# Sonoma County 2017 Fires: Mapping the Impact

GSP 270

Team Raster

Chelsea Stewart-Fusek, Shawna Bekowsky, Bayan Ahmed and Micaela Pineda

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### Abstract

The Northern California fires of 2017 were the deadliest series of fires in state history and were among the most destructive in U.S. history. The goal of this project was to map public lands burned by these fires in Sonoma County in the month of October. We conducted our project by collecting pre and post fire images of Sonoma County and conducting analysis to find the differences in burn severity and what land types the fires occurred on. Our project resulted in the creation of a few maps that display burned public land in Sonoma County and the burn severity displayed by using raster analysis of spectral indexes. This project helps landowners understand the severity of fires that have occurred on their land, and can be useful in the fire adaptation process as well as in ecological succession studies. The result of this study show that as burn severity increases, the amount of land types burned decreases. The most highly burned areas were in state or regional parks with 390.42 ha of state parks and 115.38 ha of Sonoma County regional parks burned.

#### Introduction

After a natural disaster, the first step in rebuilding and recovery is determining where damage has occurred, and to what extent. In the case of wildfire, mapping damage can help landowners determine which areas are in high-risk fire zones, which is information that can be used in the rebuilding process (Mockrin et al., 2015). A future goal for landowners and community members can be to become "fire adapted" by using land in ways that take fire-risk into consideration (Mockrin et al., 2015). It is also important to have maps of fire damage when measuring regrowth of vegetation post-fire, for general record-keeping purposes, and for determining who is responsible financially for each land type that has been impacted.

For this project we mapped public lands burned in the Sonoma County (Figure 1.) wildfires in October of 2017. The wildfires started on October 8, 2017, and were near full containment by the



month. These fires (in Sonoma, Napa, and Mendocino counties) scorched more than 245,000 acres (Daniels, 2017). The lack of rain and high gusts of winds ranging from 10 to 45 mph contributed to their severity (Ortiz et al. 2017). An estimated 8,700 structures were destroyed and at least 42 people were killed due to the fires (Daniels, 2017). The Northern California fires were the deadliest series of fires in state history and were among the most destructive in U.S. history (Sorci, 2017). Our focus was on fires that burned public land in Sonoma County, and we used raster analysis of spectral indices to create a map of these areas. We included on our map an analysis of burn severity.

Figure 1. Sonoma County's location relative to the rest of California.

#### Methods

First, we acquired a parcel ownership data layer from the Sonoma County GIS website and our before and after LandSAT 8 images of Sonoma County from the USGS Earth Explorer website (Figure 2; Figure 3). Our first step in working with the parcel data was to make a summary table that associated each landowner with a number (i.e. 1=Bureau of Land Management, 2=State Parks and Recreation, 3=State of CA, etc.). Next, we joined this summary table with our parcel layer. We then converted the polygons of the parcel layer to raster using the "Polygon to Raster" tool. We also had to convert the before and after raster images of Sonoma County to float using the conversion tool "Raster to Float." We used the "Extract by Mask" tool to get rid of the parts of each image that aren't part of Sonoma County.

To create a post-fire Normalized Burn Ratio (NBR) image, we first used the "Raster Calculator" tool. For the post-fire images, we entered the following into the Raster Calculator: (Sonoma Post-fire Band 5 - Sonoma Post-fire Band 7)/(Sonoma Post-fire Band 5 + Sonoma Post-fire Band 7) We then repeated this step with the Pre-fire images. To create a burn severity image, we calculated a delta NBR index by subtracting the post-fire NBR image from the pre-fire NBR image (Pre burn.img-Post Burn.img).

Next, we reclassified our data into burn severity categories (unburned, low-severity burn, moderate-severity burn, high-severity burn). Because the areas with water distort the burn severity raster, we had to create a water mask to show all water areas as unburned. We extracted the Land Use raster by mask, again using the "Extract by Mask" tool. We then used the raster calculator to identify water pixels. Then, we used the Raster Calculator to multiply the Burn Severity raster by the water mask raster to make a Burn Severity raster that showed burned land without the water pixels. We then reclassified the new burn severity categories to 1=unburned, 2= low, 3=moderate, 4=high.

