QUARTER 1, 2023
UNITING THE GLOBAL WILDLAND FIRE COMMUNITY

WILDFIRE

An offical publication of the INTERNATIONAL ASSOCIATION OF WILDLAND FIRE

SANCTIONS

RUSSIA FACES SHORTAGE OF MANPOWER AND EQUIPMENT FOR 2023 WILDFIRES

FIRE STORIES | PRESCRIBED BURNING | FIRED UP

8TH INTERNATIONAL WILDLAND FIRE CONFERENCE

GOVERNANCE PRINCIPLES:
Towards an International Framework

Porto | Portugal
May 16-19th, 2023

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The **8th International Wildland Fire Conference** (8th IWFC) offers a unique opportunity to profile your organisation and showcase your technical and service solutions with over 1.200 wildfire professionals from around the world.

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- Post-fire Intervention
- Qualification
- Technical Innovation

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- Risk Handling
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- Adaptive Management
- Communication
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NEWS AND OPINION

FEATURES

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TELLING STORIES

BY LAURA KING

It's not often an organization gets an opportunity to carry on a legacy that has had global impact.

As many IAWF members know, Wildfire Today founder Bill Gabbert succumbed to illness in January. As IAWF president Joaquin Ramirez eloquently explains on page 6, Gabbert asked the association to maintain his legacy of learning through his websites, which provide news, information, and insight.

So often, the stories on the Wildfire Today and Fire Aviation sites left readers with a new appreciation for the challenges of wildland fire and a greater understanding of policy, politics, and the people on the ground.

Stories, as Isabeau Ottolini and Bethany Hannah write on pages eight through 12, are tools that can help people who are not firefighters or land managers understand the world of wildland fire.

Ottolini is a PhD candidate in Spain; Hannah runs a U.S.-based organization that helps people tell stories through various mediums. Together, Ottolini and Hannah have found that storytelling is an effective way to help ordinary people understand the importance of fire in the ecosystem, the benefits, the dangers, the policies, and the strategies and tactics to manage and live with wildfire.

Amanda Monthei knows a fair bit about storytelling. Monthei is the subject of our Fired up feature on page 24. As a reporter-turned-hotshot-firefighter-turned-podcaster, Monthei is well known in North America. As Monthei explains on her website (www.amandamonthei.com), The Life with Fire podcast explores the critical role that wildfire plays in America's forests, lands and communities.

The podcast "was created to explore the ways humans interact with fire, while seeking solutions for how we can better coexist with it in the future.

". . . Our biggest objective for the podcast is simple: change the way we interact with, think about and talk about fire – and, ultimately, with the landscapes we call home."

Bequi Livingston has similar goals. Livingston's story (page 22) is remarkable. Many IAWF members know Livingston – she was the first woman recruited by the New Mexico-based Smokey Bear Hotshots for its elite wildland firefighting crew, and the regional fire operations health and safety specialist for the U.S. Forest Service in Albuquerque.

Livingston used to write for *Wildfire*; she has resumed her storytelling via a regular column that offers insight and depth, and a very personal perspective on post-traumatic stress and the healing process. We're launching the column in this issue; in the second-quarter edition, Livingston will delve further into her journey through complex post-traumatic stress and complicated grief after a series of events including the Yarnell Hill tragedy in 2013.

Sharing stories about fire helps us learn. Firefighter and former IAWF board member Rich McCrea is an extraordinary storyteller. McCrea's lengthy career in fire management and forestry, and his writing prowess, prompted him to take a hard look at the Peshtigo fire of 1871 – a conflagration that wiped out a village in Wisconsin and killed more than 1,500 people.

McCrea's skilled pen results in a rollicking yarn that provides an in-depth study of the Peshtigo fire and the effects of industry – logging and the railway – on the town, its people, and, ultimately, its legacy.

Our cover story on page 31 is an eye-opening piece that looks ahead to Russia's wildfire season and the lack of equipment and personnel. While some government officials assure residents it is prepared, state officials are girding for a "massive crisis," says freelance writer Eugene Gerden. There's no plastic to produce fire helmets, no small-sized internal combustion engines for generators and other equipment, and the soldiers who would usually fight wildfires are instead fighting in Ukraine.

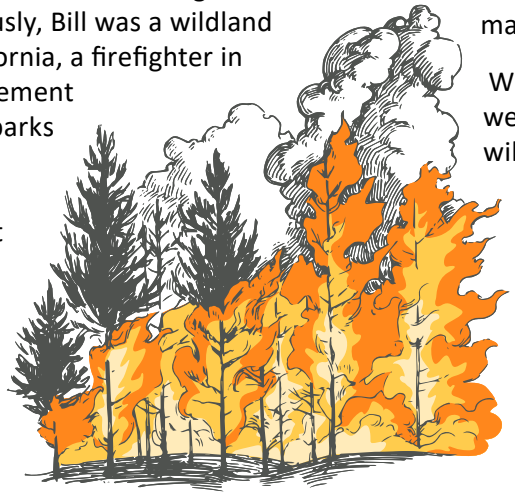
We round out this issue of *Wildfire* with three fire-science stories: the California prescribed fire monitoring program (page 14); heat-point mapping (page 36); and mobile platforms for studying wildfire weather (page 40).

Lastly, an update on NFPA's Outthink Wildfire™ program (page 26) – a policy initiative to end wildfire disasters by 2050 – reminds us that leaders such as NFPA wildland division director Michele Steinberg and others are working to change the wildfire narrative from complex and negative to managed and positive.

WE SHOULD ALL CONTINUE TO BE STUDENTS OF WILDFIRE

BY JOAQUIN RAMIREZ

Over the past year, I have written about our wildfire community and the strengths in its diversity of abilities and backgrounds. I have reflected on the knowledge we can share with each other, and the wildfire challenges we can successfully face through this collective effort. Yet, as we stand at the start of a new year, I am reminded that the chorus of our community is missing a key voice that we all came to appreciate and depend upon. On Jan. 14, Bill Gabbert passed away peacefully following a brief illness. Many will know his name, and all will know the insightful and inexhaustible industry news sites Wildfire Today (www.wildfiretoday.com) and Fire Aviation (www.fireaviation.com), that Gabbert managed for more than 15 years. Previously, Bill was a wildland firefighter in Southern California, a firefighter in Indiana, and the fire management officer for several national parks in the Black Hills of South Dakota. I valued Gabbert's service and his friendship. It was Gabbert's mission to ensure that all of us – and all the influencers around us – knew the wildfire issues of the day and the goals of our community.



In a December post about his condition entitled, "It's who stands beside you," Gabbert said, "I have long had a passion for wildland fire, and it requires continuous learning. I've always been a student of wildfire, and I wanted to create a venue for the fire community that encouraged students of wildfire." To that end, Bill asked our association to maintain his news sites and ensure that his drive for knowledge exchange throughout our community continues for years to come. I am happy to say that the IAWF is committed to serving the audience that Bill's work has gathered, the mission he served and the values he helped define. You can learn more about this on Wildfire Today and in pieces that will be in *Wildfire* magazine throughout 2023.

With Bill's legacy firmly in our minds, we start 2023 seeing the impacts of wildfire already making headlines around the world. In June, I said it seemed as if my home country of Spain had won the annual fire lottery, after devastating wildfires scorched many communities, fueled by a hot and dry summer across Europe and North Africa. As I write this in February, this time it is a dramatic fire season

for Chile, where persistent dry summer conditions in the southern hemisphere sparked numerous wildfires in December around Santiago and the loss of lives and property around the coastal town of Valparaiso. Continued wildfires in January, around and south of Concepción caused 23 deaths, and more than 900 people were injured. Chile has declared a national state of emergency and our thoughts are with its people and its firefighters and communities as they work to control the blazes. All this happened in a country with one of the best fire-analyst team in the world, which needs to be empowered to support the country's very advanced firefighting resources. We hope that by the time this appears in print the conditions have given a break to our South American community.

This year provides us with a great opportunity to continue our association's advocacy for stronger co-ordination in the wildfire community and the advancement of prescribed fire for community safety and resilient landscapes. In mid-May (16-19), the global wildfire community will gather in Porto, Portugal, for the 8th International Wildland Fire Conference, at which IAWF will be an institutional partner for the first time. The event is held every four years, the last one in Campo Grande, Brazil. The theme of the 2019 event was, "Facing Fire in a Changing World"; the conference focused on and made recommendations about reducing vulnerability of people and landscapes by utilizing integrated fire management. The event in 2023 seeks to better define international frameworks and governing principles around wildland fire. The conference website explains that, "Better wildland fire governance is needed to protect biodiversity, foster carbon sequestration and healthy forests and assure they are providing goods and services that do not vanish in wildfire smoke."

I strongly believe that the international co-ordination of scientific research is an important piece of this governing-principal puzzle; this includes the exchange of basic science processes – like we saw in November at the 9th International Conference on Forest Fire Research in Coimbra – and also a collective effort to try to bridge the known operational gap with effective applied science and technology that can keep pace with the evolving threat levels of our "fire seasons."

At international gatherings like these – and in our everyday work as well – we must collectively address and advance the holistic understanding of proactively creating resilient landscapes; this includes the role of positive forest management and the value that prescribed fires and biomass solutions can bring to these global efforts. For this appeal to be successful, there needs to be open and constructive communication among practitioners, technologists, and the scientific community. What better way to do achieve that than at these conferences! I hope to see you in Portugal this spring.

This year, I ask that you continue the great knowledge exchange that enriches our wildfire community, through our association's membership, discussion groups, and this magazine. We need to ensure that we remain a community that encourages students of wildfire, just as Bill did throughout his great career and life.

ABOUT THE AUTHOR

Joaquin Ramirez Cisneros is a wildland fire technologist who has been working for the last 25 years to bridge the gap between scientists and end users. In 2013, Ramirez moved to San Diego from Spain, and now works with agencies worldwide trying to convert the best science into actionable tools. Ramirez is the creator of several of the most advanced fire behavior software model implementations and decision support systems, including the Wildfire Analyst and fiResponse software tools. Since 2011, Ramirez has co-ordinated the first European M.S. in Forest Fires (www.masterfuegoforestal.es) with Prof. Rodriguez Francisco y Silva (UCO) and Prof. Domingo Molina (UdL). Ramirez is a founder and active member of the Pau Costa Foundation. He earned his PhD in remote sensing and GIS at the University of Leon in 2003, an M.S. in forestry from the University of Lleida, and his B.S. in forest engineering from the Polytechnical University of Madrid, Spain.

Fire STORIES

A CASE FOR COMMUNITY-BASED COMMUNICATION

BY ISABEAU OTTOLINI AND BETHANY HANNAH

For the past two years, Isabeau Ottolini has been researching community-based wildfire initiatives, as part of her PhD with the Open University of Catalonia (Spain) and the EU project PyroLife. Through interviews with international wildfire communicators, and a case study with the citizen association Pego Viu, the power and importance of stories have come up time after time as a more inclusive and transformative communication approach.

Bethany Hannah has practical experience with wildland fire storytelling as the executive director of the American Wildfire Experience (AWE) and The Smokey Generation. She has built a coalition of wildland fire photographers, videographers, writers, and creatives who are telling the story of fire from unique perspectives around the globe through a variety of initiatives.

Together, Ottolini and Hannah find that storytelling creates a shared experience from which to find common ground and envisage a path forward.

Climate change is notably impacting fire regimes across the world, and increasingly extreme wildfires often have disastrous consequences despite increased fire suppression efforts; this has prompted an urgent call for different ways to deal with, and relate to, wildfires.

The last years have shown many, many examples of catastrophic wildfires, and during the IAWF Fire & Climate 2022 conference in Pasadena, it became clear once again just how much of an urgent and global issue wildfire is.

Disasters such as extreme wildfires are clear examples of socio-environmental injustice. On one hand, communities are often impacted disproportionately, causing extreme, and often

EDITOR'S NOTE: **Isabeau Ottolini and Bethany Hannah presented at the IAWF Fire & Climate 2022 conference in Pasadena.**

unequal, impacts on people's safety and wellbeing – loss of lives, homes, or health. On the other hand, wildfire disasters affect the global environment by further contributing to climate change or killing countless animals. These issues, along with other nuanced factors, are difficult to communicate, challenging to concisely summarize, and problematic to address on conventional platforms.

Certainly, many of us in the greater wildland fire community are pushing to move from a wildfire suppression paradigm to a more hopeful wildfire future, often referred to as living with wildfire. However, scarce reflection exists on how wildfire communication can accompany and support such a paradigm shift. In fact, wildfire communication in practice remains largely entrenched in certain ways of doing things, informed by the wildfire suppression paradigm, while sufficient scientific research and practitioner experience highlight the limitations of wildfire communication and how it deepens socio-ecological vulnerability to wildfires. Let's see a few of them:

A first limitation of wildfire communication is that it frequently happens in a manner that is one-directionally and top-down, from experts to citizens.

A second limitation is the predominant use of mass campaigns, concentrated during the fire season, thus allowing only for very simple messaging.

A third limitation is the ways in which those messages are framed: that disasters are simply events in certain moments of time; that wildfires are natural disasters; and that responsibility for preventing and mitigating wildfires falls mainly on individuals, such as homeowners. All this, while we fully know that wildfires are slow disasters in the making, meaning that they are the result of many, many years of social, political, and economic dynamics, such as colonization, rural depopulation, and neoliberalism.

By incorporating community-based communication and storytelling into fire management activities, we gain the ability to connect with people through our shared experiences, convey important messaging about how we can live with wildfire, and help our communities navigate wildfires within the context of climate change.

Consequences of such wildfire communication practices are that they insufficiently recognise and addresses the underlying and long-term socio-ecological processes of extreme wildfires. Also, wildfire communication is often not embedded within local contexts, and strongly excludes the voices, knowledge, and expertise of those who are often considered non-experts (anyone who is not a scientist or practitioner by recognised/official training).

So, overall, there seems to be a disconnect in wildfire communication strategies to accompany a paradigm change toward living with wildfire; this makes the application of more transformative, inclusive, and situated communicative approaches especially important, as wildfire disasters are increasing. Through our work and research, we thus look at storytelling as a community-based wildfire communication tool that shows untapped potential for accessing and engaging the public around living with wildfire.

A CASE FOR FIRE STORIES: Lessons Learned

Wildland firefighters gather around a warming fire while on assignment to the Snake fire in 2015. Often, these moments together reflect a powerful camaraderie built among crew members. Photo by AWE digital storytelling micro-grant recipient Kyle Miller.

