

"UNITING OUR GLOBAL WILDFIRE COMMUNITY"
AUGUST 2018 - VOLUME 27.3

WILDFIRE

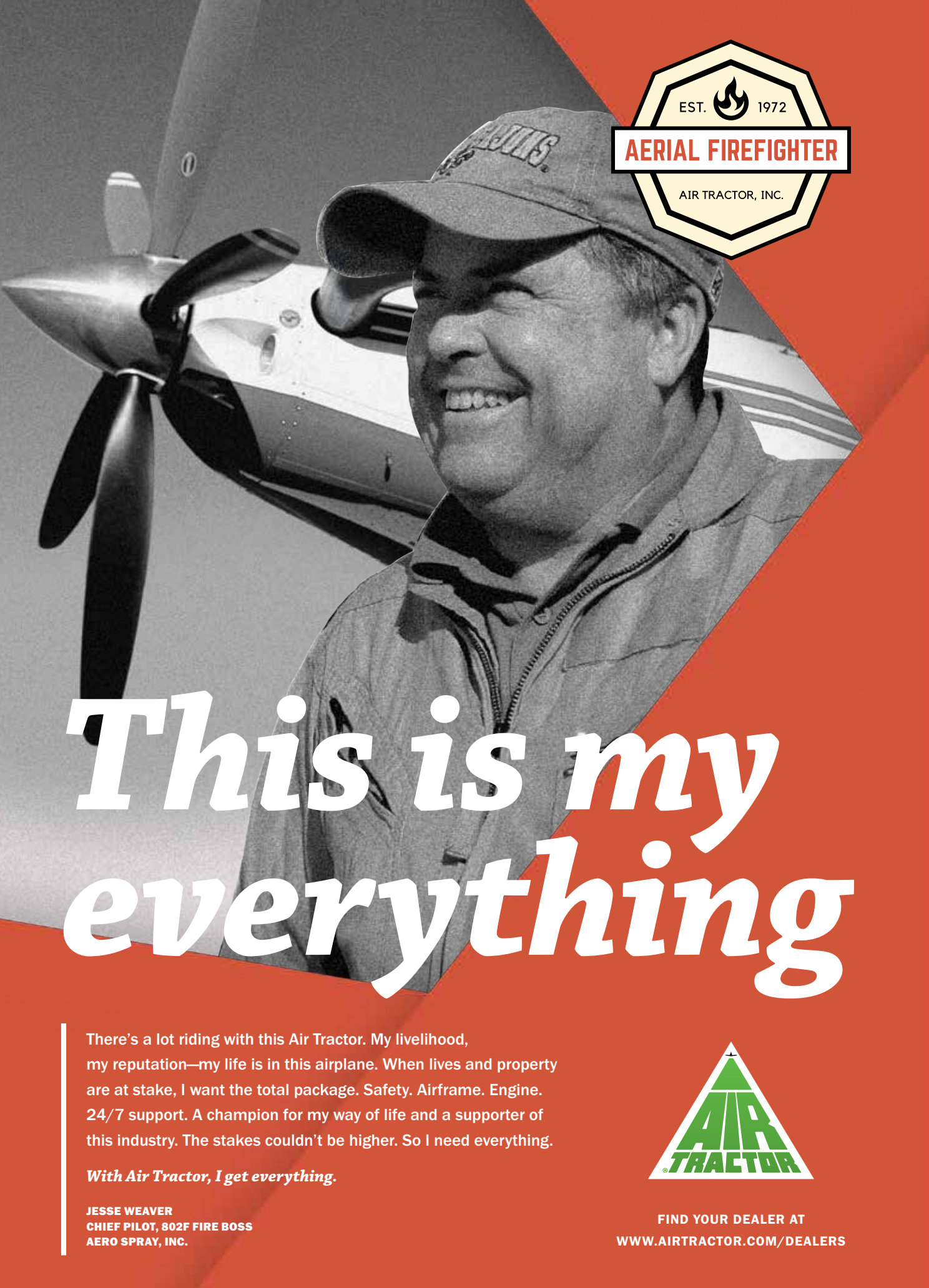


**LIVING WITH
WILDLAND FIRE**

**DIVERSITY &
FIREFIGHTER
HEALTH:
TAKING
CARE OF US**



An official publication of the **International Association of Wildland Fire**



This is my everything

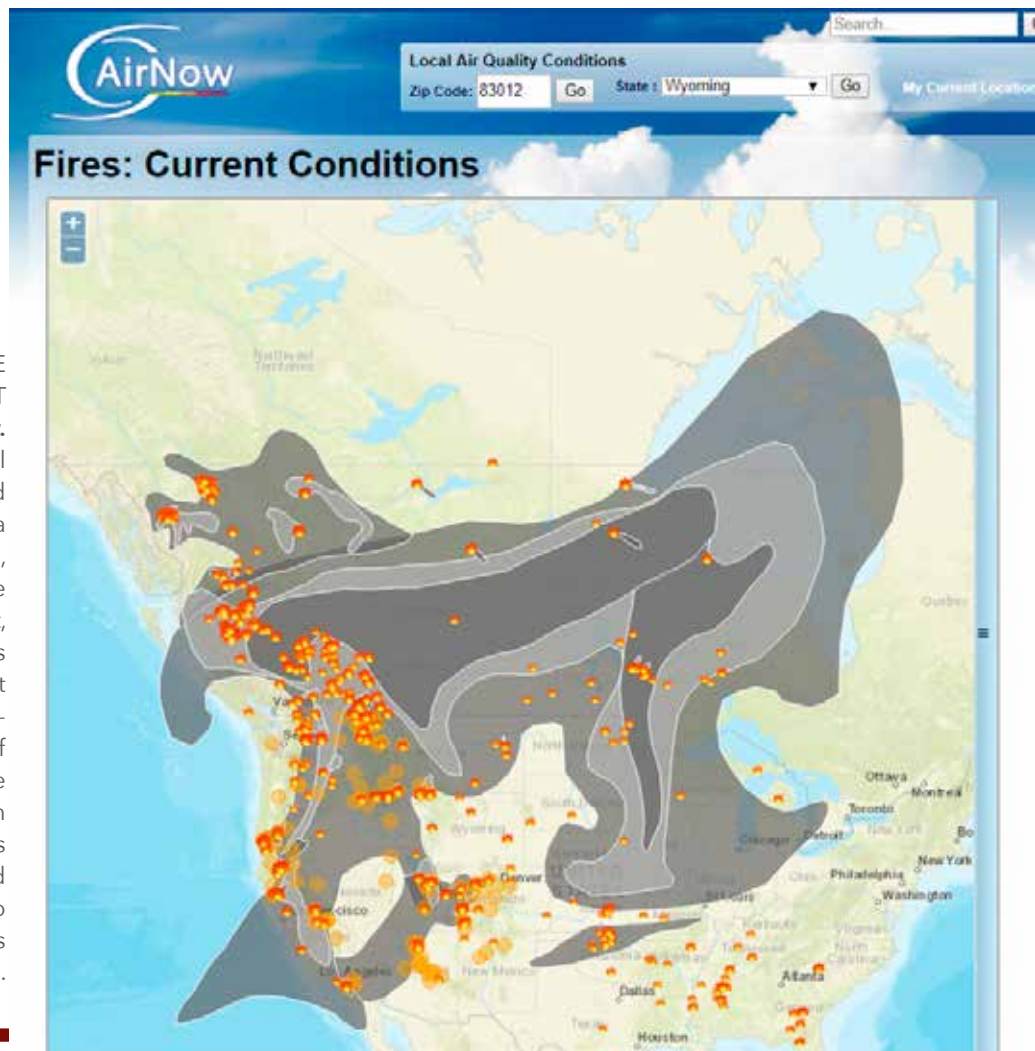
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A DAY IN THE LIFE
OF A FIRE CONTINENT
On August 11, 2018, **AirNow.gov** forecast the continental drift of smoke from wildland fires in the US and Canada, a reminder that North America, like all continents except the iciest one, is a fire continent, with fire challenges increasing in part due to past management and energy-use decisions. This issue of *Wildfire* explores the science and management needed in this new era, as well as calls for a diverse, well-mentored and safe workforce to support our success amid these challenges.

ON THE COVER:

An open, fire-managed ponderosa forest of 1897. 120 years later, this landscape is heavy with fuel and far behind its historic fire return interval. And it's here where fire managers and neighboring communities face some of the most expensive and destructive wildfires in the US. Read about how we got here and a call for restoration by Jerry Williams and Matthew Panunto. Page 22.

COLUMNS & NEWS

- 4 VICE-PRESIDENT'S DESK: #MeToo for the Wildland Fire Community
Toddi Steelman, Karin Riley
- 6 BRIEFING: A call for diversity, science, safety and health in our profession
- 8 THOUGHTS ON LEADERSHIP: Mentoring 101 - for leaders today and tomorrow
- 10 IAWF NEWS: Conferences, leadership, mentoring, in memoria
- 13, 33 FIRE TOOLS: The Updated Incident Response Pocket Guide. MyRadar app.

FEATURES

- 16 **LIVING WITH WILDLAND FIRE IN AMERICA**
Building new bridges between policy, science and management
John A. Hall, Paul F. Steblein and Colin C. Hardy
- 22 **ASSESSING HIGH-COST WILDFIRES** in Relation to the Natural Distribution of Ponderosa Pine in 11 Western States. A Peer-Reviewed Analysis.
Jerry T. Williams, Matthew H. Panunto

FIREFIGHTER HEALTH

- 34 **REPORT ON NATIONAL FIRE LEADERS: United to Reduce Line-of-Duty Deaths and Injuries of Wildland Firefighters**
Tom Harbour
- 40 **TAKING CARE OF US: The Art of Listening**
Kathy Clay

FROM THE VICE PRESIDENT'S DESK:

#MeToo

for the wildfire community.

AN INITIATIVE "TO CREATE A FIRE COMMUNITY WHERE ALL MEMBERS FEEL SAFE AND WELCOMED AND VALUED."

It is hard to miss the #MeToo movement these days. The international movement against sexual harassment and assault is everywhere in conventional and social media as well as water cooler and dinner table conversation. Important in its own right, #MeToo also has been a touchstone for broader conversations about inclusivity, diversity, equity, power dynamics and the challenges of who gets to represent whom in our culture.

These conversations have been taking place within the wildfire world as well. The resignation of United States Forest Service Chief Tony Tooke in March 2018 under allegations of sexual misconduct have highlighted the need for our wildfire communities to build our collective capacity to confront and address these controversial topics. Sexual harassment, sexual misconduct

and gender discrimination is known to be widespread in many government agencies including the US Forest Service, National Park Service and US military. The United States is not alone in facing these issues. Canada and Australia report similar trends.

In 2015, an AFE survey with almost 350 respondents revealed that

- * 32% reported observing incidents of sexual harassment in the workplace and 24% experienced it directly,
- * 54% reported observing gender discrimination of others in the workplace and 44% reported experiencing it,
- * 64% of respondents who experienced sexual harassment, and
- * 60% who experienced gender discrimination did not report it.

And it is not just about women. While women make up the majority of the cases associated with sexual assault and harassment, a significant minority of reported cases are from men who also are affected. And it is not just men who harass or discriminate. Women also play a role, as detailed in Sara Brown's unflinchingly courageous tale of her own experience as a wildland fire fighter, which can be viewed here: <https://www.youtube.com/watch?v=302W8aKQknA&feature=youtu.be>

Just so we are clear, sexual harassment is when conduct of a sexual nature in a workplace or social situation affects an individual's employment or work performance. It can take the form of unwelcomed sexual advances, requests for sexual favors or obscene remarks. Gender discrimination is when someone is treated unfairly because of their gender. It can manifest in unequal pay and/or inequitable opportunity for promotion, benefits or other professional rewards. In some cases, discrimination can be deeply embedded in a given institutional culture and people may be unaware that they are participating in discriminatory practices.



"Greater inclusivity in all we practice will make us better wildfire practitioners." A firefighter igniting a firing operation. Brianhead Fire, UT (2017). Photo: Kari Greer.

In many ways dealing with sexual harassment and assault are easier for us to find agreement on—everyone deserves a safe work space. It is the subtle forms of discrimination, the ones that manifest in sometimes visible but more often invisible ways that are harder for us to confront and address. How do we find ways to make more people feel welcomed and valued?

At the Fire Continuum Conference May 21-24, 2018 in Missoula, Montana the topic was “Preparing for the Future of Wildland Fire.” Part of this future calls for a more inclusive and diverse approach to how the International Association of Wildland Fire (IAWF) and the Association for Fire Ecology (AFE), both co-sponsors of the conference, do business.

We, Karin Riley, the Vice President of Association for Fire Ecology and Toddi Steelman, the Vice President of the International Association of Wildland Fire, addressed the audience in a plenary session to announce that our respective Associations would be responding to an inclusivity and diversity challenge posed to us by our peers. In early 2018, IAWF and AFE received a letter signed by over 50 people ranging from research to land management to the non-profit sector in at least three countries. The letter stated that, “Over the past several AFE and IAWF conferences, a disproportionate number of plenary speaking roles have been awarded to non-minority male scientists.”

After careful review of the complaints, IAWF and AFE both passed resolutions stating that diversity and inclusivity across gender and a variety of ethnicities shall be a priority in all that the two organizations do, including leadership, membership, programs, and activities including recruiting Board members, Associate Journal Editors, and reviewers.

Our aspirations for this initiative are to strive to create a fire community where all members feel safe and welcomed and valued. This will mean promoting diversity and inclusivity in all our Association activities, monitoring our progress, reporting on it publicly, rooting out structural barriers that inhibit progress and holding ourselves accountable for continuous improvement. Our Associations affirm to increase representation in ideas, viewpoints, gender, sexual orientation, culture, race, age and experience to ensure equal opportunities to participate and contribute. We are committed to doing better.

We also want to be clear about a few things that this initiative is not. It's not about blaming any one group or person for the situation. It is about all of us coming together to shine a light on how conscious and unconscious biases harm our profession. It is about ensuring that differences are embraced, all community members are welcomed, included, and valued, and that we have participation from the widest and most diverse range of wildfire professionals possible.

As we move forward, it is important to recognize that inclusivity, diversity and equality are not ends unto themselves. They are a means to a better society at large. We do not value diversity, equity and inclusivity for their own sake. We value them because they make us better in what we do. Greater equity in management will make for better wildfire management. Greater diversity in science will make for better wildfire science. Greater inclusivity in all we practice will make us better wildfire practitioners.

**Co-written by
Toddi Steelman,**

Vice President, International Association of Wildland Fire

Karin Riley,

Vice President, Association of Fire Ecology

LINKS

IAWF Diversity and Inclusion Policy:

<https://www.iawfonline.org/wp-content/uploads/2018/05/IAWF-Diversity-and-Inclusion-Policy.pdf>

AFE Position Paper on Sexual Harassment and Gender Discrimination in Wildland Fire Management:

<https://fireecology.org/resources/Pictures/AFE%202016%20position%20paper%20on%20discrimination%20final%2011-25.pdf>

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SUBMIT ARTICLES:

<https://iawf.submittable.com>

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www.iawfonline.org

A call for diversity, science, safety and health in our profession



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TODAY, IN OUR WILDFIRE COMMUNITIES, we may well claim, with some due pride, that we possess some quality of commitment when it comes to the diversity, science, safety and health that are key to our evolving vitality. Since it seems clear that without inclusiveness and safety in our fire community, how will we of help to the broader communities we serve. Yet while so many of us are committed to and successful in these goals, it doesn't take too many glances around the room or the fireline, and the reading of safety and diversity reports, to know that while our commitment may be strong, our delivery is still ramping up. In this issue and in issues to come, we (as IAWF and as publishers of *Wildfire* magazine) wish to affirm the strengths that empower us today so we may extend our strengths and bridge the gaps — so we may invite and retain an inclusive, diverse, science- and safety-focused generation of professionals who may merge with us into this compelling profession.

