

# Wildfire Threatens Outdoor Recreation in the Western US

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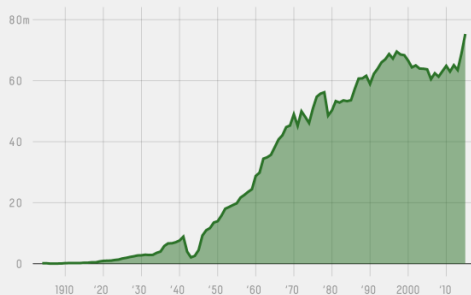
<sup>2</sup>Resources for the Future

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# Outdoor recreation in the western US

## U.S. national parks have never been so popular

Annual recreational visits to national parks since 1904



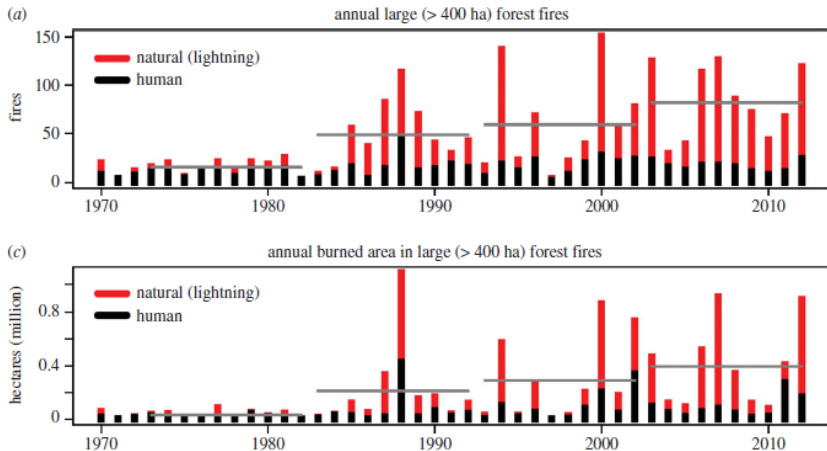
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SOURCE: NATIONAL PARK SERVICE

- ▶ In 2017, outdoor recreation accounted for 2.2% of GDP nationally, 3.3% in Utah and Colorado (BEA 2019)
- ▶ 3.9% growth in outdoor recreation, compared to 2.4% growth for economy overall

# Wildfire in the western US

Wildfire activity has increased dramatically over past 50 years



Source: Westerling (2016)

# Wildfire in the western US

## Impacts to outdoor recreation

### This paper

1. Documents extent of wildfire and smoke impact to campers within western US
2. Estimates wildfire and smoke impacts on recreation site use (e.g. avoidance)

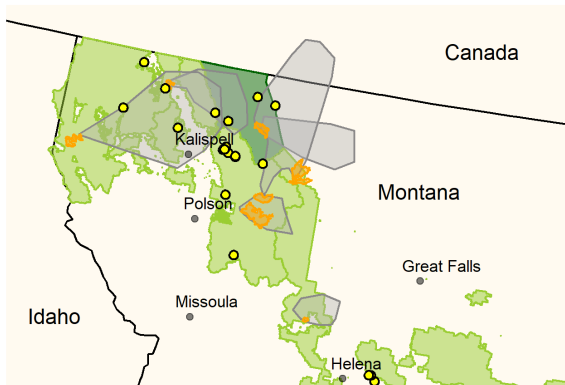
### Related literature:


- ▶ **Changes to site condition and effects on recreation demand** (Englin et al. 2001, Hesselin et al. 2004, Hilger & Englin 2009, Duffield et al. 2013, Sanchez et al. 2016, Garnache & Lupi 2018, Englin 2019)
- ▶ **Disruptions to recreation activity** (Thapa et al. 2013, Kim & Jakus 2019)
- ▶ **Health impacts** (Miller et al. 2019, Jayachandran 2008)