As environmental historian William Cronon says, "Narratives remain our chief moral compass in the world. Because we use them to motivate and explain our actions, the stories we tell change the way we act in the world." This, in large part, is why storytelling will be so important for wildfire communication if we are to move toward living with wildfire. Here are some of the lessons we have learned through our work:

Storytelling allows individuals and organizations to share emotions, validate lived experiences, and acknowledge and mitigate conflict around wildfires. For instance, common conflicts around wildfires are about which responsibilities befall individuals versus which are of a collective nature; tensions between rural and urban populations and different land uses; perspectives on what is "natural" and humans' place in the world. In such situations, sharing lived experiences through stories can foster mutual empathy and understanding.

Storytelling is empowering and can foster hope as well as healing; it is empowering both for the tellers (I can share my story; I am being heard; I am helping others to learn from my lived experiences.) and listeners (I can follow this example; I can learn from this; I don't have to be scared; there are things I can do.); this presents opportunities for compelling wildland fire communication and education, especially during community wildfire recovery.

Storytelling is a great tool to dive into the many nuances, ambiguities and complexities surrounding wildfires. Wildfires are far from simple and straightforward, despite many communication campaigns focussing time after time on very generic slogans. For example, a public campaign in the Autonomous Region of Valencia in Spain simply says, "Stop Fires." This entirely ignores the complexities and necessities of cultural and agricultural burning, for instance.

Storytelling embraces the fact that we live in a multirisk world. People are not just concerned about wildfires, despite many wildfire communication campaigns designed as such. Rather, there are many other troubles and challenges people face from day to day: socioeconomic injustices, other natural hazards, climate change, the global pandemic, and more.

Lastly, storytelling allows us to change the dominant wildfire narrative (Western, masculinized, and embedded within the fire suppression paradigm) from the bottom up, by diversifying the voices sharing the stories, and sharing and valuing knowledges that have historically, and often continue to be, ignored and excluded.

The Shapes and Power of Stories

Storytelling can take many forms via artistic expressions such as drawings, paintings, photographs, theatre, and songs; via spoken or written words; or making use of technology such as digital film or augmented reality. Storytelling can happen around the entire risk cycle, in any kind of setting and with any kind of character. As such, storytelling is an extraordinary versatile communication approach that can be fully tailored to everyone's lived experiences and embedded within local contexts.

The American Wildlife Experience's wildland fire digital storytelling micro-grants present a perfect example of the versatility of storytelling within the wildland fire community. Created to encourage and support creative wildland fire practitioners (including researchers, community members, and others), AWE has issued more than U.S. $26,000 worth of grants to people telling stories of wildland fire in profound and compelling ways. For example, Fanny Tricone, a fire ecologist based in Bellize with Dos Fuegos Fire Management, created a beautiful short video titled *The Fire Paradox* for her grant project; Marlie von Roy from Canada created a fantastic Instagram account called @firelinepoems that explores learning in wildfire; Martin Greenwood in Australia collected stories and oral histories about wildfire in and around Canberra to create a documentary for a project called Bushfire Experience; and, António Patrão in Portugal created a project called Fire Photo Voice which aims to give voice to local communities that take care of the landscapes and is tied to participatory action research. There is also the amazing storytelling of two-time grant winner Amanda Monthei, host of Life with Fire podcast, who created The Women Before Me for her grant project. These are examples of storytelling among people who know and intimately understand wildfires, but there are also phenomenal storytelling projects happening within local communities touched by wildfire. For instance, the Dixie Fire Stories Project was created by community members who experienced the nearly one-million-acre Dixie fire in Northern California in 2021.

Why do we share these examples? Because there is storytelling happening both within the wildland fire community itself and within local communities that have experienced wildfires throughout the world. These storytellers are sharing the story of fire in ways that we, as wildfire communicators, can harness, illuminate, and leverage to help us convey the important messages, nuances, and complexities of wildfire within our local communities and beyond.

A timelapse photograph of a fire burning across a mountain with the stars marking the passage of time. Photo by AWE digital storytelling micro-grant recipient Kyle Miller.

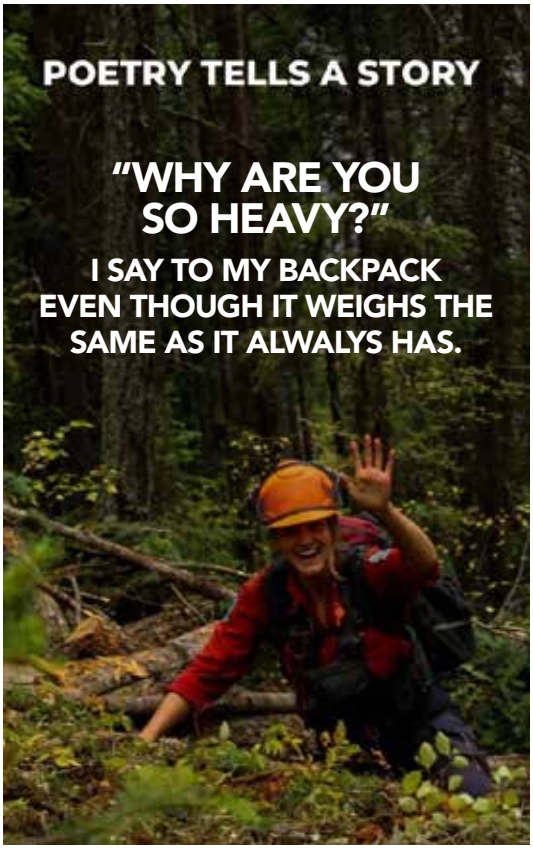
Bring Storytelling to your Community

Wyoming hotshot, Anna, using a drop torch on a night burn.
Photo by AWE digital storytelling micro-grant recipient Kyle Miller.

So, how can you bring storytelling to your work? Find the storytellers already communicating about wildfire and shine a light on their work; collaborate with your community to identify and share pertinent and community-led messages about wildfire; embrace your own creativity and recognize that you have amazing stories to share; and, if you are stretched thin (as many of us are), consider hiring experienced and passionate people to help you tell the right stories for your work, organization, or agency.

Stories are being told everywhere and all the time. As wildfire communicators, our role is to recognise there are infinite ways and formats for telling stories, capture and leverage great, community-led initiatives, and find ways to integrate stories that help people relate to a world with wildfire. By incorporating community-based communication and storytelling into fire management activities, we gain the ability to connect with people through our shared experiences, convey important messaging about how we can live with wildfire, and help our communities navigate wildfires within the context of climate change.

Interested in applying for the American Wildfire Experience's wildland fire digital storytelling micro-grant? Applications open every spring. Follow @wildfire.experience or visit wildfire-experience.org to learn more.



AWE's Wildland Fire Digital Storytelling Micro-grant recipient Marlie von Roy hiking a steep hillside, alongside her poem.
Photo by Marlie von Roy.

ABOUT THE AUTHORS

Isabeau Ottolini is a PhD candidate at the Open University of Catalonia (Spain) and the European project PyroLife. Her research focuses on community-based wildfire communication. Isabeau collaborates with Pego Viu, a land stewardship collective born from the ashes of the Vall d'Ebo wildfire in 2015, to explore how community-based initiatives contribute to a societal transformation towards living with wildfires.

Bethany Hannah is the executive director of the American Wildfire Experience and founder of The Smokey Generation. She has been involved in the wildland fire community since 1998 and has a passion for empowering others in their efforts to tell the story of wildland fire from unique perspectives.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MEASURING SUCCESS

MONITORING PROGRAM ASSESSES BENEFITS OF PRESCRIBED BURNING

BY HUGH SAFFORD, ASHLEY GRUPENHOFF, JOHN WILLIAMS, TESSA PUTZ, AND JOE RESTAINO

Fire is a natural process in most western U.S. forests and use of fire as a management tool was widespread in the Western United States before Euroamerican settlement. However, fear of fire on the part of forest managers and their failure to understand its important ecological roles led to the exclusion of fire starting in the early 20th century. A century of fire exclusion and other pyrophobic and fire-ignorant management practices in many low- and middle-elevation forest types have resulted in high surface fuel loads, high stem densities, greater fuel continuity, and an increasing proportion of fire-intolerant species. Furthermore, climate warming and its effects on fuel moisture and other factors are interacting with higher fuel loads to drive progressively larger and more severe wildfires, posing increasingly serious threats to people, biodiversity, ecosystem services, and forest persistence.

Fire as a land-management tool

Prescribed fire can be an effective way to decrease wildfire risk and restore natural disturbance processes in formerly frequent-fire forests. Properly implemented, prescribed fire is an efficient and cost-effective way to reduce surface fuels. Although prescribed fire itself releases carbon and smoke into the atmosphere, the intensity of burning during a prescribed fire is mainly low to moderate, and prescribed burns have the following advantages:

The program assesses the effectiveness and ecological effects of prescribed fire – and, where appropriate, managed wildfire – across jurisdictions.

A CFPMP team samples fuels using Brown's fuel transects before prescribed burning in a Jeffrey pine forest in 2019.

- **Reducing fuel loads and increasing ecosystem resistance and resilience**
- **Attenuating threats from wildfire to life and property and to carbon stocks and other forest ecosystem services**
- **Diminishing black carbon and fine particle emissions from subsequent wildfires, and**
- **Increasing growth rates in remnant live trees by reducing competition, thereby fostering greater sequestration of carbon.**

Orange flagging on a Jeffrey pine (left) marks a monitoring plot on the Springs fire in the Inyo National Forest. The plot was installed the day before burning by the CPFMP field crew. The crew observed and recorded fire behavior as the plot burned, then returned to the site a few days later to measure fire effects. The plot was also resampled one year later to capture delayed fire effects, plant species diversity, and tree regeneration. Photo by Hugh Stafford.

In light of these and other benefits, there has been a push in recent years to revisit the value of fire as a management tool. The IAWF's 2022 position paper on applied fire highlighted the association's support for the increased use of fire in vegetation management. California is another example: In 2015, 12 signatories (subsequently joined by 25 additional organizations) of a fire memorandum of understanding expressed their commitment to advancing the use of fire for ecological benefits and improved wildland fire management across California. The signatories included the Forest Service, the National Park Service, the California Department of Forestry and Fire Protection (CAL FIRE), The Nature Conservancy, and multiple environmental nongovernmental organizations (NGOs) and prescribed fire councils. Since then:

- **The State of California and the US Forest Service agreed in 2020 to substantially increase and sustain the pace and scale of prescribed fire (Shared Stewardship 2020).**
- **In 2022, the California Wildfire and Forest Resilience Task Force produced a strategic plan to guide the expanded use of prescribed fire (Strategic Plan 2022)**
- **The Nature Conservancy and other NGOs have conducted prescribed fires on thousands of hectares, and**
- **The number of private citizens and California tribes using prescribed fire as a management tool has substantially increased.**

Additionally, formal training sessions for fire practitioners have multiplied, and there are now prescribed fire councils or prescribed burning associations for most of California's forested area. A major resurgence of Native American Tribal interest in cultural fire use in the western United States has also occurred, coupled with state recognition of cultural fire practitioners. The California Forest Carbon Plan proposed to double the rate of forest restoration and treatment by 2020 and to nearly double that again by 2060, including through the use of prescribed fire. The plan specifically called on forest managers to "increase [the] use of prescribed and managed fire for restoration." In 2020, the Forest Service and the State of California entered into a Shared Stewardship agreement to co-operatively manage vegetation in a scientifically and ecologically sound manner on one million acres (405,000 hectares) annually by 2025 using "all available tools," including prescribed fire and managed wildfire. Recently, the California Wildfire and Forest Resilience Action Plan set high goals for the growth of prescribed fire in the state, including:

- **Up to 100,000 acres (40,500 hectares) of prescribed burning per year by CAL FIRE**
- **"Significant expansion" of burned acres by the Forest Service**
- **Development of an interagency Prescribed Fire Training Center, and**
- **Establishment of new programs to foment increased burning on tribal and private lands.**
- **The action plan also called for the expansion and improvement of monitoring, reporting, and decision-support tools.**

The large and unprecedented increase in prescribed fire foreseen for California forests over the next two decades represents a major shift in forest management strategy and policy. Such a fundamental change to forest management on the California landscape will require close monitoring to improve best management practices, minimize potentially harmful impacts, prioritize investments, and achieve objectives.

In 2019, recognizing the need, CAL FIRE joined the University of California–Davis (UC–Davis) in launching the California Prescribed Fire Monitoring Program (CPFMP).

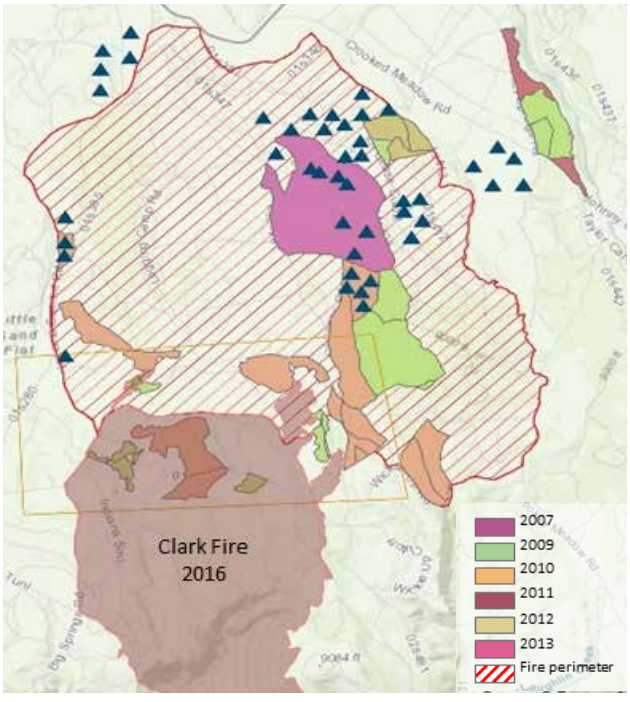


Figure 1: Location of the 2019 Springs fire (red hatching) and areas treated with prescribed fire in previous years (various colors). Thirty-four plots (blue triangles) were placed within the fire perimeter across units that were treated with prescribed fire in recent years as well as in previously unburned areas. Additional control plots were placed outside of the fire perimeter.

Program overview

The CPFMP assesses the effectiveness and ecological effects of prescribed fire – and, where appropriate, managed wildfire – across jurisdictions. The program is supported by funds linked to the California carbon cap-and-trade market adjudicated by the California Air Resources Board (CARB). The program is also a vital part of a larger statewide prescribed fire monitoring effort by CARB and CAL FIRE to connect data on fuels and fire effects to air quality data. The program is funded by CAL FIRE on a three-year renewable agreement with UC–Davis, with Hugh Safford as the program's principal investigator. The program is co-ordinated by CAL FIRE prescribed fire specialist Joe Restaino and UC-Davis project scientist John Williams, with field crews supervised by UC-Davis graduate students Ashley Grupenhoff and Tessa Putz.

