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LETTER

Finding common ground: agreement on increasing wildfire risk crosses political lines

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Abstract

Wildfire is a growing threat in the western US, driven by high fuel loads, a warming climate, and rising human activity in the wildland urban interface. Diverse stakeholders must collaborate to mitigate risk and adapt to changing conditions. Communication strategies in collaborative efforts may be most effective if they align with local perspectives on wildfire and climate change. We investigate drivers of residents' subjective perceptions regarding both issues in eastern Oregon using 2018 survey data, and examine objective evidence regarding local fuel loads, climate, and wildfire to identify trends and contextualize residents' perceptions. We find that sociopolitical identity strongly predicts climate change beliefs, and that identity and climate beliefs predict both perceptions of recent past climate and likely future trends. Political influences on climate perceptions are strongest among people whose friends mostly belong to the same party. In contrast, perceptions about future wildfire risks are largely independent of climate-change beliefs, and of individual or peer-group politics. Most people accurately perceive the rising frequency of large wildfires, and expect this trend to continue. Decision makers have an opportunity to engage diverse stakeholders in developing policies to mitigate increasing wildfire risk without invoking climate change, which remains politically polarizing in some communities.

1. Introduction

In 2018, over 58 000 wildland fires, covering over 3.5 M ha, burned across the US. Suppression costs for the federal government were $3.1B (NIFC 2018). Costs are rising due to legacy of past forest management practices, including fire suppression leading to high fuel loads, a lengthening fire season, and increased settlement in the wildland-urban interface (Dale 2006; Westerling *et al* 2006). In regions such as the Intermountain West, decades of federal management for sustained yield in timber-dependent economies were followed by environmental protections, further contributing to the current state of overgrown stands of small trees with limited commercial value and high risk of fire and disease outbreak (Nielsen-Pincus and Moseley 2013). Human-caused ignitions are also causing more fires and lengthening the fire season (Balch *et al* 2017). Current forest conditions and fire regimes coupled with public demands for complete fire suppression have created a socioecological pathology of declining forest health and increased fire risk (Fischer *et al* 2016). Residents living near forests

often perceive risk from observed changes in forest conditions, particularly on the vast majority of lands that are federally managed (Lynn *et al* 2011).

Recently, some US politicians have framed increasingly frequent large wildfires (see trends here Dennison *et al* 2014) in two ways, reflecting the politicization of climate change. Following the wildfires in California in 2018 that resulted in human fatalities, Governor Jerry Brown described the disasters as 'the new abnormal,' ascribing the unprecedented wildfires largely to climate change (Ashton 2018). In contrast, President Trump attributed the disasters solely to inadequate fuels management. As described above, fire scientists view the wildfire problem as a confluence of all of these factors. Many also conclude that communities must adapt to a future of increasingly frequent destructive wildfires, because fuels management is unlikely to occur at the pace and scale necessary to combat the effects of warming on wildfire risk (Schoennagel *et al* 2017).

Temperatures have risen 1.0 °C (1.8 °F) between 1901 and 2016 over the contiguous US. Conservative climate projections predict a 1.4 °F rise in mean temperature in the next few decades (2021–2050) across the US relative to the average from 1976–2005 (Wuebbles *et al* 2017), as well as reduced precipitation in some regions, and increased frequency and severity of drought (IPCC 2014). Future climate changes will impact the 300 M ha of forest in the US, including changes in species communities, productivity, and the extent, frequency, and intensity wildfires and other disturbances (e.g. hurricanes and insect outbreaks) (Kurz *et al* 2008, Allen *et al* 2010, Waring *et al* 2011). Interactions between shifting climate and wildfire regimes may also cause forests to transition to novel ecosystem states (Schoennagel *et al* 2017, Davis *et al* 2019).

Mitigating wildfire risks and impacts requires collaborative efforts between stakeholders at local and regional levels, including private landowners, public lands managers, as well as local, state, and federal government agencies. However, few studies consider how communication and dialogue among stakeholders may be most effectively oriented around the two causative factors of fuel loads and climate change, or some synthesis of both. Emphasizing the role of climate change may cause climate change skeptics to resist or question the credibility of risk information about wildfire and other hazards (Dixon *et al* 2018). Therefore, communication within these collaborative processes may be most effective if the perspectives of those involved are clear from the outset.

