

Social and Biophysical Predictors of Public Perceptions of Extreme Fires

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Introduction

Background

Research has typically defined an ‘extreme’ wildfire by its biophysical characteristics, such as fire size, burn severity, and fire duration, and is a subject mainly investigated by biophysical scientists (e.g., Lannom et al., in press). Social science research has primarily focused on individual fires and their impact on social systems, without explicit regard to how biophysical characteristics of the fire influence these impacts or perceptions of impacts.

While much of the social science research on wildfires has provided useful insights into individual and community preparation, adaptation and recovery in relation to wildfire events, it can be difficult to explore the magnitude of the relationships between various factors from current research because it is challenging to generalize findings from case study research on individual fires to other wildfire events. *This study attempts to integrate social and biophysical characteristics of wildfires and their impacts to generate findings that span many wildfires in hopes of leading to more generalizable insights.*

To achieve the following objectives, we selected 25 from 2011 and 2012 fires representing a range of biophysical characteristics and randomly selected individuals from each fire to complete a survey questionnaire, then applied statistical techniques to the data.

Research Objectives

1) Understand people’s perceptions of wildfire impacts across a range of wildfires with varying biophysical characteristics

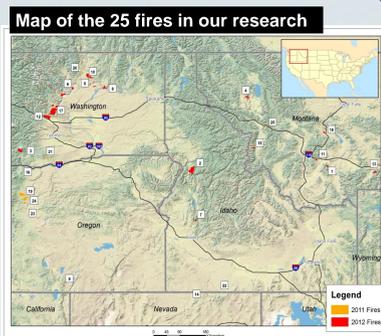
2) Explore the influence of biophysical and social characteristics on these perceptions

Methods

Fire Selection Process

- 1) Fires > 1,000 acres were selected within forested ecoregions in WA, OR, MT, and ID
- 2) Using a 15 km buffer, only fires intersecting Census places and urban clusters within the forested ecoregions were selected
- 3) Removed fires with < 200 available mailing addresses from the Census block whose centroid intersected the sampling frame

This process resulted in 25 fires



Select biophysical characteristics of the fires

ID #	Fire name	Year	Duration (days)	Acres
1	Pony	2012	14	5,156
2	Sheep	2012	61	48,636
3	Cascade Creek	2012	33	20,098
4	West Garceau	2012	11	9,862
5	Manila Creek	2012	3	1,620
6	Antoine 2	2012	4	6,838
7	Springs	2012	18	6,154
8	Buffalo Lake Road	2012	5	11,302
9	Hickey	2012	n/a	2,805
10	St Marys Mission Road	2012	12	16,853
11	Nineteen Mile	2012	9	4,233
12	Taylor Bridge	2012	15	28,077
13	Pine Creek	2012	2	9,589
14	McCall	2012	n/a	1,031
15	Sawtooth	2012	56	5,927
16	Highway 141	2012	8	1,635
17	Wenatchee Complex	2012	83	95,090
18	Corral	2012	7	1,851
19	High Cascade Complex	2011	43	44,498
20	Salmon	2011	5	2,014
21	Monastery Complex	2011	14	3,683
22	Pole Creek	2011	1	1,420
23	Alder Springs	2011	4	1,588
24	Elk	2011	1	1,167
25	West Riverside	2011	24	3,566

Sample Selection

Purchased a random sample of 5,500 mailing addresses from Survey Sampling International. Addresses within the Census blocks (assigned to the nearest fire) were isolated, sorted by fire, and stratified to randomly select 220 addresses for each fire.

Data Collection

We used a mixed-mode internet/mail approach following the Dillman method (Dillman, 2007) to collect survey responses from August to October 2013.

Variables (measured on a 5-point Likert scale)

Dependent Variables:

- Impacts on psychological well-being
- Perceptions of the wildfire ‘extremity’ (operationalized as ‘typicality’)

Predictor Variables:

- Biophysical characteristics of the fire (duration and acres)
- Perceptions of the biophysical characteristics (size, proximity to homes, spread, intensity, duration, climate conditions, fire behavior)
- Individual and community level recovery
- Satisfaction with management of the fire
- Feeling informed and prepared before the fire

Analysis and Results

We received a total of 834 completed surveys out of a final sample size of 4,989 (after removing bad addresses) for a **17% response rate**.

Analysis (in SPSS)

We used factor analysis techniques (oblique rotation) to identify latent constructs among the items in the main sets of variables (when the construct was measured by more than 1 item). E.g.,

Factor analysis table for perceptions of biophysical characteristics of the fire	
Item	Factor Loading
<i>scale: strongly disagree (-2) to strongly agree (2)</i>	
The fire spread more rapidly than typical	0.86
The fire burned more intensely than typical	0.85
The fire burned longer than typical	0.78
The size was bigger than typical	0.77
The fire exhibited unusual behavior	0.73
The fire conditions (e.g., wind, temperature) were unusual	0.68
The fire was closer to homes than typical	0.57
Factor mean (SD)	0.34 (.92)
Eigenvalue	3.97
% Variance explained	56.77
Cronbach’s alpha	0.87