The CPFMP is a field-based effort that monitors:

1. **Prescribed fire treatment effectiveness, including measuring reductions of fuel loading and continuity (as compared to either pre-burn measurements or unburned control plots) and reductions in flame length and fire spread rate (as compared to either empirical observations or modeled outputs under predefined fire weather conditions before and after treatment).**
2. **Prescribed fire treatment effects, including measuring changes in aboveground carbon and fuels; tree mortality and damage (standard fire severity measures); soil surface conditions (such as cover of litter and bare soil); and understory plant species (diversity and cover).**
3. **Other variables of interest to collaborators and land managers, such as air quality impacts, changes in plant species composition, and tree regeneration**

Sampling is carried out before project ignition, during the burn, and immediately following prescribed fire. Additional sampling episodes occur one year after burning, and during subsequent years if conditions, phenology, and scheduling permit. When possible, the program also focuses on areas of specific research interest, including sites previously prescribe-burned (maintenance burning), post-wildfire restoration (prescribed fire following wildfire), and fire effects in specific vegetation types and conditions (i.e., first entry prescribed fire in Coast redwood).

Figure 2: Emissions outputs as calculated by the CONSUME module in BlueSky for an example day on the Springs fire. Real-time measurements of fuel loadings carried out by the CPFMP team on the fire (a maximum of 15.1 tons per acre) were less than half the values predicted by LANDFIRE (a maximum of 37.4 tons per acre); this allowed for more accurate emissions emissions estimates. Source: L. Tarnay, USDA Forest Service.

Standard CPFMP field protocols for forested sites are modified from the widely used Forest Service common stand exam and Brown's fuel transect. Detailed data are collected in 1/10-acre (405-m^2) plots on:

- **Site conditions and history;**
- **Vegetation and ground cover;**
- **Tree size and status (including burn effects) for all trees greater than 3 inches (>7.6 cm) in diameter at breast height;**
- **Fuels and coarse woody debris (via four Brown's transects);**
- **Plant species abundance and cover; and**
- **Tree regeneration in a 14.3-foot radius (60-m2) sub-plot using the protocol of Welch and others (2016).**

Work to refine protocols for prescribed fire effects in grasslands, shrublands, and oak woodlands is ongoing. Where feasible, particulate matter (PM 2.5) generated from prescribed fire smoke is measured using an array of temporary and permanent environmental beta attenuation monitors. We work closely with the California Air Resources Board and local air quality districts to co-ordinate the deployment of monitors with active prescribed fire.

Program accomplishments

As of February, roughly four years into the program, the CPFMP has established a network of almost 800 plots distributed over more than 30 sites across central and northern California, characterizing almost 17,000 acres (~8,000 hectares) treated across more than 100 individual burn units. Project sites sampled were located on properties managed by 13 entities, including federal and state agencies, county and local agencies, universities, NGOs, and private landowners.

The 2019 Springs fire: A case study

On July 26, 2019, a lightning strike ignited a wildfire in the rolling volcanic country northeast of Mammoth Lakes, California (figure 1). Based on fire history, fuels, and projected weather, the Inyo National Forest decided to manage the fire with a containment strategy that would help realize resource benefits after a long-term lack of fire in the area, which was dominated by a Jeffrey pine woodland that had burned frequently before Euroamerican settlement. Based on Fire Return Interval Departure, the area was highly departed from reference conditions, and weather and fuels conditions were perfect to return fire to a place from which it had mostly been long absent.

Shortly after ignition, representatives from the Inyo National Forest contacted the CPFMP about possibly deploying monitors on the Springs fire because several prescribed fires had been carried out within the projected burn perimeter over the previous decade (figure 1). The forest managers wanted to document the effectiveness of the treatments in influencing fire behavior as well as the effects of the treatments on fuels, forest structure, and plant species composition before and after wildfire passage. After obtaining permissions and co-ordinating with the incident management team, the CPFMP team began working onsite on Aug. 8, 2019.

The CPFMP team was on the Springs fire for 10 days. As the fire progressed, fuels and weather conditions continued to be excellent, and the incident management team undertook a major prescribed fire effort to maximize resource benefits from the incident. Co-operation between the CPFMP team and fire management personnel on the ground led to beneficial outcomes on both sides. Communication among the incident management team, ground personnel, and the CPFMP team allowed for real-time response to movement of the flaming front and planned prescribed burning, which facilitated placement of sampling plots and timing of before- and after-fire sampling.

As the CPFMP team collected pre-burn fuels data, it passed the data to the incident air resource advisor, which resulted in highly accurate smoke concentration and dispersion modeling and allowed for more nimble management of prescribed burning than would have been possible with LANDFIRE data (figure 2). (LANDFIRE is a shared program between the wildland fire management programs of the U.S. Department of Agriculture Forest Service and U.S. Department of the Interior, providing landscape scale geo-spatial products to support cross-boundary planning, management, and operations.) Additionally, a team from the University of Nevada–Reno sampled terrestrial LiDAR data for a short time to better quantify pre-burn fuels. The effort ended when the incident commander decided that the available fire personnel were not enough to ensure proper co-ordination with and safety for the LiDAR team.

The CPFMP crew informally trained off-duty fire personnel to take fuels and forest structure measurements, and CPFMP staff with incident qualification red cards received informal training in firing techniques. In the summer of 2021, the CPFMP delivered a report to Inyo National Forest personnel detailing, among other things, the effectiveness of prescribed fire treatments in reducing fuel loads and future fire severity, the effects on carbon stocks, and comparisons of the ecological effects of the fire in

Field-trip stop on Bald Mountain, Inyo National Forest, during the 2021 California Fire Science Retreat. The obvious fire boundary in the background attests to the strong limiting effect of the 2019 Springs fire (above and beyond the black) on the 2021 Dexter fire (severe burning in the middle ground). Photo by Hugh Safford.

PRELIMINARY RESULTS FROM THE SPRINGS FIRE

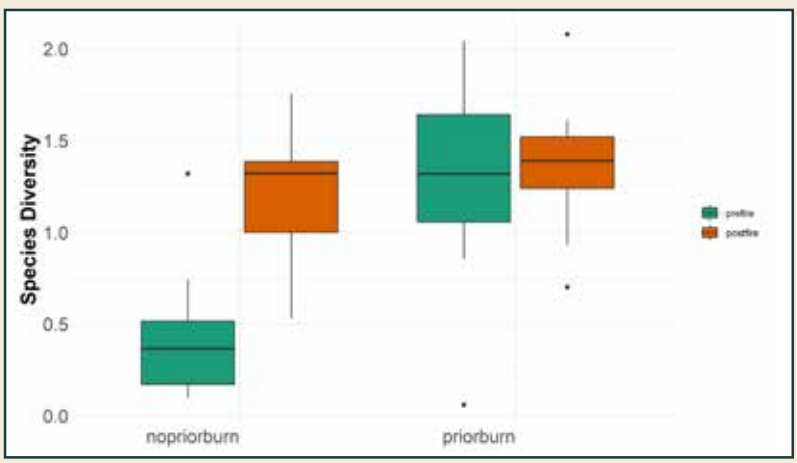
Control plot; no prior burning.

2007 prescribed burn; 12 years TSLF.

2010 prescribed burn (nine years TSLF)

2013 prescribed burn (6 years TSLF)

Stand and fuels conditions immediately before the Springs fire in areas prescribe-burned at different times in the past (TSLF = time since last fire). Photos by Ashley Grupenhoff.



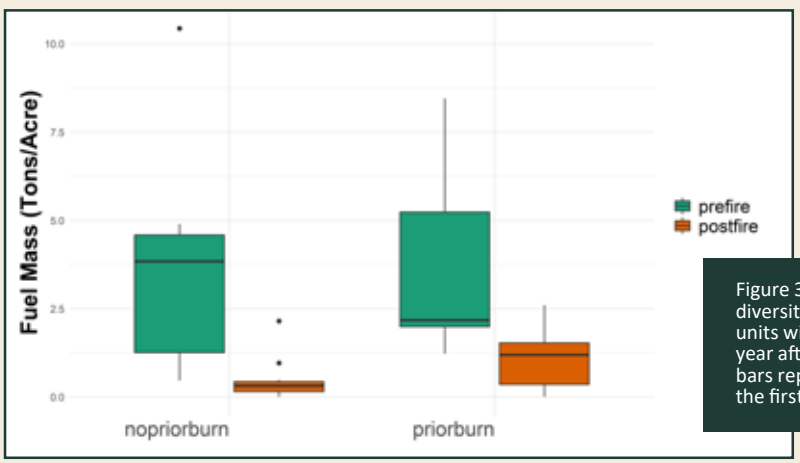


Figure 3: Comparison of fuel loading (bottom) and plant species diversity as measured by the Shannon-Wiener Index (top) across units with variable prior treatment before (green bars) and one year after (orange bars) the Springs fire. Horizontal lines within bars represent the median; the boxes represent data between the first and third quartiles; and dots are outliers.

In 2019, the California Prescribed Fire Monitoring Program crew established 34 monitoring plots within the Springs fire perimeter as well as an additional 10 control plots outside the fire perimeter (see figure 2, page 17). The field crew returned one month after containment of the Springs fire to collect initial post-burn data and then again in August 2020 to collect one-year-post-fire data.

Generally speaking, prescribed burning in the years before the Springs fire reduced mean fuel loads; it also greatly increased plant species diversity (estimated with the Shannon-Wiener Index, which measures the balance of plant cover among species) (see graphic). Overall, aside from occasional jackpots and canopy torching, fire effects were low, with low rates of spread and flame lengths generally less than two feet (60 centimetres).

Total fuel load (1- to 1,000-hour fuels) prior to the Springs fire varied slightly between areas with prior treatment, due mostly to variation in 10- and 100-hour fuels and was highest in areas with no prior burning and units burned 12 years prior. After passage of the Springs fire, fuel loads showed significant decreases in both previously burned and previously unburned plots (see graphic), mostly due to changes in 1- and 10-hour fuels. However, in areas without prior prescribed burning, there was more consumption of 100- and 1,000-hour fuels (not shown).

Measures of species diversity and richness (number of plant species) varied slightly across areas with prior treatment before the Springs fire. The Springs fire did not induce any significant changes to richness one-year post fire, but diversity did increase in areas that had no prior burning (see graphic).

pretreated versus untreated forest stands. (For some of the monitoring results, see sidebar, page 19.)

The Springs fire has served as an excellent opportunity for communicating the benefits of fire use before and during wildland fires. The 2021 California Fire Science Retreat, organized by the Joint Fire Science Program-supported California Fire Science Consortium, included a field day in and around the Springs fire perimeter. Participants from multiple management agencies, research and academic institutions, and NGOs viewed fire effects both inside and outside of pre-event prescribed burning as well as the major influence of the Springs fire perimeter on the 2021 Dexter fire.

Outlook for the CPFMP

As California increases the pace and extent of prescribed fire use, monitoring programs such as the CPFMP will play an essential role in building the capacity and efficacy of a larger-scale managed-fire program. California needs a large-scale managed-fire program to mitigate the risks of high-severity wildfire and restore the health and ecological integrity of its forests. CPFMP monitoring helps California balance fuel reduction with carbon stocking as well as minimize environmental degradation while maximizing ecological benefits. The program also serves as a resource for other inventory, monitoring, and research efforts needed to better understand the impacts of fire use on organisms, ecosystems, ecological processes, and human society and health, among other things. For example, the CPFMP is – or has discussed – collaborating with various partner projects that measure, among other things, surface fuel loadings, fire emissions, fire intensity, soil carbon, and fire effects on xylem structure, lichen diversity, and smoke microbes.

As CPFMP prepares to enter its fifth year, it continues to add more sites to its portfolio, covering an ever-expanding range of conditions, stand histories, and jurisdictions. In 2022, the program increased the number of collaborations with private and non-profit land holders, including a local college and two conservation NGOs that manage natural reserves. The CPFMP has also added sites on lands managed

by the Southern California Edison Company and the Humboldt–Toiyabe National Forest. Other recent project sites include the 1,305-acre planned ignition at the South Grove Natural Preserve of Calaveras Big Trees State Park, as well as a network of first-entry treatments for the restoration and stewardship of Coast redwood (*Sequoia sempervirens*) ecosystems. In the future, we plan to revisit sites burned years earlier, as well as sites that have been burned more than once so we can quantify the effects of multiple entries and build a database of longer-term trends that can help provide more guidance on such matters as the proper balance of quantity (area burned) and quality (fuel reduction and restoration), the longevity of prescribed-burn effectiveness and ecological effects, and re-entry timelines.

An impediment to the CPFMP's success – and the State of California's goals – is the relatively low completion rate for burning in California. The CPFMP site selection process prioritizes projects that are at the top of the queue for ignition, yet to date less than 40 per cent of sampled areas have been successfully burned. This shortfall is due to a variety of causes, including lack of personnel and/or support resources, funding, liability and permissions, extreme weather, and wildfires (2020 and 2021 were record-breaking wildfire years), and burn bans by CAL FIRE and the Forest Service in recent years that shut down all discretionary burning for long periods of time. Such seasonal moratoria on prescribed and other burning have become the rule rather than the exception in recent years, posing a major challenge to the expansion of fire as a management tool in California.

ABOUT THE AUTHORS

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Ashley Grupenhoff is a PhD candidate, **John Williams** is a project scientist, and **Tessa Putz** is a PhD student in the ESP department at the University of California, Davis, CA.

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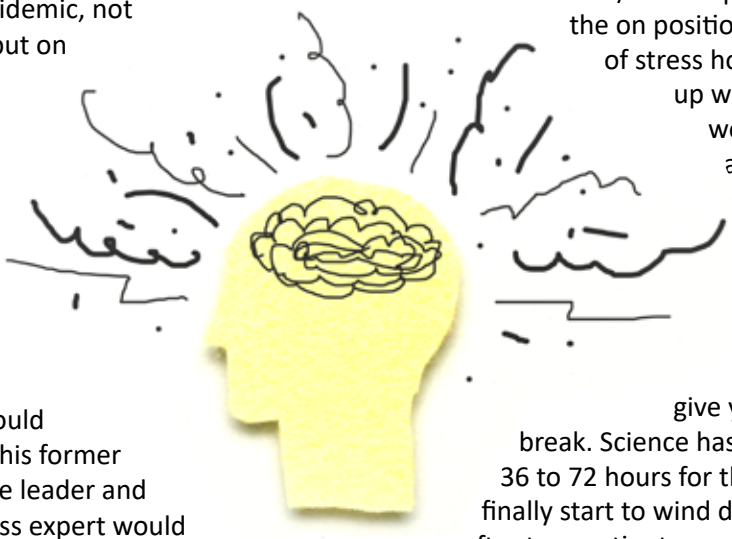
DIAGNOSIS
UNDERSTANDING, AND ACCEPTING, POST-TRAUMATIC STRESS

BY BEQUI LIVINGSTON

What if I were to tell you that post-traumatic stress (PTS), complex post-traumatic stress (CPTS) and complicated grief (CG) are not disorders, they are not diseases, and they do not require labels? They are all, simply injuries to our sensitive nervous system – a system that was designed specifically to keep us safe and out of harm's way. Yet, how many stories have you heard from fellow wildland fire personnel, or their families, about their personal struggles with traumatic stress? Post-traumatic stress has become an epidemic, not only in our community, but on the world stage.