Consider this a call to form a stronger, smarter, more connected, diverse, resilient and safer profession. In these pages we launch this call, beginning with two leaders in wildland fire — the vice presidents of the International Association of Wildland Fire (Toddi Steelman) and the Association of Fire Ecology (Karin Riley), who share a key initiative to consciously build a more diverse community of voices and expertise in our profession.

Beyond gender, race, age, experience, global connectivity, economic status, and a range of other characteristics that together will help us bridge our diversity gap, this issue examines how we can focus on our fundamentals — and what's more fundamental than who we work with and serve (which should, on this fire globe, be nearly everyone)? — or how and where and from where we gather and share our ideas?

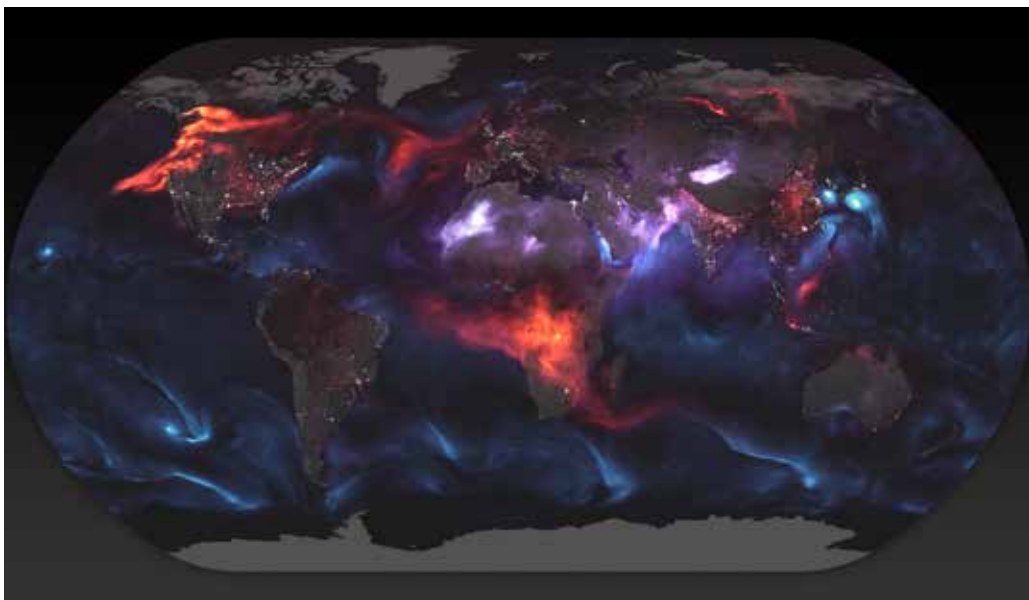
As Toddi and Karin write, "Greater inclusivity in all we practice will make us better wildfire practitioners." A principle which can help us fill a range of gaps we face as practitioners, managers and scientists of wildfire and bushfire.

Continue reading the issue and we'll explore a call for mentorship (in Mike DeGrosky's *Thoughts on Leadership* column), which is such a key process for engaging new leaders. And in IAWF News, we thank the professional community that's built when we gather at conferences, and we announce a pilot Mentorship Program, and we remember one of our ranks who has passed.

In our *Fire Tools* section, we remind folks of the community of practice that is gathered in the Incident Response Pocket Guide, with a new purple cover (which seems, in my mind at least, another subtle call for diversity?). The updated IRPG is worth it if only for the slightly revised but easier to use Medical Incident Report. (And in the spirit of community and as someone who has worked two medical incidents with the new Medical form, I simply say "thanks.") We also share another safety innovation from the world of weather apps — the MyRadar platform now integrates wildfire locations and wind layers with real-time storm-tracking.

In our *Features* section, we look at wildfire science from two perspectives. First, three leaders of US fire science delivery reflect on where we are in and where we need to go in the world of focusing and applying fire science. Next, we share a peer-reviewed analysis — the first we know of in these pages to apply what's typically been a science-journal approach compared to our typical fire-journalism and fire-practitioner approach.

And in our two closing columns, we look at how to bridge our current standard-operating-procedures so we might develop not just a Cohesive Fire Strategy (which we certainly need and are building upon), but also a unified safety culture and strategy.



*The planet,
with wildfires &
storms.
August 23, 2018...*

*...and a note of apology.
Perhaps it was the
combination of smoky skies
and active fires in the Western
US, and the unplanned timing
of article edits. But this issue
focuses far too much on the
United States. Next issue we'll
return, with vigor, to covering
the global fire challenge.*

WILDFIRE DESTROYS AND CREATES. As fire scientists, managers and practitioners we know this. Yet when the firestorm strikes, our science and profession are far-too-intimately entwined in the trauma of wildfire in our communities. We lose colleagues, or watch communities we know suffer the unmeasurable loss of citizens and homes.

In *Wildfire* issues past, we've shared our solace with colleagues and wildfire victims and survivors in South Africa, Australia, Canada, Chile, Portugal, the US and elsewhere.

Now, we share our hopes for recovery and resilience to fire managers and survivors in Greece and California, and wherever the fires are burning beyond our immediate response and point-protection and evacuation capabilities. We have much to learn and do as we learn from past disasters and seek to prevent the next. So the good work of our profession continues, with no shortage of objectives. Share what you've learned, perhaps as a writer or an IAWF mentor, so all our good efforts may coalesce in a new paradigm of fire resilience.



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NEW



Mentoring 101 – for leaders today, and tomorrow

Think of mentoring both as a powerful form of leadership and as a serious responsibility to another person.

by Mike DeGrosky

I was recently invited to participate in a leadership panel at work on which the panelists, all senior managers in our organization, were asked to address questions about our own leadership influences and development and offer a bit of advice to developing leaders who made up the audience. The panel moderator asked us to speak to the influence of mentors in our lives and careers. The panelists were also asked to express our views on opportunities for employees to grow within our organization and the relationship between those opportunities and mentoring.

As I prepared to answer the first question, I reflected on how, though having never benefitted from a formal mentoring relationship, a number of mentors had shaped my life and career, as well as my leadership philosophy and approach. Some people, whose mentorship really mattered to me, were only passing through my life; temporary influencers who, just the same, left me some gift. Sometimes those gifts were big, other times small; sometimes obvious, other times not-so-obvious and maybe even unknown to me at the time. Other mentors played a big role in my life and career and affected me obviously and profoundly. From each, I learned life and leadership lessons that stuck with me, shaped me, influenced me, helped me pursue my potential, and brought me closer to being the person I could be.

Technically, mentoring is a professional relationship in which an experienced person assists a less experienced person in developing specific skills and knowledge that will enhance the less-experienced person's professional and personal growth. Effective organizations know that people perform better, advance faster, and choose to stay in their organizations when they have effective mentors.

I've been doing a little reading-up on mentoring lately, and discovered three excellent articles that resonated with, and are influencing, me. First, is an article by W. Brad Johnson and David G. Smith (<https://hbr.org/2018/01/the-best-mentors-think-like-michelangelo>). The second is an article by Anthony K. Tian (<https://hbr.org/2017/02/what-the-best-mentors-do>). Rounding out the group is a second article by Johnson and Smith on reciprocal mentorship and cross-gender mentoring relationships (https://hbr.org/2018/03/mentoring-women-is-not-about-trying-to-rescue-them?utm_campaign=hbr&utm_source=linkedin&utm_medium=social). I recommend each of these articles to anyone contemplating a mentoring arrangement either as a mentor or a mentee.

As I read these articles and I reflected on my recent answers to our panel's assigned questions, I recalled why I am such an advocate of mentoring. However, I also remembered that mentoring can be ineffective and even risky if not done well. What appears below is a fusion of ideas I assembled from the articles above as well as my own thoughts on mentoring based on my experiences both as mentor and protégé. I think of each as an essential mentoring principle.

Think of mentoring both as a powerful form of leadership and as a serious responsibility to another person. When we choose to mentor someone, we are committing to helping someone reach their potential and come closer to the person they want to be. Leadership is a duty and, done well, requires a somewhat selfless commitment to others. This may be truer to mentoring than almost any other form of leadership, because mentoring is so personal and requires a high degree of trust to succeed.

A mentor's job is not to make or re-make their protégé

into something; and is certainly not to replicate the mentor. A mentor's fundamental purpose is to help the mentee find and release the more ideal person that exists within them.

The relationship comes before the mentorship. For a mentoring arrangement to succeed, there must first exist some basic and authentic relationship, empathy, and affinity between mentor and mentee. In my experience, a relationship of trust and a climate of mutuality must exist or the mentoring arrangement will struggle. Mentoring requires connection and rapport if the mentor and mentee are to transcend their usual formal organizational roles and relate to one another as people. In my experience, to achieve rapport and transcend hierarchy requires a deliberate emphasis on shared power.

High-quality mentoring relationships benefit both mentor and mentee. The best mentoring relationships, the ones with the most meaningful and durable impact, are both mutual and reciprocal. By definition, the mentor should bring more experience to any mentoring arrangement than their mentee. However, in high-quality mentoring relationships, both mentor and protégé learn and grow from the relationship. It stands to reason that any protégé worth mentoring brings insight, experience, and talents to the table. Consequently, mentors in a high-quality mentoring partnership should want and expect to be influenced by their mentee's perspective, and both people in the relationship should expect professional and personal growth. Our panel moderator asked us how individuals can develop themselves as leaders. I offered that I believe a person can grow as a leader, not only by being mentored, but by mentoring someone. I have found that, by helping someone become their ideal self, I connect with the person I strive to be.

The most effective mentors, those who can help proteges achieve truly transformational change, approach their mentoring task with humility. A humble mentor is one that understands that, by exposing their own vulnerability and imperfection they can provide a relatable, empowering role model; reduce the power differential between mentor and mentee; and open the door to their influence. This can present a challenge for senior leaders, requiring them to check their egos, be honest about what they don't know, and model comfort with a reciprocal relationship.

Focus on the whole person and extend the breadth of mentoring outcomes. Too often, mentors approach their assignment simply as a training program focused around the mentee gaining job skills or as a quick path to career advancement. However, my best mentors took me well beyond skill building and job seeking; helping to shape my character and values and find my professional identity. The best mentors I encounter these days are helping their mentees with personal confidence, stress resilience, overall effectiveness, and their emotional intelligence.

Effective, reciprocal mentoring relationships require mutual listening. Listen generously, learn your mentee's true aspirations and draw out their genuine self, keep an open mind, maintain a learning orientation, and avoid assumptions.

Be very loyal to your mentee. Organizations use mentoring to retain their high potential employees, to help them achieve their potential contribution to the organization, and to inspire

commitment. In my experience, the best mentors achieve all three by fully and selflessly committing to the mentee. To me, a mentor is not there simply to help uncover their protégé's strengths, but to explore their underlying interests, help them find their professional identity, and make a difference to that person beyond simply serving as a career counselor. Mentors are people committed to helping others become more complete versions of who they are, and that takes being "all-in" for your protegee. Consequently, I have also found that I need to be frugal with my mentoring. I don't mentor a lot of people but, those that I do, should get a lot out of me.

Be honest with your protégé. A really good mentor can let their mentee know if they are not a good fit for a job, can help an ambitious employee maintain realistic perceptions of their mobility, and can help a valued employee pursue a different role in the organization or even move on from the organization. Conversely, a high potential mentee should understand how channel their potential to maximum benefit, both to themselves and the organization.

Effective organizations know that people perform better, advance faster, and stick around when they have effective mentors. That's why smart organizations have embraced the concept of mentoring. Technically, mentoring is a professional relationship in which an experienced person helps a less experienced person develop specific skills and knowledge, thereby enhancing the less-experienced person's professional and personal growth. However, good mentoring is more than a training program focused around the mentee gaining job skills or a quick path to advancement.

I think of mentoring both as a powerful form of leadership and as a serious responsibility to another person. When we mentor someone, we commit to helping them reach their potential and come closer to the person they want to be. Consequently, mentoring needs to be taken seriously and done well. I recommend that, if you intend to be someone's mentor, that you focus on the principles of helping your mentee identify and release what is within them, focusing on the relationship, seeking mutual benefit, being humble in your mentorship, focusing on the whole person, listening, being loyal, and honesty.

+

*See page 11 for an announcement of
LAWF's new Mentoring Program, or visit
www.iawfonline.org/what-we-do.*



Mike DeGrosky is Chief of the Fire and Aviation Management Bureau for the Montana Department of Natural Resources and Conservation, Division of Forestry.

He taught for the Department of Leadership Studies at Fort Hays State University for 10 years. Follow Mike on Twitter @guidegroup or via LinkedIn.

Thanks to everyone who attended The Fire Continuum Conference

THE
FIRE CONTINUUM
PREPARING FOR THE FUTURE OF WILDLAND FIRE CONFERENCE

It was a great week in Missoula this May, filled with top-notch presentations, fantastic sponsors and exhibitors and tons of great networking opportunities. We were honored to partner with the Association for Fire Ecology on another successful endeavor. Check out the photos from the conference on the conference webpage, www.firecontinuumconference.org.

Upcoming Conferences

**RETHINKING THE GLOBAL
WILDFIRE 'PROBLEM':
ARE WE FOCUSING ON THE RIGHT
PROBLEMS AND RIGHT SOLUTIONS?**
15TH
INTERNATIONAL WILDLAND FIRE SAFETY SUMMIT
AND 5TH HUMAN DIMENSIONS CONFERENCE

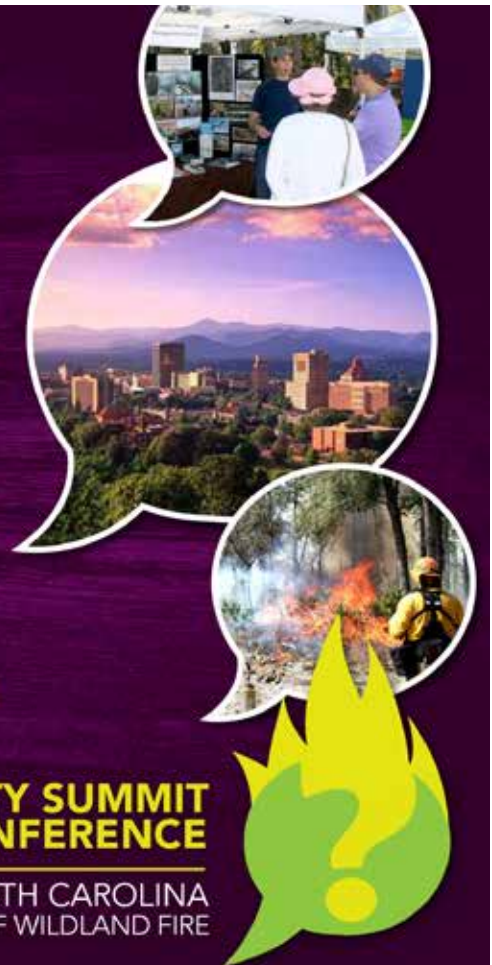


SAVE *the* DATE

RETHINKING THE GLOBAL WILDFIRE 'PROBLEM': ARE WE FOCUSING ON THE RIGHT PROBLEMS AND RIGHT SOLUTIONS?