We focus on the Blue Mountains of northeast Oregon, where previous telephone and mail surveys found high concern about forest conditions among local residents. Most people perceive that forest conditions have worsened in the last 20 years, and they worry about wildfire (Hartter *et al* 2015). There is overwhelming concern that public lands are

managed poorly as a whole and have high wildfire risk, but there is a much lower concern about climate change. Awareness of past warming is correlated with respondent education and political beliefs, but not with years lived in this area. Fewer than half expect future warming, a pattern that limits support for climate adaptation planning (Hamilton *et al* 2012, 2014, 2015, 2016, Hartter *et al* 2015, Boag *et al* 2015). This paper extends the work with new data from a 2018 telephone survey. We examine the social bases of perceptions concerning past and future trends in wildfires—which diverge from perceptions about climate.

To provide context for resident' perspectives we look at forest conditions on public and private lands to understand current fuel loads, then use local climate and wildfire data to identify trends in climate and area burned. Our survey polled residents on their subjective perceptions concerning climate change and wildfires. Analyses of survey responses test how individual characteristics and sociopolitical identity influence the accuracy of perceptions of both topics; and to what extent climate-change and wildfire perceptions are linked. The physical links between these phenomena are well studied, but their subjective links are complicated by political beliefs.

2. Study site

The Blue Mountains (62 000 km^2), situated between the Cascade Mountains and the Rocky Mountains, are located in the northwestern United States and cover areas in Washington, Oregon, and Idaho (figure 1). The Blue Mountains in eastern Oregon are characteristic of the broader region, with ponderosa pine (*Pinus ponderosa*) dominating drier and warmer sites. Grand fir (*Abies grandis*), lodgepole pine (*Pinus contorta* var. *latifolia*), western larch (*Larix occidentalis*), and Douglas fir (*Pseudotsuga menziesii*) forests occur at mid-elevations and in wetter sites. Subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), whitebark pine (*Pinus albicaulus*), and lodgepole pine characterize higher-elevation, moist, and cool sites. Over a century of environmental alterations have led to changes in forest structure, fire regimes, species assemblages, and riparian conditions, and in recent decades the region has seen reduced forest vigor and increased mortality from wildfire, insects, and disease (Langston 1995, Hessburg *et al* 2005).

In this paper, we examine forest conditions and public opinion in a subset of three counties in the Blue Mountains: Wallowa, Union, and Baker, which exemplify the region's social, ecological, and economic conditions, and where we have conducted previous survey research. Baker (pop. 16 134 in 2010), Union (pop. 25 748), and Wallowa (pop. 7008) counties are some of the least populated and most rugged places in
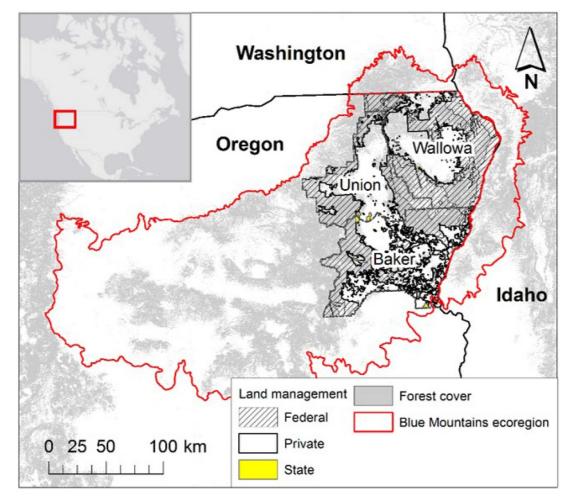
Figure 1. Three counties included in this study in eastern Oregon's Blue Mountain ecoregion, where 53% of land and 70% of forest is managed by the federal government.

Oregon, and the federal government manages much of the land (1.1 M ha, ~53% of total land area) in these counties. Timber production from both small and large operations fell drastically over the last 20–30 years, led by a decline of more than 90% in federal-land harvests. Harvesting on some private lands has increased, but it has not offset the federal change. Overall harvest decline, coupled with rising global competition, caused most of the industrial-capacity mills to close within the last 25 years.

Northeast Oregon exemplifies the national trend of the disintegration of large timber companies separating their manufacturing and lands. Retirees have increasingly purchased private lands, as have the independently wealthy and those with careers that allow them to work remotely. Amenity-based property buyers have purchased small to medium tracts of land as seasonal or second homes, or have moved to these areas permanently. These changes in land ownership have changed the ways forests are valued, managed, and used.