I know this story well, having been diagnosed with complex post-traumatic stress and complicated grief back in 2016, after a series of personal crises, starting with the Yarnell Hill tragedy in 2013. Who would have ever guessed that this former elite athlete, wildland fire leader and teacher, healer and fitness expert would be taken to her knees, unable to work and barely able to function? Yep, that was me back in 2016. No one could have ever warned me of the perils of working in such a demanding and stressful environment, and for so many decades. Yet, in my opinion, no one really had the right to tell me much of anything, without first having experienced this for themselves. It's like a male OB/GYN telling pregnant clients what it's going to feel like to experience childbirth. You don't learn this stuff from books, not even college; you only learn it through personal experience, and only then do you have the right to share this wisdom with others. And as I love to say, don't tell me how to tie the laces on my fire boots, unless you have a pair as well.

So, by beginning this timely dialogue, I think it's important to share a few simple notions regarding traumatic stress and complicated grief. As wildland firefighters, we experience traumatic stress and grief on a continual basis, oftentimes daily. I liken it to our adrenaline/cortisol pump being stuck in the on position, creating a cascade of stress hormones that ends up wreaking havoc on our work, our relationships, and our personal health 24/7/180 or 365 for most of us. And please understand, that two days of R & R during the fire season does not give you a real recovery break. Science has proven that it takes 36 to 72 hours for the nervous system to finally start to wind down and relax a bit after traumatic stress, and then poof, were back at it!

Just for context, traumatic stress is defined as, "any event, or events, that occurs leaving the individual to feel as if they are powerless to control the circumstance or event. This event can then create a nervous system injury, or morale injury, causing great fear, oftentimes changing the individual's beliefs about the world and themselves." Complicated grief is defined as "grief and loss that is not able to be released or processed in a timely manner, thus, accumulating in

the somatic body." How perfectly does that fit our job description in wildland fire? And it doesn't matter so much what your position or job title may be, it's more a matter of how we react and deal with these events. What I find so fascinating, especially with wildland firefighters and emergency first responders, is the prevalence of Post-Traumatic Stress and Complex Post-Traumatic Stress. And as stated earlier, we now know that these conditions arise due to this injury to our sensitive Autonomic Nervous System (ANS), which is designed to protect us and keep us safe, especially in threatening environments and circumstances. Somewhere and somehow along the way our nervous systems become injured through cumulative traumatic events. And yes, wildland fire is considered a traumatic event. Think of how many wildland fires you have fought or been a part of, or even been part of a tragic wildland event. Also important is the difference between PTS and CPTS (there's a distinct reason that I do not call it a disorder). Post-traumatic stress is usually from a one-time or short-duration event such as an aircraft or vehicle accident, medical trauma, burglary, assault or wildfire burnover, whereas complex post-traumatic stress is cumulative, ongoing, chronic, oftentimes relatoinal, and affected persons feared for their lives and did not think they might escape or survive. Examples include war, natural disasters (wildland fire), burn overs, abuse, neglect, shame, abandonment and being an emergency first responder.

When activated, our nervous systems, in order to protect us, go into the sympathetic response mode (fight, flight, flee), or in some cases, the parasympathetic response mode (freeze, shutdown). The parasympathetic response includes rest and restore as well. And that, the Polyvagal Theory, is a science to be talked about later. Regardless of which system gets activated, we do know that our pre-frontal cortex (cognitive thinking brain) goes offline, and our amygdala (reptilian brain) takes over, thus known as amygdala hijack. That's why, in so many cases, when the threat happens, we can't make a decision or think straight but we can run, fight or freeze and shut down. This makes so much sense for those of us who have experienced tragedy, either in life or wildland fire. Maybe you can think of a time that you experienced a traumatic event, and you just froze. Maybe you were in an event where all you could do is to run away, and then fell apart afterwards.

The other huge impact that this traumatic stress has is on our bodies, and even our relationships. When we are in this response mode, our bodies are flooded with a cascade of stress hormones, meant to send blood to our extremities, to help us fight or run away. Then, once the danger has passed, the stress hormones lessen, and our bodies go back to homeostasis – normalization. However, when we are in a constant state of arousal, such as during wildland fire season, our stress hormone switch gets turned to the on position and oftentimes gets stuck there. This results in an overload of stress hormones, wreaking havoc on our endocrine system and organs, sometimes leading to adrenal fatigue burnout, chronic fatigue, and chronic illness. This is why we can't ever recover on our days off, during fire season, and even afterwards. Plus, this also interferes with our moods and our ability to self-regulate our emotions, thus wreaking havoc in our most precious relationships. Addictions, along with other unhealthy coping mechanisms, are a direct result of experiencing traumatic stress in our nervous systems.

It's important to understand the fact that we *can* heal through the effects of traumatic stress, and we can learn healthy coping strategies that will better allow us to deal with the rigors of wildland fire and help heal our relationships. First, we must recognize and admit that wildland fire is traumatic; then we develop the awareness of what is happening and come to understand our bodies' language during stress; and lastly, we must develop our own personal roadmaps to deal with traumatic stress. There are myriad healthy and holistic modalities out there that can help us heal our overwhelmed nervous systems, especially before things get much worse. Being proactive is the key. Wisdom is power, and understanding what's happening validates that we are not alone in the darkness.

ABOUT THE AUTHOR

Bequi Livingston was the first woman recruited by the New Mexico-based Smokey Bear Hotshots for its elite wildland firefighting crew. She was the Regional Fire Operations Health and Safety Specialist for the U.S. Forest Service in Albuquerque, New Mexico.

TELLING IT LIKE IT IS

HOTSHOT FIREFIGHTER INFORMS PUBLIC THROUGH PODCAST

BY DYLAN BRUCE

Many writers are motivated to seek out adventure in the real world to inspire and inform their work. Amanda Monthei is no different; a writer and podcaster from the northwest United States, Monthei followed her need for experience all the way to the fire line.

Monthei started working as a wildland firefighter in 2016 in northern Idaho and quickly became determined to join a hotshot crew.

"As soon as I started working on the engine, I realized that my perception of wildfire centred on the type of work hotshot crews did," Monthei said.

Hotshot crews are small elite teams of firefighters who deploy to construct and hold firebreaks. "I ended up working on a hotshot crew in Oregon for two seasons before leaving fire to pursue writing again."

Monthei always intended to return to writing despite loving her work on the fire line, and the pressure of being stationed far from home and being disconnected from family and friends pushed her to make the switch in 2019.

"It was a hard choice, because I knew leaving meant giving up something that had really helped me grow as a writer and a person".

From the outset of restarting her writing career, Monthei drew upon what she learned in her time fighting fires for inspiration. She wanted to share and utilize her first-hand experiences in fire in a way that she hadn't seen done by many other writers in the field.

"My writing was very much geared towards others who wanted to try fire out – mostly other women – so I tried to provide as realistic a glimpse of the job as possible.

"Since then, my objectives have shifted towards educating the public on the importance of fire, in addition to the challenges faced by wildland firefighters."

Monthei has written about wildfires and other natural hazards for such outlets as NBC News, The Washington Post, Outside, The Atlantic and Patagonia.

Beyond her writing, Monthei is the creator and host of the Life with Fire podcast, which explores the ways humans interact with fire and seeks solutions to better coexist with it.

Monthei says the podcast is her way of educating people about the ecological importance of fire, and she is always eager to speak with those who are leading the way with prescribed-fire implementation and working to change the public's perspective on fire. Over more than 40 episodes, Monthei has spoken with a range of people in fire, including First Nations land managers, diversity advocates in the field, and experts in prescribed burning and fuels reduction.

With the podcast and writing, Monthei puts into practice her beliefs about how communicating with the public about fire can evolve and improve. Particularly, Monthei believes there is a need for more authenticity and frankness when communicating with the public about fire.

"It makes the whole operation feel more human when you can be vulnerable and real with people, which I believe contributes to greater public trust in what's happening on the ground and the very real challenges we're facing on the fire line these days."

ABOUT THE AUTHOR

Dylan Bruce is an Australia-based writer and regular contributor to *Wildfire*.

Amanda Monthei works on the Cougar Creek Fire on the east slope of the Cascades in Washington during her first season on a hotshot crew in 2018. Monthei's hatred of cup trenches can likely be traced to this fire, thanks to all the rolling ponderosa pinecones. Photo by David Schaad.

FIRED UP

FIRED UP features those who have advanced and contributed to wildfire and bushfire operations, mitigation and prevention, and training and research. The IAWF invites members and the greater wildland fire community to submit recommendations for profiles of individuals or groups to **info@iawfonline.org.**

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AIR TRACTOR DELIVERS.

AIR TRACTOR DELIVERS THE PERFORMANCE, EFFICIENCY, AND PRECISION THIS JOB DEMANDS.

IT'S TIME YOU DEMAND MORE.

SHIFTING THE PARADIGM

TWO YEARS AFTER LAUNCH, OUTTHINK WILDFIRE™ MAKING HEADWAY

BY MICHELE STEINBERG

Two years have passed since NFPA launched Outthink Wildfire™, a policy initiative and a bold call to action to end wildfire disasters by 2050. The growing burden of wildfire on thousands of American communities brings with it a window of opportunity to advocate for solutions to this complex problem. In 24 months, the National Fire Protection Association (NFPA) and many organizations that have a part to play on the fire safety stage have begun to make progress toward solutions by speaking up, reaching out, convening experts, and taking advantage of opportunities driven by both crisis and public sentiment.

Outthink Wildfire is based on two important realities. One is that wildfire is a natural phenomenon in our environment and is here to stay. The other is that because wildfires can threaten hundreds or thousands of buildings simultaneously, there is no chance for firefighters to respond safely or effectively. The platform of this policy initiative consists of five tenets: safety upgrades to the built environment so that all structures are ignition-resistant; the use of current codes and standards in planning and building

NFPA convened a summit in May 2022 that brought together representatives of 40 organizations. The resulting report, "Policy Recommendations to Reduce Home and Community Loss from Wildfire," focused on these six key issues: aligning policy across government; advancing science; developing a wildfire risk mitigation workforce; improving access to funding for home safety upgrades; improving education; addressing social and cultural challenges.

Summit participants agreed that major financial and societal investment is needed in prevention, preparedness, response, and recovery – in that order – to effectively address the wildfire disaster problem. Photos by Michele Steinberg.

new communities exposed to wildfire; securing firefighter safety and effectiveness when responding to wildfires impacting structures; increased resources for managing vegetative fuel on public lands; and engaging and educating people living in vulnerable areas.

Launching such an initiative has required a lot of "push." NFPA staff partnered with two supporting organizations for an online inaugural event, created a website, and have presented information to more than 30 organizations at a variety of speaking engagements and conferences. At the two-year mark, it's heartening to start to feel the "pull," as we're beginning to hear from state fire marshals, college professors, fire service training and institutions and more, requesting presentations that describe the policy framework, or workshops that can dig into one or more of the supporting tenets.

In a similar push-and-pull scenario, NFPA reviewed dozens of pieces of federal and state legislation, providing comment or testimony wherever possible. In early 2021, states such as California, Colorado and Oregon were emerging from some of the worst wildfire disasters in their history, and bills and proposals began piling up in state legislatures. Whether NFPA's position and comments were welcomed or disregarded, using our organizational voice to join with others on important issues was a foundational step that helped introduce Outthink Wildfire to elected officials who take such a vital role in decision making in the safety arena. When the Marshall fire occurred in Boulder County, Colorado, in late 2021, NFPA had already initiated conversation and begun to build trust with state agencies that now faced a major crisis. NFPA was invited to be part of Colorado's Fire Commission and wildland urban interface subcommittee to offer our perspective on the value of statewide regulations and guidelines governing construction and land use in areas prone to wildfires.

To exchange, share and test ideas for solutions to the problem of millions of vulnerable homes already on the landscape, NFPA convened a summit in May 2022 that brought together representatives of 40 organizations. The resulting report, "Policy Recommendations to Reduce Home and Community Loss from Wildfire," focused on these six key issues:

- Aligning policy across government
- Advancing science
- Developing a wildfire risk mitigation workforce
- Improving access to funding for home safety upgrades
- Improving education
- Addressing social and cultural challenges

Overall, the participants agreed that major financial and societal investment is needed in prevention, preparedness, response, and recovery – in that order – to effectively address the wildfire disaster problem. The summit participants voiced observations, opinions, and perspectives that were soon echoed by members of the newly created presidential Wildland Fire Mitigation and Management Commission that kicked off in September 2022.

The commission emerged from federal legislation, Public Law 117-58, the Infrastructure Investment and Jobs Act of 2021, aka the Bipartisan Infrastructure Law. As part of statutory language, the new commission was created to develop recommendations to Congress on an array of wildfire preparedness, mitigation, and response topics. The USDA Forest Service, the Department of the Interior, and the U.S. Fire Administration were tasked with creating a commission that would include a diverse membership of representatives from federal and state agencies, tribal organizations, local governments, and nonprofit organizations. To do that, the agencies opened an application process for any would-be non-federal members; they received more than 500 applications to fill 36 seats on the commission, clearly a measure of the strength of public sentiment about the importance of this work. I was honored to be selected to serve to represent the property development industry and to be able to continue to voice NFPA's perspective on how we can end wildfire disasters. It has been the honor of my career to work on this commission alongside my fellow IAWF board member Kelly Martin and so many other distinguished and passionate individuals. Most encouraging to me is how much the tenets of Outthink Wildfire seem to resonate across this diverse group.

As part of statutory language, the new commission was created to develop recommendations to Congress on an array of wildfire preparedness, mitigation, and response topics.

In addition to working with commission members to make recommendations to Congress this coming September, I and others at NFPA and the Fire Protection Research Foundation will be working to learn more about public sentiment on wildfire mitigation measures in states where new regulations will be going into effect soon. Even with recent wildfire disasters, not everyone in California, Oregon, and other impacted states will readily embrace safety measures if they feel they are unfair or unnecessary. We seek to understand what people know and believe about wildfire safety and mitigation practices, and what messages and approaches may work best to gain acceptance for things like defensible space ordinances or ignition-resistant building standards.

It is clear to me from the experience of these past two years that wildfire disasters continue to hold the attention of elected officials and community leaders across the country. It is an exciting time with myriad opportunities to look beyond the problems toward solutions and changing future outcomes. A unified policy approach to ending wildfire disasters has never been more relevant than today. I look forward to sharing future results of NFPA's work in the policy arena, including the commission recommendations to Congress, for which I'm so grateful we have an opportunity to shape.