Factor analysis table for impacts of the fire on psychological well-being	
Item	Factor Loading
<i>scale: 1 = not at all to 5 = extremely</i>	
Lost sleep	0.89
Felt anxiety about property damage	0.82
Felt anxiety about the fire injuring self or family	0.80
Felt helpless	0.79
Health suffered	0.65
Factor mean (SD)	1.60 (.80)
Eigenvalue	3.13
% Variance explained	62.62
Cronbach’s alpha	0.85

Regression

We used linear regression models to explore the impact of the predictor variables on 1) the psychological well-being measure and 2) perceptions of the ‘typicality’ of the wildfire event

Linear Regression Predicting Impact on Perceptions of Typicality				
Predictor	Standardized Beta	t	Sig.	
Fire duration	-0.10	-1.41	0.16	
Acres burned	0.14	1.98	0.04*	
Perceptions of biophysical characteristics	0.24	6.10	0.00*	
Satisfaction with Management	-0.01	-0.06	0.96	
Perceptions of personal and community recovery from impacts	-0.11	-2.81	0.01*	
Proximity of fire to home	0.04	1.00	0.32	
Well-being	0.02	0.42	0.67	
Feeling informed and prepared before the fire	0.01	0.21	0.84	
F-statistic			9.44*	
Adjusted R ²			0.09	
p < .05				

Linear Regression Predicting Impact on Well-being				
Predictor	Standardized Beta	t	Sig.	
Fire duration	0.15	2.33	0.02*	
Acres burned	-0.12	-1.97	0.04*	
Perceptions of biophysical characteristics	0.19	5.25	0.00*	
Satisfaction with Management	0.03	0.69	0.49	
Perceptions of personal and community recovery from impacts	-0.27	-7.54	0.00*	
Proximity of fire to home	0.28	8.22	0.00*	
Perception of typicality	0.02	0.42	0.67	
Feeling informed and prepared before the fire	-0.08	-2.37	0.02*	
F-statistic			30.18*	
Adjusted R ²			0.26	
*p < .05				

Hierarchical Linear Modelling (HLM)

We began to explore the nested nature of our study design using HLM to help understand which effects were at the wildfire level and which effects are at the individual level, and the extent of those effects.

Mixed Model Results for Perceptions of Typicality			
Null Model			
Random Effect	Variance Component	Standard Error	
Level 2 effect (wildfire)	0.05	0.02	
Level 1 effect (individual)	0.77	0.04	
Variance explained = 0.05/(0.05+0.77) = 0.06			

Fixed Effects Model (only sig. pred. shown) for Perceptions of Typicality				
Parameter	Estimate	Std. Error	t	Sig.
Perceptions of biophysical characteristics	0.23	0.04	5.76	0.00*
Perceptions of recovery from impacts	-0.13	0.04	-2.73	0.01*

Mixed Model Results for Impacts on Well-being			
Null Model			
Random Effect	Variance Component	Standard Error	
Level 2 effect (wildfire)	0.03	0.01	
Level 1 effect (individual)	0.60	0.03	
Variance explained = .03/(.03+.60) = 0.05			

Fixed Effects Model (only sig. pred. shown) for Impacts on Well-being				
Parameter	Estimate	Std. Error	t	Sig.
Duration	0.01	0.00	2.19	0.04*
Perceptions of biophysical characteristics	0.16	0.03	5.29	0.00*
Perceptions of recovery from impacts	-0.22	0.03	-7.54	0.00*
Proximity to house	0.16	0.02	8.22	0.00*
Feeling informed and prepared	-0.07	0.03	-2.41	0.01*

Discussion

The initial analyses indicates that both social (perceptual) variables and biophysical variables influence people’s perceptions of the typicality of the wildfire as well as the impact on their psychological well-being.

Specifically, linear regression results indicate that perceptions of typicality were significantly predicted by:

- acres burned, perceptions of the biophysical characteristics of the fire, and perceptions of individual and community recovery from the wildfire impacts (explaining about 9% of the variance)

Impacts on psychological well-being from wildfires were significantly predicted by:

- The duration of the fire, acres burned, perceptions of the biophysical characteristics, perceptions of personal and community recovery from impacts, proximity of the fire to one’s home, and a feeling of being informed and prepared before the fire (explaining about 26% of the variance)



Initial hierarchical linear modelling (HLM), which accounts for the nested nature of our research design more appropriately than linear regression, provides similar insights into the factors that affect each of our dependent variables.

The null model also indicates that about 6% of the variance in perceptions of typicality is between wildfires and about 5% of the variance in impacts on well-being is between wildfires (i.e., not at the individual household level).

Future Work

- 1) The next phase of analysis will explore the nested design with more detail, paying special attention to fixed and random effects so we can make more definitive statements about the role of social and biophysical variables
- 2) Follow-up interviews with willing respondents to explore the relationships found in the questionnaire data in more depth
- 3) Gain a better understanding of the biophysical characteristics of the fires by including more variables (e.g., burn severity) in the HLM analysis, as well as analyzing pre- and post-fire remotely sensed images for a bigger picture perspective



References

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