3. Data and methods

We assessed forest structure using live and dead standing basal area, volume of coarse woody debris (CWD;

defined identically to 1000 hour fuels), and stand density index (SDI). SDI provides a more sensitive measure of stand density than basal area, because it accounts for tree size (Kershaw *et al* 2016), and the inclusion of CWD and dead basal area helps to assess overcrowding and fuel loads. We derived all measures from 3414 US Forest Service Forest Inventory and Analysis (FIA) program inventory plots for the Blue Mountains ecoregion, reflecting the most recently completed panel under the current annualized design across the entire study region (through inventory year 2016). We also completed the same analysis using 14 095 plots from the broader Inland Northwest region (see supplementary information (stacks.iop.org/ERL/15/065002/mmedia)), recognizing that conditions across the broader region may also affect local perceptions. Plots were categorized by ownership (Public/Private) and by forest type, with stratum weights as defined by the relevant POP_EVAL_GRP and PLOTSNAP tables for each state in the FIA database. Full description of methods for computing estimates of standing totals or areal means under the stratified, annualized FIA plot design can be found in Bechtold and Patterson (2005); descriptions of the raw data tables can be found in US Forest Service (2015). Additional detail

on the downed wood portion of the inventory is provided by Woodall *et al* (2019).
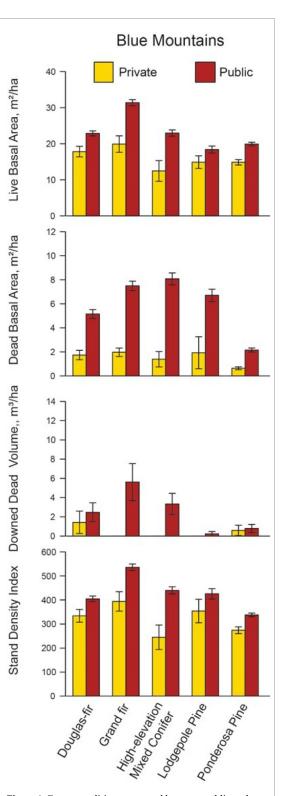
We acquired fire data from three different sources for the Blue Mountains to develop a comprehensive historical fire database: Oregon Department of Forestry (www.odf.state.or.us/DIVISIONS/protection/fire_protection/fires/FIRESlist.asp), FIRESTAT (wildfire.cr.usgs.gov/firehistory/data.html), and GEOMAC (rmgsc.cr.usgs.gov/outgoing/GeoMAC/historic_fire_data). Data were merged based on the following format: FIRESTAT records from 1980 thru 2016, ODF records from 1959 thru 2018, and GEOMAC records from 2017 thru 2018. From these data, records within one kilometer of each other were found and fire report dates were compared. If the report date was within one day of each other, one record was removed and if the dates were more than a day apart, they were both kept.

Residents' perceptions on climate change and wildfire were examined using a telephone survey conducted in September 2018 ($n = 1097$). Phone numbers (land and cell phones) were selected at random within three northeast Oregon counties (Baker, Union and Wallowa) to obtain a representative cross-section of their public. Surveys lasted 10–15 min, conducted by trained interviewers at the University of New Hampshire Survey Center. Sampling or probability weights were calculated, and applied to all graphs and tables in this paper, using a scheme similar to that described in Hamilton *et al* (2014). The weights allow mostly minor adjustments to compensate for possible design or response bias arising from variations in household size or telephone coverage, population differences between counties, and differences between sample and population age/sex distributions. Table 1 gives the wording, codes, and weighted response percentages for questions analyzed in this paper.

Weighted logit regression models, widely used for survey analysis, were employed to characterize the effects of respondent characteristics and location as predictors of views concerning past or future climate change and fires. These models estimate the odds for a binary dependent variable (such as recent temperatures warmer, or not) as functions of any number of categorical or measurement predictors. Interaction effects correspond to effects from a composite variable formed by multiplying the two interacting terms, although for these models a more direct method was used. Modeling and other survey analyses, including graphics and adjusted margins plots, were performed using Stata version 16. See Hamilton (2013) for background on methods and software.

4. Results

Our analysis of forest plot data indicates significantly denser forests on public versus private lands, as measured by both BA and SDI, and public lands held more standing and downed dead fuels (figure 2).