ABOUT THE AUTHOR

Michele Steinberg is the director of NFPA's wildfire division and writes the wildfire column for *NFPA Journal*. NFPA is a global nonprofit dedicated to eliminating loss, injury and death from fire, electrical and related hazards. Steinberg is a past board member and secretary of the IAWF board of directors. Contact Steinberg at msteinberg@nfpa.org and follow her on Twitter @Michele_NFPA.

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SANCTIONS

RUSSIA FACES SHORTAGE OF EQUIPMENT AND TECHNOLOGY FOR 2023 WILDFIRES

BY EUGENE GERDEN

Russia will face serious problems fighting forest and wildland fires this summer, as the ongoing military conflict with Ukraine and unprecedented sanctions imposed by the West lead to a shortage of firefighting equipment and technology.

Since the collapse of the USSR in 1991, forest and wildland fires have become pressing for Russia and its government, due to the almost complete destruction of the former Soviet system of fire prevention and safety.

During the 1990s, there was a significant increase in wildland fires compared to the 1980s. Complicating matters was chronic underfunding of the fire-prevention sector and the entire Russian firefighting service, mainly due to a series of economic and political crises in Russia at the time.

The situation generally stabilized during the 2000s, when states began to pay more attention to wildland fire and fire prevention.

In the second half of the 2010s, reducing the number of forest and wildland fires in Russia became a priority for local governments.

The Russia-Ukraine war had not resulted in the collapse in the wildland firefighting industry; despite the economic crisis in Russia and unprecedented sanctions by the West, the Russian government has had enough reserves to keep the situation under control. In general, according to official Russian state spokespeople, 2022 was generally successful for Russia in regard to forest and wildland fires.

As Ivan Sovetnikov, head of the Russian forestry regulator Federal Forestry Agency (Rosleskhoz) said in an interview, in 2022 the area affected by forest and wildland fires in Russia decreased by almost three times compared to 2021 and amounted to 3.5 million hectares. The number of fires also decreased. According to Rosleskhoz's data, in 2021 there were 15,100 forest fires registered in Russia, and 12,500 in 2022; the average area of a wildland fire decreased by 2.2 times to 165 hectares. According to Sovetnikov, that was mainly achieved by earlier detection of wildland fires.

Despite those successes, the industry is preparing for a massive crisis this summer due to the shortage of firefighting supplies, equipment and technology. Senior Russian state officials have confirmed those fears.

Alexander Chupriyan, first deputy head of the Russian Ministry of Emergency Situations – a state agency responsible for all firefighting activities in Russia – said in November during the 3rd International Fire and Rescue Congress (one of Russia's most important annual events in the field of fire fighting), that Russia faces a shortatge raw materials necessary for the production of firefighting equipment, in particular, plastic for producing helmets. Prior to February 2022, when Russia attacked Ukraine, 100 per cent of the material used to make firefighting helmets was imported, but due to sanctions, supplies are no longer available.

"Western sanctions revealed a number of problematic issues in the industry," Chupriyan said. "One of the most painful for the Ministry of Emergency Situations became blocks [of communication systems], which are made on the bases of foreign electronic components. This problem mainly affects our ability to provide firefighting units with communications, intelligence, search systems and public warning systems."

According to Chupriyan, Russia also does not have its own small-sized internal combustion engines, which are used in drones, special rescue tools, mobile

Russian firefighters extinguish smouldering grass after a wildland fire in the Russian Ural Federal District. Photo by Kirill Shipitsin TASS.

Troops extinguish a fire in the Russian Sakah (Yakutia) Republic, one of Russia's most northern regions and a center of diamond production in the country. Photo courtesy Russian Ministry of Emergency Situations.

pumping stations, and electric generators. Finally, there are serious problems with personal protective equipment for firefighters and rescuers.

"The share of foreign components for the production of protective equipment for firefighters is 100 per cent," Chupriyan said. "As a rule, shells of helmets for domestic firefighters are made exclusively from foreign ABS plastic. The lack of supplies has created serious problems for the industry."

A decision by the European Union in July 2022 to impose a ban on exports of fire equipment and technology to Russia has resulted in the suspension of many necessary supplies and the exodus of most of global players from the Russian market.

One of such companies is Austria-based Rosenbauer International, which supplied components for a wide range of Russian firefighting equipment. In addition, Rosenbauer Panther 6x6 heavy vehicles also have no analogues in Russia and its firefighting sector. According to some Russian media reports, Western sanctions directly imposed a ban on the activities of the Russian-Austrian joint venture Spetstekhnika Pozharukhushivaniya LLC and forced the Russian government to consider the establishment of similar production of domestic firefighting vehicles.

According to several analysts, establishing local production of the necessary firefighting equipment is cost-prohibitive for Russia, and would require significant time and resources – difficult for a country in the midst of a military conflict and an ever-deepening economic crisis.

One possible way to deal with the lack of equipment is parallel imports, essentially a non-counterfeit product imported from another country without the permission of the intellectual property owner. However, this concept has not gained popularity mainly due to

high logistics costs and legal issues.

Thus, Moscow is relying on increasing supplies from the so-called friendly countries such as China and India. In November, Russia sent India a list of more than 500 items for potential shipments, including various wildland fire technologies and products to partially replace the banned Western imports. The Russian Ministry of Emergency Situations says it is currently unclear whether India will be able to meet any of these needs. In addition, most analysts believe the quality of most of Indian and Chinese products will be significantly lower than the Western counterparts.

Analysts expect that due to the economic crisis and the ever-growing isolation of Russia in the international arena, the country may this year face a wildfire season similar to that of 2021, when wildland fires caused record damage, destroying 18.8 million hectares of forest, steppe and peat bogs – the equivalent of some European states in area.

According to Greenpeace Russia, the magnitude of wildland fire in 2023 may pose a threat not only to a Russian ecosystems, but on global scale, as, according to its data, almost half of the amount of carbon dioxide emitted into the atmosphere comes from peat bogs located along the Arctic Circle, particularly Russian Siberia – a total of about one billion tons of CO2.

In addition to a shortage of industry equipment, this year the wildland firefighting industry may also experience a shortage of manpower. Before Feb. 24, 2022, the Russian government actively used troops for these purposes, however because of the war, most of the country's military were sent to Ukraine and are unavailable for firefighting activities. Probably the most significant shortfall will be in aviation fire fighting, particularly helicopters. Most helicopters and their spare parts have been delivered to Russia from abroad, and in recent months most deliveries have been suspended; many of these helicopters have been redesigned for military need and have been sent to Ukraine.

Before the Russian invasion of Ukraine, Russia had a large fleet of aircraft for wildland fire fighting, mainly Be-200s, multipurpose amphibious aircraft, (which have the capacity of 12 tonnes of water and attracted interest from the United States), IL-76s, and some other aircrafts and helicopters. Due to current sanctions, the number of aircraft in the Russian firefighting aviation fleet will gradually decline.

As for spare parts for planes and helicopters, some are still produced within the country but the priority for repair and maintenance will shift to aircraft used in the war.

In this regard, experts of the Ministry of Emergency Situations and some independent analysts consider serious risks of large-scale wildland fires in regions such as Transbaikalia, the Amur, and Khakassia, as well as Eastern Siberia, which has been traditionally problematic in terms of its fire risks.

To try to prevent a massive crisis and reduce the risk of large wildland fires, the Russian government is working on measures to strengthen domestic ability, including the development of a methodology for each Russian region to assess the efficiency of fighting wildland fires. The regions with the worst wildfires risks will be subject to sanctions and fines from the federal government. The planned measures include more active air monitoring of forests and wildlands, the division of the country's forests into quarters (for the passage of firefighting equipment and localization of crown fires), as well as building trenches and fire breaks.

The government also plans to impose a ban on the construction of homes close to hay storage areas, and a ban on hay storage close to any villages and rural settlements.

In addition, the government plans to implement the Soviet model of installing special collapsible pipelines to help fight burning peat bogs, and, as part of state plans, the establishment of fire breaks in each Russian rural settlement.

There are also plans to design a new system of wildland and forest zoning to ensure more strict monitoring and detection of fire sources. According to planned regulations, firefighting brigades should arrive to wildland fires no later than three hours from the time of detection, regardless of weather conditions.

"Russia currently experiences a shortage of single, unified system of wildland fires fighting, " said Anatoly Tsiganok, a professor at the Russian Academy of Military Sciences and one of Russia's leading experts in the field of fire fighting.

"Such a system, which existed during the Soviet times, was completely ruined after the collapse of the USSR

in 1991. During the Soviet times, there were several different services involved in protection of forests and wildlands in the country, including fire fighting. At the same time, the country experiences a shortage of volunteer fire brigades and federal aerial forest fire centers."

Wildland fires are complicated by illegal logging, an ongoing problem for Russian Siberia and the Far East. Most of the illegally logged wood is supplied to China and other Asia Pacific countries and later, after its processing, shipped to Western markets including the United States. According to the Russian *AIF* business paper, at present the area under illegal logging in Russia is comparable to the area of forest and wildland fires. As a result, giant deforested territories are drying up, the level of groundwater is lowering, and the wind is becoming more unfavorable; this creates optimum conditions for the spread of fires in forests and wildlands.

In the meantime, amid almost complete suspension of firefighting supplies, equipment and technology from the West to the Russian market, local states plan to build their own domestic products. Some progress has been made; Russia had planned to complete a final design of a new domestic fire extinguishing system for helicopters by February 2023

Georgy Zevig, chief designer at Kumrtau Aviation Production Enterprise JSC – a research enterprise in Russia that is implementing the project – says the new fire extinguishing system, known as SP-32, which was developed by Kumrtau and Russia's Mil & Kamov, will consist entirely of domestically produced components by this year. Zevig says at present the American-made Hercules pump with a Rotax engine remains the only foreign part in the newly designed system but there are plans to replace these parts by mid-2023.

In the meantime, senior Russian state officials are optimistic about the wildland firefighting sector.

Rosleskhoz's Sovetnikov says more than 43,000 Russian Mil & Kamov units of forest fire equipment and equipment have been purchased, while the staffing of the regions is estimated at more than 93 per cent.

"We have been running the ecology federal project for several years now, and from the very beginning, we have relied on Russian equipment," Sovetnikov says. "Russia produces the entire range of products related to fire engines and forest-patrol vehicles. There are no serious major problems with equipment used for wildand and forest firefighting activities in the country as well as the necessary spare parts for repairs and service of such equipment."

Hopes are also high for more financial support from the state. State funding of wildland and forest firefighting activities in Russia had more than doubled to 14.2 billion rubles in 2022 from six billion rubles in 2021, and there is a possibility that the same volume of funding will be provided this year.

ABOUT THE AUTHOR

Eugene Gerden is a freelance writer who specializes in the global fire fighting and rescue industries. He has written for several industry titles and can be reached at gerden.eug@gmail.com.

Alexander Chupriyan, first deputy head of the Russian Ministry of Emergency Situations, said in November during the 3rd International Fire and Rescue Congress (one of Russia's most important annual events in the field of fire fighting), that Russia faces a shortatge raw materials necessary for the production of firefighting equipment, in particular, plastic for producing helmets.Photo courtesy Russian Ministry of Emergency Situations.

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HEAT-POINT MAPPING

USING SATELLITES TO TRACK WILDLAND FIRE

BY GRACE VEENSTRA

Dynamic. That is how Alaska smokejumper Pat Johnson describes wildland fire in Alaska.

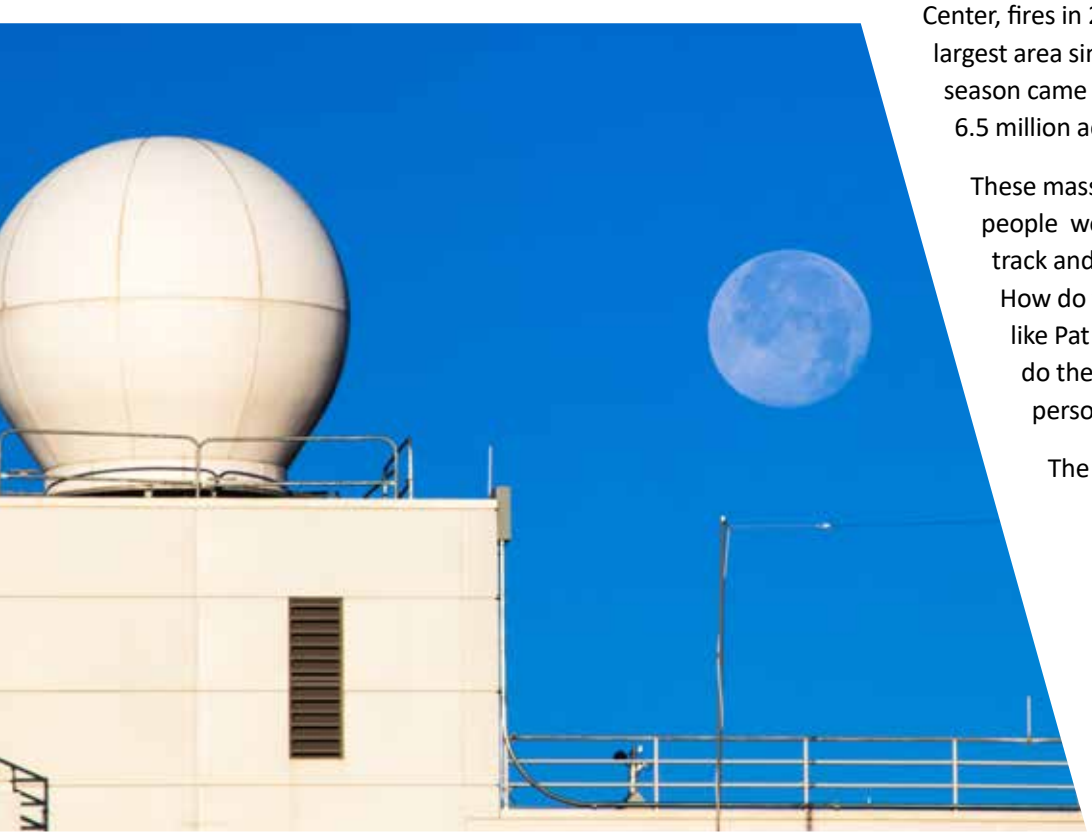
"It may be relatively calm, a little smokey," Johnson said. "The fire is smoldering and easily put out by beating out the flames and cutting back the brush. But on larger, more intense, rapidly growing fires, you will see a smoke column rising into the sky, smell the smoke in the air, feel heat from the fire if you are close enough."

Johnson spent two weeks in the summer of 2022 fighting the Donut fire about 30 miles (48 kilometres) south of Ruby, Alaska, a village on the Yukon River. Johnson and three other smokejumpers protected a cabin from the advancing flames.

