NCASI Briefing Note
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The Labor Day Fires of 2020

SEPTEMBER 2021

Introduction

Western Oregon experienced an extraordinary period of wildfire activity in early fall 2020. In just two days (September 7-8), more than 700,000 acres burned. Western Oregon experienced the worst air quality in the world, 40,000 people (1% of the state's population) were evacuated from their homes, and nearly $7 billion worth of property (1% of the state's total real market property value) was destroyed by the fires.[1]

The 2020 fires accounted for 28% of all acres burned in western Oregon since 1950. Three-quarters of all area burned in the last 70 years in the twelve counties of northwestern Oregon burned in 2020.

Figure 1. Map of 2020 Labor Day Fires

1.0 By the Numbers

Five large fires (Beachie Creek, Holiday Farm, Archie Creek, Riverside, and Lionshead) accounted for 88% of the 842,255 acres burned in western Oregon in 2020 (Table 1).

Table 1. Acres Burned and Structures Lost from Five Large Fires in western Oregon in 2020

Fire Name	Ignition Date	Ignition Source	Acres Burned	Estimated Structures Lost
Beachie Creek	Aug 18/Sept 7	Lightning/human	193,566	1,323
Holiday Farm	Sept 7	Human	173,393	768
Riverside	Sept 7	Human	138,151	230
Archie Creek	Sept 7	Human	131,596	109
Lionshead	Aug 18	Lightning	108,086	280

2.0 Why Here, and Why Now?

Three primary factors contributed to the quick spread and high intensity of the 2020 Labor Day fires. First, significant late fire-season drought created dry fuels in western Oregon. In the two weeks preceding the fires, Evaporative Demand Drought Index and Energy Release Component, two commonly used measures of fuel dryness, reached the 98th and 90th percentiles, respectively, of 30-year normals.[2] Second, smaller fires that were already burning throughout August and the first week of September and new ignitions from human sources in the second week of September provided multiple opportunities for fires to rapidly propagate.

Third, and most importantly, extremely strong easterly winds contributed to the rapid spread of fire and the large area burned in the second week of September. Beginning on September 6, a high-pressure system stretching from the Pacific Ocean across Canada developed in tandem with a low-pressure system centered around the Four Corners region of Arizona, Colorado, New Mexico, and Utah. This highly unusual juxtaposition of high and low pressure pushed very dry air from the east downslope through river valleys of the Cascades. Downsloping winds are associated with further drying and warming, taking an already dry airmass to less than 10% humidity. The effects of these winds were most noticeable as they accelerated through mountain gaps and down west facing river valleys. Sustained wind speeds from this anomaly exceeded any recorded in more than 50 years. Late summer wind speeds for the western Cascades average 2 to 3 miles per hour. For 48 hours from September 7-8, sustained wind speeds were greater than 20 miles per hour with gusts up to 60 miles per hour.[3]

[1] https://oregoneconomicanalysis.com/2020/10/01/wildfires-impacts-in-the-forecast/
[2] Climate data from http://climateengine.org
[3] Data from seven remote access weather stations along the western slope of the Cascades

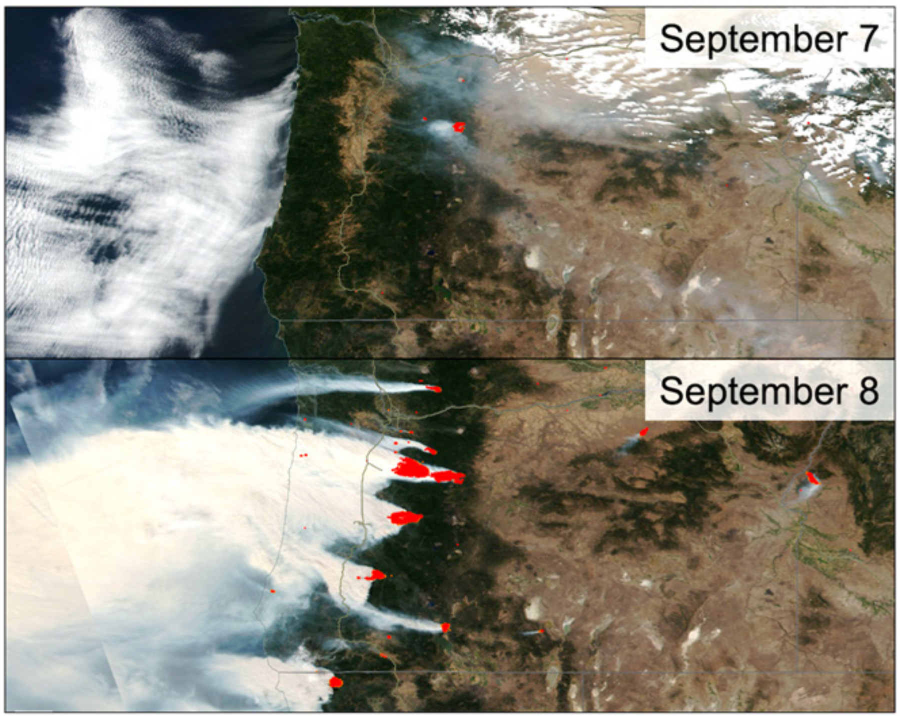

Figure 2. Wind Shift and Fire Growth in Western Oregon from Mid-Day September 7 to Mid Day September 8, 2020
[photos from https://firms.modaps.eosdis.nasa.gov]

3.0 Was Climate Change Responsible for the Labor Day Fires?

Climate change is responsible for warmer temperatures, declining snowpacks, reduced summer rains, and earlier springs, all of which contribute to longer fire seasons and greater extent of fire (Littell et al. 2018). Although western Oregon was experiencing significant drought when the Labor Day fires occurred, this type of drought is neither unprecedented nor were previous droughts associated with such extensive fires. It remains unclear to what degree late season drought in Oregon in 2020 can be attributed directly to anthropogenic climate change, although climate change increases the probability of drought in some regions and will probably be a significant contributor to future drought events.

