

Examining the influence and effectiveness of communication programs and community partnerships on public perceptions of smoke management: A multi-region analysis

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Principle Investigator

Dr. Eric Toman
School of Environment and Natural Resources
The Ohio State University
Columbus, OH 43210
Phone: 614.292.7313
Fax: 614.292.7432
Toman.10@osu.edu

Co-Principle Investigator

Dr. Christine Olsen
Department of Forest Ecosystems & Society
Oregon State University
Corvallis, OR 97331
Phone: 541-737-8669
Fax: 541-737-1393
Christine.Olsen@oregonstate.edu

Federal Cooperator

A. Paige Fischer
Western Wildland Environmental Threat Assessment Center
Pacific Northwest Research Station
USDA Forest Service
Corvallis, OR 97331
Phone: 541-758-7793
paigefischer@fs.fed.us

Research Team

Stacey Sargent Frederick
Danielle Mazzotta
Kathleen Rose
Devyani Singh



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I. Abstract

Wildland fires have increased in extent and severity in recent years. At the same time, the number of people living in harm's way has increased dramatically. This has not only resulted in more people and private property potentially at risk from future fire events, but also an increased population who may critically evaluate and experience the negative impacts of fuels reduction efforts. In the United States, citizen acceptance of fuels treatments, including the use of prescribed fire, is relatively strong and has proven fairly stable (for a review, see Toman et al. 2013). However, responses also indicate some concerns with these treatments including potential negative impacts of smoke emissions from prescribed fire use. Given the nature of smoke, emissions from treatments have the potential to affect citizens far beyond the treated area. While concerns about smoke are often cited by fire managers and residents as a potential limiting factor in developing successful fuels programs, limited prior research has examined public beliefs and attitudes about smoke emissions or smoke management approaches.

This project was designed to help fill this gap by examining social acceptability of smoke management practices, factors influencing acceptability, and the effectiveness of different communication approaches on acceptability and beliefs. The project was completed in three distinct phases with data collected in four study locations. Project support was augmented by additional funding from the USDA Forest Service Western Wildlands Environmental Threat Assessment Center (allowing data collection at four rather than the three initially proposed study locations) and through a Joint Fire Science Program Graduate Innovation Award (allowing a longitudinal assessment of responses in one study location – GRIN outcomes are reported separately in the Final Project Report for project number 12-3-01-21).

II. Background and Purpose

Management of wildland fire presents an increasingly complex challenge for land managers. Wildland fires have grown larger and more frequent in recent decades (NIFC 2010). Moreover, the number of homes in the wildland–urban interface (WUI), where “houses meet or intermingle with undeveloped wildland vegetation” (USDA and USDI 2001) has also increased substantially. Several efforts have sought to address these challenges – from national-level policy initiatives (e.g., the National Fire Plan in 2000, Healthy Forests Restoration Act of 2003, to the more recent National Cohesive Wildfire Management Strategy) and on-the-ground management actions that seek to reduce the threat of fire on the landscape through mechanical vegetation removal and the use of prescribed fire.

Substantial research has accompanied this shift in fire management approaches. This research has addressed both ecological and social aspects of fire management. A recent review found more than 200 articles authored by well over 100 authors addressed the social science aspects of fire management between 2000 and 2010 (Toman et al. 2013). Of these peer or editor-reviewed publications, 83 focused on citizen acceptance of fuels reduction treatments. Findings provided substantial insight into beliefs and attitudes

towards treatment use by public agencies and demonstrated increasing support for treatments over time (e.g., Manfredo et al. 1990, Shindler and Toman 2003, Blanchard and Ryan 2007). Indeed, findings from a range of studies conducted in different locations of the U.S. have found approximately 80% of participants accepted some amount of both prescribed fire and mechanical vegetation removal (e.g., Absher and Vaske 2006; Brunson 2008; Lim et al. 2009; McCaffrey 2006; McCaffrey et al. 2008; Toman and Shindler 2006; Vogt et al. 2007).

