

FINAL REPORT

PUBLIC PERCEPTIONS OF SMOKE AND AGENCY COMMUNICATION: A LONGITUDINAL ANALYSIS

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Report prepared by Stacey Frederick

Abstract

Wildfires have increased in number and severity in recent years, while the number of people living in communities at risk of fire has also dramatically increased. A result of this is that more people are being exposed to smoke from both wildfires and prescribed fires that are designed to reduce wildfire risk. The need to understand public acceptance of smoke has become increasingly clear, yet there has been little research on this topic in the past. This study examined citizens' perceptions of smoke management before and after exposure to an active wildfire and smoke season. After reviewing events in four previously surveyed sites for fire and smoke impacts (see JFSP project number 10-1-03-7), a follow-up questionnaire was sent to communities around the Shasta-Trinity National Forest in northern California. The follow-up survey was administered to the same individuals who completed a survey the year prior, producing longitudinal data and allowing us to analyze how their opinions changed after an active wildfire and smoke season. Need for this type of longitudinal information has been expressed by managers and scientists alike.

In addition to general perceptions of smoke, opinions of the forest and air management agencies were also examined. Changes in perceptions were measured using paired t-tests. These tests revealed no changes in the public's acceptance of smoke, regardless of the type of fire it was coming from. The majority of citizens' risk perceptions associated with smoke impacts also remained unchanged with the exception of a few impacts related to recreation and outdoor activities which increased significantly after the fire and smoke season. Other changes between years included shifts in the usefulness of different communication sources, an increase in the knowledge deficit regarding smoke, and decreases in the confidence for federal and state agencies to complete specific tasks.

Background and purpose

The purpose of this project was to improve our understanding of the factors that influence citizen acceptance of smoke and assess the impacts that fire and smoke experiences may have on perceptions of smoke and fire and smoke management agencies. There have been multiple fire social science studies that included a few smoke-related questions but most have not focused on smoke as a major topic of study. This study has additional value by incorporating a longitudinal component, a type of data rarely seen in this field (Stidham et al. 2014). Gaining insight into the response community members have after a fire and/or smoke event can also provide new ways for managers to improve their communication methods or to discover what is working well. Such knowledge can provide guidance regarding how people may react to smoke and how to deal with the conflicts that could arise from fire and smoke management (Bengston 1994).

Smoke from fires, regardless of the source, can affect air quality on local and regional scales. The resulting poor air quality can negatively impact citizens in many respects, from recreation impairment to the triggering of health issues. Roughly a third of the United States population suffers from a respiratory ailment that can be exacerbated by smoke (McCaffrey and Olsen 2012). Understanding public perceptions of smoke and how they may change after an active fire season can assist with future management strategies and goal setting.

Much like the difference in severity between prescribed fires and wildfires, studies are finding that there may be a difference between the smoke produced from wildfires and from fuel treatment fires. One study found that the smoke from prescribed fires may have less health impacts than wildfire smoke (Hardy et al. 2001).

While previous research has shown an increase in the acceptance of prescribed fire in many areas of the country, concerns over its use and the smoke it produces still remain (Loomis et al. 2001; Winter et al. 2002; Shindler and Toman 2003). Acceptability of smoke can influence the use of prescribed fire as a management tool and how agencies communicate with communities during wildland fires (Taylor et al. 2007, Weisshaupt et al. 2005, McCaffrey 2006). One study that focused on smoke perceptions found that even a small negative smoke event can influence the perceptions and attitudes of citizens and that the origin or source of the smoke influences acceptance (Carroll et al. 2005).

To examine social acceptance of smoke from different sources and how this and other associated factors may change over time, a random sample of residents was surveyed following the outline of a longitudinal panel study mail survey. This study focused on three research questions: 1) What are citizens' opinions of recent smoke, fire, and communication event(s)? 2) How do opinions differ before and after an event? 3) What factors influence citizen perceptions of smoke, fuel reduction strategies, and citizen-agency communication?

Study description and location

This study used a longitudinal panel design, a method that studies change by comparing the same respondents answering the same questions at different points in time. In spring of 2012, 4800 mail-back surveys were sent to four sites in the United States using a modified Dillman approach (2007), including a postcard announcing intent, complete survey packet with cover letter and questionnaire, a reminder postcard, and a final complete survey packet. Many question types were included in the questionnaire such as linkert-type scales and confined answer options.

