires was shrublands (fig. 11). In 2003, the Cedar Fire burned 268,362 acres (fig. 12). Over 75 percent of the Cedar Fire was classified as high (52 percent) or moderate (24 percent) severity by the MTBS project (fig. 13). Four years later, the 2007 Witch Fire burned 167,559 acres (fig. 12) on the north side of the Cedar Fire burn scar with 14 percent of the burn classified as high severity. The remaining mapped burn severities for the Witch Fire were relatively evenly distributed across the unburned to low (29 percent), low (28 percent), and moderate (24 percent) classes (fig. 13). The Witch Fire reburned 43,706 acres within the 2003 Cedar burn scar. Within this area, 65 percent of the original Cedar Fire was classified as high (13,809 acres) or moderate (14,399 acres) severity. Four years later, only 23 percent of the area reburned by the Witch Fire was classified as high (1,957 acres) or moderate (8,284 acres) severity (fig. 14). Although the 2003 Cedar and 2007 Witch Fires were wildland fires, they highlight an example of what happens to landscapes that are burned regularly, and provided insight to how fuel treatments could affect the Southern California landscape. Today many management agencies are calling for greatly reduced or abandonment of fuel treatments (prescribed fires or fuel manipulations) in the lower elevations of Southern California, that already experience an unnaturally high frequency of fires (Keeley and others, 2005).

2003 Cedar Fire



Figure 1. The 2003 Cedar Fire burned 268,362 acres. A) Postfire Landsat 5 image of the Cedar Fire with fire perimeter. B) The five-class thematic burn severity map of the 2003 Cedar Fire. C) Original burn severity of the 2003 Cedar Fire this area burned again in 2007.

2007 Witch Fire

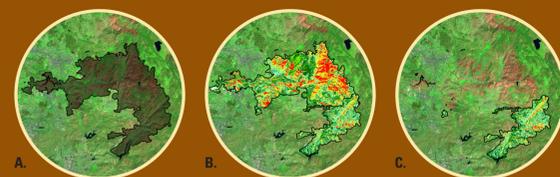


Figure 2. The 2007 Witch Fire burned 167,559 acres. A) Postfire Landsat 5 image of the Witch Fire with fire perimeter. B) The five-class thematic burn severity map of the 2007 Witch Fire. C) Area of the 2003 Cedar Fire that was reburned by the Witch Fire totaling 43,706 acres.

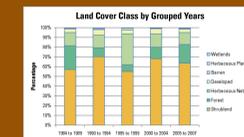


Figure 11. Land cover classes from the 2001 National Land Cover Database grouped by years for Southern California fires from 1984 to 2007.

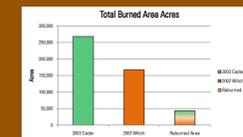


Figure 12. Total burned area in acres for the 2003 Cedar Fire and 2007 Witch Fire, and the reburned area.

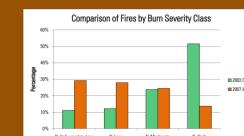


Figure 13. Comparison of the 2003 Cedar and 2007 Witch Fires by burn severity class.

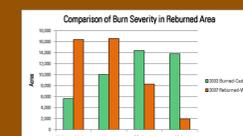


Figure 14. Comparison of the reburned area by acres burned within each burn severity class.

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