These studies have also found that a number of factors may influence treatment acceptance. In particular, knowledge of fuels treatment practices (e.g., Absher and Vaske 2006, Blanchard and Ryan 2007, Brunson and Shindler 2004, McCaffrey 2004, Shindler and Toman 2003) and trust in the implementing agencies (McCaffrey 2006; Shindler and Toman 2003; Vogt et al. 2005; Winter et al. 2002, 2006) have been found to influence treatment acceptance. Other factors also appear influential including awareness of potential outcomes (e.g., Loomis *et al.* 2001; Brunson and Shindler 2004), the degree that local residents have been involved in developing fuels management plans (e.g., Winter *et al.* 2002; Blanchard and Ryan 2007), as well as situationally specific variables (e.g., size of treatment, proximity to homes, weather conditions; Winter *et al.* 2002).

Several studies have also identified a variety of concerns with fuels reduction treatments, including the potential for increased smoke (Shindler and Toman 2003). In one study, a majority of public respondents indicated moderate or great levels of concern about increased levels of smoke as a result of prescribed fires in three locations – Utah, Oregon, and Arizona (Brunson and Shindler 2004). However, relatively little is known about smoke concerns; much of the prior data on smoke resulted from a few questions embedded within broader studies of treatment acceptability. Of particular importance is developing a better understanding of the factors that influence smoke concerns, the potential influence of these concerns on citizen acceptance of fire management practices, and how the concerns may be addressed. One study found that the origin of smoke influenced acceptability; residents were more willing to accept smoke from prescribed fire (because the potential benefits are shared in common) than agricultural burning (as the benefits only accrue to the individual landholder) (Weisshaupt et al. 2005). Smoke concerns may be particularly difficult to manage as smoke has the potential to affect people far from the location of the fire and are often linked to negative impacts to human health directly through respiratory effects or indirectly through reduced visibility and the resulting potential for traffic accidents on roadways. These characteristics of smoke may lead to a vocal opposition to the use of prescribed fire, even if such concerns are held by a minority of residents.

In addition to these concerns, fire managers also have to navigate air quality regulations that may restrict the timing, location, or size of prescribed fires due to potential smoke emissions. Indeed, the ability of some managers (e.g., those in designated non-attainment areas) to conduct burn programs may be severely limited by local weather patterns as well as air pollution from other sources.

To better understand these challenges, the Joint Fire Science Program (JFSP) conducted two roundtable discussions with fire managers and scientists. Recognizing the scope of the

potential needs, the JFSP then took steps to develop a Smoke Science Plan. The plan was developed in three phases, including: 1) developing a more comprehensive needs assessment through interviews with land managers and completion of a literature review of related prior research; 2) review of prior research on wildland smoke to identify existing knowledge and gaps that could be addressed through additional research; and 3) development of a series of projects and areas of research to address existing needs (Riebau and Fox 2010). The Smoke Science Plan informed JFSP's 2010 Request for Applications that included a call for projects addressing questions related to public perceptions of smoke management (JFSP 10-1-04) that supported this project. This project was designed to address existing gaps in understanding regarding social acceptance of smoke management.

III. Study Description and Location

This project was completed in three stages using a multiple case-study design.

Stage one: The project began with semi-structured interviews using a series of open-ended questions about the participant's role in fire and/or smoke management, experiences and strategies for communication, partnerships they are involved in, and challenges and ways to address these challenges. Interviews lasted from 45 – 90 minutes and were usually conducted with a single participant, though some were small group interviews. A total of 60 individuals were interviewed across all four locations (described below). Participants were purposively chosen based on their role as a decision-maker or key stakeholder involved in fire and/or smoke management discussions. Participants included land managers and air quality regulators, representatives of environmental non-governmental organizations, private individuals who use fire on their land, local governments, local fire protection, and timber industry

Stage two: Based on interview findings, a questionnaire was administered to a random sample of 1,200 residents in each of the four study locations (see Table 1). The survey was implemented following Dillman's Tailored Design Method (Dillman 2007) and included a notification postcard describing the upcoming survey, followed by a complete survey packet (containing a cover letter, questionnaire, and a postage-paid return envelope) a few days later, a reminder postcard to those who had not yet replied after another two weeks, and complete packets to all remaining non-respondents after three weeks.

Of the 4,800 packets that were mailed, 4,325 were successfully delivered and 992 were returned. Response rates and sample size varied between the four sites with 30% in Montana (n=323), 25% in Oregon (n=270), 24% in California (n=252), and 13% in South Carolina (n=147). A non-response bias check was conducted via telephone where a subsample of the non-respondents were given an abbreviated version of the survey. This phone sample was compared to the original responders, and no significantly important differences were found for demographics or survey questions.