Sites were initially chosen to reflect multiple geographic regions and diverse situations where smoke from wildfire and prescribed fire was a concern. The final four sites were near four national forests that had active prescribed burn programs and where air quality was sometimes a concern due to smoke. The four sites included counties in south-central South Carolina, northwestern Montana, south-central Oregon, and northern California. For this initial survey, a non-response bias check was performed between the survey respondents and non-respondents with no important statistically significant differences shown. This bias-check was made using a shortened version of the survey administered over the phone to a sample of non-respondents.

One of these sites was chosen for a follow-up mail-back survey based on fire and smoke events. The events of the summer following the initial survey were reviewed using informal interviews, local news sites, and fire incident information sites in each of the four areas. The site selected for resurvey was the Shasta-Trinity National Forest in northern California. This site included large population centers such as Redding and Shasta Lake as well as smaller towns including Weed, Palo Cedro, Mount Shasta, and Cottonwood among others. The sample of names and addresses

were obtained through a private sampling company that used the zipcodes of towns and counties near the Shasta-Trinity National Forest.

Following the active fire season of 2012, a follow-up survey was sent in spring 2013 to the 252 respondents who had answered the first survey. The response rate from the follow-up survey was 61 percent (n=146 out of 252). Many of the same questions were asked in both surveys but the follow-up had fewer overall questions and included new questions regarding their experiences with the 2012 fires season. While the repeated questions enabled changes to be observed for research questions 2 and 3, these new questions provided context for such changes and addressed the first of the research questions.

The 2012 Active Fire Season

The 2012 fire season in the Shasta-Trinity National Forest area was most notable for the wildfires that occurred in or near the surveyed counties. Governor Brown declared two surveyed counties, Shasta and Tehama, in a state of emergency due to fires during the season (Record Searchlight 2012). These included large fires like the Ponderosa fire (26,676 acres; lightning-ignited) that was covered prominently by media. This level of media coverage was due to its close proximity to highly populated areas. This fire threatened 940 homes, caused widespread evacuations, and destroyed 52 residences and 81 outbuildings, including one residence and five outbuildings affected in counties included in the survey (Record Searchlight 2012).

Another large wildfire was the Bagely fire (46,040 acres; lightning-ignited). While further removed from highly populated areas, it significantly impacted recreation through road, trail, and campground closures, as well as sending smoke to surveyed counties (Benda and Longoria 2012). Given the ability for smoke to spread far from the fire source, other large fires like the 42,000 acre North Pass fire that was over 70 miles away was linked to the poor air quality conditions in the area (Benda and Longoria 2012).

The Reading fire was a naturally-ignited fire in Lassen National Park that was allowed to burn according to the parks' management plan. However, due to unforeseen condition changes, this fire burned out of containment, beyond both the initial confinement and beyond the park boundary onto non-park land. It threatened the nearby residents of Shingletown (a surveyed community) and burned far longer than anticipated, creating closures and cancelations of both park and other events due to both the fire and the smoke.

There were also several smaller fires (<5,000 acres) that had social impacts worth noting. For example, the Coal fire (241 acres) burned only 20 miles from Redding, California and impacted travel. It also threatened the homes of individuals who had been evacuated just two months prior from the Salt Creek fire (980 acre) (Record Searchlight 2012, USFS 2012). Another example is the air quality advisory for Trinity County put into effect due to the Stafford fire near the small town of Hayfork, CA (Record Searchlight 2012).

Findings

Even though this fire season was fairly active, changes in respondents' perceptions were not observed for most questions from before the fire season to after the fire season. Even though half of the respondents knew of an escaped prescribed fire, many of their overall perceptions about

agencies and smoke remained the same. Instead, the few observed changes were closely associated with the fire and smoke events that occurred during the season, like recreation impacts from smoke. Findings from this case-study project should be applied on a case-by-case basis as they are not generalizable to other areas or situations.

Respondent experiences with fire and smoke during the 2012 fire season

The majority of respondents were older, male citizens as predicted given the demographics of the area and patterns in mail surveys. Around a third of the respondents had a respiratory ailment, congruent with the U.S. census data that shows a third of the U.S. population also has such ailments. Given the site context, it is not surprising that respondents had a longstanding relationship with fire. For example, a large majority believed that a wildfire was likely to occur near (five miles or less) their home. Approximately one third actually lived in a neighborhood that had a community wildfire protection plan.