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Outstanding Leadership Award

Each year we honor several outstanding students who participate in training classes. We are pleased to honor Annie Benoit who was awarded the Outstanding Leadership Award at the S-590 class at NARFI this Spring. Benoit is a Training Specialist, Washington Office-Workforce Development Branch-USFS/NWCG. During the course, she exhibited exceptional fire analyst skills. She maintained a consistent focus on honing her skills using a critical mindset to acquire information, analyze it and deliver interpretation of complex situations. She also exhibited leadership qualities by assisting peers with grasping skills and improving as a team. She entered the course with a high skill set and sought to improve herself, others and the profession.



Congratulations Annie.
She will be awarded with a one-year membership to the IAWF.

If you have a class and would like to honor an outstanding student, please contact us at execdir@iawfonline.org

IAWF Mentoring Program

The IAWF is piloting a Mentoring Program and would like to invite you to participate, either as a mentor or mentee. We are currently gathering a list of interested individuals, who will then be assigned based on interests and geographical locations if possible. Please visit our webpage for more information and to express your interest.

www.iawfonline.org/what-we-do



July 7, 2018, the founder and long-standing former head of the Department of Physical and Computational Mechanics of Tomsk State University, Honored Scientist of the Russian Federation, Member of the National Committee on Theoretical and Applied Mechanics, Honored Professor of Tomsk State University, Professor, Anatoly Grishin, passed away on the 80th year of his life. Since 1976, a total of over 150 peer-reviewed scientific publications have been produced in national press of Russia on mathematical and physical modelling of wildfires, including 9 monographs and 7 textbooks. Anatoly Grishin was co-author of 26 USSR authors certificates, 5 utility model certificates, and 8 patents of the Russian Federation, for new methods of fighting forest fires. His results on the theory of ignition and combustion, the theory of conjugate problems of mechanics of reactive media, the mathematical theory of wildfires, and catastrophe theory were included in the reviews and tutorials. The memory of him will forever remain in the hearts of his students and colleagues. Sincere condolences to his family, friends and colleagues.



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To learn more, visit our website at dauntlessair.com and download our new vision paper, Transforming Aerial Firefighting for a Changing Environment, or reach out to us at **320-297-9088** to find out how you can strengthen your initial response and direct air attack capabilities.

THE UPDATED Incident Response Pocket Guide -

Look for the new
purple cover for 2018

Jesse Bender, NWCG

The National Wildfire Coordinating Group (NWCG) this spring published a revised Incident Response Pocket Guide (IRPG). The IRPG is an operational job aid carried by all state, local, federal, tribal, and territorial wildland firefighters in the United States. It is a compilation of standards for wildland fire incident response and provides a collection of best practices for firefighters while encouraging continued learning through training and experience. It does include some direction for all-hazard response as well.

NWCG revises the IRPG every four years to update standards and maintain the most current references. For example, this revision added information on smoke hazard mitigations and removed outdated information on working with airtankers. Because the IRPG is a collection of best practices, rather than the sole source for information, the revision has been carried out in concert with edits or changes to other NWCG products. The S-131, Firefighter Type 1 course will be modified to include edits made to the Look Up, Look Down, Look Around section of the IRPG. And ICS 206 WF form, the Medical Incident Report, was updated to reflect edits to the Medical Incident Report, found on the final pages of the IRPG.

Changes to the IRPG are field-driven. Solicitation for potential edits is made early in the revision process. Nearly everyone who carries an IRPG has an idea for how to improve its usefulness. This results in a large volume of suggestions which are vetted and field reviewed before edits are made to the pocket guide.

Those reviewing change submissions stick by a handful of guiding principles: keep the content brief but accurate, avoid agency policy, and make the guide relevant to those working from Firefighter Type 2 up to the Division Supervisor and Incident Commander Type 3 level.

The IRPG is the highest requested item from the Great Basin Cache, the primary provider of the publication. They average sales of over 140,000 IRPGs annually. Since the 2018 IRPGs arrived in April, they've had trouble keeping them on the shelf, with orders going out as quickly as the printer can deliver pallets. Already they've sold over 152,000 of the 2018 edition.

Find the IRPG at

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OPERATIONS AND TRAINING COMMITTEE

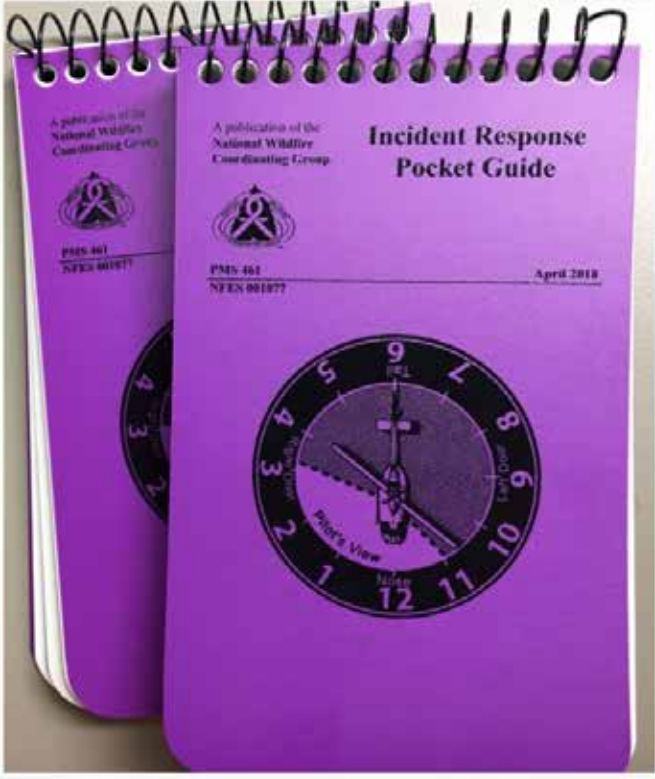
Incident Response Pocket Guide, PMS 461

The 2018 IRPG is now available on the NWCG website and for order from the cache. The Revision Summary is found on [page i](#).

Impacts to other publications include:

- The Medical Incident Report has been revised and updated in [ICS 206 WF](#) and e-ISuite.
- The following aviation pocket cards are integrated into the IRPG and removed from NFES:
 - Helicopter Passenger Briefing, NFES 1132,
 - Twelve Standard Aviation Questions That Shout "Watch Out!", NFES 1129,
 - Five Steps to A Safe Flight, NFES 1399, and
 - 10 Principles of Retardant Application, PMS 440-2, NFES 2048.

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Living with Wildland Fire in America

Building new bridges between policy, science and management

By John A. Hall, Paul F. Steblein and Colin C. Hardy

In his October 26, 2017 commentary in these pages (Wildfire Magazine 26.4; 4–5), Dr. Tom Zimmerman highlights a number of ongoing and future challenges faced by wildland fire management. To address these challenges he also identifies an important role for science and in particular management-relevant wildland fire research. Here, we first briefly elaborate on Dr. Zimmerman's challenges and how they relate to new opportunities for the role of science in wildland fire management. Second, we focus on three additional institutional or "cultural" barriers or divides that could helpfully be acknowledged and addressed when forging a path forward for wildland fire research and its

necessary companion: science delivery. As commenters on these matters, the authors represent only a small portion—even within the federal wildland fire science community—of those responsible for or interested in the funding, execution, and delivery of actionable science to end users. Nevertheless, we represent key programs with specific missions to serve federal wildland fire-related science, management, and policy information needs.

Ongoing and Future Challenges

To paraphrase and amplify Dr. Zimmerman, the forces that shape our understanding of and response to wildland fire are both converging and dynamic. We live with the history of long-term fire suppression, ongoing changes in trends and variability in fuels and climate that are altering fire regimes in those ecosystems that historically experienced fire and those that didn't, and land-use patterns that increase human and asset exposure in a manner that is unsynchronized with the necessary cultural adjustments. The preceding forces interact in non-linear and complex ways, which means their future expression will be difficult to predict. These forces, and others, place new and accelerating demands on our understanding of wildland fire, its management, and response to it within both ecological and social contexts. The needs are both short-term and long-term. As a result, scientists may need to be comfortable with providing imperfect but useful information while still seeking better understanding, whereas users of science are encouraged to support both the tactical (short-term: *I need an answer now*) and the strategic (long-term: *I need to better prepare for the future*) aspects of the science enterprise. In the latter context, knowledge discovery is still a vital component; however, within the

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Acknowledgments

We thank Matt Jolly for providing the sidebar-example information and the review comments of Ed Brunson, Randy Eardley, Mona Khalil, Mark Miller, John Phipps, and Robin White.

scope of wildland fire research it is still problem-driven and ultimately management/policy relevant. Finally, technological advances in such areas as computational power, unmanned platforms, and enhanced sensors facilitate our ability to better understand fire-related phenomena—e.g., the physics of fire, plume dynamics, fire effects—that can result eventually in enhanced data and tools for management and other purposes (see sidebar and Figure 2).

Much more can be said about the forces of change and the resulting challenges, as well as associated opportunities afforded by scientific and technological advances to meet those challenges; however, in the remainder of this article, we will focus on three key organizational areas that could help improve efficiency and effectiveness in the execution and use of wildland fire science.

Getting the Wildland Fire Policy, Science, and Management Communities on the Same Page

This is an age-old story and one not unique to wildland fire science. Research that is relevant to policy and management is not always equally obvious to the different communities and, depending on the degree of scientific understanding of a problem, such research is not necessarily ready to be conducted in an applied way that leads to a potential solution in the near-term. The key, whether fundamental or applied research is involved, is that the science to be performed is responsive to the problem posed by managers or policy-makers. Moreover, translating the problem or need (versus wants) into a scientific question that can be addressed by research, as well as translating research results into useful and actionable information, are both critical elements of the coproduction of knowledge by those producing and using the science. Neither of these steps may be viewed as intuitively obvious as to how they are accomplished, nor will only one approach necessarily suffice. We are learning how to do better at both—indeed wildland fire science has some good models to offer; however, improvement and ongoing commitment is still needed given the challenges articulated above.

We view the path forward as three-fold.

First, ongoing dialogue is needed between science producers (the doers, the scientists, but also the funders of research), managers, and policy-makers, not as a one-time event but over time at a frequency appropriate to ensure the continued match of research produced with needed information. Such dialogue could have the goals of:

1. Furthering the objectives of the National Cohesive Wildland Fire Management Strategy;
2. Defining a shared understanding of the critical short- and long-term challenges in wildland fire management and policy that further research can address;
3. Setting realistic expectations of the potential outcomes of such research and the timelines over which desired data and tools may be available; and
4. Defining the manner in which resultant research outcomes can be provided to ensure they are accessible, useful, and actionable.

Although this could be accomplished informally, clear and

supportive leaders' intent would enhance this dialogue.

Second, new approaches to research and knowledge delivery are needed that engage both scientists and the users of their science in problem formulation, research design and execution, and interpretation and application of research results. This coproduced knowledge is not arrived at via a one-size-fits-all approach; rather, the degree of needed engagement is best tailored to the nature and our current understanding of the problem and the situation under which it is occurring. For example, is it a locally applicable and well-studied problem that can quickly have an identified solution? Or is it a poorly understood and regionally or nationally significant problem that first requires fundamental research? Regardless, in either case we will need new business models that facilitate funding and executing research in a coproduction mode. Our Australian colleagues at the Bushfire and Natural Hazards Cooperative Research Center have experience here (<https://www.bnhcrc.com.au/>). Our collective objective is to work with partners over the next year to explore potential models.

Third, wildland fire science has made great strides in the area of science delivery that in important ways has fundamentally advanced the practice and science of delivering actionable information to a variety of end users. Examples include Forest Service and US Geological Survey interactions between their scientists and agency managers, the fire-related projects funded by the Department of Defense's Environmental Security Technology Certification Program, a demonstration and validation program, and the national, collaborative network of 15 regional fire science exchanges (or Fire Science Exchange Network [FSEN]; see Figure 1) established and maintained by the Joint Fire Science Program. The FSEN infrastructure represents a significant investment in capacity that in the wildland fire world is unmatched in its breadth of audiences targeted and depth of information provided. Our common objectives here are to:

1. Further the integration of science delivery and translation across our agencies and programs, so that from the end-user's perspective it appears seamless and comprehensive regarding the available information;
2. Continue to innovate in the science of delivery, and
3. Expand the audiences that can be the recipients of wildland fire science.

Fire and the Land are Inextricably Linked — So Too Should Be Our Understanding and Response

Fire is an essential ecological process that to differing degrees shapes the ecology and land management responses for many of our ecosystems. Fire also is responsive to other ecological processes and land-use practices. In practice, wildland fire cannot be separated from other aspects of land management. Fire inevitably, and on its own terms if need be, will occur on the landscape. Our ability to prevent it will be temporally and spatially limited; however, by acknowledging its role in a broader ecological and social context, we may be able to shape its occurrence and effects and thereby better live with fire on the landscape. Given the history of fire suppression, we will be challenged to determine how to



Figure 1. Geographic distribution of Fire Science Exchange Networks.

use all the tools of vegetation management, including prescribed fire, to not only reduce the risk of catastrophic wildfire but also to maintain, and increase if needed, an ecosystem's resiliency under changing environmental conditions and its capacity to provide the variety of ecosystem services that society demands.

To accomplish the preceding, the linkage then also applies to the study of fire and land management and, ultimately, to how we respond to and use fire. As a result, wildland fire science and management would benefit by more explicit and purposeful integration with other discipline/management areas—hydrology, soils, species biology, and so on—for which fire plays a role but is not the sole focus. Integrating applicable disciplines can help address issues such as invasive species and how they may alter fire regimes; post-fire effects on erosion, debris flows, watershed health, and vegetation recovery; fire-atmospheric interactions; and the human dimensions of fire. Decisions on land-management actions will require similar integration. The fire science and management communities are well served by crossing the hall and talking with their colleagues that do not live and breathe fire on a daily basis. It is better to avoid silos around land management versus fire management, in addition to the walls between science and management. Science, especially if research is conducted in a coproduced manner, can assist in strengthening the linkages between fire and land management.

Agency and Program Silos are Impediments to Effectiveness and Efficiencies

When faced with scarce resources, we may tend to focus on a tighter circle of responsibility. So understandably would agencies

and programs that must be responsive to their specific missions. In addition to the need for increased and ongoing dialogue between policy, science, and management, we also see benefits to be gained from increased coordination and leverage across those agencies and programs involved in wildland fire science. This can be accomplished while still being responsive to agency missions, at the same time working to improve efficiency and effectiveness.

We have started this collaborative work among ourselves and in some cases with other agency partners. For example, the Western Wildfire Campaign is a collaborative effort during 2018 and 2019 among the Joint Fire Science Program, Forest Service, National Oceanic and Atmospheric Administration, National Aeronautics and Space Administration, Environmental Protection Agency, and National Science Foundation to advance the understanding of the chemistry of smoke, its temporal changes (or aging), and transport and their relationships to fuel characteristics and consumption. For the future, we look to develop new models of how to work together.