Table 1: Sample size and response rates by study site

Study site	Mailed questionnaires	Undeliverable questionnaires	Completed questionnaires	Response rate (%)
California	1200	128	252	24
Oregon	1200	130	270	25
Montana	1200	106	323	30
South Carolina	1200	111	147	13
Total	4800	475	992	23

Stage three: Using an experimental design, the final stage of the project examined effects of message framing on participant knowledge, beliefs, and attitudes toward smoke emissions management and prescribed burn use in addition to their influence on information seeking and processing behaviors in three of our study locations. The sample consisted of 1020 adult residents of the communities near the Fremont-Winema National Forest in Oregon, Shasta-Trinity National Forest in California, and Francis Marion National Forest in South Carolina (sample size limitations prevented us from completing the experiment in Montana). The experiment was administered online with participants first receiving a pre-test survey, followed by a randomly assigned informational message, and finally a post-test survey. Each of the three study sites received six different message treatments and a control message. Drawing on the analysis in Stage 2, the research team developed a series of messages with a different “frame” (e.g., focus of the message) designed to emphasize particular aspects of smoke emissions and management. The particular frames were developed based on findings from stage two of this project as well as prior theory in communication and risk and decision-making – primarily the Hazard Acceptance Model (risks and benefits frames) and Psychological Distancing and Construal Level Theory (local/concrete and distant/abstract frames). Message frames emphasized:

- *Benefits: message described the benefits of prescribed fires*
- *Control over risk: message described ways individuals can reduce their risk of impacts from smoke emissions*
- *Psychological distance and Construal: messages framed either using 1) general descriptions and a national level focus or 2) specific description of local-level activities and outcomes*
- *Control: messages included only general introduction slides containing basic information concerning fire and smoke emissions*

A total of 13 information messages were developed. Each study site included approximately 330 participants, with at least 46 participants per treatment. The survey consisted of questions about smoke emissions and prescribed fire, including experience, acceptability, attitudes/beliefs, and risk perceptions. Additional questions addressed information seeking and processing behaviors and information needs, as well as agency perceptions and trust.

Research Sites

Data was collected in four locations (due to limited sample availability, Montana was not included in the stage three communication experiments). Study locations were selected to provide a diverse array of geographic, ecological, and social conditions, as well as a variety of communication strategies and partnerships related to smoke management issues.

Northern California: Communities in and around the Shasta-Trinity National Forest (STNF) were chosen for study, including Mt. Shasta, Redding, Weaverville and Hayfork. The majority of the land area in this region is federally-owned and largely forested. The STNF is marked by wilderness areas, steep gradients and dense forests making fire management particularly challenging. Prescribed burns are generally conducted on the STNF to reduce surface fuels and/or treat slash piles between October 1 and June 1 each year. Wildfire is a yearly occurrence in the STNF region, generally occurring in the summer and fall, and smoke from wildland fires and other sources (e.g., agricultural field burning) regularly impacts local communities. In an effort to mitigate smoke effects from prescribed burning, many forest and air quality managers in this region have developed a partnership called the Northeast Air Alliance. Members report and discuss planned burn projects and collectively determine project suitability based on potential smoke impacts to the surrounding areas.

Northwestern Montana: Kootenai County including the communities of Libby and Eureka, Montana were selected for this study for their proximity to the Kootenai National Forest (KNF), which is bordered to the north by British Columbia, Canada. The KNF ranges from open lands characterized by gentle rolling hills to mountainous regions with rugged peaks. The KNF averages approximately 145 wildfires each year, usually in mid or late summer, just under half of which are attributed to escaped debris burning. The prescribed burn season occurs in the spring and late fall, avoiding the winter season when snow is on the ground and air stagnation is more common. These burns are generally conducted to treat surface fuels and slash. Inversions and air stagnation have contributed to the larger of these two towns, Libby, being listed by the U.S. Environmental Protection Agency (EPA) as air quality non-attainment for PM-2.5 (particulate matter). Forest managers working within and near the KNF are members of the Idaho-Montana Airshed Management Group (AMG), which manages burn projects for smoke impacts.