Figure 2. Forest condition compared between public and private ownership in the Blue Mountains. Average stand density of FIA plots on public and private lands in terms of (a) Live basal area, (b) Standing dead basal area, (c) Coarse woody debris volume, and (d) Stand density index (SDI). Paired bars represent plots on public vs private lands, across 5 major forest types. Bars represent standard error. Differences in SDI, dead basal area, live basal area are statistically significant based on Tukey's HSD at the $\alpha = 0.01$ level.

The difference was consistent at both the scale of the Blue Mountains (figure 2) and the Inland Northwest (see supplementary information). The consistency of

Table 1. Variable definitions with weighted summary statistics from the 2018 survey, and coding employed for regression analysis in table 2. Wildfire and temperature questions were asked before climate change or political questions; the order of response choices for both types was rotated in interviews. We distinguish a fourth political group, Tea Party supporters (regardless of their nominal party identification), because research has established this group as substantially more conservative than non-Tea Party Republicans, across many environment-related issues (Hamilton and Saito 2015).

Wildfire, weather and climate

Firepast—'Which of the following statements about wildfire in this region do you believe is most accurate?
Large wildfires in Northeast Oregon over the past 20 years…'
Have been less frequent, on average, than 30 or 40 years ago (0, 6%)
Have been about the same frequency, on average, as 30 or 40 years ago (0, 17%)
Have been more frequent, on average, than 30 or 40 years ago (1, 69%)
Do not know/no answer (0, 8%)

Firefut—'Which of the following statements best describes your belief about future wildfire in this region?
Large wildfires in Northeast Oregon over the next 20 years are likely to become …'
Less frequent, on average, than wildfires of the past 20 years (0, 5%)
About the same frequency, on average, as wildfires of the past 20 years (0, 21%)
More frequent, on average, than wildfires of the past 20 years (1, 70%)
Do not know/no answer (0, 5%)

Tempast—'Which of the following statements about past climate in this region do you believe is most accurate?
Northeast Oregon summer temperatures over the past 20 years …'
Have been cooler, on average, than summers 30 or 40 years ago (0, 5%)
Have been about the same, on average, as summers 30 or 40 years ago (0, 41%)
Have been warmer, on average, than summers 30 or 40 years ago (1, 46%)
Do not know/no answer (0, 7%)

Tempfut—'Which of the following statements best describes your belief about future climate in this region?
Northeast Oregon summer temperatures over the next 20 years are likely to be …'
Cooler, on average, than summers of the past 20 years (0, 3%)
About the same, on average, as summers of the past 20 years (0, 44%)
Warmer, on average, than summers of the past 20 years (1, 44%)
Do not know/no answer (0, 9%)

Climate—'Which of the following three statements do you think is more accurate?'
Climate change is happening now, caused mainly by human activities (1, 48%)
Climate change is happening now, but caused mainly by natural forces (0, 38%)
Climate change is not happening now (0, 6%)
Do not know/no answer (0, 8%)

Respondent Characteristics
Age—Age in years (18–96 years, mean 52)
Sex—male (0, 49%), female (1, 51%)
Lived—'How many years have you lived in this area?' (1–96 years, mean 30)
Education—High school or less (−1, 29%), some college or technical school (0, 30%), college graduate (1, 27%), postgraduate work (2, 13%).
Party—Democrat (−1, 25%), Independent (0, 15%), Republican (1, 39%), Tea Party supporter (2, 20%).
Friends—'Would you say that most of your friends prefer the same political party that you do (1, 34%)? Or do most prefer different parties (0, 10%)? Or are they about evenly divided (0, 47%)?'

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the difference in measured SDI supports the inference that differences are not merely due to larger trees or differences in forest type between public and private lands. On public lands across all forest types, more than 30% of plots exceeded 30 m² ha⁻¹ of live basal area; such dense plots exceed guidelines to maintain healthy, pest-free stands with acceptable surface and ladder fuel loads, and consequent lowered risk of high intensity fires (e.g. crown fires) on nearly all combinations of forest type, site class, and average stand diameter (Cochran *et al* 1994, Stine *et al* 2014). There are, however, dense plots on private lands as well, where more than 10% of plots exceed 30 m² ha⁻¹. These same patterns are reflected in standing and downed dead fuels, though differences were not always statistically significant for downed

dead fuels due to low sample size in individual forest types, and patchy distribution of dead wood at the plot scale.