In closing, we suggest that the challenges facing the nation with respect to living with fire in a rapidly changing world require new paradigms for how the fire science community needs to respond to ensure users of science—practitioners, managers, and policy-makers and their advisors—have the requisite information they need to make informed decisions. We highlighted three institutional divides that are potential impediments and offered our perspectives on how these divides may be bridged. In the end, it will take the efforts of many others besides ourselves to build these bridges. In so doing, we honor the “Cohesive” part of the National Cohesive Wildland Fire Management Strategy.

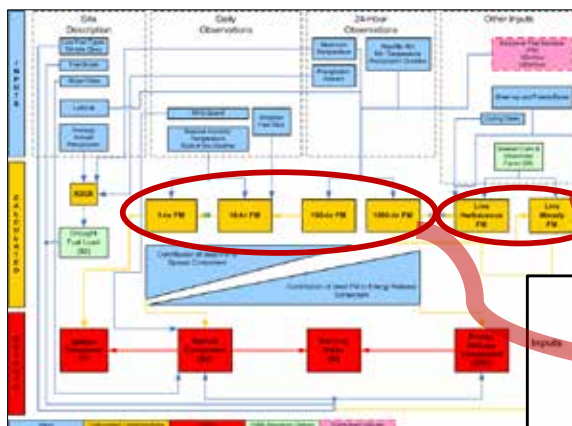
An example of adaptive wildland fire science: *The National Fire Danger Rating System*

The United States National Fire Danger Rating System (NFDRS) is used nationwide to guide wildland fire preparedness and response decision-making. The modular system was developed to rapidly deliver the best available science to fire managers while providing opportunities to improve individual components when better models were available.

The original NFDRS developers recognized that a standardized national system was needed, but they also knew that some of the components necessary for a high-quality system were incomplete or primitive. For example, at the time no generalized methods for modeling live fuel moisture existed that could be integrated into a nationwide system. Much of the other science at the time, however, was robust and suitable for delivery to the field; therefore, they developed the system with the best information available at the time and created a framework in which future innovations could easily be integrated into the system.

Since its inception in 1972 and updates in 1978 and 1988, science and technology have improved. Remote weather stations are now telemetered by satellites, models of both live and dead fuel moistures have improved, and we have increased our understanding of fire danger applications best practices. Now, since 2016, scientists and applications developers built upon this modularity of NFDRS and released an improved version of the system that addresses many of the early constraints of the system (see Figure 2 [Sidebar], below). Although imperfect, it provides managers with the critical information they need to make well-informed decisions. This new system itself will be improved over time as additional science and technology advancements become available.

What's changed in NFDRS?



The modular structure of 1978/1988 NFDRS...

...evolved to support a streamlined and adaptable 2016 NFDRS

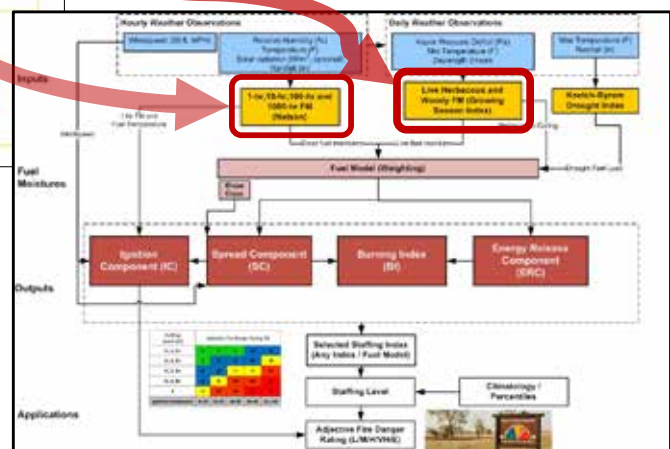


Figure 2 (Sidebar). What's Changed in the NFDRS.



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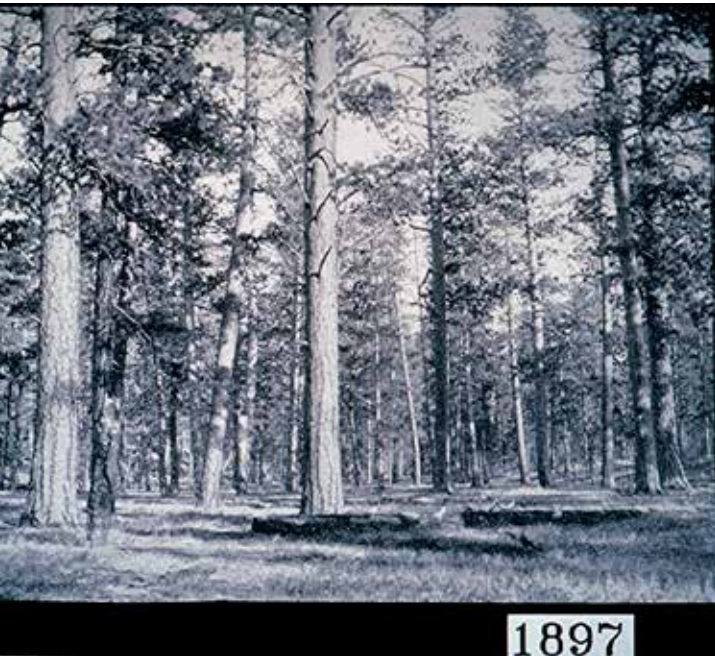


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ASSESSING HIGH-COST WILDFIRES IN RELATION TO THE NATURAL DISTRIBUTION OF PONDEROSA PINE IN THE 11 WESTERN STATES (2000-2017)



By Jerry T. Williams,
*Former National Director of Fire & Aviation
Management, U.S. Forest Service, Retired AND*
Matthew H. Panunto.
*Ecologist, U.S. Forest Service, Rocky Mountain
Research Station Fire Sciences Laboratory*

A PEER-REVIEWED ANALYSIS.

Editor's Note: *This analysis introduces the occasional publication of peer-reviewed papers in Wildfire Magazine. While all articles in Wildfire are reviewed and edited, we often seek the more immediate work of professional practitioners and wildfire journalists. The more formal peer-review process has been reserved for science-based journals (such as our sister LAWF publication, the International Journal of Wildland Fire). But often a work of analysis is best suited to reach a mix of practitioners, fire researchers and fire managers, who are the readers of Wildfire. To submit an article to Wildfire for peer-review, please visit our Submittable site.*

This coarse-resolution assessment suggests that much of the West's wildfire problem traces to the deteriorated condition of its dry ponderosa pine sites.

INTRODUCTION AND BACKGROUND

In this analysis we introduce a broad-scale long-term overview of the US West's costliest wildfires in relation to the natural distribution of ponderosa pine (*Pinus ponderosa*). The species is dependent on frequent, low-intensity burning, but in absence of this function, it has become one of the region's most altered ecosystems (U.S. Government Accounting Office, 1999; U.S.D.A. Forest Service, 2000; Arno and Allison-Bunnell, 2002; Fiedler and Arno, 2015). This analysis illuminates the relationship between deteriorated forest conditions over very large scales and the potential for severe, high-cost wildfires. Based on this analysis, we argue that the West's wildfire crisis is fundamentally a forest land management problem and not a fire control failure, as it is more commonly perceived (Williams, 2013).

This analysis also calls for a much-expanded restoration program as a means to establish a more cost-efficient, safer, and more ecologically appropriate wildland fire management strategy in high-risk fire-prone forests.

It has been some 50 years since the first federal wildland fire management agencies began transitioning from a fire control protection model to a fire management protection model (van Wagtenonk, 2007). Concerns for run-away firefighting costs, safety, and ecological damage were the genesis for this change in wildland fire protection policy (Pyne, 1982). In the intervening years, none of these concerns have diminished. In fact, outside of large wilderness areas, where much-expanded fire-use has been restoring natural processes and re-establishing a diverse vegetative mosaic (Teske, et al, 2012),



Figure 1: A comparison of a frequent, low intensity fire maintained ponderosa pine forest circa 1897 (left and on the cover), and a ponderosa-pine dominated forest where fire has been long excluded circa 1990s (above).

wildfire costs, losses, damages, and dangers have climbed at alarming rates. Since 2000, at least 7 of the 11 western states have suffered their worst wildfires on record (Williams and Hyde, 2009; Williams, 2014). Despite a half-century of movement toward a fire management model, the concept's goals for reigning in costs, improving margins of safety, and restoring ecological integrity have not been realized.

A number of agency reports, research papers, field studies, staffing documents, and other investigations have observed a relationship between altered forest conditions and the propensity for more severe, stand-replacement wildfires, particularly in the West's dry forest types (USDA Forest Service, 1995; U.S. Government Accounting Office, 1999; USDA Forest Service, 2000; Pyne, 2004; Fiedler and Arno, 2015; Ferguson, 2017). This paper offers a comprehensive, 18-year long-term assessment that shows a widespread pattern confirming these observations across the eleven Western states. The consistency of this pattern and the costs associated with it might encourage a re-evaluation of our over-reliance on firefighting as the principal means for protection and, instead, examine other options that focus on restoring more resilient forest conditions in fire-adapted, fire-dependent ecosystems.

In the US West, perhaps no fire-adapted forest type has been more thoroughly studied than ponderosa pine. At least three generations of scientists have examined the role of frequent, low-intensity fire in maintaining the health and resilience of these dry-site forests (Leopold, 1928; Weaver, 1943; Biswell et al, 1973; Hall, 1976; Covington et al, 1997; Arno, Smith, and Krebs, 1997; and Fiedler and Arno, 2015). Ironically, many of today's worst wildfires are occurring in these heavily altered forests that, a century ago, were among the most benign in terms of potential fire severity.

Following more than a century of high-grade logging, livestock grazing, and the virtual elimination of frequent, low-intensity surface burning, these forests are much changed, in terms of species composition, stand structure, density, and fuel loading (Figure 1). In turn, these changes have predisposed broad landscapes to high-intensity stand-replacement wildfires that often remain uncontrollable until firefighters can capitalize on a change in weather or exploit a break in fuels.

The history, use, ecology, condition, and distribution of the West's dry ponderosa pine forests have relevance in understanding today's wildfire problem. Government officials began inventorying and mapping the nation's forests in the late 1800s. Sargent was among the first in 1884, while subsequent inventories followed in 1897 and 1913 by Mohr and Sudsworth respectively (Little, 1971). These inventories focused on the natural distribution or native range of major tree species. Presence of a particular species was indicated, but abundance or density was not always included. However, early journals and photos from explorers and settlers commonly characterized ponderosa pine forests as open with elevated crowns and grassy understories. The marriage of these early inventories, journals, and photos provides a good idea of the extent and condition of the West's ponderosa pine forests before early logging, grazing, and fire exclusion began to so profoundly change them.

Fiedler and Arno (2015) estimate that roughly 90% of the West's ponderosa pine forests have been cut over. Gordon (2014) notes that these forests were heavily exploited and rapidly depleted in the early- to mid-1900's by timber barons in response to intense demand for lumber, rail ties, mine timbers, and cordwood. Their valley-bottom and foothill sites were easily accessible, hastening their exploitation

and removal. During the post-WW II construction boom, old-growth ponderosa pines on higher mountain slopes (also the product of relatively frequent low-intensity fires) were massively harvested, often in large clear-cut logging units. Throughout its range, widespread grazing took out the grasses that once carried low-intensity fire across the forest floor and limited the encroachment of invasive species in ponderosa pine forests. The wholesale elimination of landscape-scale underburning allowed fire-intolerant species to establish and expand their distribution. Ponderosa pine forests that were once described as having 50 or so large trees per acre are, today more commonly described as having upwards of 1,000 spindly ponderosa pine and younger fire-intolerant trees per acre (Gruell et al, 1982; Gruell, 2001). The distribution of ponderosa pine in an open, resilient condition has shrunk to become only a small remnant of its historic extent (Fiedler and Arno, 2015).

Although the look of these forests has changed dramatically over the past 150 years, their site characteristics remain relatively warm and dry; made even drier physiologically as a result of many more trees intercepting and transpiring a lesser quantity of available water. Certainly, the onset of climate change has exacerbated the aridity of these sites (Westerling et al, 2006). Together, these changes go a long way in explaining today's wildfire problem in the West.

METHODS

Wildfire occurrence was collected for the eleven Western states and then overlaid onto the natural distribution of ponderosa pine. A \$20 million threshold was established to distinguish high-cost incidents (the \$20 million threshold was selected somewhat arbitrarily, based on the approximate cost of an extended twenty-one day-long Incident Management Team assignment on a complex wildfire costing roughly \$1 million per day).

The green-shaded area in Figure 2 is from Little (1971), which shows the natural distribution of ponderosa pine in the 11 western states. The graduated symbols displayed in Figure 2 represent the reported latitude/longitude of wildfires with reported suppression costs greater than \$20 million.

Incident locations and firefighting costs were derived from information reported in SIT-209's (NFAM, 2018) and/or National Incident Coordination Center (NICC) Annual Summaries (NIFC, 2018). This assessment used data from 2000, onward (official NICC annual summaries began in 2000). Reported suppression costs are a compilation of all monies expended in fighting the fire during the effort to control or suppress it. They do not break out firefighting costs to protect private or public values at risk, nor do they reflect any judgments on cost-effectiveness. The reported costs are for suppression only; they do not include private property losses, natural resource damages, or other wildfire-related impacts.

Some named wildfires were made up of two or more incidents, managed as a single incident or multiple incidents that eventually burned together. All dollars are those spent in the year of the fire (they do not account for inflation). The authors acknowledge that these summaries or reports sometimes reflect data that are incomplete or inconsistently collected from year-to-year.

RESULTS AND DISCUSSION

This assessment found that, from 2000 and 2017, there have been 187 wildfires having reported suppression costs greater than \$20 million in the eleven Western states. Most of these incidents cost much more than \$20 million to control. In all, the total suppression costs, alone, exceeded \$8 billion for these 187 incidents.

The true, total costs of wildfires go far beyond the suppression costs reported here; they include private property losses, natural resource damages, as well as environmental degradation, human health effects, infrastructure repairs, adverse impacts to local economies, post-fire rehabilitation, and other long-term costs. They are not accounted for in existing summaries and, therefore, remain largely unknown. Two studies indicate that these un-reported costs, losses, and damages may be 5- to 10-times, or more, greater than reported suppression costs alone (WFLC, 2010; Hessburg, 2017). For example, following the disastrous 2017 fire season, the California insurance commissioner subsequently reported that nearly \$12 billion had been submitted in wildfire-related property claims alone (California Department of Insurance, 2018).