The majority of respondents had at least heard or read about the fire activity in northern California during the 2012 fire season. Wildfires were the most commonly experienced fire, followed by prescribed fire, debris pile burns and agricultural burns. Roughly half of the respondents said that they were aware of a prescribed fire that went out of control during the season. A majority of respondents experienced smoke during this season with a moderate rating of severity, though a decrease in the types of smoke impacts experienced by respondents was observed. Few respondents had direct impacts from fire such as evacuations or property damage though some had a friend or family member that had such experiences.

However, self-reported knowledge levels regarding smoke were low overall. This may point to a new paradigm of citizens who have been dealing with season after season of wildfires and are more aware of prescribed fire and the benefits it may provide. These citizens may have normalized the occurrence of wildfire, rather than viewing it as the natural disaster it was once perceived to be. In other words, fire may no longer be eliciting the emotional response it once did (Burchfield 2007; Weisshaupt et al. 2005) and this may be reflected in the perceptions observed here. It may also show that the public is not as fickle as often stated, that while they recognized events like the escaped Reading fire are not ideal, they were more forgiving of the event than predicted from previous research. Other factors may include the distance of the fire from some of the surveyed locations, the minor impacts of this escaped fire, and that not all respondents knew of the event.

No change in the acceptance of smoke

No significant changes in public perceptions of smoke (i.e., smoke is a necessary inconvenience or smoke is acceptable if it results in a healthier forestry or I don't worry about smoke) were observed. For all types of smoke (wildfire, prescribed fire, pile debris burns, and private-use fire) there were no significant changes in smoke acceptability. The trend from the first survey remained, with a majority of respondents agreeing that smoke from a wildfire was acceptable. Again, the trend of the first survey continued where less respondents, with only a slight majority, agreed that smoke was acceptable from prescribed fire, naturally-ignited fire, pile burns, agricultural burns, and private refuse burn smoke. This lack of change is contrary to previous literature that found a small smoke or fire event may change perceptions (Carroll et al. 2005) but

may be reflecting that respondents report a moderate smoke severity rating on average. The frequency of fire and smoke seasons like this one in the past may also be playing a site-specific role here.

Perceived Risk of Impacts

For many of the perceived risks associated with smoke impacts (measured by the likelihood and severity of an impact occurring) there was no significant change. These included negative impacts to health, road closures, and ability to work or do work on an individual's property. Where significant increases were seen after the fire season was in the perceived risks of recreation-related impacts such as the risk of scenery impacts, reduced recreation and tourism visits, and reduced opportunities to participate in outdoor recreation activities. Given that smoke severity was reported as moderate on average, these changes could imply some fairly influential impacts directly on recreation. These changes could also have occurred because the major fires (like the Bagley and Reading Fires) that had numerous impacts on recreation during peak summer tourism times. It is also worth noting that overall, risk perceptions of all impacts was on the lower end of the scale for both years, indicating that for many people, smoke may not pose great risk. There were tradeoffs with some impacts having a lower likelihood but a higher severity and visa-versa. For example, while the average health impact likelihood was low, for those that did have these issues, the severity was fairly high. In contrast, there was a reverse relationship for scenery impacts from smoke.

Agency Relationships

Trust ratings are an important component in understanding the relationship between the public and management agencies. Previous research has indicated that more local entities like the state forest management agencies and the local forest service staff have higher ratings of trust than the more nationalized entities like the Environmental Protection Agency and the Forest Service agents in Washington D.C (McCaffrey and Olsen 2012). In this study trust ratings were moderate overall and showed no significant differences between the two years. However, confidence in state and federal agencies to complete specific tasks was significantly lower after the fire season. These specific tasks included management of local public forests, reducing fire risk, and the federal agencies' ability to manage smoke. There are more variables that play a role in forming an opinion about general trust. This makes general trust ratings more resilient to change than specific measures of agency abilities (Winter, Vogt, and McCaffrey 2004; Earle 2010). Thus, while the results from this study are expected, it points to the need to evaluate the agency relationship in a continuous fashion given the recent events (both positive and negative) for confidence in agency ability to complete management tasks.

Communication and Knowledge

For the list of 11 possible sources of smoke information, only a few changed in their usefulness ratings. An increase in the usefulness of TV and radio messages and a decrease in the usefulness of informational brochures and flyers were observed. In both years the most useful sources of information were interactive sources (i.e., educational workshops and conversations with agency staff) and websites (i.e., general websites, air quality information websites, and agency websites). In year two, social media was also added to the questionnaire, with a minority of respondents

indicating they use this source. Social media also received a low usefulness rating. This lack of social media use, and the lack of expected change in various websites, is likely a reflection of the older age of the respondents who may not use online and social media resources as frequently as a younger population. Additionally, few changes in the communication methods may have occurred given the short time period between surveys.