The Donut fire was just one of hundreds of wildland fires that burned more than three million acres in more than 580 blazes across the state in 2022. According to the Alaska Interagency Coordination Center, fires in 2022 burned the fifth-largest area since 1990. The record season came in 2004, when more than 6.5 million acres burned across Alaska.

These massive numbers might make people wonder how fire managers track and monitor all of these fires. How do they protect firefighters like Pat Johnson? And how do they know where to send personnel?

The answer? Satellites.



Geographic Information Network of Alaska's "Big Dog" antenna on top of International Arctic Research Center. Photo courtesy of Geographic Information Network of Alaska.

SATELLITES AND FIRE POINTS

Carl Dierking is the satellite liaison at the Geographic Information Network of Alaska, part of the Geophysical Institute at the University of Alaska Fairbanks. GINA is responsible for collecting and processing the raw data received from the satellites of the Joint Polar Satellite System. GINA then makes this information available to the public in the form of data and visuals. The information helps scientists such as meteorologists and oceanographers, but GINA's staff also provides information to agencies like the Alaska Fire Service and the Alaska Volcano Observatory.

"GINA's role in fire management is to provide fire-related satellite imagery as quickly as possible so the managers can make proper decisions," Dierking said.

GINA does this through the use of what's known as "direct broadcast," where a satellite scans Earth as it passes overhead and simultaneously transmits that data to antennas on the ground. This allows GINA to publish data in near real time, often around 15 to 20 minutes after the satellite data finishes downloading.

GINA also produces "fire heat points," which are used to aid fire managers.

If you go on the Alaska Wildland Fire Information Map, you'll be greeted with a view of shaded fire perimeters and burn areas as well as collections of red dots. These dots are the heat points, or, if you want to be fancy, the VIIRS Active Fire Detection Algorithm. Dierking describes these points as signifying intense radiation. Since fires are much hotter than everything around them, they are what appear as heat points.

There are, of course, anomalies. Volcanos and industrial locations can also create a heat point since they emit similar levels of energy. But since they occur persistently in the same location, managers can tell the computers to ignore them.

These heat points are plotted in maps such as the Wildland Fire Information Map. The map is accessible by the public and organizations such as the Alaska Interagency Coordination Center, a group of Alaska agencies that handle wildland fires.

From here, the heat points and other fire products are used to inform fire managers about a fire's growth and what the response should be.

Once fire managers see a new heat point, they can decide on a number of responses depending where the fire is located and what it is being threatened. Managers might choose active

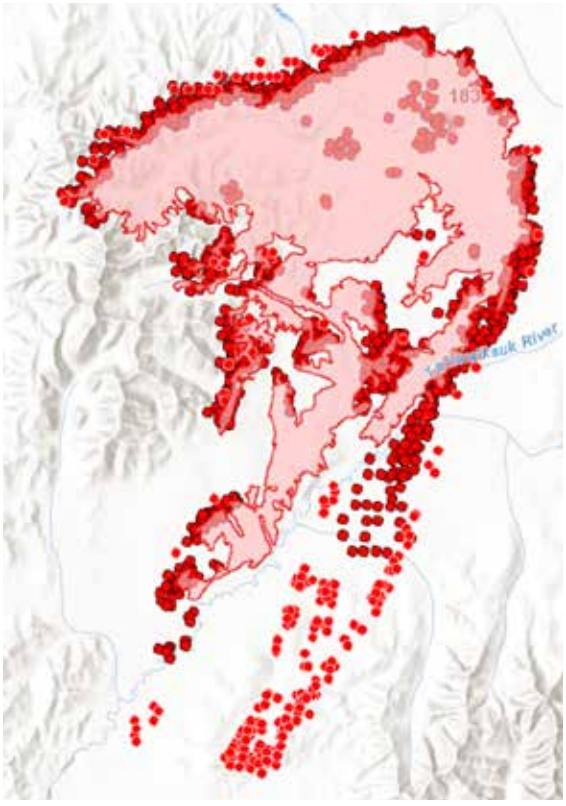


Image of the Tatlawiksuk Fire taken June 8, 2022, showing the fire heat points that indicate fire growth. Image courtesy of Alaska Wildland Fire Information Map.

Firefighter Pat Johnson spent two weeks in the summer of 2022 fighting the Donut fire about 30 miles (48 kilometres) south of Ruby, Alaska, a village on the Yukon River. Johnson and three other smokejumpers protected a cabin from the advancing flames.

suppression of the fire, in which case they'll send out aircraft and firefighters to fight from the air and on the ground. Or they may decide to let the fire burn and monitor it to see if and when suppression may be needed.

"Fires that occur in Alaska are oftentimes in places that are difficult to reach," said Robert "Zeke" Ziel, a fire analyst associated with the Alaska Fire Science Consortium, part of the International Arctic Research Center at UAF. Fire analysts like Ziel are responsible for analyzing and predicting the behavior of wildland fires.

"But there are still things that require protection," Ziel said. "In these instances it's difficult to maintain knowledge of what that fire is doing and to determine what is being threatened and what needs to be done about it."

It is for this reason that satellites are so critical: they can give researchers and managers a view into remote areas.

"Before satellites, everything was done by aircraft," said Alison York, co-ordinator for the Alaska Fire Science Consortium. "Fire management in Alaska is still very dependent on aircraft. They are important for the transport of firefighters, supplies and water, and are still used for monitoring."

Prior to the use of satellite imagery, not many fires were directly detected by the agencies. Most first reports of fires were from private and military pilots who would notice the smoke as they flew over the state.

But Alaska has a land area of more than 580,000 square miles, and these pilots can't be everywhere.

One example is the 2007 Anaktuvuk River tundra fire on the North Slope: it took several days before any fire agencies knew it existed, and by that time it had already grown very large. The fire burned for three months and consumed nearly a quarter million acres, making it the largest tundra fire on record for the North Slope.

"Remote fires are a challenge if we can't catch them early on," Ziel said. "If you don't know about it, it's easy for the fire to get out of control."

Fires such as the Anaktuvuk River Fire, and the record setting year of 2004 during which thick smoke grounded the aircraft needed for fighting and monitoring fires, drove home the value of satellites.

SAVING LIVES AND RESOURCES

Established in 2001 as an initiative of the University of Alaska president, the Geographic Information Network of Alaska focuses on remote sensing for Alaska and its surrounding area. Using its satellite dishes —one at the university and another 14 miles northeast of Fairbanks — GINA captures the data from polar-orbiting satellites. By collaborating with federal, state, and academic partners, GINA provides this data through public portals. An inventory of satellite images over the state of Alaska is available online, and these images can be freely downloaded.

Today, GINA and its satellites are a critical part of fire monitoring and detection in Alaska. From Jan. 1 to Sept. 6, 2022, more than 260,000 heat points were collected in Alaska and surrounding territories, with more than 5,000 in the Fairbanks North Star Borough and 89,000 in the Yukon-Koyukuk Census Area.

"The satellite imagery and heat points are used to locate and monitor fires so people have a sense of where they're moving," York said. "They're used by people in the field making decisions about where to deploy resources. They're used by fire behavior analysts for longer-term planning in deploying and requesting resources."

Satellites save resources. Whether it's GINA and its fire heat points, or satellites such as LANDSAT and Sentinel that provide high resolution imagery, satellite data is used daily by fire managers. Satellites prevent the need for hundreds of additional aircraft in the skies, protect communities and homes in both outlying areas and closer to the cities, and keep personnel out of excess harm.

York put it simply: "This satellite imagery is what is going to help us keep people out of unnecessary risk."

Wildfires affect many Alaskans each year, whether it's due to a home being threatened by the flames or difficulty breathing due to the smoke that chokes the air. But thanks to satellites, fire managers and, most importantly, the firefighters risking their lives, we are all kept that much safer.

ABOUT THE AUTHOR

Grace Veenstra works for the Geographic Information Network of Alaska at the University of Alaska Fairbanks. As a lifelong Alaskan, Grace is very interested in Arctic issues, among them the impact of wildfire on Alaska.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CHASING WILDFIRES FOR SCIENCE

MOBILE PLATFORMS HELP RESEARCHERS STUDY WEATHER

BY CRAIG CLEMENTS

When thinking of tornado and hurricane research, meteorologists immediately envision mobile radars and storm chasers tracking thunderstorms or C-130 hurricane hunters penetrating into the eye of the storm to determine its intensity.

But when we think of wildfires, these technologies have been absent until recently.

In 2012, The Fire Weather Research Laboratory at San Jose State University mounted its Doppler lidar, a laser-based radar that detects aerosols and smoke in the atmosphere, on the back of a Ford F250 pickup truck. Equipped with an automatic weather station mounted on a rack above the truck and a weather balloon system, the California State University Mobile Atmospheric Profiling System or CSU-MAPS was born.

The lidar is leveled using an airbag frame system mounted in the bed of the truck that also stores up to three helium cylinders for weather balloons. The truck is equipped with wifi so data can be uploaded to the web and sent to Incident Meteorologists (IMETS) and Fire Behavior Analysts (FBANS) when requested.

This nimble offroad platform changed the way fire weather is monitored at incidents. Between 2013 and 2019, more than 35 wildfires were sampled with the MAPS leading to several new and unprecedented observations of plume dynamics and other fire weather phenomena including pyrocumulonimbus, winds generated by smoke shading, turbulent

Radar taking measurements on Aug. 15, 2020, during the Dixie fire. San Jose State University graduate students monitoring fire behavior. All photos by Craig Clements.

properties of wildfire plumes, and fire generated vortices. These observations were made during a small field campaign called RaDFIRE-Rapid Deployments to Wildfires Experiment, funded by the National Science Foundation. From these experiences, it was demonstrated that applying storm chasing techniques to wildfires can be successful. There is one caveat and a big one—all San Jose State University personnel have to be red-carded (U.S. federal fireline qualifications), which is a requirement of incident management teams.

In 2019, San Jose State University acquired a new tool that transformed our wildfire monitoring capability, Doppler radar mounted on a second truck. This facility is quite amazing as it is specially designed for studying clouds and the smaller ash particles found in wildfire plumes. The radar was designed and built by Prosensing, Inc. and is a Ka-band dual polarized radar, which means it transmits two pulses, one horizontal and one vertical, which allows for the particle shape and type to be determined. The radar has been deployed to eight wildfires and the measurements obtained from it are groundbreaking. The radar truck is equipped with auto-leveling jacks that can level the truck and radar in three minutes while the radar is booting up. Observations can be taken in as little as three minutes once on site; this provides a much safer platform for the fire environment as the truck can leave quickly as well. Additionally, the radar has a much longer range than the lidar, so researchers can scan the plume faster, in greater detail and at a safer distance from the fire. Another unique aspect of the radar is that because it scans faster and is quicker to start up, it is better at general reconnaissance of the fire environment than the lidar. The radar has really changed how researchers monitor fires and fire weather, and allows us to see what's going on inside the plume.

Now, the team deploys both the lidar truck and the radar at an incident, providing a much more complete observational suite for understanding fire weather and plume dynamics. While the radar is rapidly scanning the plume and tracking the fire-induced winds inside the plume, the lidar is profiling the winds vertically up to one kilometer above the truck. So, for the first time, we can measure the ambient winds not only at the surface but much higher in the atmosphere while simultaneously observing what the plume and fire are doing. In addition to the remote sensing systems, the team has the ability to launch radiosondes – a meteorological package that is attached to a weather balloon, which is about one meter in diameter. Radiosondes provide profiles of the atmosphere through the troposphere and lower stratosphere and provide measurements of temperature, humidity, wind speed and wind direction. These observations and data can be very useful for IMETS and the trucks are often requested for large incidents, particularly

SJSU team deployed to the Dixie fire in 2021.

Lidar and radiosonde system deployed during the King fire in 2014.

because the radiosondes can show where temperature inversions are present. For example, during the Detwiler fire near Yosemite in 2017, the team was asked by the IMT to launch weather balloons for just that purpose – to determine the strength of the inversion and whether the smoke would lift in time to allow air suppression activities to begin. Coupled with the lidar data of the smoke depth and vertical wind profiles, these observations allow us to see through the smoke and get a sense of the conditions above the socked-in smokey valleys that so often occur in mountainous regions. The lidar in this case provides a new set of eyes to the IMET.

While the ground-based assets are providing new and critical observations of the fire environment, we still need better observations of fire behavior. To address this need, we have developed a new airborne infrared fire imaging system that will be flown on an aircraft this fall. The high-resolution imaging system, developed by one of our faculty in the Wildfire Interdisciplinary Research Center at San Jose State University, allows us to see the fire in greater detail with less saturation so we can determine really hot areas of active spreading and not so hot regions behind the fire front. Additionally, new spot fires can be observed and tracked; this will allow critical fire behavior metrics such as fire rate of spread, heat release rate, and spotting to be monitored more completely. These images, coupled with the Doppler lidar and radar data, will provide for the first time, observations that link plume dynamics to fire behavior at an unprecedented detail.

These tools and field deployment strategies, while not new to the severe weather research community, are helping to break ground in wildfire science and provide unprecedented situational awareness for IMTs. For large fire incidents, the technology and protocols are well developed, so IMTs should really be taking advantage of this. The San Jose State University team and facilities are available by request through the Tahoe National Forest or by contacting me directly. The team will travel anywhere in the western United States.

ABOUT THE AUTHOR

Craig Clements is professor and chair in the Department of Meteorology and Climate Science at San José State University and director of the National Science Foundation I/UCRC Wildfire Interdisciplinary Research Center. He leads research on fire weather, extreme fire behavior, fire-atmosphere interactions, and conducting wildfire field experiments. He teaches courses in fire weather, wildfire science, mountain meteorology, climate change, and meteorological instrumentation. He received his PhD in geophysics from the University of Houston, his MS in meteorology from the University of Utah, and a BS degree in geography from the University of Nevada. His research has been featured in *PBS NOVA*, *Rolling Stone*, *The New York Times*, *Time*, *CNN*, and *Scientific American*.

Preparing radiosonde during the King fire in 2014.

San Jose State University researchers controlling the radar and watching data during the Kincade fire in California in 2019.

Typical deployment with both trucks positioned close together making co-ordinated measurements, during the Kincade fire in 2019.

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PESHTIGO FIRE FUELED BY SLASH FROM LAND CLEARING

RICHARD MCCREA

The 150th anniversary of the Peshtigo fire was commemorated in 2021. On Oct. 8, 1871, a firestorm swept through the town of Peshtigo, Wisconsin, destroying the village and killing between 1,500 and 2,500 people.

Peshtigo had a population of 1,700 at that time, and there were many transient workers in the area. There was a tremendous loss of property that year as forest fires consumed and devastated towns, businesses, farms, sawmills, logging and railroad camps, bridges, fences, haystacks, and barns.