The 187 incidents burned over 15 million acres (approximately 23,400 square miles). Among the 187 incidents, 116 (62.03%) occurred within the natural distribution of pon-

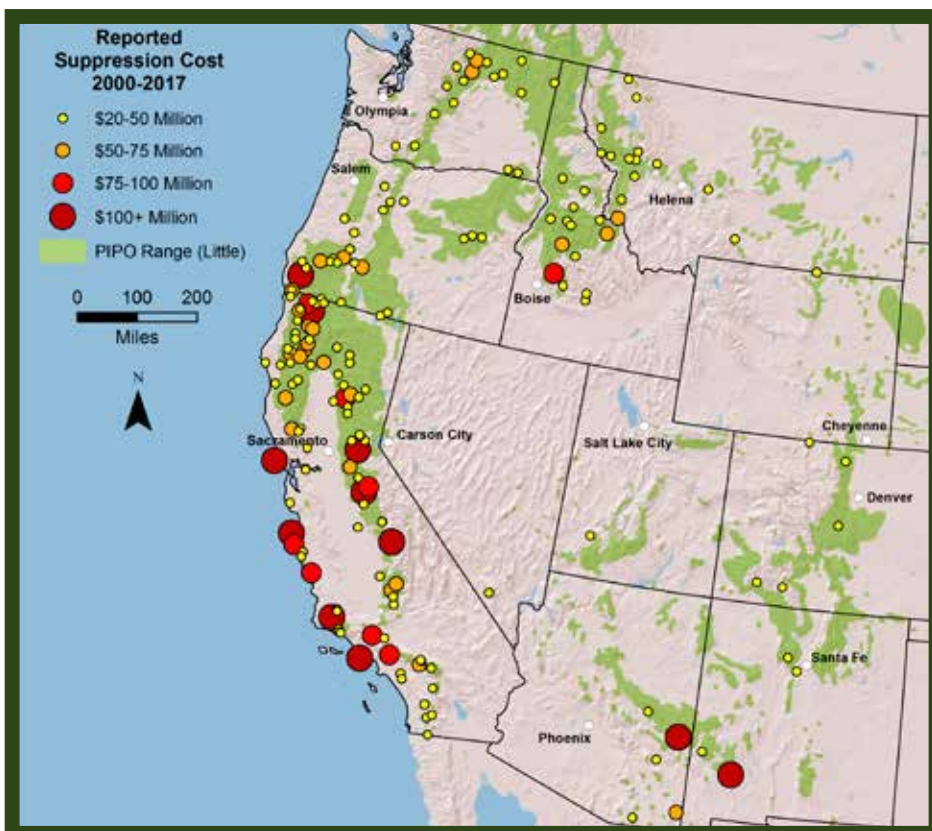


Figure 2: Reported locations of high-cost wildfires in relation to the natural distribution of ponderosa pine in the 11 Western states (2000-2017).

ponderosa pine, as mapped by Little (1971). These 116 incidents burned over 9.7 million acres (64.7% of the total) and cost over \$5 billion to control (64.3% of the total).

California had the greatest number of reported high-cost incidents; 97 out of the 187 (52%). Of these 97 incidents, 59 were within Little's natural range of ponderosa pine (60.82%).

Of the West's ten wildfires with highest reported suppression costs, seven were located in California, including the 132,000 acre Soberanes Fire (2016), the nation's most expensive wildfire on record with a reported suppression cost of \$262.5 million.

CONCLUSIONS

Although very large wildfires typically burn across a variety of forest types, many of them are concentrated in forests that, today, are burning at intensities well beyond those experienced historically. The preponderance of high-intensity, stand-replacement wildfires occurring in ponderosa pine ecosystems is a significant departure from historical patterns. The prevalence of high-cost incidents within the mapped natural distribution of ponderosa pine infers an important pattern: 150-years of change on these sites have predisposed present day forests to most of today's highest cost wildfires.

Because these forests also tend to occupy valley-bottoms and foothills, where people, property, and other high values are often most concentrated, wildfires in these areas almost always result in high losses and damages. Throughout much of the West, homeowners who locate in wildland-urban interface settings are not required to reduce fuel hazards or comply with Firewise standards (NFPA, 2018) as a requisite for wildfire protection or as an incentive for insurance coverage. Consequently, the protection of private property in these areas typically carry inordinately high costs. Compounding the situation is the fact that protecting private property often occurs at the expense of public values (e.g. damage to watersheds, critical habitat, air quality, others).

In broad terms, the results of this assessment point to a serious and urgent forest land management crisis. In Arizona, alone, between 1990 and 2010, Swetnam (2012) estimated that nearly 20 percent of Arizona's forests burned over with near-complete mortality. Despite the commonly held view that today's worst wildfires are considered either "accidents of nature," a result of poor management decisions, or due to a lack of firefighting effort, this assessment helps support the analysis that much of today's wildfire problem traces to vulnerable forest conditions on dry sites. In this context, uncharacteristically severe wildfires in these altered forests are among the least natural of the natural disasters that, today, confront those living in the US West.

Nearly two-thirds of all western wildfires with reported suppression costs exceeding \$20 million occurred within the natural distribution of ponderosa pine. These wildfires burned almost two-thirds of the total acreage documented in this assessment and accounted for close to two-thirds of the assessment's reported suppression expenditures. The proportions involved are perhaps a "bad-news – good news" story. The bad news is that these forests, over a century of exploitation and neglect, have devolved into a condition that makes them highly susceptible to severe, high-intensity burning. However,

the good news is that their ecology holds the key to their resilience and, in turn, our ability to better protect them and provide for our own safety. At appropriate fire intensities and fire return intervals, and at meaningful scales, ponderosa pine can be maintained in a resilient, sustainable condition. This observation is consistent with the findings of wildland fire scientists stretching back to the late 1920's.

NEXT STEPS

The high suppression costs, as well as the unaccounted losses and damages reflected in this assessment may change the calculus of how alternative wildfire protection models (including greater investments in fuel hazard mitigation) are evaluated. It is unclear that there exists a threshold where high suppression costs, coupled with high wildfire-related losses and damages, might combine to challenge the efficacy of "staying the course" and prompt a change in the protection strategy for the West's dry forests (Williams, 2014). Certainly, a more complete accounting of the true and total wildfire costs would better reflect the realities involved and help support a more accurate analysis of future protection options.

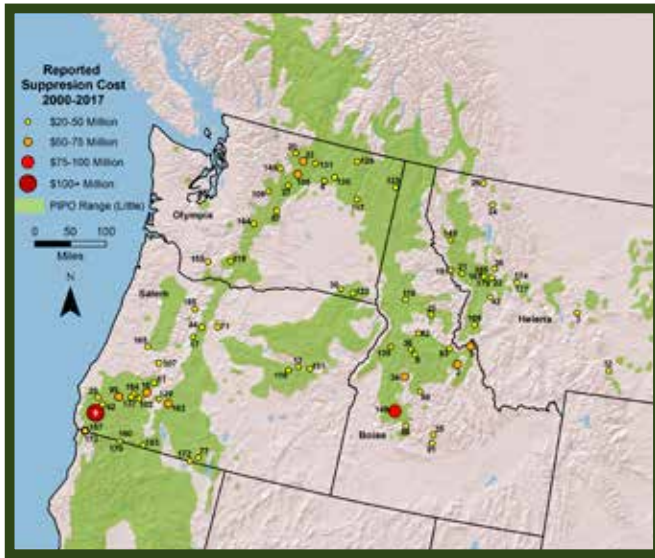
The very large size of many incidents described in this analysis is not lost within the scale of Little's map, but a more detailed, site-specific analysis would better support land management decisions.

Although this paper focuses on the relationship between high-cost wildfires and the natural distribution of altered ponderosa pine forests, an overlay of high-cost wildfire perimeters onto LANDFIRE data (Rollins, 2009) may more precisely frame the relationship between vegetation type, condition, and wildfire potential. An integration of more precise fire and vegetative data may also provide an ecological basis for evaluating wildfire protection options. This understanding will be especially critical in the West's fire-prone ponderosa pine forests where safe, cost-effective protection depends so much on more resilient conditions.

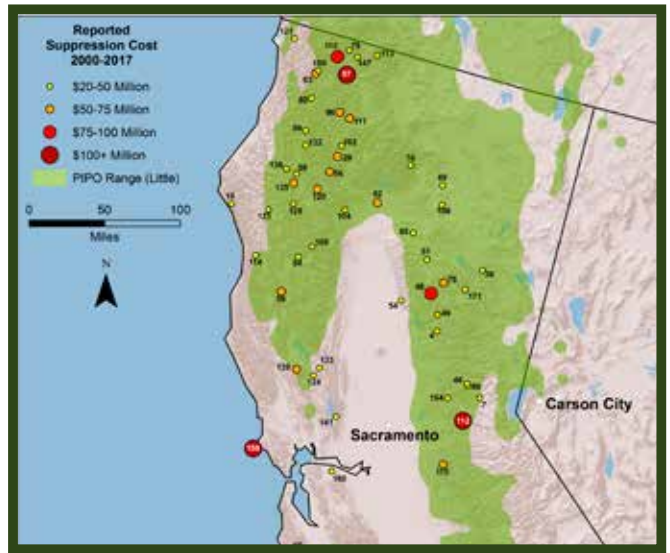
ACKNOWLEDGMENTS

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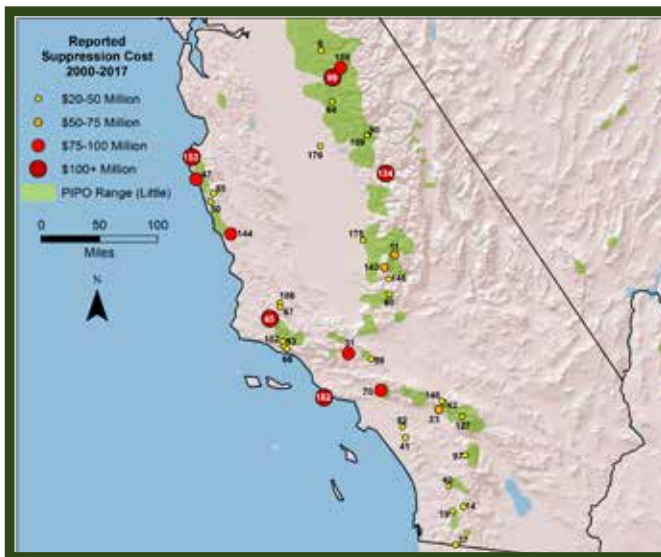
The authors take full responsibility for any mistakes or omissions that may have occurred in summarizing the data.



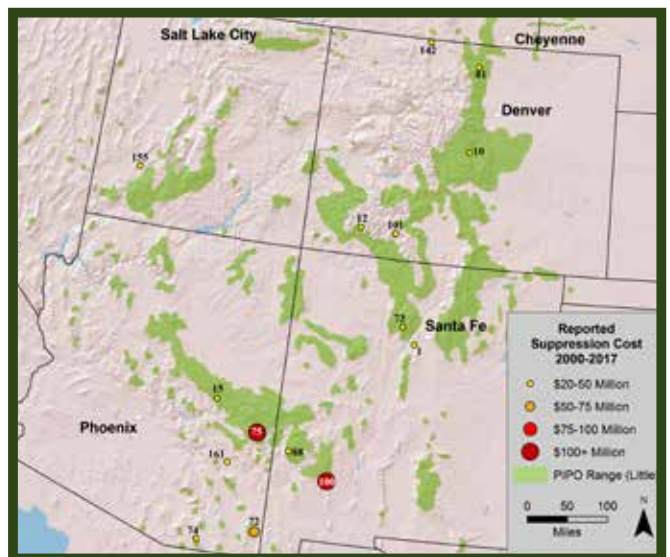
APPENDIX A.



APPENDIX B.



APPENDIX C.



APPENDIX D.

APPENDICES

APPENDIX A. Distribution of high suppression cost wildfires and their relationship to the native range of ponderosa in the states of Oregon, Washington, and Montana (2000-2017). Wildfire numbers in all Appendices correspond to those numbered in Appendix E.

APPENDIX B. Distribution of high suppression cost wildfires and their relationship to the native range of ponderosa pine in North Zone, California (2000-2017).

APPENDIX C. Distribution of high suppression cost wildfires and their relationship to the native range of ponderosa pine in South Zone, California (2000-2017).

APPENDIX D. Distribution of high suppression cost wildfires and their relationship to the native range of ponderosa pine in Nevada, Colorado, New Mexico, and Arizona (2000-2017).



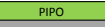

APPENDIX E. A summary of all wildfires with reported suppression costs greater than \$20 million in the eleven western states (2000-2017). This assessment can also be found online at wildfiremagazine.org/article/high-cost-wildfires-in-ponderosa/.

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Appendix E - Summary of all wildfires with reported suppression costs greater than \$20 million in the 11 Western states. (2000-2017)