While few communication sources changed in their usefulness, there was still a significant drop in the self-assessed knowledge levels of the respondents about smoke. In contrast, there was no change in the level of smoke knowledge respondents wished they possessed. The abilities of agencies to provide the best information available in a timely manner also showed no change. Although there was no decrease, these ratings were relatively low for both years and showcase the need for more communication and information about smoke and smoke concerns.

Management Implications

Acceptance of smoke from all sources is moderate

Though it was anticipated that the 2012 fire season would influence public acceptance of smoke, especially given the escaped Reading fire, this did not seem to be the case in this study. In fact, with only a few exceptions, most of the smoke and agency-perception variables were fairly resilient to change, even after the active fire season. Observed changes were connected to the events of the fire season, like the recreation impacts of smoke increasing the risk perceptions to outdoor activities and tourism. The lack of significant changes in acceptance may suggest that some communities may be somewhat habituated to wildfire and smoke events due to their frequent occurrence, as is the case in this study region. This may suggest that efforts to help the public understand that fire is a common and beneficial process have been effective and that a social culture of living with fire may be emerging in some areas. While additional research and time are needed to assure this shift, continuing to promote the messages of beneficial fires is a positive course of action for management agencies. Other locations with different fire experiences may not yet be at this point of understanding fire. Sharing information about successful communication strategies from more accepting areas may promote the understanding of living with fire in other locations where fire is not as well accepted.

Understanding who does not accept smoke may help with shaping outreach messages

This study also shows that a third of respondents do not accept smoke. Understanding the backgrounds of people who object to smoke, especially if based on a health reason, can help in the development of communication and outreach messages that best address their concerns. For example, increased efforts to inform citizens with health issues before a smoke event, coupled with highlighting the differences between prescribed fire smoke (planned and managed) and wildfire smoke (not planned and uncontrollable) might aid in increasing acceptance. It is also important to consider other alternatives to prescribed and pile burning fire where applicable. Given the very real implications smoke may have on those with severe respiratory ailments (the highest risk perceptions were about health impacts), asking this often vulnerable portion of the population to cope with smoke may not always be the best course of action. Careful consideration of the alternatives and the impacts from smoke remains a vital part of the planning process for managers. Development of additional alternatives to reduce fuels and mitigation strategies for those with health issues from smoke may come from future research. Laying down

a system to readily incorporate these new findings into management activities now may help with future implementation.

Opportunities to build the agency-public relationship and to give more and better information about smoke

Designing effective communication plans around wildfire is partially dependent on the relationship between the public and the agencies providing the information. Open dialogue between the public and agencies is an important piece of building this relationship (Shindler and Cramer 1999; Toman, Shindler, and Brunson 2006; Weisshaupt et al. 2005). In this study, there was a clear contrast between overall trust remaining the same while specific confidence in the agencies to complete tasks decreased. This suggests that while trust may be fairly resilient to change given all of the many factors that play a role, specific abilities to complete tasks appears to be more variable. This flexibility in agency confidence could provide the opportunity for improvements in the perceptions of agencies following a successfully implemented management action. To take advantage of this fact, successful prescribed burns and similar management should be highlighted after the fact through a variety of means.

This trust relationship also influences communication, with information received from a trusted source more likely to be accepted (Earle 2010). Information about smoke can be put into two categories: awareness or rapid access for information about smoke situations (for example, checking a website to see the smoke conditions) and information that aims to increase understanding of the issues (such as a conversation about why fire is being used on the landscape). The decrease in the usefulness of flyers, brochures, and handouts shows less interest in short, easily outdated information sources. On the other hand, sources that primarily function as rapid or awareness building sources (TV/radio) increased in usefulness. Likewise websites remained some of the highest rated sources. Thus, focused effort in designing websites for easy access should continue.

Relationship to other recent findings and ongoing work

This project was an addition to a much larger Joint Fire Science Program research project. This larger project (Examining the Influence of Communication Programs and Partnerships on Perceptions of Smoke Management – Project ID 10-1-03-7) has spanned several years of work. Findings from this longitudinal component were used in the creation of outreach messages that were tested in communication-based experiments in the final stage of the larger research project.