South-central Oregon: Communities in and around the Fremont-Winema National Forest (FWNF) were selected for study, including Chiloquin, Chemult, Klamath Falls, Bly and Lakeview. The majority of the land area in this region is federally-owned and ranges from heavily-timbered mountains to arid shrublands. Similar to the region in northwestern Montana, the local topography surrounding the communities of Klamath Falls and Lakeview creates a pre-disposition for air inversions and stagnation, especially during the cold winter months. Wood stove use (as a home heating source) contributes to the challenge of air quality attainment in this region; both Klamath Falls and Lakeview are very close to a EPA designation of PM-2.5 non-attainment. Prescribed fires are generally conducted to reduce surface fuels and treat slash from October through March, and wildfire season is summer through early fall. A number of formal local partnership groups actively

collaborate on forest health and management concerns, including the Lake County Resources Initiative (LCRI), the Lakeview Stewardship Group, the Klamath-Lake Forest Health Partnership, and the Lakeview Collaborative Forest Landscape Restoration Project (CFLRP).

Central coast South Carolina: Communities in and around the Francis Marion District of the Francis Marion-Sumter National Forest (FMSNF) including Charleston, Awendaw, and Mount Pleasant, Columbia, and Cordesville were selected for this study. Located in the coastal plain of South Carolina, the Francis Marion Ranger District (FMRD) is situated between the metropolitan areas of Myrtle Beach and Charleston, and exhibits a diverse ecosystem ranging from fire dependent longleaf pine stands to swamp and marshland. Prescribed burning on the FMRD is generally conducted between January and May. State, non-governmental organizations, and private landowners also commonly utilize prescribed fire in this region. Numerous partnership alliances emphasize forest management within the state and the Southern region. Multi-state efforts such as the Southeast Regional Partnership for Planning and Sustainability (SERPPAS) and the Southeast Fire Ecology Partnership (SEFEP) advocate forest health through the responsible use of prescribed fire. Also evident in the region is public education and outreach for prescribed fire use carried out on the state and local level by groups such as South Carolina Prescribed Fire Council.

IV. Key Findings

Several findings emerge from this research that merit additional consideration. The key findings include:

- **Communication regarding smoke issues faces several challenges.** Agencies were using a wide variety of approaches to communicate with their publics regarding smoke emissions and management. These messages can generally be classified as 1) notifications of emissions associated with particular smoke events (ranging from signs on a road near an active prescribed burn to one-on-one contacts with nearby residents prior to a burn being initiated), 2) awareness-building messages that included information about smoke in the context of forest/fire ecology and management, or 3) messages specifically about burning and associated smoke regulations on private land. Unidirectional, mass media approaches were the most commonly used communication methods (e.g., highway billboards, public service announcements, brochures), but some locations also employed more interactive forms of communication including homeowner visits and interpretive information and discussions near burn areas. In general, managers were uncertain whether their communication efforts were effective. In most cases, these communication efforts also seemed to lack a strategic focus and were not coordinated across agencies. Similarly, at the local level, communication efforts were generally understaffed and underfunded; particularly, interactive methods seemed to be treated as an “add-on” responsibility to agency personnel who already had a full plate of other duties.
- **The source of the smoke (fire-type) influenced smoke perceptions.** The smoke sources in question were: prescribed fire, pile or debris burns, naturally-ignited fire,

agricultural burn, private land refuse burn, and a wildfire being suppressed. There were differences in the acceptability of smoke from these sources and on the types of impacts respondents experienced from these fires. The factors influencing acceptance also differed between these different sources. For example, while smoke risks and agency-relationship both played important roles in determining acceptance for most smoke sources; other factors were unique to one type of fire smoke. The majority of respondents believed they could distinguish the source of smoke they experienced.