In the Great Lakes region of the United States (Michigan, Wisconsin, and Minnesota), 1871 was a year of drought, followed by large conflagrations that swept across the landscape. An estimated 1.5 million acres (607,000 hectares) burned that fall in northeastern Wisconsin and upper Michigan. Other conflagrations ravaged the countryside in adjacent states. The Great Chicago Fire erupted on Oct. 8, 1871, burning an estimated 17,000 structures, killing about 300 people.

Peshtigo is located on the Peshtigo River, which flows into Green Bay, a western arm of Lake Michigan, and the Door Peninsula dominates the east side of the bay. Peshtigo is about 40 miles (64 kilometres) north of the town of Green Bay. The town of Marinette lies just to the northeast of Peshtigo, on the banks of the Menominee River, a river that delin-

Families huddled in a field in the sugar bushes to the west of Peshtigo,attempting to escape the Peshtigo Fire. Image courtesy of the Wisconsin Historical Society.

At that time there was no organized fire suppression of forest fires, nor any rules governing the disposal of logging slash or the use of fire. It was the frontier after all. The Peshtigo wildfire ranks as one of the deadliest firestorms in U.S. history.

eates the boundary between Michigan and Wisconsin. The local newspaper in the Peshtigo area was called the *Marinette and Peshtigo Eagle*, commonly known as the *Eagle.*

In 1845 lumber barons Isaac Stephenson and William Ogden established a sawmill and a woodenware factory at Peshtigo. Stephenson was the manager of the Peshtigo Company, which operated sawmills, logging camps, the woodware factory, and had extensive holdings of timber lands. The woodware factory built such things as wooden buckets, shingles, broom handles and clothes pins. During that era timber companies purchased large tracts of forested lands in the lake states, and with that came a flood of mill workers and woodsman; they came for the coveted white pine (*Pinus strobus*) which was found in abundance in that region and in southern Ontario, in Canada.

The lumberjacks felled trees and skidded the logs to the Peshtigo River, where they were floated to the sawmills at Peshtigo. The forests were thick in that region, and some said there were a billion trees on a million acres. Large areas were logged over in northeastern Wisconsin and expansive areas of slash were common. Settlers soon followed the logging and they dispersed across the countryside and cleared parcels of land. One of the handiest tools on this frontier was fire, which was used to clear fields of brush, and to burn slash and large stumps. There were no laws governing burning or slash disposal.

According to books and newspaper articles about the fire, the roads from the farm settlements that led into Peshtigo were littered with sawdust, stumps, and slabs and the debris made it difficult for farmers to get crops to market. Woody refuse from the mills in Peshtigo was a given and sawdust and slabs were heaped in piles wherever it was convenient, including onto the roads and under city sidewalks. Lumber and decks of logs were stacked near the mills, waiting to be processed.

This region of Wisconsin was gripped by a drought that began in the spring of 1871 and stretched into October. The Peshtigo and Menominee rivers were the lowest they had been in many years and settlers in the outback said the cranberry bogs and creeks were drying out. The loggers decked logs near the rivers, waiting for the rains to bring up water levels, when the rounds could then be floated downstream.

In mid-September 1871 work started on a railroad from Green Bay to Peshtigo. Large gangs of railroad workers slashed through the woods clearing the right of way, piling up long pyres of slash then setting it all afire, indiscriminately scattering flames into the woods.

On Sept. 9, 1871, the *Eagle* noted; "Mulligan's Brigade of choppers, axes in hand, armed and equipped as the railroad authorities direct, thirty-two strong, rank and file, passed this place on Saturday en route for the north side of the river, to clear the track for the railroad between Peshtigo and Marinette." Seven days later the Eagle reported, "heavy fires on the northeast of the village (Peshtigo) in the woods." Some said it was Mulligan's Brigade doing its work.

On Thursday, Sept. 21, forest fires erupted on the western shore of Green Bay and many areas of northeastern Wisconsin. At the settlement of Little Suamico, men were at work digging trenches to stop the flames and near Oconto, fires burned up the telegraph lines that ran along the railroad right of way. Infernos flared at Manitowoc, burning houses, barns, fences, and piers on Lake Michigan.

That Saturday, Sept. 23, flames raged on the north side of the Peshtigo River, and embers blew across those waters and started a fire near the woodenware factory. The citizens of town and mill workers rushed out to suppress this new start. On Sunday, it was noted that fires were burning in all directions from the town of Green Bay, destroying buildings and settlements and as soon as one ignition was suppressed another popped up.

Accounts of the fires indicate that on that same day in Peshtigo, Stephenson put men to work digging trenches as he was sure the fierce blaze six miles south of town would soon overrun the city. The woods to the west of Peshtigo were full of flames.

In the Peshtigo region things settled back to some normalcy after the fire battles of Sept. 23 and 24. The first week of October brought smokey skies with a glaring red at night from the fires. On Tuesday, Oct. 3, an ominous report was issued by S. Robinson, general superintendent of the Northwest Telegraph office in Milwaukee, which stated that extensive fires were raging in the forests between Green Bay, Wisconsin and Escanaba, Michigan, a distance of 107 miles. Fires were also reported from the Dakota Territory to Lake Michigan and in parts of Minnesota the conflagration had swept over 150 miles and people were fleeing for their lives with great loss of property.

Weather observers in Chicago noted that on Wednesday, Oct. 5, winds had switched to the northwest with increasing velocity through the day, and by nine that night were clocked at 25 miles per hour (40 km/hr); a storm was brewing. On Oct. 7, the Eagle reported "Fires are lurking in the woods around Marinette, ready to pounce upon any portion of the village in the event of a favorable wind." On Sunday afternoon a deepening low-pressure system moved over Wisconsin, bringing dry air and high winds out of the southwest. Weather observers at Milwaukee, Wisconsin, 140 miles (225 km) south of Peshtigo, recorded winds of 32 miles per hour (51 km) out of the southwest by midafternoon.

On Sunday morning, Oct. 8, some 200 railroad workers arrived in Peshtigo, and established themselves in the Forest House and the Hotel de France, and soon overflowed into the nearby saloons, mixing in with lumberjacks and sawmill workers. Following in the footsteps of these boisterous crews, high winds swept out of the southwest, stoking smoldering and sleeping embers from past days, which soon erupted into flaming fronts and crown fires. At noon in Peshtigo the smoke thickened, and the sun disappeared, and at suppertime black and white ash was drifting over town. At dark, folks could see a sullen red over the treetops to the southwest.

Stewart Holbrook in his book B*urning an Empire* interviewed John Cameron, a log scaler and timber cruiser, about his experience on the Peshtigo fire. Cameron told a riveting story of his experiences that night. About 9 p.m. on that Sunday, he could hear a low noise emanating from the forest, which gradually turned to a roar. Cameron peered into the dark and, all the sudden, a whirling slab of fire came hurtling out of nowhere. In a flash, rooftops and pine plank sidewalks caught fire. The roar of the firestorm was like a hurricane of galloping flame and it seemed as if within five minutes the entire area was enveloped in a vast inferno. Cameron fled to the waters of the Peshtigo River and was followed by more humans tumbling over the banks, mixed with cows and dogs.

The firestorm, running in a northeasterly direction, some 12 miles wide, engulfed the town with tremendous force; boards were blown off fences, train cars loaded with logs lifted into the air, and buildings tore off foundations. Embers ignited the woodenware factory and towering flames erupted from its walls and strong

updrafts launched thousands of blazing wooden buckets into the dark sky, which dropped everywhere, like ligneous meteors.

People ran through the streets toward the safety of the river, but the slabs of deadly flame outpaced many of them. The Peshtigo River became a nightmare of struggling men, women and children fighting for breath along with animals escaping the heat. Logs in the river ignited and the swift currents pushed those burning torpedoes into survivors. Sheets of flame ignited people's hair in the water, and they had to continually wet their heads as embers and chunks of burning wood fell out of the sky.

The settlements and countryside near Peshtigo were nothing but a vast cauldron of fire, as the conflagration swept through the forests and fields. The settlers fought the blazes with shovels and pickaxes, but the battle was futile, and they soon fled on foot or horse drawn wagons, for the safety of creeks, plowed fields and wells.

The firestorm swept through Peshtigo and continued its run to the north, largely sparing the town of Marinette, but soon spotted across the Menominee River and incinerated a sawmill and all the nearby houses. At nearby Menekaune the flames ignited three sawmills, 30 houses, three stores, dock, shipyard, and warehouse. The fire front continued to run for about another 25 miles into Michigan, before cooler weather and rain set in.

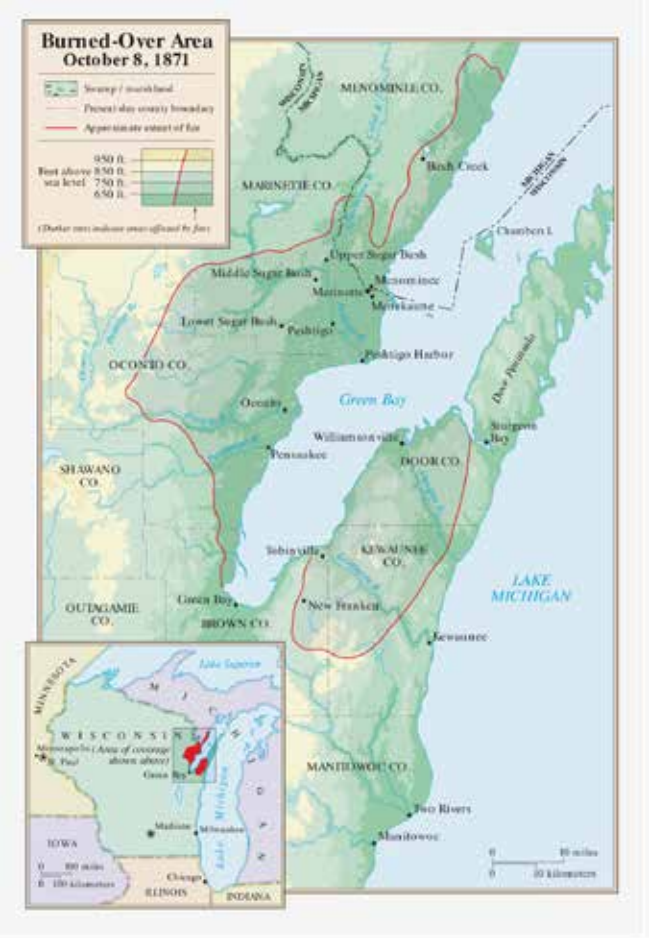
On the Door Peninsula, on the east side of Green Bay, the same tragedy was playing out as smoldering fires erupted into a conflagration, burning down farms and towns.

In Williamsonville every building was destroyed, and survivors headed for Little Sturgeon Bay, walking through miles of ash and devastation.

As the flames in Peshtigo slowly subsided, the survivors, some with burn injuries, emerged from the river, as late as 3 a.m. There was nothing let of town except foundations and foul-smelling air. The refugees were soaking wet and in the chilly night air they sought out areas that were still burning and attempted to dry their clothes and warm up. Folks called out, searching for missing family members. Sixty bodies lay in the streets and more lined the riverbank and floated in the waters. Large pine trees were uprooted by the high winds and church bells and railroad car wheels were melted.

Rescue and burial parties set out to find survivors and simple wooden crosses were erected on the graves of folks that could be identified. The unidentified were put in mass graves, one of which ended up interring the bodies of 350 people. After the burials were finished in Peshtigo search parties moved out into the countryside and they did not have far to go and in a nearby corn field, they found 68 bodies. On the roads they encountered burned up wagons and the fields were scattered with dead cows and horses. Burial parties found the bodies of settlers in burned up buildings, fields, and wells.

Many folks were unaccounted for after the Peshtigo conflagration; the numbers of new immigrants in the area, and the railroad workers and loggers who mostly lived a roving life, made it difficult to account for everyone. One group of 50 railroad workers were never located and another fire crew was entirely lost and the only evidence of them were the firelines they dug and their melted shovels and pickaxes. The official reports indicate that 1,500 to 2,500 people died in the firestorm, but the actual number will never be known.



Wisconsin Historical Society

Many blamed the railroad for the great fires. For weeks before the firestorm, railroad crews slashed a wide swath through the forest, piling logs and slash on both sides of the right of way, then burning the woody debris. As the crews moved deeper into the forest the number of piles of slash and smoldering heaps of flame and embers increased. Stephenson, in his book *Recollections of a Long Life*, 1829-1915, wrote "But in our efforts to better our position we unwittingly paved the way for disaster. The summer and autumn of 1871 were unusually dry, and the forests and brush were reduced to tinder. To make conditions worse, the wind blew almost continuously day after day from the southwest. When work on the railroad began, fires were started to clear the right of way. The contractors carelessly allowed these to spread, and they ran through the country with startling rapidity, feeding on the dry forests. In some instances, even the marshes and bogs were burned to a depth of four feet."

One cannot put the full blame on Mulligan's brigade; they were rugged frontiersman simply doing their jobs, in deadly dry forests and fields heaped with dead wood. The extent to which the logging slash accumulations contributed to fire behavior is unknown, however, the Peshtigo conflagration burned over large acreages of slash.

The town of Peshtigo was devastated by an enormous firestorm, a cataclysm of high winds, low humidity, and an abundance of extremely dry forest fuels including logging slash and brush from field clearing. The towns of that era were largely constructed of wood, shingle roofs and pine plank sidewalks, with adjacent sawmills that had yards full of logs, lumber, and waste wood – all extremely susceptible to fire. All that fuel stoked the inferno, and it was the perfect setup for a catastrophe. At that time there was no organized fire suppression of forest fires, nor any rules governing the disposal of logging slash or the use of fire. It was the frontier after all. The Peshtigo wildfire ranks as one of the deadliest firestorms in U.S. history.

The arrival of the railroad in northern Wisconsin in 1870 brought major social and economic change. Locomotives were used to haul logs and transport lumber from the mills, which revolutionized timber operations. Trains also carried settlers looking to establish farms and carried produce and manufactured goods to market. As the lumberjacks axed and hewed their way through the rich pineries, a wasteland of slash remained. Slash fires are nothing like average forest fires, as the piles of dead wood burn with great intensity and ferocity.

Over the next 50 years, until about 1918, there were at least seven major wildfire catastrophes that occurred in the lake states and Ontario, burning perhaps seven million acres with more than 4,000 fatalities – numbers that will never be accurately known.

As Stephen Pyne relates in his book *Fire In America*, regarding the conflagrations in the lake states from 1871 to 1918 "This relative homogeneity is borne out in uncanny similarity among the great fires. For 50 years the fires were interchangeable. The names, dates, and locations varied, but otherwise the account of one fire could substitute for that of another."