A complementary study regarding the social aspects of fire smoke was conducted through the Idaho State University by Blades and Hall (2012). Many of the major findings from these two projects align. For example, there appears to be a vocal and concerned minority opposed to smoke due their smoke-triggered health issues. This longitudinal component shows that an eventful wildfire season may not be a major influencer on public acceptance of smoke, especially in communities that have been coping with active wildfire seasons for years. The Blades and Hall (2012) project also established that impacts to recreation and tourism may be of significant concern. Interestingly, while the Blades and Hall study found that the risk of a prescribed fire escaping was not offset by the benefits of prescribed fire, this longitudinal study suggest that an escaped burn did not decrease the acceptance of smoke from these types of fires. Finally,

community preparedness was shown in Blades and Hall (2012) to increase smoke tolerance. This could be playing a major role in the lack of change in smoke acceptance for the Californian site given its fire history.

Just as awareness about the ecological benefits of prescribed fire is increasing among the public, research shows similar tradeoffs between prescribed fire and wildfire smoke may exist. For example, prescribed fire smoke caused less asthma-related hospital visits than wildfire smoke (Hardy 2001). A little over half of the respondents in this study agreed with the tradeoffs between smoke types, a number that could be improved as outreach about the benefits of prescribed fire continues. McCaffrey and Olsen (2012) support this development in communication tactics; their synthesis suggests that the balance between risks and benefits of a management action are weighed in the determination of acceptance, with management actions that are seen as environmentally beneficial gaining more acceptance.

Future work needed

Through this and other recent projects, a general understanding of the public perceptions and attitudes about smoke is being established. From here, additional studies regarding the social aspects and concerns over smoke can expand our understanding of these issues.

Given that a fairly large minority of residents do not accept smoke, a next step would be to investigate why these judgments have been made. Many in this group who do not accept smoke may be negatively impacted due to respiratory and health ailments. These health impacts are an issue of great concern that affects almost a third of the US population and a third of this respondent group. Research into citizens' ability to mitigate smoke impacts seems key, as well as how mitigation strategies can be incorporated into management plans. Strategies for dealing with the impacts from smoke include remaining indoors with a filtered air cooling system or evacuation. Research into the availability of these strategies should be conducted to see if barriers exist to their use.

Just as the trade-offs and benefits of prescribed fire have aided in the public acceptance of fuel reduction practices, additional research on the tradeoffs between prescribed fire smoke and wildfire smoke can aid in increasing acceptance. While one study has shown that impacts of prescribed fire smoke on asthma may be less than wildfire smoke (Hardy et al. 2001), further research to support the benefits of prescribed fire smoke over wildfire smoke is needed. This area of research should include both the chemical differences of smoke and any differences of smoke impacts to human populations.

Finally, as information needs and methods for disseminating knowledge continues to evolve rapidly, research into the most effective methods of communication seems prudent. Of particular interest may be the development of social media as an up-to-date information tool that is being used more and more by agencies and news networks. Understanding the needs of the social-media audience and the ability of the agencies to meet those needs could be of great benefit in designing new information campaigns.

Deliverables

Deliverable Type	Description	Status
Non-refereed publication	Frequency Report	Delivered April 2013
Conference Presentation	<p>Presentation of findings at the International Smoke Symposium in Adelphi, Maryland</p> <p>Frederick, S.S., Olsen, C.S., and E. Toman. 2013. Longitudinal panel results: How the 2012 fire season impacted public perceptions in Northern California. Presented at the International Smoke Symposium, 21-24 October, Adelphi, Maryland.</p>	Delivered October 2013
Manager Presentation	Presentation of findings at the Willamette National Forest to USFS personnel in Eugene, Oregon and via VTC the Deschutes NF	Delivered February 2014
Annual Report	Annual report of project progress	Delivered September 2013
Training session/webinar	<p>Presentation of findings via webinar in collaboration with parent project, WWETAC, and NW Fire Science Consortium</p> <p>Olsen, C.S., Toman, E., and S.S. Frederick. 2013. Public Perceptions of Smoke in Oregon & California. Part of the Northwest Fire Science Consortium Webinar series, September 5.</p>	Delivered October 2013
Website	Web presentation of findings and key points.	In progress
Masters' Thesis	Manuscript	Delivered December 2013
Refereed publication	Manuscript submission to Journal of Forestry	In progress
Final Report	Final report to JFSP	Delivered June 2014

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