1. Recreation.gov database
  - 1,019 campground facilities in western US
  - 2008-2017
  - 25 million individual transaction records
  - Records include: reservations, cancellations, transaction dates, billing zip codes, number of campers, equipment type
2. MODIS fire detection data
  - Filtered for wildfires using large wildfire perimeters from USGS Monitoring Trends in Burn Severity (MTBS)
3. NOAA Hazard Mapping System smoke plume data
  - Daily smoke plumes 2008-present, mapped from GOES imagery
  - Low, medium, and high density smoke plumes


# Data


## Illustration of wildfire and smoke data




 Glacier National Park

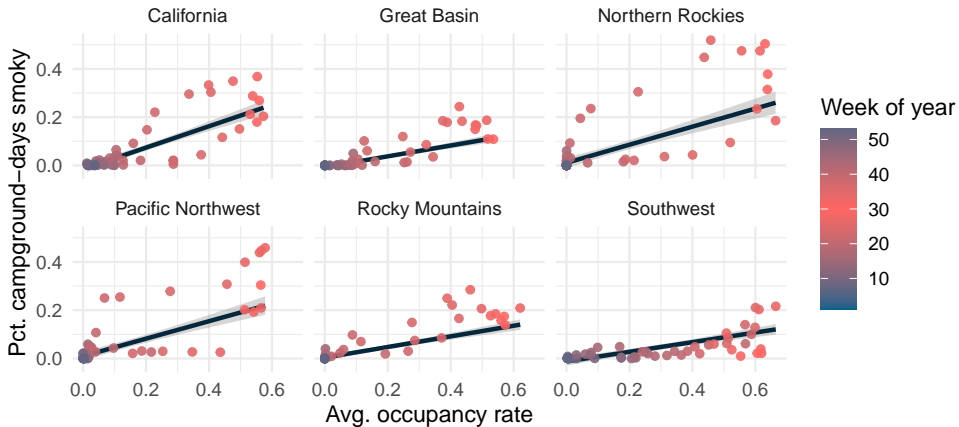
 National Forests

 Heavy smoke, August 12-14, 2015

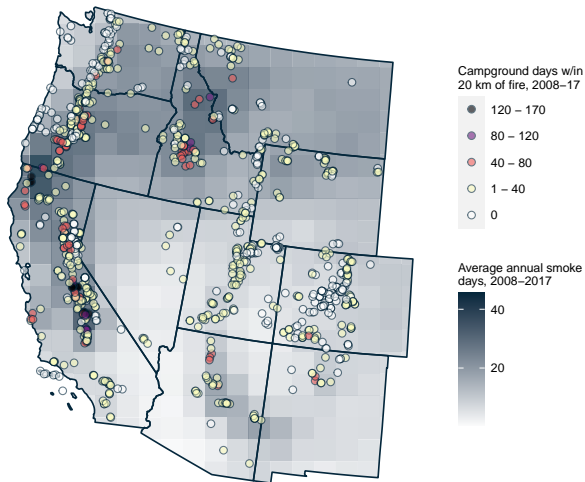
 Wildfires, August 12-14, 2015

 Campgrounds in Western Montana

# Wildfire and outdoor recreation seasons coincide



# Geographic incidence of campground exposure





# Exposure to fire

## Summary statistics for campgrounds and campers by region

	Campground-days		Camper-days (thousands)		Total
	Avg. annual days per campground	Pct. of total available campground-days	Avg. annual camper-days	Pct. of total camper-days	
California	2.5	2.0	86	2.1	4,086
Pacific Northwest	1.5	2.2	13	0.9	1,440
Rocky Mountains	0.5	0.6	2	0.2	1,014
Great Basin	0.5	0.6	3	0.3	885
Southwest	2.1	2.0	14	1.8	766
Northern Rockies	1.5	1.9	7	1.0	670
Total	1.5	1.7	124	1.4	8,860

Note: Fire days are defined as days in which a campground is within 20 km of an active wildfire. Percentage campground-days near fire is calculated as percentage of days on which campgrounds had at least one occupant.