In the Blue Mountains we see no clear trends since 1970 in the frequency of wildfires greater than 100 acres (40 ha), or greater than 1000 acres (405 ha). Extremely large fires, above 20 000 acres (8094 ha), have become more common. Most fires do occur on public lands, but not exclusively. Some start on private land and then cross onto public land, while others remain on public or private lands only.

Figure 3(a) charts the frequency of very large wildfires (>20 000 acres) in the Blue Mountains by decade, up to our 2018 public survey. No fires this large were observed in 1959–68 or 1969–78; two happened in 1979–88 and five in 1989–98. In

contrast, seven very large wildfires occurred in each of the two most recent decades. This two-decade span corresponds, intentionally, to the wording of our 2018 survey question asking whether large wildfires in this region became more frequent in the past 20 years, compared with 30 or 40 years ago (exact wording in table 1). The 20 000 acre cutoff pictured in figure 3(a) is admittedly arbitrary, although an alternative metric—total area burned—yields similar results. Lower cutoffs produce inconsistent results, but the pattern seen with of 20 000-acre fires in figure 3(a) (or with total area burned) fits well with public perceptions about (vaguely defined) 'large wildfires.' Overall, 69% of respondents agreed that large fires have become more frequent. Figure 3(b) shows minor age differences (young or middle-aged respondents were more accurate) but no significant differences by respondent education, climate beliefs, or political party.

Regarding the age dimension in figure 3(b), we do not assume responses about past wildfires or temperatures are memory-informed; many people will be too young, or too recently moved to this region, to answer from memory. Their subjective perceptions about past fires might equally well be informed by things they have read, heard from others, or just guessed. To some degree, the possibility of memory effects can be viewed as an empirical hypothesis, to be tested more formally in table 2. The weakly significant ($p = 0.03$) bivariate age effect in figure 3(b) suggests that on average, older respondents were less accurate on this fire question.

Observed fire season (summer) temperatures in northeast Oregon also follow an upward trend, one that is clearer and of longer duration than the trend for large fires. Figure 4(a) charts June–September temperature anomalies by decade in this region, highlighting the exceptional recent conditions. Our metric in figure 4(a), decadal average temperatures, was chosen to fit the survey question's wording. Whereas more than two-thirds of survey respondents accurately perceived the increase in fires, fewer than half (46%) acknowledge rising average temperatures. Figure 4(b) shows wide variation in temperature responses depending on people's climate beliefs and political identity. Those who do not believe that human activities are changing the climate, along with those who identify as Republicans or Tea Party supporters, are far less likely to acknowledge summer warming. Although wildfire and summer temperatures in this region both are consequential, personally experienced, and objectively well measured phenomena, temperature perceptions evoke sociopolitical identity in ways that wildfire perceptions do not. Respondent age has no effect on the accuracy of past-temperature perceptions.

Table 2 presents a systematic analysis of individual respondent characteristics as predictors of responses about past and future trends in wildfires and summer

temperatures, along with more general beliefs about climate change. Odds ratios and corresponding Wald test probabilities from five weighted logit regression models are shown. Odds ratios describe multiplicative effects from a 1-unit increase in each predictor variable, on the odds that the dependent variable equals 1 (variables and coding defined in table 1). For example, odds of responding that fires have become more frequent (*firepast* = 1) are multiplied by 0.984, or decreased by 1.6%, with each one-year increase in respondent age; they decrease by about 15% (are multiplied by $0.984^{10} = 0.85$) with each 10 years of age. That is, older respondents are significantly less likely to say that fires have increased, although in fact they have.

The *education × party* interaction terms in these models test for effects that proved important in many previous studies of climate-related beliefs (e.g. Hamilton 2008, McCright and Dunlap 2011), including previous studies in northeast Oregon (Hamilton *et al* 2014, 2016). The results show significant effects on perceptions that past temperatures and fires have increased (*tempast* and *firepast*). In both cases, odds ratios below 1.0 indicate that the odds of accurately perceiving recent warming or fire trends increase with education among Democrats, but actually decline with education among Tea Party supporters; other political groups fall in between. Such patterns were expected for these interactions, having been seen in many previous studies with environment or science-related dependent variables. If *education × party* interaction terms were not included in our models, they would essentially average positive (Democrat) with negative (Tea Party) effects, leading to a false conclusion that education has 'no effect.'