- **The majority of the public accepts smoke from fuels reduction activities.** Contrary to the common narrative of strong opposition and complaints regarding smoke, this study revealed that such derision may not be the case for the majority of respondents. For this majority, smoke from many types of fuel reduction fires was at least somewhat acceptable. Smoke from a wildfire was still the most acceptable source to most respondents. Even though most respondents feel smoke is acceptable, further studies and management considerations should focus on the perceptions of those expressing low levels of acceptance, with special emphasis on issues of personal or family health.
- **Perceived tradeoffs (risks vs benefits) influence smoke acceptance.** Lower perceptions of risk from smoke were associated with greater levels of acceptance of smoke from different fire types. Residents who perceive fewer risks from smoke as well as those who recognize more benefits of prescribed fire are more likely to have a higher acceptability of smoke.
- **Informational messages can influence smoke acceptance.** Each of the messages used in the communication experiment resulted in a significant decrease in participant concerns about smoke. Participants were also more likely to indicate they had a greater ability to control their own exposure to smoke emissions. Participants also both felt that their level of knowledge regarding smoke emissions and management increased as did their appreciation of the complexity of smoke management. Ultimately, participants expressed greater acceptance of both prescribed fire use and smoke emissions following exposure to the informational messages.
- **Informational messages can also influence perceptions of agency managers.** In addition to influences on knowledge and treatment acceptance, participants were also more positive towards agency managers after receiving the informational messages. Participants were more likely to agree that managers could effectively manage smoke and were more confident in their ability to do so.

V. Management Implications

- **In general, citizens appear to understand (or are capable of understanding) the tradeoffs associated with fire and smoke management.** Indeed, citizens generally understood and were more accepting of smoke from prescribed fire than might have been expected based on managers' experiences. Moreover, communication efforts appear likely to be able to increase this understanding as well. While those actively opposing prescribed fire use due to smoke may not represent a majority of local residents, their concerns should not simply be disregarded. Approximately one-third of US households have at least one resident with health issues that may be aggravated by smoke (McCaffrey and Olsen 2012); such citizens deserve particular attention during the treatment planning process. Communication efforts could focus on developing strategies to help improve their ability to control their exposure to emissions. While such concerns are unlikely to be alleviated simply by providing information, it is important to note there is evidence that smoke from smaller prescribed fires is less harmful to human health (asthma) than the more intense emissions from a large wildfire (Bowman and Johnston 2005).
- **Prioritize communication and relationship-building.** Managers have a long list of responsibilities and are unlikely to welcome another duty being added to their plates that seemingly takes them away from their primary responsibilities. However, consistent with other natural resource issues, communication and relationship-building can facilitate managers' abilities to achieve their broader objectives. As noted above, a variety of communication tools are being used to communicate about smoke, often within the context of forest ecology and management. While communication efforts are not likely to be a panacea for all smoke concerns, our findings suggest they could provide substantial dividends by highlighting the benefits of prescribed fire use and encouraging residents to consider smoke emissions and management within the broader context of forest management. In addition, and perhaps more importantly, these efforts can also influence citizen confidence in agency managers (several studies have found that confidence is linked to treatment acceptance – see review in Toman et al. 2013). Accordingly, we suggest development of strategic communication efforts that align communication objectives with appropriate methods and content.
- **Enhance interagency coordination in communication efforts.** Multiple agencies and organizations play a role in the management of smoke emissions. While this can provide positive opportunities to coordinate communication efforts, it can also result in confusion if messages appear inconsistent across sources. Inconsistent messages can not only lead to a lack of understanding of smoke management but can also contribute to increased frustration with resource agencies. Managers in multiple locations discussed the importance of working together to develop a strategic communication plan across agencies and landscapes. Such an approach could lead to the development of unified messages where responsibilities and objectives overlap. In other cases, messages could be more clearly designed to avoid appearing inconsistent (e.g., messages describing the benefits of prescribed fire are not necessarily in contradiction

to those describing air quality regulations and the need to seek a permit before burning). Interagency coordination can also provide a means to spread limited communication resources further and reach greater collective communication goals. Agencies can strategically plan to address different communication objectives, develop specific messages, or use different tools (e.g., one develops billboards and public service announcements while another develops interpretive information at a demonstration site).