WILDFIRE NUMBER	RANGE	YEAR	START DATE	STATE	INCIDENT ID	INCIDENT NAME	LAT	LONG	ACRES	REPORTED SUPPRESSION COST
0	PIPO	2000	07/14/2000	ID	ID-PAF-008	BURGDORF JUNCTION	45.16	-115.53	64,496	\$23,484,252
1		2000	05/05/2000	NM	NM-BAP-0009	CERRO GRANDE	35.51	-106.24	47,650	\$32,449,962
2		2000	07/10/2000	ID	ID-SCF-P46044	CLEAR CREEK COMPLEX	45.14	-114.27	216,961	\$71,500,000
3		2000	08/16/2000	MT	MT-CES-103	MAUDLOW/TOSTON	46.6	-111.10	81,687	\$23,150,000
4	PIPO	2000	08/17/2000	CA	CA-PNF-848	STORRIE	39.55	-121.20	46,280	\$22,703,120
5		2000	07/31/2000	MT	MT-BRF-11445	VALLEY COMPLEX	45.55	-114.00	292,070	\$61,986,078
6	PIPO	2001	09/05/2001	CA	CA-TCU-06632	DARBY	38.15	-120.37	14,280	\$21,476,122
7	PIPO	2001	08/25/2001	CA	CA-ENF-12745	STAR	39.04	-120.47	16,761	\$28,200,000
8	PIPO	2001	08/13/2001	WA	WA-COA-132	VIRGINIA LAKE COMPLEX	48.22	-119.28	74,243	\$25,200,000
9	PIPO	2002	07/13/2002	OR	OR-SIF-003	BISCUIT (FORMERLY FLORENCE)	42.41	-123.87	499,570	\$152,658,738
10	PIPO	2002	06/08/2002	CO	CO-PSF-404	HAYMAN	39.05	-105.43	137,760	\$39,200,000
11	PIPO	2002	07/21/2002	CA	CA-SQF-1888	MCNALLY	35.92	-118.47	150,696	\$55,587,000
12	PIPO	2002	06/09/2002	CO	CO-SIF-26804	MISSIONARY RIDGE	37.50	-107.75	70,485	\$40,700,000
13	PIPO	2002	07/12/2002	OR	OR-MAF-103	MONUMENT-MALHEUR COMPLEX	44.40	-118.71	44,062	\$30,761,594
14		2002	07/29/2002	CA	CA-MVU-05658	PINES	33.07	-116.59	61,690	\$24,976,052
15	PIPO	2002	06/18/2002	AZ	AZ-FTA-251	RODEO/CHEDISKI COMPLEX	34.10	-110.43	468,638	\$48,737,663
16	PIPO	2002	07/12/2002	OR	OR-UPF-069	TILLER COMPLEX	43.10	-122.67	68,775	\$58,917,923
17	PIPO	2003	08/19/2003	OR	OR-DEF-848	B & B COMPLEX	44.44	-121.83	90,769	\$41,198,000
18		2003	09/03/2003	CA	CA-HUU-004435	CANOE/HONEYDEW	40.17	-124.13	24,882	\$33,900,000
19		2003	10/25/2003	CA	CA-CNF-003056	CEDAR	32.99	-116.73	273,246	\$32,616,213
20	PIPO	2003	06/29/2003	WA	WA-OWF-199	FAWN PEAK COMPLEX	48.62	-120.33	81,343	\$39,790,496
21	PIPO	2003	08/09/2003	MT	MT-LNF-000264	FISH CREEK COMPLEX	46.98	-114.65	36,956	\$27,000,000
22		2003	08/06/2003	MT	MT-LNF-00332	MINERAL-PRIMM	47.01	-113.76	25,202	\$22,907,000
23	PIPO	2003	10/25/2003	CA	CA-BDF-10329	OLD/GRAND PRIX/PADUA COMPLEX	34.18	-117.27	161,175	\$55,107,829
24		2003	07/23/2003	MT	MT-FNF-000048	ROBERT	48.48	-114.15	57,570	\$30,744,892
25	PIPO	2003	07/07/2003	ID	ID-NPF-000014	SLIMS COMPLEX	46.03	-115.30	14,473	\$22,000,000
26		2003	07/16/2003	MT	MT-FNF-036	WEDGE CANYON	48.88	-114.55	53,315	\$34,000,000
27	PIPO	2004	06/26/2004	WA	WA-OWF-271	POT PEAK/SISI RIDGE COMPLEX	47.94	-120.31	47,170	\$27,739,172
28	PIPO	2005	07/21/2005	OR	OR-SIF-11	BLOSSOM COMPLEX	42.73	-123.94	15,600	\$28,424,301
29	PIPO	2006	07/23/2006	CA	CA-SHF-001693	BAR COMPLEX	40.89	-123.01	100,414	\$61,331,547
30	PIPO	2006	08/21/2006	OR	OR-UMF-000411	COLUMBIA COMPLEX	46.14	-118.04	109,422	\$35,400,000
31		2006	09/04/2006	CA	CA-LPF-2023	DAY	34.60	-118.80	162,702	\$78,000,000
32		2006	08/22/2006	MT	MT-GNF-000047	DERBY FIRE	45.53	-109.93	223,570	\$20,000,000
33	PIPO	2006	07/24/2006	WA	WA-OWF-398	TRIPOD COMPLEX	48.50	-120.04	113,011	\$68,175,390
34		2007	07/17/2007	ID	ID-BOF-000635	CASCADE COMPLEX	44.67	-115.69	302,376	\$53,240,816
35		2007	08/16/2007	ID	ID-STF-002132	CASTLE ROCK	43.64	-114.56	48,520	\$25,000,000
36	PIPO	2007	07/07/2007	ID	ID-PAF-007071	EAST ZONE COMPLEX	45.25	-115.68	300,022	\$33,000,000
37		2007	10/21/2007	CA	CA-MVU-010427	HARRIS	32.59	-116.58	90,440	\$21,000,000
38		2007	08/03/2007	MT	MT-FHA-115	JOCKO LAKES	47.20	-113.73	36,388	\$31,423,766
39	PIPO	2007	09/03/2007	CA	CA-PNF-000670	MOONLIGHT	40.22	-120.85	64,997	\$34,000,000
40		2007	10/23/2007	CA	CA-MVU-10643	POOMACHA	33.28	-116.87	49,410	\$20,658,000
41		2007	10/21/2007	CA	CA-ORC-68555	SANTIAGO	33.75	-117.67	28,400	\$21,650,000
42		2007	07/31/2007	MT	MT-LNF-211	SAWMILL COMPLEX	46.61	-113.70	68,500	\$20,864,000
43		2007	10/22/2007	CA	CA-BDF-10570	SLIDE	34.28	-117.22	12,759	\$27,147,745
44	PIPO	2007	07/12/2007	OR	OR-WSA-073	WSA LIGHTNING COMPLEX	44.68	-121.67	13,077	\$20,988,400
45		2007	07/04/2007	CA	CA-LPF-001087	ZACA / ZACA TWO	34.78	-120.09	240,207	\$122,533,385
46	PIPO	2008	06/21/2008	CA	CA-TNF-1011	AMERICAN RIVER COMPLEX	39.14	-120.67	20,541	\$23,950,980
47		2008	06/21/2008	CA	CA-LPF-1649	BASIN COMPLEX	36.21	-121.74	162,818	\$78,096,079
48	PIPO	2008	06/21/2008	CA	CA-BTU-007660	BTU LIGHTNING COMPLEX	39.88	-121.40	64,995	\$94,825,683
49	PIPO	2008	06/21/2008	CA	CA-PNF-000539	CANYON COMPLEX	39.70	-121.25	47,680	\$45,501,474
50		2008	09/27/2008	CA	CA-LPF-002754	CHALK	35.99	-121.43	16,269	\$24,042,000
51	PIPO	2008	06/21/2008	CA	CA-LNF-2713	CUB COMPLEX	40.18	-121.56	19,718	\$21,000,000
52		2008	11/15/2008	CA	CA-ORC-075221	FREEWAY COMPLEX	33.87	-117.74	30,305	\$24,328,779
53		2008	07/01/2008	CA	CA-LPF-1778	GAP	34.49	-119.78	9,443	\$20,970,000
54		2008	06/11/2008	CA	CA-BTU-007089	HUMBOLDT	39.74	-121.74	23,344	\$20,568,690
55		2008	06/08/2008	CA	CA-LPF-1491	INDIANS	36.10	-121.42	76,554	\$42,500,000
56	PIPO	2008	06/21/2008	CA	CA-SHF-1057	IRON & ALPS COMPLEXES	40.73	-123.05	105,805	\$73,974,917
57	PIPO	2008	06/21/2008	CA	CA-KNF-3393	KLAMATH THEATER	41.66	-123.19	192,038	\$126,086,065
58	PIPO	2008	06/20/2008	CA	CA-SHF-1041	LIME COMPLEX	40.53	-123.45	99,585	\$59,329,698
59	PIPO	2008	06/20/2008	CA	CA-MEU-004608	MEU LIGHTNING COMPLEX	39.51	-123.21	54,819	\$66,000,000
60	PIPO	2008	06/28/2008	CA	CA-SQF-001356	PIUTE	35.43	-118.40	37,026	\$25,000,000
61	PIPO	2008	08/17/2008	OR	OR-UPF-008209	RATTLE	43.33	-122.54	19,775	\$21,057,784
62	PIPO	2008	06/21/2008	CA	CA-SHU-004727	SHU LIGHTNING COMPLEX	40.57	-122.36	86,500	\$56,438,391
63	PIPO	2008	06/21/2008	CA	CA-KNF-002975	SISKIYOU / BLUE 2 COMPLEX	41.59	-123.58	82,186	\$65,692,836

Legend and Summary of Assessments

Data Source		Obtained directly from SIT209 Database	ALL FIRES	Total Reported Suppression Cost	\$8,052,345,713
		Obtained from NICC Annual Summary Report		Total Burned Acres	15,092,281
Ponderosa Range		Reported fire location - IN Ponderosa Pine Range (Little, 1971)	PONDEROSA FIRES	Total Reported Suppression Cost	\$5,179,497,094
		Reported fire location - NOT IN Ponderosa Pine Range		Total Burned Acres	9,768,916

WILDFIRE NUMBER	RANGE	YEAR	START DATE	STATE	INCIDENT ID	INCIDENT NAME	LAT	LONG	ACRES	REPORTED SUPPRESSION COST
64	PIPO	2008	07/25/2008	CA	CA-MMU-009779	TELEGRAPH	37.57	-120.00	34,091	\$38,350,000
65	PIPO	2008	06/20/2008	CA	CA-SRF-1126	UKONOM-SOUTH COMPLEX	41.35	-123.54	58,871	\$23,581,000
66		2009	05/05/2009	CA	CA-LPF-1479	JESUSITA	34.47	-119.72	8,733	\$20,002,000
67		2009	08/08/2009	CA	CA-LPF-002631	LA BREA	34.95	-119.98	89,489	\$35,120,000
68		2009	08/12/2009	CA	CA-CZU-007246	LOCKHEED	37.14	-122.19	7,817	\$30,788,744
69	PIPO	2009	08/01/2009	CA	CA-SHU-5594	SHU LIGHTNING	40.90	-121.62	17,623	\$31,653,934
70		2009	08/26/2009	CA	CA-ANF-003622	STATION	34.25	-118.19	160,577	\$95,510,000
71		2011	08/24/2011	OR	OR-WSA-000108	HIGH CASCADES	44.77	-121.23	108,154	\$28,294,465
72	PIPO	2011	05/08/2011	AZ	AZ-CNF-011047	HORSESHOE 2	31.82	-109.21	222,954	\$52,000,000
73	PIPO	2011	06/26/2011	NM	NM-N65-000451-N	LAS CONCHAS	35.81	-106.54	156,593	\$48,385,000
74		2011	06/12/2011	AZ	AZ-COP-001102	MONUMENT	31.55	-110.42	30,526	\$20,411,500
75	PIPO	2011	05/29/2011	AZ	AZ-ASF-110152-1	WALLOW	33.60	-109.45	538,049	\$109,000,000
76	PIPO	2012	08/18/2012	CA	CA-SHF-002744	BAGLEY	41.00	-122.08	46,011	\$37,063,416
77	PIPO	2012	08/06/2012	OR	OR-FWF-120680	BARRY POINT	42.11	-120.80	93,071	\$23,247,235
78	PIPO	2012	07/29/2012	CA	CA-PNF-1001	CHIPS	40.01	-121.28	75,431	\$53,300,000
79	PIPO	2012	08/05/2012	CA	CA-KNF-5659	FORT COMPLEX	41.89	-123.25	23,658	\$26,747,381
80		2012	07/27/2012	ID	ID-SCF-012151	HALSTEAD	44.45	-115.17	181,948	\$26,413,932
81	PIPO	2012	06/09/2012	CO	CO-LRX-329	HIGH PARK	40.59	-105.40	87,284	\$38,400,000
82		2012	08/27/2012	ID	ID-NPF-00531	MCGUIRE COMPLEX	45.60	-115.56	43,621	\$24,741,628
83	PIPO	2012	07/30/2012	ID	ID-SCF-12190	MUSTANG COMPLEX	45.42	-114.59	341,488	\$38,323,413
84	PIPO	2012	08/18/2012	CA	CA-MMF-001446	NORTH PASS	39.87	-123.13	41,983	\$30,493,184
85	PIPO	2012	08/18/2012	CA	CA-TGU-6696	PONDEROSA	40.39	-121.82	27,676	\$33,051,301
86		2012	08/03/2012	ID	ID-BOF-000628	TRINITY RIDGE	43.71	-115.37	146,832	\$41,228,912
87	PIPO	2012	09/09/2012	WA	WA-OWF-000559	WENATCHEE COMPLEX	47.37	-120.45	56,478	\$32,394,876
88	PIPO	2012	05/16/2012	NM	NM-GNF-000143	WHITewater-BALDY	33.34	-108.71	297,845	\$23,000,000
89	PIPO	2013	08/10/2013	CA	CA-TNF-001562	AMERICAN	39.12	-120.65	27,440	\$27,310,674
90	PIPO	2013	07/22/2013	CA	CA-SNF-1732	ASPEN	37.28	-119.32	22,992	\$32,289,100
91		2013	08/07/2013	ID	ID-TFD-000337	BEAVER CREEK	43.46	-114.55	111,490	\$26,500,000
92	PIPO	2013	07/26/2013	OR	OR-712S-133-14	BIG WINDY COMPLEX	42.61	-123.76	26,725	\$36,489,789
93		2013	07/01/2013	NV	NV-HTF-500068	CARPENTER 1	36.20	-115.70	27,883	\$20,183,000
94	PIPO	2013	08/10/2013	CA	CA-SRF-1486	CORRAL COMPLEX	41.04	-123.49	12,503	\$36,666,073
95	PIPO	2013	07/26/2013	OR	OR-732-05314	DOUGLAS COMPLEX	42.86	-123.38	48,679	\$55,000,000
96	PIPO	2013	08/31/2013	CA	CA-KNF-005949	FORKS COMPLEX/SALMON RIVER COMPLEX/BUTLER FIRE	41.30	-123.14	37,246	\$59,806,008
97		2013	07/15/2013	CA	CA-BDF-10080	MOUNTAIN	33.70	-116.73	27,531	\$25,856,300
98		2013	05/30/2013	CA	CA-ANF-2297	POWERHOUSE	34.60	-118.44	30,274	\$27,321,000
99	PIPO	2013	08/17/2013	CA	CA-STF-002857	RIM	37.86	-120.09	257,314	\$127,350,000
100	PIPO	2013	06/07/2013	NM	NM-GNF-000230	SILVER	32.89	-107.81	138,546	\$143,000,000
101		2013	06/05/2013	CO	CO-SJF-000285	WEST FORK COMPLEX	37.46	-106.94	109,615	\$31,261,047
102	PIPO	2013	07/26/2013	OR	OR-UPF-130132	WHISKEY COMPLEX	42.94	-122.82	17,891	\$22,128,577
103	PIPO	2014	07/30/2014	OR	OR-711S-161-15	BEAVER COMPLEX	42.05	-122.35	35,302	\$22,220,837
104	PIPO	2014	07/11/2014	CA	CA-SHU-006248	BULLY	40.42	-122.73	12,661	\$23,865,759
105	PIPO	2014	07/14/2014	WA	WA-NES-000534	CARLTON COMPLEX	48.21	-120.10	256,108	\$68,800,000
106		2014	07/15/2014	WA	WA-OWF-000356	CHIWALKUM COMPLEX	47.71	-120.83	13,895	\$28,516,174
107		2014	08/11/2014	OR	OR-WIF-140274	DECEPTION COMPLEX	43.74	-122.57	6,033	\$28,450,000
108	PIPO	2014	07/31/2014	CA	CA-LNF-003502	EILER	40.72	-121.56	32,416	\$26,334,929
109	PIPO	2014	07/28/2014	CA	CA-SNF-001619	FRENCH	37.27	-119.33	13,838	\$21,600,000
110	PIPO	2014	08/14/2014	CA	CA-KNF-005956	HAPPY CAMP COMPLEX	41.80	-123.37	134,056	\$88,214,725
111	PIPO	2014	08/03/2014	CA	CA-KNF-005564	JULY COMPLEX	41.27	-123.00	50,042	\$50,295,981
112	PIPO	2014	09/13/2014	CA	CA-ENF-023461	KING	38.79	-120.60	97,717	\$119,000,000
113	PIPO	2014	07/30/2014	CA	CA-KNF-005497	KNF BEAVER	41.92	-122.88	32,496	\$27,128,721
114	PIPO	2014	07/30/2014	CA	CA-MEU-007202	LODGE COMPLEX	39.77	-123.65	12,536	\$41,500,000
115	PIPO	2015	09/09/2015	CA	CA-AEU-024918	BUTTE	38.34	-120.70	70,868	\$74,720,784
116	PIPO	2015	08/12/2015	OR	OR-MAF-015192	CANYON CREEK COMPLEX	44.28	-118.96	110,261	\$31,453,602
117	PIPO	2015	08/14/2015	WA	WA-SPA-000046	CARPENTER ROAD	48.00	-118.20	63,972	\$22,650,000
118	PIPO	2015	08/10/2015	ID	ID-NCF-000720	CLEARWATER/MUNICIPAL/MOTORWAY/NORTH COMPLEX	46.22	-116.13	83,243	\$41,527,637
119	PIPO	2015	08/10/2015	WA	WA-YAA-000157	COUGAR CREEK	46.13	-121.37	53,534	\$23,500,000
120	PIPO	2015	07/31/2015	CA	CA-SHF-002067	FORK COMPLEX	40.54	-123.14	36,499	\$51,700,000
121		2015	07/31/2015	CA	CA-SRF-001488	GASQUET COMPLEX	41.85	-123.97	30,361	\$42,548,342
122	PIPO	2015	08/13/2015	OR	OR-UMF-000947	GRIZZLY BEAR COMPLEX	46.11	-117.68	83,148	\$20,968,610
123	PIPO	2015	07/30/2015	CA	CA-HUU-005606	HUMBOLDT COMPLEX	40.22	-123.66	4,883	\$30,560,608
124		2015	08/09/2015	CA	CA-LNU-007410	JERUSALEM	38.83	-122.53	25,118	\$25,000,000
125	PIPO	2015	08/18/2015	WA	WA-COF-001302	KANIKSU COMPLEX	48.42	-117.14	26,125	\$26,343,033
126	PIPO	2015	08/11/2015	WA	WA-COF-001264	KETTLE COMPLEX	48.76	-118.46	76,512	\$37,557,251