# Exposure to smoke

## Summary statistics for campgrounds and campers by region

	Campground-days		Camper-days (thousands)		
	Avg. annual days per campground	Pct. of total available campground-days	Avg. annual camper-days	Pct. of total camper-days	Total
California	28	22	707	17	4,086
Pacific Northwest	31	44	345	24	1,440
Rocky Mountains	20	24	163	16	1,014
Great Basin	16	19	107	12	885
Southwest	14	13	54	7	766
Northern Rockies	34	43	211	32	670
Total	26	28	1,588	18	8,860

Note: Percentage campground-days near fire is calculated as percentage of days on which campgrounds had at least one occupant.

# Estimated visitor exposure at selected national parks

**Table:** Annual camper-days and annual estimated visitor-days affected by smoke and fire at selected national parks

	Fire		Smoke	
	Camper-days per year	Estimated visitor-days per year	Camper-days per year	Estimated visitor-days per year
Glacier National Park	0.5	8	28	530
Yosemite National Park	40	176	115	500
Rocky Mountain National Park	0.009	0.8	22	358
Grand Canyon National Park	9	91	17	186
Mount Rainier National Park	0	0	15	144
Total (all parks in sample)	52	313	254	3,302

Note: Estimated smoky visitor-days and visitor-days near fire are calculated by multiplying total smoke and fire camper-days per month at each NPS site by the ratio of visitors to campers in that month at each site.

# Regression results

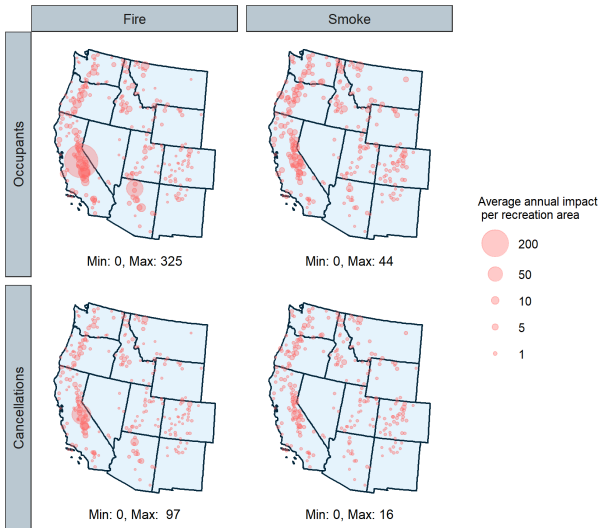
Table: Estimated effects of wildfire and smoke on campground use.

	(1) Percent Occupancy	(2) ln(New Reservations)	(3) ln(Pre-arrival Cancellations)	(4) ln(Cancellations During Stay)
Fire	-7.2** [.9]	-.097** [.031]	.21** [.029]	.037** [.006]
Smoke	-1.3** [.25]	-.013* [.0062]	.045** [.0079]	.0015 [.0016]
Mean of dep. var.	42	1.2	.43	.013
No. obs.	739,496	739,496	739,496	739,496

Note: All columns include campground, recreation area-by-month of year, recreation area-by-year, week-of-year, and day-of-week fixed effects, as well as indicators for holidays and days before holidays. Campground observations are weighted by the number of campsites, and standard errors are clustered by recreation area, \*\* p<0.01, \* p<0.05.

# Implied impacts on site use

Annual impact per campground (average and min/max)



# Conclusions

- ▶ Extensive wildfire and smoke impacts to campgrounds in some regions
  - 30% of visitor-days are smoky in Northern Rockies
- ▶ On average, smoke and fire do not displace large numbers of visitors each year
- ▶ Increasing concerns under climate change
- ▶ Prescribed fire, managed wildfires, and other forest restoration activities can be used to mitigate impacts at popular recreation sites

**Thanks!**