The historical record shows that strong easterly winds, similar in magnitude to the winds responsible for the 2020 Labor Day fires, drove very large fire events in the 1930s (the Tillamook Fires) and at the turn of the century (the Yacolt Burn of 1902) (Morris 1934). Available evidence suggests that the high pressure system that caused strong dry winds on September 7-8 was related to atmospheric wave trains from an unprecedented tempo of western Pacific Ocean typhoon formation (Stuivenvolt Allen et al. 2021). Available evidence also suggests that climate change may be associated with more intense typhoons and more northerly typhoon tracks (Cha et al. 2020). Additional research will add to our understanding about the relationship between climate change and extreme weather that caused the rapid spread and intensity of the Labor Day fires.

4.0 What Lands were Affected?

In previous years, most lands burned by wildfire were federal lands managed by the US Forest Service or Bureau of Land Management. However, an unprecedented amount of private land was burned in the 2020 fires, with 343,800 acres of private land burned (41% of the total area burned). One-third of the total area burned (277,700 acres) in 2020 was highly productive low- and mid-elevation forests managed by institutional timberland owners.

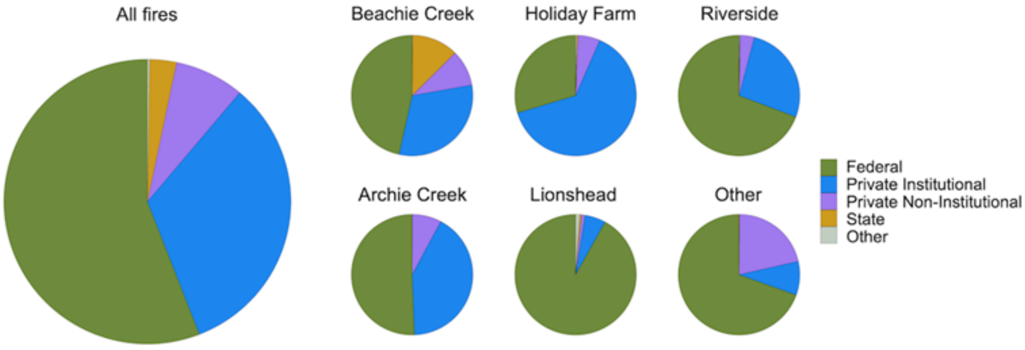

Figure 3. Area Burned by Ownership in the 2020 Labor Day Fires

5.0 Were the Labor Day Fires Unusually Severe?

Fire severity can describe the ecological, economic, or social impacts of fire. Measured by the economic impacts, the severity of the Labor Day fires of 2020 was unprecedented in Oregon's history. Fire severity is most often measured by ecologists as the proportion of tree cover and other vegetation killed by fire. Estimates or direct measurements of severity can be binned into severity classes. For instance, "low" severity fire is usually considered to be fire that results in mortality of less than 25% of stand basal area, while "moderate" and "high" severity fires result in 25 to 75% and greater than 75% stand basal area mortality, respectively.

The Labor Day fires of 2020 resulted in significant acreage burned at high severity. Preliminary estimates indicate that a total of 364,000 acres—or 46% of the total acreage that experienced fire—burned at high severity (Table 2).[4] Fires that burned in western Oregon over the three decades prior to 2020 resulted in high severity fire across approximately 25% of the total area burned (Reilly et al. 2017).

Table 2. Acreage and Percent of Total (in parentheses) Burned at Different Fire Severities in 2020 Labor Day Fires

Low	Moderate	High
240,441 (30.1%)	194,579 (24.4%)	363,828 (45.5%)

There was little difference in the proportion of different forest structural classes that were burned at high severity. High severity fire affected approximately the same proportion of stands dominated by saplings, poles, small, medium, or large trees (Table 3).

Table 3. Percent of Different Forest Structural Types Burned at High Severity in 2020 Labor Day Fires

Sapling or Pole[a]	Small or Medium Tree[b]	Large Tree[c]	Giant Tree[d]
44.2%	40.5%	44.1%	47.9%

[forest structure data from Bell et al. 2021 Gradient Nearest Neighbor maps]
[a] sapling or pole = stands with mean diameter <10 inches
[b] small or medium tree = stands with mean diameter 10-20 inches
[c] large tree = stands with mean diameter 20-30 inches
[d] giant tree = stands with mean diameter >30 inches

6.0 Summary

The 2020 Labor Day fires were unusual in size, location, resources affected, and proportion of area burned at high severity. Historically, wind events with strong east to west flows were responsible for some of the largest fires in western Oregon. Drought is also associated with large areas burned, and ongoing climate change will increase the length, intensity, and frequency of drought events. There is some evidence that climate change will increase the frequency of large wind events, although additional research is needed to understand how warming trends and wind events will contribute to future fire risk.

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[4] This is a preliminary estimate that may change as trees continue to die from fire damage.