Appendix E - Summary of all wildfires with reported suppression costs greater than \$20 million in the 11 Western states. (2000-2017)

WILDFIRE NUMBER	RANGE	YEAR	START DATE	STATE	INCIDENT ID	INCIDENT NAME	LAT	LONG	ACRES	REPORTED SUPPRESSION COST
127	PIPO	2015	06/17/2015	CA	CA-BDF-007894	LAKE	34.16	-116.90	31,359	\$30,000,000
128	PIPO	2015	07/30/2015	CA	CA-SRF-001433	MAD RIVER COMPLEX	40.34	-123.38	37,462	\$33,350,510
129		2015	08/01/2015	OR	OR-RSF-000836	NATIONAL CREEK COMPLEX	43.04	-122.28	20,960	\$21,100,000
130	PIPO	2015	08/13/2015	WA	WA-COA-000157	NORTH STAR	48.34	-119.00	218,138	\$45,000,000
131	PIPO	2015	08/14/2015	WA	WA-NES-001203	OKANOGAN COMPLEX	48.52	-119.66	145,282	\$46,296,090
132	PIPO	2015	07/30/2015	CA	CA-SHF-002066	RIVER COMPLEX	40.91	-123.44	77,081	\$32,678,783
133		2015	07/29/2015	CA	CA-LNU-006984	ROCKY	38.91	-122.49	69,438	\$46,100,000
134	PIPO	2015	07/31/2015	CA	CA-SNF-001746	ROUGH	36.87	-118.90	151,623	\$120,930,243
135	PIPO	2015	07/30/2015	CA	CA-SRF-001476	ROUTE COMPLEX	40.64	-123.59	35,675	\$25,275,680
136	PIPO	2015	08/01/2015	CA	CA-SHF-002108	SOUTH COMPLEX	40.62	-123.45	29,416	\$31,770,000
137	PIPO	2015	07/30/2015	OR	OR-7325-000090	STOUTS CREEK	42.92	-123.05	26,452	\$38,000,000
138	PIPO	2015	08/12/2015	ID	ID-PAF-000192	TEPEE SPRINGS	45.21	-116.25	95,709	\$31,540,000
139	PIPO	2015	09/12/2015	CA	CA-LNU-008670	VALLEY	38.84	-122.76	76,067	\$56,220,000
140	PIPO	2015	06/29/2015	WA	WA-OWF-000287	WOLVERINE	48.23	-120.67	72,123	\$35,000,000
141		2015	07/22/2015	CA	CA-LNU-006678	WRAGG	38.51	-122.13	8,051	\$21,655,500
142		2016	06/19/2016	CO	CO-RTF-000088	BEAVER CREEK	40.95	-106.61	38,380	\$31,000,000
143		2016	08/16/2016	CA	CA-SQF-002595	CEDAR	35.74	-118.58	29,322	\$58,446,000
144		2016	08/13/2016	CA	CA-SLU-008948	CHIMNEY	35.67	-121.00	46,344	\$78,300,000
145	PIPO	2016	07/31/2016	MT	MT-LNF-005092	COPPER KING	47.60	-115.18	28,553	\$26,467,287
146		2016	06/23/2016	CA	CA-CND-001415	ERSKINE	35.61	-118.47	48,019	\$23,000,000
147	PIPO	2016	08/27/2016	CA	CA-KNF-007501	GAP	41.85	-123.12	33,867	\$29,700,000
148		2016	08/07/2016	CA	CA-BDF-010205	PILOT	34.29	-117.25	8,110	\$25,000,000
149	PIPO	2016	07/18/2016	ID	ID-BOF-000539	PIONEER	43.95	-115.76	188,404	\$90,000,000
150	PIPO	2016	06/07/2016	CA	CA-KNF-004500	PONY	41.62	-123.56	2,860	\$20,500,000
151	PIPO	2016	07/31/2016	OR	OR-WWF-000582	RAIL	44.41	-118.38	41,706	\$34,900,000
152		2016	08/18/2016	CA	CA-LPF-002809	REY	34.55	-119.81	32,606	\$29,910,000
153		2016	07/22/2016	CA	CA-BEU-003422	SOBERANES	36.46	-121.90	132,127	\$262,500,000
154	PIPO	2016	06/28/2016	CA	CA-NEU-015200	TRAILHEAD	38.96	-120.86	5,646	\$25,782,000
155		2017	06/17/2017	UT	UT-SWS-000218	BRIANHEAD	38	-113	71,675	\$36,600,000
156		2017	10/09/2017	CA	CA-LNU-010104	CENTRAL LNU COMPLEX	38	-123	110,720	\$102,000,000
157	PIPO	2017	07/12/2017	OR	OR-RSF-000326	CHETCO BAR	42	-124	191,125	\$72,000,000
158	PIPO	2017	07/16/2017	CA	CA-MMU-014474	DETWILER	38	-120	81,826	\$90,000,000
159		2017	09/02/2017	OR	OR-CGF-000493	EAGLE CREEK	46	-122	48,831	\$20,251,700
160	PIPO	2017	08/15/2017	CA	CA-KNF-006098	ECLIPSE COMPLEX	42	-123	78,698	\$46,006,691
161		2017	06/07/2017	AZ	AZ-CNF-000467	FRYE	33	-110	48,443	\$20,000,000
162	PIPO	2017	08/30/2017	CA	CA-SHF-001770	HELENA	41	-123	18,316	\$30,640,000
163	PIPO	2017	08/13/2017	OR	OR-RSF-000636	HIGH CASCADES COMPLEX	43	-122	27,476	\$65,000,000
164	PIPO	2017	08/11/2017	WA	WA-OWF-000361	JOLLY MOUNTAIN	47	-121	36,808	\$24,400,000
165		2017	08/10/2017	OR	OR-WIF-170191	JONES	44	-123	10,114	\$22,075,117
166	PIPO	2017	07/15/2017	MT	MT-FHA-000105	LIBERTY	47	-114	28,694	\$20,600,000
167	PIPO	2017	07/15/2017	MT	MT-LNF-001288	LOLO PEAK	47	-114	53,902	\$48,500,000
168	PIPO	2017	10/09/2017	CA	CA-MEU-012169	MENDOCINO LAKE COMPLEX	40	-123	38,730	\$25,000,000
169	PIPO	2017	07/14/2017	MT	MT-BDF-002217	MEYERS	46	-114	62,034	\$32,800,000
170	PIPO	2017	08/14/2017	OR	OR-RSF-000647	MILLER COMPLEX	42	-123	39,716	\$38,924,000
171	PIPO	2017	07/29/2017	CA	CA-PNF-001043	MINERVA 5	40	-121	4,310	\$20,500,000
172		2017	07/24/2017	CA	CA-MDF-000671	MODOC JULY COMPLEX	42	-121	83,120	\$35,200,000
173	PIPO	2017	07/25/2017	CA	CA-SRF-000741	ORLEANS COMPLEX	42	-124	27,276	\$44,000,000
174		2017	07/14/2017	MT	MT-HLF-000146	PARK CREEK	47	-113	18,000	\$20,050,123
175		2017	08/29/2017	CA	CA-SQF-002385	PIER	36	-119	36,556	\$38,760,000
176		2017	08/29/2017	CA	CA-SNF-001743	RAILROAD	37	-120	12,407	\$21,500,000
177		2017	07/24/2017	MT	MT-LNF-001464	RICE RIDGE	47	-113	160,187	\$49,251,000
178	PIPO	2017	08/13/2017	CA	CA-KNF-006081	SALMON AUGUST COMPLEX	41	-123	65,889	\$39,805,700
179	PIPO	2017	07/24/2017	MT	MT-LNF-001463	SAPPHIRE COMPLEX	47	-114	43,733	\$35,406,736
180		2017	10/09/2017	CA	CA-LNU-010105	SOUTHERN LNU COMPLEX	38	-122	51,624	\$48,509,895
181		2017	07/16/2017	MT	MT-LNF-001336	SUNRISE	47	-115	26,310	\$31,700,000
182		2017	12/04/2017	CA	CA-VNC-103156	THOMAS	34	-119	270,000	\$123,836,000
183		2017	07/09/2017	MT	MT-MCD-000163	TONGUE RIVER COMPLEX	45	-107	32,965	\$26,500,000
184	PIPO	2017	08/11/2017	OR	OR-UPF-000406	UMPQUA NORTH COMPLEX	43	-123	43,158	\$42,890,561
185		2017	07/23/2017	OR	OR-WIF-170123	WHITWATER	45	-122	14,451	\$39,702,783
186		2017	07/08/2017	CA	CA-LNF-001770	WHITTIER	35	-120	18,430	\$38,500,000

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MyRadar weather app integrates wildfire layer

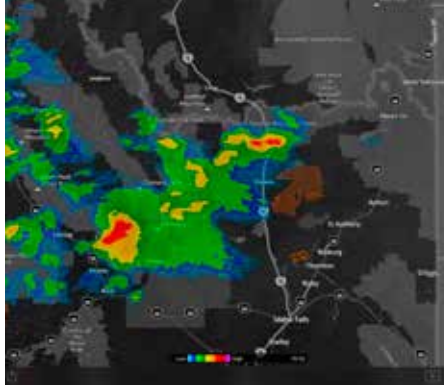
MyRadar weather and information app has added a wildfires layer, allowing fire managers and community members to better prepare for storm-based changes in fire behavior.

This new overlay highlights documented wildfires across the United States and includes specific details on each fire including their intensity. The data is curated from key US sources, including the United States Geological Survey, Inciweb, the the Risk Incident Information Management System by the United States Forest Service and others, and highlights those areas on the map with an icon. Where fire boundaries are available, MyRadar will draw the fire shape on the map (see the “orange” perimeter in the screenshot, with thunderstorm approaching from the southwest and wind layer on).

Users can then tap on each fire to bring up additional information about the fire, including containment status, initial cause (if known), size of the fire, and a greater detailed narrative from the firefighting agency, when available.

“The Wildfire layer can be an invaluable tool to help stay on top of the latest danger zones around the country,” said Andrew Green, CEO of the app developer, ACME AtronOmatic.

“When used with the animated surface Winds layer that MyRadar provides, it helps residents and fire managers gain an understanding of the natural forces driving the fire and can even help municipalities plan for air quality concerns.”



MyRadar receives US radar data

directly from individual radar stations, and processes that data on its own server farms in real-time to render an accurate, up-to-date weather picture available on any mobile device. This direct access to weather telemetry opens up capabilities that allow MyRadar to work with the raw

data, sharing innovative services directly to user fingertips.

Green added that the tool might prove its utility on rapid fire events, such as the Carr Fire in the Redding, California area. Green observed that “fire tornadoes” or, more aptly a ‘fire whirl’ or ‘fire devil,’ are not a real meteorological event, it is instead a highly localized physics observation that is caused by rapid, centralized heat swirling upwards in the air – and as such, it’s not likely that it would be picked up on

radar. However, the surface winds feature can be extremely helpful in gauging the effects of nature on the spread of a large fire. The animated winds layer plainly shows which direction the surface winds are flowing, and at what strength. This data can help gauge which areas may be at risk from a spreading fire.”

A secondary tool is the photo feature, which would allow residents and officials to share geo-tagged photos of the fire to help raise situational awareness among the population in the area.

MyRadar is a free weather and environmental information app, available for iOS, Android, Windows, and Android TV. In the app store since 2008, the app has been downloaded over 45 million times.

Downloads at Android and IOS stores, and www.myradar.com.

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A REPORT ON A NATIONAL MEETING OF WILDLAND FIRE LEADERS ... United to Reduce Line-of-Duty Deaths and Injuries of Wildland Firefighters

THOUGHTS ON OUR WASHINGTON D.C WILDLAND LEADERS' MEETING – 17 APRIL 2018

By Tom Harbour

FIRES WHICH OCCUR OUTSIDE BUILDINGS, improvements, and structures, whether fueled by grass, brush, forest, timber, or other materials, are the “wildland fire” we deal with in the fire service. It can take the form of thousands of acres of trees on fire, the purposeful burning we do to improve ecosystems, or the small vacant lot grass fire, but we refer to them all as wildland fire. These were the fires confronted by our ancestors, that we continue to struggle with to this day. And with more than one billion burnable wildland acres in the US, every day of the year some part of the American fire service is dealing with wildland fire.

Too many of our brothers and sisters in the fire service are dying in the line of duty while fighting fire in the wildland environment. Data suggests wildland firefighters die at a higher rate than those involved in structural fire response, and the emotional, social and fiscal costs of wildland firefighter death, accident, and injury weighs heavily on each of us. These costs have generation-long impacts that are too devastating to simply absorb as “the price of doing business.” Unless we choose to change the ways in which we operate, too many wildland firefighters will continue to die in preventable incidents. We need change – positive change. We need to improve our strategies, tactics, and human factors training in wildland fire so more of us live long and healthy lives after engaging.

The National Fallen Firefighters Foundation (NFFF) has taken on the task of working to coalesce the many voices of wildland fire in support of reducing line-of-duty death (LODD), accident, and injury among our firefighters. As an initial step, the NFFF

conducted a wide-scale needs assessment of all populations involved in wildland fire response, including natural resource management organizations. After a year of focused inquiry, the NFFF presented their findings and engaged a representative sample of American wildland fire leaders in active discussion at a meeting held outside Washington D.C., on April 17, 2018, ahead of the Congressional Fire Service Institute’s annual National Fire and Emergency Services Dinner & Symposium.

This group of leaders was asked for their input, review, comment, and commitment to a series of actions and recommendations emanating from the NFFF’s needs assessment. The event began with thoughtful opening comments by leaders from the NFFF, US Fire Administration, Wildland Firefighter Foundation, Congressional Fire Service Institute, US Department of Agriculture (home of the Forest Service), and US Department of the Interior (home to four federal wildland fire organizations). Attendees represented a broad range of additional stakeholder organizations, including:

- * National Volunteer Fire Council
- * International Association of Fire Chiefs
- * International Association of Fire Fighters
- * International Association of Wildland Fire
- * International Fire Service Training Association
- * National Fire Protection Association
- * National Institute for Occupational Safety and Health/Center for Disease Control
- * National Institute of Standards and Technology
- * National Wildfire Suppression Association
- * State forestry organizations

The diverse group of leaders assembled thoughtfully considered actions in both the large group and smaller, more focused, discussion sessions. It was important for attendees to understand why the NFFF, at this juncture, was prepared to engage in this effort to support the wildland community. The NFFF's intention to form and sustain collaborative relationships and build coalitions among organizations with the support of each organization's leaders will be important tools in advancing national efforts to reduce wildland fire LODDs. Widely acknowledged for reducing LODDs among structural firefighters through programs under the Everyone Goes Home® umbrella, the NFFF now proposes to leverage their strengths and resources to do the same for wildland firefighters. Their assets and expertise include:

- More than a decade of experience focusing on firefighter health and safety.
- A broad array of tools, programs, and resources that can be easily adapted for use by the wildland fire community.
- A proven track record of working with diverse agencies to unite efforts in pursuit of the common goal of reducing firefighter fatalities. NFFF is known for its efforts in recognizing each agency's unique organization and culture, then tapping into those characteristics to build a cohort that strengthens partnerships and collaboration – keys to successful change.