The *friends × party* interaction term follows a more recent report of similar effects on temperature perceptions in New England (Hamilton *et al* 2018). We see significant effects on the three explicitly climate-linked variables (*tempast, tempfut, climate*) but not on the fire variables, a noteworthy pattern depicted later in graphical terms.

Accuracy in characterizing past fire trends (*firepast*, increasing frequency of large fires) is significantly lower among older respondents, as expected from figure 3. Accuracy is higher, however, among longer-term residents, suggesting that the age effect might partly reflect retirees who arrived from outside the region. More educated respondents also are more accurate, and the education effect is stronger among self-identified Democrats or Independents, compared with Republicans or Tea Party supporters (interpreting the significant *education × party* interaction effect). Most respondents (70%) also expect large wildfires to become more frequent in the near future (*firefut*). This expectation rises with education, but appears otherwise unrelated to respondent characteristics.
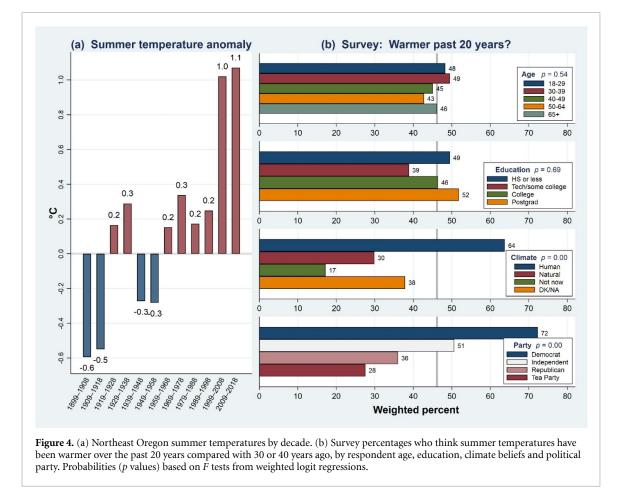
Figure 3. (a) Extremely large fire (>20 000 ac) frequency by decade. (b) Affirmative responses to the survey question, 'Which of the following statements about wildfire in this region do you believe is most accurate? Large wildfires in northeast Oregon over the past 20 years have been more frequent, on average, than 30 or 40 years ago' by respondent age, education, climate beliefs, and political party. Probabilities (*p* values) based on *F* tests from weighted logit regressions.

Table 2. Respondent characteristics as predictors of views concerning past and future wildfire frequency, past and future summer temperature, and climate change. Values shown are odds ratios (e^b), or multiplicative effects on the odds that $y = 1$ (see coding in table 2), with Wald test *p*-values from weighted logit regressions (estimation sample $n = 981$).

| Predictor | Dependent variable | | | | |
	Firepast	Firefut	Tempast	Tempfut	Climate
Age	0.984(0.001)	0.996(0.364)	1.004(0.455)	0.998(0.699)	0.984(0.001)
Sex (female)	1.334(0.060)	0.938(0.683)	0.715(0.032)	0.960(0.808)	1.125(0.468)
Lived	1.008(0.041)	1.008(0.057)	1.000(0.966)	0.991(0.046)	0.996(0.374)
Climate	1.056(0.761)	0.958(0.821)	3.097(0.000)	4.037(0.000)	…
Education	1.227(0.023)	1.334(0.002)	1.010(0.907)	1.202(0.029)	1.164(0.102)
Party	0.981(0.852)	0.842(0.083)	0.738(0.002)	0.570(0.000)	0.501(0.000)
Ed × party	0.836(0.011)	0.950(0.460)	0.852(0.027)	0.957(0.555)	0.900(0.204)
Friends	1.026(0.891)	0.872(0.481)	1.119(0.543)	1.296(0.203)	2.428(0.000)
Friends × party	1.299(0.071)	1.138(0.382)	0.734(0.044)	0.716(0.050)	0.401(0.000)
F statistic	3.05(0.001)	1.82(0.060)	15.75(0.000)	24.81(0.000)	18.15(0.000)

Responses concerning past and future temperatures, as well as climate change itself, exhibit no age effects, but much stronger associations with sociopolitical identity. *Tempast* (recent temperatures warmer than past) and *tempfut* (future temperatures warmer than present) are predicted both by climate-change beliefs and political identity. Moreover, political effects on temperature perceptions (and also on climate-change beliefs) are stronger among respondents who say that most of their friends belong to the same political party they do (interpretation of the *friends × party* interactions). Table 2 results thus support a conclusion that wildfire perceptions

are comparatively realistic, and mostly independent from sociopolitical identity. Temperature perceptions concern an equally physical phenomenon, but in this region they tend to be less realistic—given that summers have objectively warmed quite a bit, and are projected to warm further. Unrealistic temperature perceptions are influenced by rejection of climate change, which again links to sociopolitical identity.