VI. Relationship to other recent findings and ongoing work on this topic

- **Troy Hall, Lead PI. Public Perceptions of Smoke: Contrasting Tolerance amongst WUI and Urban Communities in the Interior West and the Southeastern United States. (JFSP Project 10-1-03-2).** This project was funded in response to the same RFA as our project. The project examines how tolerance is related to length of exposure and concentration of smoke, the source of the smoke/purpose of the fire, and the degree of active fire management and contrasts wildland-urban interface communities that evidence high levels of fire preparation with those that have not yet prepared. We have communicated regularly with Dr. Hall and her research team throughout the research process to share findings that could inform both projects and encourage a complimentary research approach between projects where possible. We have worked together to develop special sessions to present project findings at three conferences and in two web-based training sessions. We are also working on a joint journal manuscript that combines survey findings from both projects, with an anticipated submission to *Journal of Forestry* later in 2014.
- **Joint Fire Science Program, Knowledge Exchange Consortia.** The research team is actively engaged in two of the JFSP Knowledge Exchange Consortia (the Lake States Fire Science Consortium and the Northwest Fire Science Consortium). Interactions with practitioners through these Consortia informed our research design and included questions to improve our ability to answer questions of relevance to managers within each of our regions. In addition, results have been and will be shared through Consortia channels (including one webinar to date and distribution of research briefs and project summaries).

VII. Future work

- Future smoke social science work should include more complex modeling with more factors to determine smoke acceptance. Such studies should be careful to distinguish between different sources of smoke and their acceptance level. Additional studies that include pre/post surveys and interviews will continue to be a tool in assessing any changes in perceptions overtime.
- There is a strong need to show additional scientific evidence of the difference between wildfire smoke and smoke produced by fuel management activities. This research may compare the chemical and particulate make-up as well as the impacts these smoke

sources would have on populations and the environment. Currently, new studies that identify characteristics of wildfire smoke are beginning to emerge, but no studies comparing types of smoke could be found as of this report date. Additional studies should be designed to test these differences in detail. This information could play directly into the suggested management implication of increasing smoke acceptance.

- Further studies and management considerations should focus on the perceptions of those who express low acceptance of smoke emissions, with special emphasis on issues of personal or family health.
- Studies that examine perceptions of risk associated with smoke, as well as protective actions that people take, would improve our understanding of acceptance levels as well as provide guidance on communication message content that may address information needs among smoke-affected communities.

VIII. Deliverables cross-walk (detailed deliverables noted in the attached Appendix)

Deliverable	Description	Status
Qualitative summary	Key findings from initial qualitative research assessing contextual factors	Completed
Study protocol	Questionnaire for expanded replication and evaluation	Completed
Survey results	Reports from quantitative research for each site	Completed
Preliminary findings	Summary of preliminary results	Completed
Progress reports	Description of progress towards objectives, timeline of project, findings to date	Completed
Executive summaries	Key results in graphical format with supporting text – these will be the primary, easily disseminated, attractive product to share with managers	Completed
Interactive workshops	With agency and community partners to examine findings, interpret results, and discuss their application	Completed
Final report	Summary of research design, findings, and influence of factors on citizen responses	Completed
Refereed publications	Submitted to scientific and applied journals	Ongoing (2 accepted, 3 in preparation)
Conference presentations	Findings will be presented at professional conferences	Completed
M.S. thesis	While these were not included in the original proposal, this project has supported at least portions of three M.S. projects	2 completed and 1 ongoing (expected graduation date August 2014)

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Appendix: Project deliverables (completed to date)

Workshops

Olsen, C.S. 2014. Public Perceptions of Smoke. Plenary speaker at the Environmental Protection Agency (EPA) Region 10 Smoke Management in the Northwest Annual Meeting, Portland, OR, March 26.

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. <http://www.youtube.com/watch?v=mfjMFB-JNy0>

Toman, E. and C.S. Olsen. 2012. The Influence and Effectiveness of Communication Programs and Community Partnerships on Public Perceptions of Smoke Management. Presented to the Joint Fire Science Program Smoke Science Plan Development Committee, 12 March.

Olsen, C.S., Mazzotta, D., and E. Toman. 2012. Wildland Fire Smoke Messaging and Perception. Presented to the Joint Fire Science Program and the National Wildfire Coordinating Group Smoke Committee (Smoc), 28 June.

Refereed publications

Olsen, C.S., Mazzotta, D., Toman, E., and A.P. Fischer. In Press. Communicating about smoke from fire: Challenges and ways to address them. *Environmental Management*.