At the April meeting, leaders heard the results of the NFFF's comprehensive survey of stakeholders, as well as a detailed report of six "listening sessions." These sessions were a series of focus groups held across the country to solicit direct feedback from firefighters representing the range of departments and organizations who deal with wildland fire. One of the resounding themes heard during these sessions was the need to work to end the perceived "worlds apart" between wildland and structural firefighters and organizations. Firefighters acknowledged the need to work and train collaboratively across organizations, and clearly want to build bridges and bring both worlds together. It is evident that from leadership down, there is consensus that we need to bridge the thinking which separates natural resource organization firefighters from those in the structural fire service. The frequency of the two groups coming together to mitigate incidents makes a stronger collaboration critical to reducing the LODD and injury incidents.

COMMUNITY RISK REDUCTION was also a common topic of discussion at the listening sessions. Participants acknowledged the need to engineer a future where wildlands are less flammable, and communities are better equipped to deal with wildfire. However, participants also recognize that the "Design it Out" option for wildland fire is a strategic vision of a grand scale that will take an extensive investment of time, people, and funding. Those investments suggest far-reaching resolutions

in the wildland fire environment that will not likely transpire in the immediate future. While the participating firefighters want leaders to continue to advance advocacy for these efforts at the state, local and federal levels, they recognize that they can't wait for that future to become reality, and other, more immediate, actions are needed to improve their safety.

Participants stressed the need for accountability at all levels, and the willingness to "do more" at the individual, crew, and company level to increase personnel safety. Firefighters clearly want to reduce LODDs and recognize that reducing fatalities is intertwined with other issues. These include the lack of access to good data, the need for firefighter physicals and fitness testing to develop a baseline for health and wellness, and a growing awareness of the gaps in available resources supporting the emotional wellness of personnel and their families.

Another dominant topic at the listening sessions was risk management. While risk management is a well-known concept in the structural fire service, natural resource management agencies with wildland fire responsibility are just now using the term more frequently. It is evident, though, that the specifics of the application of risk management are neither understood nor utilized across organizations.

All of us involved in wildland fire know that risk is inherent to our profession. Firefighters, fire managers, fire leaders, fire chiefs, etc. all purposefully engage a hazard – whether that hazard is fire we light (prescribed fire) or unplanned fire (wildfire). Currently, our willingness to accept risk in response to wildfire is out of alignment with the biophysical reality we face. We still respond to fire in the same manner we always have, without adjusting to the reality of today's fires.

We routinely accept risk, but we never accept loss. But doesn't accepting risk mean we are accepting the chance of suffering loss? There is a clear and evident need to have the difficult conversations surrounding risk. This will include frank discussions about what the community is willing to risk, and what the community is willing to lose when fighting a wildland fire. That discussion, and multiple other factors, continue to cloud the application of risk management within wildland fire response, and that ambiguity leads to the conflict, including:

- There is no commonly accepted definition of risk management nor application of risk management principles among the wildland community, including those final decision-makers (agency administrators).
- Expectations regarding the acceptance of risk are different in protecting public vs. private lands.
- Managing fire through prescribed fire reduces risk but is of-



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16 FIREFIGHTER LIFE SAFETY INITIATIVES

1. Define and advocate the need for a cultural change within the fire service relating to safety; incorporating leadership, management, supervision, accountability and personal responsibility.
2. Enhance the personal and organizational accountability for health and safety throughout the fire service.
3. Focus greater attention on the integration of risk management with incident management at all levels, including strategic, tactical, and planning responsibilities.
4. All firefighters must be empowered to stop unsafe practices.
5. Develop and implement national standards for training, qualifications, and certification (including regular recertification) that are equally applicable to all firefighters based on the duties they are expected to perform.
6. Develop and implement national medical and physical fitness standards that are equally applicable to all firefighters, based on the duties they are expected to perform.
7. Create a national research agenda and data collection system that relates to the initiatives.
8. Utilize available technology wherever it can produce higher levels of health and safety.
9. Thoroughly investigate all firefighter fatalities, injuries, and near misses.
10. Grant programs should support the implementation of safe practices and/or mandate safe practices as an eligibility requirement.
11. National standards for emergency response policies and procedures should be developed and championed.
12. National protocols for response to violent incidents should be developed and championed.
13. Firefighters and their families must have access to counseling and psychological support.
14. Public education must receive more resources and be championed as a critical fire and life safety program.
15. Advocacy must be strengthened for the enforcement of codes and the installation of home fire sprinklers.
16. Safety must be a primary consideration in the design of apparatus and equipment.



The Everyone Goes Home® program is made possible through the National Fallen Firefighters Foundation with funding provided by the Department of Homeland Security, Assistance to Firefighters Grant and the generosity of Fireman's Fund Insurance Company.



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ten not an option. Laws, rules, regulations, practice, and other influences often limit wildland fire management.

- Managing community building practices reduces risk but is often difficult to achieve.
- Individual tolerances for risk vary widely and are influenced by many factors.
- Perceptions of risk levels and risk tolerances can vary between levels of leadership on the fireground and between leaders and firefighters.
- The public seems conflicted about risk, so firefighters are conflicted about risk.
- Having one partner, or group of partners perceived as being “risk-averse” can lead to additional risk burdens for other firefighters, landscapes, and for communities.

The discussion surrounding risk management will be critical to undertake and will impact wildland fire policies and tactics for decades to come. The sooner this dialogue can start, the sooner the wildland community can begin to establish a common vision. All stakeholders (firefighting personnel, leaders [agency and political], public, and researchers) need to be present at the table to discuss values at risk (monetary, biological, egos, ownership, etc.). One of the root questions to ask is, “What are we protecting or not protecting, and what are the positive and negative effects of these decisions in the long- and short-term?” We should be clearly asking upfront if the gains are worth the exposures – the discussion about values and trade-offs is critical.

The wildland fire service leadership present at the April 2018 meeting was able to reach consensus on initial steps to take to improve the health and safety of wildland firefighters. Below is a series of recommendations for the agencies present, guided by the experience and oversight of the National Fallen Firefighters Foundation, to begin to be implemented immediately to reduce injuries, deaths, and accidents among wildland firefighters.

STRATEGIC AND TACTICAL RECOMMENDATIONS

1. “Two worlds apart” must become closer. Natural resource management and fire service organizations need to become worlds who learn to support one another in wildland work.
2. Increase application and understanding of risk management concepts.
3. Change the wildland fire paradigm from, “Can we accomplish the mission?” to “Can we survive the mission?” As an industry, we need to ask, “How can we respond in a manner which protects citizens, sustains landscapes, and allows reasonable risk for responders?”
4. Change the expectation that we can be successful in EVERY wildland mission ALL the time.
5. Increase awareness of the 16 Firefighter Life Safety Initiatives (16 FLSIs) among wildland firefighters. (see graphic below and more info at <https://www.everyonegoeshome.com/16-initiatives/>). The 16 FLSIs are strategies for implementation of the EGH program but are not well known among wildland firefighters. To broaden awareness and utilization, we can: a) Explore whether the 16 FLSIs can be tweaked to become more broadly inclusive of wildland culture; b) Better explain the interaction between the wildland community’s well known “10/18/LCES/Watch Outs” with the 16 FLSIs; and c) Develop materials to explain implementation of the 16 FLSIs within a wildland context.
6. Adapt effective Everyone Goes Home® tools for wildland use and target marketing of these tools to wildland fire agencies/organizations. Existing and future EGH tools can be made more inclusive of wildland firefighters and organizations. Targeted marketing efforts, beginning at the state wildland fire academy level, will broaden exposure of wildland firefighters EGH.
7. Utilize state EGH Advocates to provide outreach to wildland fire organizations. The NFFF’s well-developed network of state-based volunteers can be used to advocate for the EGH program and provide training to wildland fire organizations. Special effort also needs to be made to recruit additional Advocates from within the wildland fire community.
8. Increase the use of medical screenings and fitness/wellness programs to improve the health and safety of all firefighting personnel. Identification of pre-existing risk factors through NFPA 1582 medical screenings and increased adoption of holistic health programming such as IAFC/IAFF’s Fire Service Joint Labor Management Wellness Fitness Initiative should be prioritized.
9. Enhance the ability of the wildland fire service to take care of its people prior to and in the aftermath of a firefighter injury or fatality. Firefighters want access to tools to support emotional wellness for themselves and their families, such as those that were developed to fulfill the NFFF’s FLSI 13.
10. Continue to focus research and prevention efforts on the major categories of line-of-duty death and/or injury in wildland fire accidents. These include: a) Medical incidents, which include cardiac events, rhabdomyolysis, hyperthermia, occupational cancers, etc.; b) Motor vehicle accidents, including unsafe driving, lack of seat belt use, etc.; c) Burnovers/entrapments; d) Aviation accidents; and e) Snags/rocks/rolling debris.
11. Introduce results of research products and findings at all levels of the organization, down to the lowest level applicable. There is a tremendous amount of good science information which is not being effectively utilized. This information should be used to inform and improve practices, training, and education.

12. Data problems need to be reconciled. While the NFPA has done much work in this area, currently there is no authoritative national census on wildland firefighters across the spectrum of agencies and organizations.
13. Increase marketing efforts for the National Wildland Fire Cohesive Strategy. There is little overall awareness for the National Wildland Fire Cohesive Strategy. Where it has been implemented, it has demonstrated effectiveness. These “points of light” (including Central Oregon, Flagstaff, GOAL), where the “worlds apart” are now working together, can be used to model implementation.

The session closed with an inspirational call to action from the State Forester of Florida, chair of the National Association of State Foresters Wildland Fire Committee. He stated that clearly, there is significant work to do to change. Nevertheless, change we must. Every year, wildland fires engage thousands of firefighters from federal, state, local, and private entities. While they understand the need to “take action at the lowest level” to improve their own health and safety, the NFFF’s listening sessions revealed that these firefighters also have high expectations for leaders. They are counting on us. This revelation demands that the wildland community embark on a more vigorous campaign to reduce

LODDs, which is a worthy goal for all and a common starting point for better collaboration. We need to enlist everyone’s help, and have every agency with an interest in the wildland fire problem engaged. Fortunately, we can rely on the National Fallen Firefighters Foundation to lead the way.

Tom Harbour,
*a board member
of the IAWF
since 2018, is
a recognized
expert in wildland
fire and aviation
management policy
and operations
and served as*



*National Director of Fire and Aviation Management
(National Fire Chief) for the US Forest Service.*



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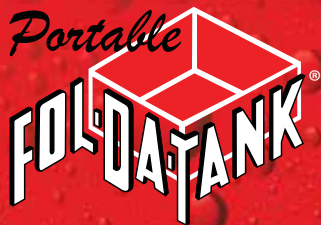
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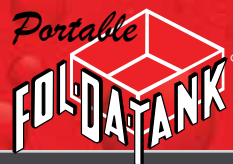


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TAKING CARE OF US THE ART OF LISTENING

The tools we carry now include listening.

By Kathy Clay

We carry tools with us fighting wildland fire. Pulaskis, chain saws, shelters, gloves, sunglasses, sunscreen. A tool you may not consider, and one often overlooked, is the tool of listening.

The National Fallen Firefighter Foundation (NFFF) took the tool of listening across the country in six cities over the course of four months – from October 2017 to February 2018 – to hear and learn how to reduce wildland fire line-of-duty deaths and injuries.

Well entrenched in the structural firefighting arena, NFFF's Everyone Goes Home message is timely as wildland fire burns into neighborhoods across the nation – east to west. Firefighting in the wildland urban interface is often the job of the local fire department – trained in structural firefighting and rarely trained or equipped for the wildland urban interface fire. In 2016, one-third of the firefighters who died in the line of duty on wildland fires were structural firefighters.

As a Battalion Chief and Fire Marshal for Jackson Hole Fire/EMS, I had the privilege of being a part of the NFFF's listening session held in Boise, Idaho. Energetic conversations ensued with retired Chief Tom Harbour at the helm of facilitations. And who better? Chief Harbour's 40 years of wildland firefighter experience anchored us all in respect and admiration. Around our informal circle, voices of care and concern rose from the

hearts of representatives from the US Forest Service, Bureau of Land Management, National Volunteer Fire Council, aviation leaders, Ranch Fire Protection Agencies, researchers, and boots-on-the-ground firefighters. Passionate pleas to stop the dying of wildland firefighters welled up from glossy seasoned eyes that have seen much over the course of many years.

The wildland fire world is not familiar with NFFF's 16 Firefighter Life Safety Initiatives (Foundation, 2018) and this one message resonated in all six regional listening sessions. Developed in 2004 at a Firefighter Safety Summit in Tampa, Florida, the Initiatives have promoted a culture of safety in the US fire service and have become the foundation for thousands of fire departments leaning forward to take a passionate role to ensure their responders return home safely.

Everyone Goes Home. The message resonates loudly in the wildland fire world and will become a continued and expanding challenge as firefighters are asked to respond to the complex and hazardous interface where wild meets urban.

Input from the six listening sessions will guide development of wildland-specific safety materials and messages. The collective message gleaned from the six listening sessions were presented in June 2018 at a Washington, D.C. meeting involving national wildland fire leaders.

The National Fallen Firefighter Foundation is committed to firefighter safety – those wearing bunkers and those in Nomex, those carrying halligans (<https://www.fireengineering.com/articles/2017/10/the-halligan-part-1.html>) and those carrying pulaskis or drip torches.

This effort to listen and hear, focused on the desire to make change, gives all of us in the fire service an opportunity to embrace a culture of safety and be sure *Everyone Goes Home*.

These are the 16 Initiatives that NFFF identified as key to firefighter safety, now migrating from structural firefighters to wildland firefighters – basically, to anyone who responds to fires.

1. Cultural Change
2. Accountability
3. Risk Management
4. Empowerment
5. Training & Certification
6. Medical & Physical Fitness
7. Research Agenda
8. Technology
9. Fatality, Near-Miss Investigation
10. Grant Support
11. Response Policies
12. Violent Incident Response
13. Psychological Support
14. Public Education
15. Code Enforcement & Sprinklers
16. Apparatus Design & Safety

Whether we work with a halligan or a pulaski, a common culture of safety will help us make sure that *Everyone Goes Home*.



For more information, visit <https://www.everyonegoeshome.com/16-initiatives/> and see the prior article by Tom Harbour.



About the Author

Kathy Clay is Fire Marshal and Battalion Chief for Jackson Hole Fire, Wyoming, USA, and an IAWF board member since 2013. She serves the fire world promoting fire and injury prevention, works with new and existing structures to ensure code compliance, investigates structure and wildland fires, provides command on emergency incidents, and maintains EMT certification for medical first response.



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