The 'socio' part of sociopolitical is emphasized by *friends × party* interaction effects, statistically significant for both temperature items and for climate change, but not for either fire item. Figure 5 visualizes these interactions with adjusted margins

Figure 4. (a) Northeast Oregon summer temperatures by decade. (b) Survey percentages who think summer temperatures have been warmer over the past 20 years compared with 30 or 40 years ago, by respondent age, education, climate beliefs and political party. Probabilities (*p* values) based on *F* tests from weighted logit regressions.

plots, calculated from four of the models in table 2. In each case except fires (panel 5a), we see a clear partisan gradient, from higher to lower recognition of summer warming or climate change as we move from Democrats and Independents to Republicans and Tea Party supporters. The interactions cause that gradient to steepen, so political effects become stronger for people whose friends mostly belong to the same party.
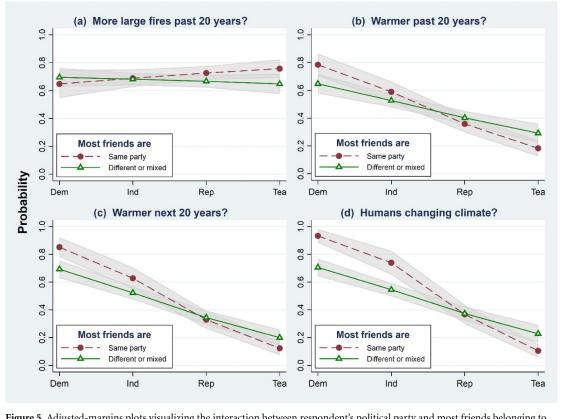
5. Discussion and conclusion

Forests in the US West are impacted by climate change combined with land management practices and policies. We show that eastern Oregon forests—reflecting conditions across the broader Intermountain West—have high fuel loads, particularly on public lands, consistent with concerns expressed by community members (Hartter *et al* 2015). We also demonstrate that most survey respondents accurately perceive the increasing risk of large wildfires. Importantly, increasing wildfire risk is a common touchpoint around which individuals with different political identities can rally: it provides a bridge among social circles and identities and a way to connect with disparate members of communities.

There have been highly publicized calls to increase forest restoration in western US forests

(Huago *et al* 2015). Public opinion matters because forest management and restoration are expensive, and require public support. Our survey results highlight the disconnect between mostly realistic perceptions of fire trends, and partly realistic but partly political perceptions about the climate changes affecting those trends. Previous analyses found that although many people in the region acknowledge changing climate conditions, they often attribute these to natural causes (Boag *et al* 2018, Hartter *et al* 2018).

Temperature records show that fire seasons in this region have warmed dramatically, at roughly double the pace of global climate change (Hamilton *et al* 2016). Model projections suggest greater warming lies ahead (NRC 2011, Alder and Hostetler 2013). However, even the tangible and well documented recent changes go unrecognized by many area residents. For some, perceptions are shaped instead by climate change beliefs tied to their sociopolitical identity. Despite overwhelming agreement among scientists on the reality of anthropogenic climate change, admitting that reality remains a very polarized, contentious issue among the general public in this region, as it is nationwide (Zia and Todd 2010, McCright and Dunlap 2011, Brewer 2012, Marquart-Pyatt *et al* 2014, Hamilton *et al* 2015, Shwom *et al* 2015, Dunlap *et al* 2016, Shao 2016a). Northeast Oregon residents who reject the reality of

Figure 5. Adjusted-margins plots visualizing the interaction between respondent's political party and most friends belonging to same party, affecting the probability of thinking that (a) Large wildfires have been more frequent in the past 20 years. (b) Summer temperatures have been warmer the past 20 years. (c) Summer temperatures will be warmer in the next 20 years and (d) Humans are changing climate. Calculated from logit models in table 2.

anthropogenic climate change also reject the reality of local warming, along with scientific predictions that it will continue into the future.