By 1918 the narrative of large catastrophic fires ended, for a wide variety of reasons. Industrial logging in the lake states was rapidly waning, as the lumber barons started migrating toward the Pacific northwest seeking untouched stands of old growth trees, a movement that was largely underway by 1900. State governments were also gradually enacting laws that governed the disposal of slash from logging operations. Agricultural settlement slowed, and associated land clearing and unregulated burning diminished. In 1905 the state of Wisconsin appointed 249 town fire wardens, with the authority to hire firefighters, and the state's first forest rangers were employed in 1911. And lastly, perhaps, the townsfolk, farmers, and timber owners, grew tired of decades of flaming destruction, and became savvier and more skilled in the use of fire and fire suppression tools to create fire breaks around their properties. Wildfires in the coming decades, especially during times of drought, would continue to burn large acreages in some years but they were no longer as destructive as in the past.

ABOUT THE AUTHOR

Rich McCrea works as a wildland fire management consultant and freelance writer. During his career, he worked 32 years with the Department of Interior in fire management and forestry. Outfitted with a degree in forestry, he started his career as a seasonal employee with the US Forest Service as a forestry technician and member of the Helena Hotshot Crew. McCrea has considerable experience working with incident management teams including over 20 years' experience as a qualified fire behavior analyst. He assisted in the preparation of the Granite Mountain IHC Entrapment and Burnover Investigation for ADOSH, by completing a review of entrapment-fatality fires from 1990 to 2013.

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LEADING IN CHALLENGING TIMES

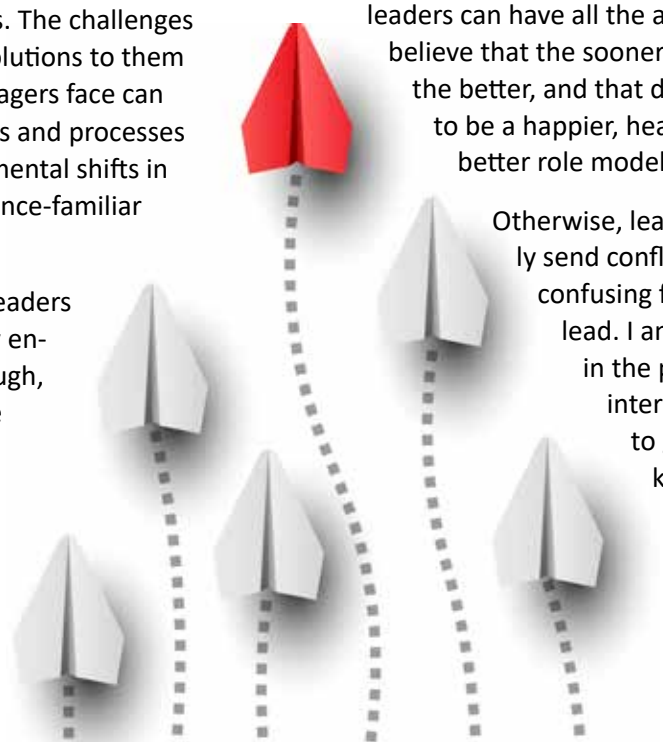
BY MICHAEL DEGROSKY

Ours is a complex world, getting more complex all the time. Climate change, technology, demographics, global economics, politics, and other factors have aligned in ways that make the environments in which we live and work exceedingly complex. Complexity encroaches on every aspect of organizational life these days and can prove highly disruptive.

Fire management is a microcosm of our big complex world. Many contemporary fire managers work in exceptionally complex environments compared to when they started their careers. The challenges can seem enormous and the solutions to them elusive. The problems fire managers face can render well-established systems and processes ineffective and demand fundamental shifts in how people think about their once-familiar work.

In this environment, effective leaders will help their constituents stay engaged and motivated even though, often, they may not yet be able to see a light at the end of the tunnel. Good leaders do this by helping people gain and maintain perspective about the nature of the problems they are trying to solve, the solutions to those problems, and realistic timeframes for implementing those solutions.

Helping others with perspective requires strong self-leadership on the leader's part. Today, effective leaders must accept that they cannot avoid ever-increasing complexity and uncertainty and expect that things will regularly prove both uncertain and uncomfortable. The reality is that we no longer operate in a world in which we can even pretend leaders can have all the answers all the time. I believe that the sooner a leader realizes this the better, and that doing so enables one to be a happier, healthier leader and a better role model.



Otherwise, leaders can inadvertently send conflicting signals that are confusing for the people they lead. I am nearly certain that, in the past, I telegraphed my internal sense of urgency to good people who knocked themselves out trying to match my intensity, even

though what I really wanted was for them to take good care of themselves.

The internationally known psychologist Daniel Goleman has written about leaders with courage and foresight making decisions "with the long horizon in mind." Today's fire management leaders must come to grips with the reality that they work on huge problems defying quick resolution. I encourage fire management leaders, regardless of organizational level, to look for that long horizon. Without the benefit of an occasional step back to gain distance and perspective, people set unrealistic goals and work very hard at failing to achieve them.

The trouble is, confronting big, complex and long-term challenges can be pretty intimidating, leaving us feeling unable to affect change. Recently, I've benefitted from the thinking of Lucia Csoma, a personal development coach, whose content on LinkedIn caught my eye. Csoma believes that the feeling that one is too small to be able to change something often comes from the tendency to focus on solving the whole problem. From this perspective, if a problem seems too big to solve, people tend to get overwhelmed and give up. So, break it down. You may not have the answer to reforming your agency's hiring system, but you can make the best hire possible this time, and the next time, and the next. You can encourage others to do the same and show them the way.

Make sure you have goals. Goals provide clarity of direction and align activities with organizational objectives. Csoma suggests that individuals can increase our chance of reaching our goals by first knowing what we are starting with, writing down a few areas in which we wish to see change or growth, rating our current state, and reflecting on where we want to be in one year while taking care to be ambitious but realistic given resources, capacity, and barriers. Csoma recommends breaking down action steps into small tasks you can complete in short periods of time, thereby enabling regular small wins, tracking progress, and celebrating accomplishments as you go. Not only is this a good approach for individual leaders but one that can be applied at the organizational level, if the part of the organization for which the leader is responsible lacks a more formal strategy.

Leading can prove extra demanding when peoples' challenges seem too big and the solutions to them seem too far off. Without solid leadership, people can lose motivation and the sense that their work has meaning. From my seat, solid leadership in a 21st century fire management organization increasingly looks like helping people gain and maintain perspective on the nature of the problems they are working to solve, breaking down big, long-term solutions into smaller, goal-driven actions that people can complete in relatively short periods of time, and celebrating the regular, small wins achieved as those actions are implemented and completed.

> **Today, effective leaders must accept that they cannot avoid ever-increasing complexity and uncertainty and expect that things will regularly prove both uncertain and uncomfortable.**

ABOUT THE AUTHOR

Mike DeGrosky is the former chief of the Fire Protection Bureau for the Montana Department of Natural Resources and Conservation, Forestry Division. He taught for the Department of Leadership Studies at Fort Hays State University for 10 years. Follow DeGrosky on Twitter @guidegroup, or via LinkedIn.

INVITATION TO PORTUGAL

TOWARD AN INTERNATIONAL WILDLAND FIRE RISK GOVERNANCE FRAMEWORK

BY TIAGO MARTINS DE OLIVEIRA

Responding to the severe and globally widespread wildland fire seasons of the 1980s, representatives of government entities and private institutions of all continents organized, in Boston in 1989 the 1st International Wildland Fire Conference – "Meeting Global Wildland Fire Challenges."

In 1997, near the turn of the century, the 2nd conference was hosted in Vancouver, dedicated to "Wildland Fire and Sustainable Development," attended by participants from 38 countries. Since then, every four years, a growing community gets together on a different continent to learn from each other and share knowledge and expertise under the scope of integrated fire management.

Prior conferences helped organizations and professionals from more than 70 nations develop a common fire lexicon, doctrines, training manuals, techniques, and operational standards. We excelled in preventing, detecting, and extinguishing wildland fires, mastering a portfolio of technological solutions.

Through time, the political and physical systems that we are part of tackled mostly the consequences (suppressing fire) instead of addressing the root causes (human activity and how it uses the land). The reinforcement of suppression, without investing in fuel management, is a proven quick fix, but ultimately escalates the problem to a higher level; this is the firefighting trap or fire paradox, in a global warmer and drier environment, exposing different biotas and communities to severe fires, wildfires, bushfires, forest, vegetation, landscape and rural fires as they are named from north to south, west to east.

In the last decade, severe and extreme fire events destroyed lives, buildings, and natural habitats; they cornered and puzzled politicians, institutional leaderships, and professionals. In 2017, wildfires tragically challenged Portuguese society. Since then, all our efforts converged into integrated fire management; this is no longer a niche or a subject for a few wildland firefighters or landscape planners. It is all about reaching out to other communities of practice, economic sectors, and local and Indigenous people. As fire management becomes a complex socio-ecological issue, it demands robust institutions, transparent and accountable procedures, and permanent communication with key stakeholders. It also demands a balanced budget between fuel treatment and suppression, in a set of cohesive policies. This means dismantling a culture of silos, promoting interdepartmental dialogue, avoiding unintended consequences of cross-cutting public policies (agriculture, forestry, energy, development, environment, fiscal and others). In Portugal, at the 8th International Wildland Fire Conference May 16-19, we aim to engage different audiences, different geographies, and levels of authority.

Following up the recommendations of the 7th International Wildland Fire Conference, which was hosted by Brazil in 2019 and addressed the theme "Facing Fire in a Changing World: Reducing Vulnerability of People and Landscapes by Integrated Fire Management," we are now challenged to put words into action.

Better wildland fire governance is needed to protect biodiversity, foster carbon sequestration and healthy forests, and ensure they are providing goods and services that do not vanish in wildfire smoke.

The deadline for submitting an abstract has closed. We are very honored to have received 520 proposals!

Through the coming month, members of the

scientific committee will select those to be presented in an oral or poster session. We are also very confident that the conference will have relevant scientific work being presented, from different countries, exhibiting evidence and presenting solution to address complexity and uncertainty when governing or managing wildfire risk.

In Porto, delegates will have a lifetime influencing professional experience, through the opportunity to meet with thousands of people coming from all over the world. We all share similar problems and are deeply committed to work on the solutions.

IAWF joined us as a partner in this conference, providing promotional and advertising opportunities to its diverse and international membership, and by also providing expert advice on relevant topics and speakers who support the conference themes.

We will be honored to host delegates in Porto, to discuss and participate in defining governance principles toward the development of an international framework. We believe that your piece of the puzzle will matter to help your nation and all nations to be better prepared to deal with the challenges ahead of us and to build fire-resilient landscape and societies.

As chairman and on behalf of the organizing committee of the 8th International Wildland Fire Conference, we invite you to come to Portugal with your knowledge, insights, and thoughts.

ABOUT THE AUTHOR
Tiago martins de Oliveira is chair of the AGIF board of directors.

8TH INTERNATIONAL WILDLAND FIRE CONFERENCE

IAWF BOARD GAINS MORE GLOBAL PERSPECTIVE

NEW MEMBERS REPRESENT IRELAND, AUSTRALIA, UNITED STATES

SCOTT GOODRICK

Scott Goodrick has been a research meteorologist with the U.S. Forest Service, southern research station, since 2002 and serves as director of the station's Center for Forest Health and Disturbance. Goodrick's general area of research spans fire-atmosphere interactions and smoke management with a focus on how prescribed fire ignition patterns influence plume dynamics and smoke dispersion. Past research has covered fire-climate dynamics, fire weather, and wind-related forest disturbance. Goodrick has written more than 100 peer-reviewed publications and conference papers. Before joining the Forest Service, Goodrick spent four years as the fire weather meteorologist for the state of Florida and helped develop the weather and smoke components of its fire management information system. Goodrick received his M.S. and PhD in atmospheric science from the University of Alabama in Huntsville.

CIARAN NUGENT

Ciaran Nugent graduated from University College Dublin with a degree in forestry in 1996, and a master's degree in forest engineering from University College Dublin in 2004. He joined the Forest Service as a district forestry Inspector in 2000 and leads on forest engineering within the Forest Service. Nugent has extensive experience in land management and land-use policy development with a focus on forest infrastructure and forest protection.Since 2010 Nugent has led fire management development in Ireland, including the adaptation of guidance to Irish conditions and development of prescribed burning guidance and improved fire danger rating systems for use in the Irish forestry sector. Nugent is a member of the European Commission Expert Group on Forest Fires. He has participated in several international fire and forest risk management projects including the FRISK/GO Forest Risk Facility and the World Meteorological Organisation (WMO) review of Fire Danger Rating systems. Nugent strongly believes in the role of exchange and networking as enablers of adaptation and practical development in countries and organisations new to fire management challenges. Nugent lives in Tralee, Co. Kerry, Ireland, with his wife Cathy and their three children.

DAVID SHEW

David Shew retired from the California Department of Forestry and Fire Protection (CAL FIRE) in August 2018 as a staff chief for the division of planning and risk analysis in the California Office of the State Fire Marshal. He helped establish electronic data collection programs for pre- and post-fire inspections, land-use planning initiatives, and GIS analysis. He also served as the liaison for the California Strategic Fire Plan and other wildfire regulations with the California Board of Forestry and Fire Protection. Shew spent many years responding to large wildfires and other emergencies across California and served on one of the state's emergency management teams as the public information officer. Prior to Shew's firefighting career, he practiced as a licensed architect, which provided a unique perspective on structure ignitions. When Shew retired, he established Wildfire DefenseWorks, a consulting firm that seeks ways to improve community wildfire resilience and reduce structure loss from wildfires. Shew has provided consultation to insurance companies, communities, and individuals to better understand their wildfire risk analysis. Shew also works part time for the National Fire Protection Association (NFPA) as a wildfire field representative with Firewise USA®, and is on the board of directors for the California Fire Safe Council. Shew remains connected to research efforts seeking solutions to wildfire impacts and has provided many presentations nationally and internationally on this topic. Shew and his family reside in Napa, California.

VIVIEN THOMSON

Vivien Thomson holds a graduate certificate in rural leadership and has other qualifications in horticulture, agriculture, emergency management, coaching and governance. Thomson has been involved in fire fighting for more than 35 years; she began her career as a ranger in the Parks Service in Canberra where she worked her way up to captain. Her roles included working as a sector leader, divisional commander, and incident controller. Thomson ran the training for the Australian Capital Territory (ACT) bushfire service and introduced competency based training; she worked as a fire management officer; and was president of the ACT Fire Controllers Group during and after the devastating fires in 2003 in the ACT. Thomson's passion is mental health for firefighters and other personnel involved in fire fighting. She has written two books: *What You Wouldn't Believe* (a collaborative project) and *Ashes of The Firefighters*, has presented at numerous conferences, and has given evidence at senate inquiries on firefighter mental health. Thomson has been awarded four medals for her work and continues to be involved in mentoring and the senior leadership team, through which she is able to support women through mentoring and education.

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