Finally, to display the burn severities within each land type, we created four rasters. We used the Raster Calculator to find All Burned Areas, Low Burned Areas, Moderate Burned Areas and High Burned Areas by multiplying each by the parcel layer. This resulted in four different maps, each displaying a different burn severity category.

#### Results

This project resulted in the creation of maps and a table that show the damage done to public lands in Sonoma County in the October 2017 wildfires.



Figure 2. Sonoma County pre-fire (Sept. 2017-USGS)

Figure 3. Sonoma County post-fire (Oct. 2017-USGS)



**Figure 4.** Sonoma County land use categories. County.

Figure 5. Burn severity of fires in Sonoma



Figure 6. All Public lands burned in Sonoma County.



Figure 7. Public lands with high severity burns.





**Figure 9.** Public lands with moderate severity burns.

**Figure 10.** Public lands with moderate severity burns zoomed to the southeast corner of Sonoma County.



Figure 11. Public lands with low severity burns.



**Figure 12.** Public lands with low severity burns zoomed to the southeast corner of Sonoma County.

CATEGORY	LAND OWNERSHIP	Area Burned Low	Area Burned Moderate	Area Burned High
1	BUREAU OF LAND MANAGEMENT	29.88	49.95	54.09
2	STATE PARKS & REC	881.82	1007.91	390.42
3	STATE OF CA	99.63	2.61	-
4	SONOMA CO. REGIONAL PARKS	470.34	304.74	115.38
5	SONOMA CO. WATER AGENCY	0.18	-	-
6	STATE LAND COMM	57.78	97.47	0.72
7	SONOMA STATE UNIVERSITY	8.46	0.09	-
8	UNITED STATES OF AMERICA	-	-	-
9	U.S. FISH AND WILDLIFE SERVICE	8.19	0.81	-
10	MILITARY	14.76	1.8	0.27
11	SONOMA COUNTY	0.36	-	-
12	BUREAU OF INDIAN AFFAIRS	56.25	10.8	-
13	ARMY CORP OF ENGINEERS	368.28	30.78	6.03
14	CA FISH AND WILDLIFE	35.01	-	-
15	TOWN WINDSOR	0.27	-	-
16	FORESTVILLE PARK DEVELOPMENT INC.	0.27	-	-
17	CITY OF SONOMA	0.63	-	-
18	CITY OF SEBASTOPOL	2.25	-	-
19	CITY OF SANTA ROSA	12.69	6.03	0.18
20	CITY OF RHONERT PARK	-	-	-
21	CITY OF PETALUMA	66.6	18	3.06
22	CITY OF HEALDSBURG	0.45	-	-
23	CITY OF COTATI	-	-	-
24	CITY OF CLOVERDALE	0.27	-	-

## Table 1. Area in hectares (ha) of land categories affected by each level of burn severity.

## Implications/Discussion

From the maps created as a result of this study, we can see that as burn severity increases, the amount of land types burned decreases. This is an excellent finding because it means that there wasn't a lot of high severity burn areas. This will make the rebuilding of Sonoma County and environmental recovery a lot easier. However, unfortunately, most of the high severity burn areas were in state or regional parks, see table 1 (State Parks and Recreation= 390.42ha and Sonoma Co. Regional Parks= 115.38ha). Therefore, a good follow up study could be conducted in those areas to observe vegetation recovery and how long it takes. The largest area burned was on State Parks and Recreation land, see table 1 (Area = 1007.91). This is an example of why a study like this is so important. It highlights which lands are burned and who is financially responsible for each land. Therefore, owners can come up with preventative solutions to be fire adaptable. It was difficult to collect the post-fire image from USGS. The latest image from November 12th had a lot of cloud cover and was not sufficient in helping us with data collection/analysis or creating maps so we decided to use an older image from October 27th.

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