We recognize there may be other factors affecting perceptions as well. Research suggests people only consider extreme weather remarkable if it is unusual compared to weather in recent years, and therefore they may fail to perceive climate change-induced weather that is extreme compared to historical normals (Moore *et al* 2019). However, extreme-weather perceptions, like temperature perceptions, often show effects from sociopolitical identity (Cutler 2015, Shao 2016b, Borick and Rabe 2017).

Our analysis contrasted temperature and climate perceptions with views on large wildfires, where an objective increase is recognized by most respondents. Most respondents also believe that such fires will grow more frequent in the future. The lack of sociopolitical divisions on wildfire, unlike those on climate, suggests that fires are viewed less politically. Speculatively, however, there is another possible explanation: sociopolitical divisions exist on wildfire too, but are offsetting. That is, people who accept the reality of anthropogenic warming might see rising large-wildfire frequency, in the recent past and near future, as consistent with warming. At the same time, people who reject anthropogenic warming may have different but also identity-consistent explanations for

increasing fire risks, tied to widely-expressed critiques of federal management, and reduced cutting (Boag *et al* 2018). Importantly, our regressions showed climate change beliefs did not predict views on past/future large fires, but that non-significant result may reflect this offsetting phenomenon.

Our main political-identity indicator refers to parties, and at earlier times we might have linked this to ideology. There is nothing ideological about temperature, however. Increasingly it seems more realistic to interpret party statements in terms of individuals' sociopolitical identity, instead; members of particular groups share beliefs about reality. The *friends* variable makes social effects on such beliefs explicit by visibly magnifying partisanship: people whose friends mostly belong to the same party they do hold views more aligned with that party. Cause and effect could involve positive feedback, with stronger partisans choosing like-minded friends, and like-minded friends inducing greater partisanship. These results from northeast Oregon parallel observations of similar *friends × party* interaction effects on perceptions of winter warming among residents of northern New England (Hamilton *et al* 2018). Replication of similar effects across different rural regions and locally-focused questions invites further research testing how widespread such interactions might be.

Climate change and wildfire risk threaten fragile economies in this region that have a legacy dependence on forests and public lands. Climate change and variability are particular threats to many rural communities, potentially exposing and magnifying their vulnerabilities (Flint *et al* 2009).

For instance, forecasted increases in catastrophic wildfires, drought, and insect proliferation impact the capacity of communities to adapt and to mitigate associated risks (Torn *et al* 1998, Gude *et al* 2008). Communities historically dependent on the forest products industry and underlying forest conditions are at the nexus of these changes and are therefore highly vulnerable.

However, we find that neither politics nor climate beliefs affect views on the risk of future wildfires. People who believe anthropogenic climate change is happening are neither more nor less likely than other residents to expect more large fires. Across different climate beliefs and sociopolitical identities, most people recognize the rising frequency of large wildfires, and expect this trend to continue. Given this sociopolitical context, land managers in the Inland Northwest might engage the public effectively in forest management policy by focusing messaging on restoration toward more fire-adapted forests, without invoking the polarized issue of climate change. Bipartisan local concern may also provide avenues for more frank discussions about altering development in the wildland urban interface (WUI). This is a key issue that was beyond the scope of this study and should be a priority for future research.

While more successful in the short term, a causality-agnostic approach has limitations. It precludes discussions of broader climate change adaptation planning, and it is highly unlikely that fuels management will occur at the pace and scale necessary to counteract the effects of warming on wildfire risk at landscape scales (Schoennagel *et al* 2017). At regional scales, fuel treatment area has little relationship to trends in area burned, which is primarily driven by drought and warming (Dennison *et al* 2014, Abatzoglou and Williams 2016, Schoennagel *et al* 2017). It also precludes conversations about aggressive climate change mitigation, and without emissions reductions, future climate change will overwhelm adaptation efforts.

While scientists should not shirk their responsibility to help forest owners, managers, and communities prepare for a hotter, drier future, focusing on fuels management in the short term in regions with high levels of politicization around climate change will appeal to a diverse set of stakeholders and may promote collaborative, cross-ownership management (Ager *et al* 2017). Such nuances in forest policy and management in the West are critical in the current, polarized political climate. Efforts led by agencies and nonprofits can use fire to connect with communities and build broad support for effective science-based

policy. For example, investing in forest restoration now could retain local jobs and milling infrastructure, essential to retaining future management options and keeping restoration costs down. A cohesive and cooperative strategy is necessary to plan for and adapt to climate change and wildfire across public and private lands.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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