Mazzotta, D., Olsen, C.S., and E. Toman. 2012. Perceptions of smoke management and prescribed fire programs: an analysis of opportunities in communication, community-based partnerships and interagency decision making. Full paper in Fox, R. (ed). *Proceedings of the Third Human Dimensions of Wildland Fire Conference*. Available at http://www.iawfonline.org/HD_Seattle_2012/Errata_3rd_Human_Dimensions_Conference_Proceedings.pdf. Pages 90-108. [editor reviewed]

Presentations

Olsen, C.S., Toman, E., Frederick, S.S., and D. Mazzotta. 2014. Public and agency perceptions about smoke: interview and survey results from four states. Presented at the Large Wildland Fires: Social, Political & Ecological Effects Conference, 19-23 May, Missoula, Montana.

Olsen, C.S., Frederick, S.S., Toman, E.L., and D. Mazzotta. 2013. Public and agency perceptions about smoke: Interview and survey results from four states. Presented at the International Smoke Symposium, 21-24 October, Adelphi, Maryland.

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.

Rose, K., Toman, E., Olsen, C.S. and S. Frederick. 2013. Smoke and people: The implications of beliefs, attitudes, and perceived risk for communication. Presented at the International Smoke Symposium, 21-24 October, Adelphi, Maryland.

Frederick, S.S., Olsen, C.S., and E. Toman. 2013. Public acceptance of smoke from wild, prescribed, and private-use fire. Presented at the 19th International Symposium on Society and Resource Management (ISSRM), 4-8 June, Estes Park, Colorado.

Rose, K., Toman, E., Olsen, C.S., and S. Frederick. 2013. The hazards of smoke from fire and fuels management: application of the Risk Information Seeking and Processing Model. Presented at the 19th International Symposium on Society and Resource Management (ISSRM), 4-8 June, Estes Park, Colorado.

Olsen, C.S., Frederick, S.S., and E.L. Toman. 2012. Communicating about smoke: public opinions and information about information sources and sufficiency. Presented at the 5th International Fire Ecology and Management Congress, 3-7 December, Portland, Oregon.

Frederick, S.S., Olsen, C.S., and E. Toman. 2012. Perceptions of smoke management: survey results from communities near four national forests. Presented at the 5th International Fire Ecology and Management Congress, 3-7 December, Portland, Oregon.

Olsen, C.S., Mazzotta, D., and E. Toman. 2012. Fire managers and air quality regulators on communicating with the public about smoke: stories from four states. Presented at the 18th International Symposium on Society and Resource Management (ISSRM), 17-21 June, Edmonton, Alberta, Canada.

Frederick, S., Olsen, C.S., and E. Toman. 2012. The influence of communication strategies on public acceptance of smoke: preliminary results from communities adjacent to four U.S. national forests. Presented at the 18th International Symposium on Society and Resource Management (ISSRM), 17-21 June, Edmonton, Alberta, Canada.

Toman, E., Olsen, C.S., and S. McCaffrey. 2012. Where There's Smoke: An Introduction to Public Perceptions of Smoke Management. Presented at the 3rd Human Dimensions of Wildland Fire Conference, 17-19 April, Seattle, Washington.

Frederick, S., Olsen, C.S., and E. Toman. 2012. Public tolerance for smoke and influencing factors: A look at survey findings from four states. Presented at the 3rd Human Dimensions of Wildland Fire Conference, 17-19 April, Seattle, Washington.

Mazzotta, D., Olsen, C.S., and E. Toman. 2012. Perceptions of smoke: An examination of the challenges and opportunities in smoke management across four U.S. national forests. Presented at the 3rd Human Dimensions of Wildland Fire Conference, 17-19 April, Seattle, Washington.

Mazzotta, D. and C.S. Olsen. 2011. Communication strategies and sustainable partnership development in forest management: An examination of tolerance for smoke from

prescribed fire in four U.S. communities. Presented at the 17th International Symposium on Society and Resource Management (ISSRM), 6-8 June, Madison, Wisconsin.

Thesis

Singh, D. 2012. Exploring the Factors that Characterize the Decision Process for the Use of Prescribed Fire in South Carolina. M.S. Thesis. School of Environment and Natural Resources, The Ohio State University.

Frederick, S. 2013. Public Perceptions of Smoke from Wildfire, Prescribed Fire, and Fire Use. M.S. Thesis. Department of Forest Ecosystems and Society, Oregon State University.