QUARTER 1, 2024
UNITING THE GLOBAL WILDLAND FIRE COMMUNITY

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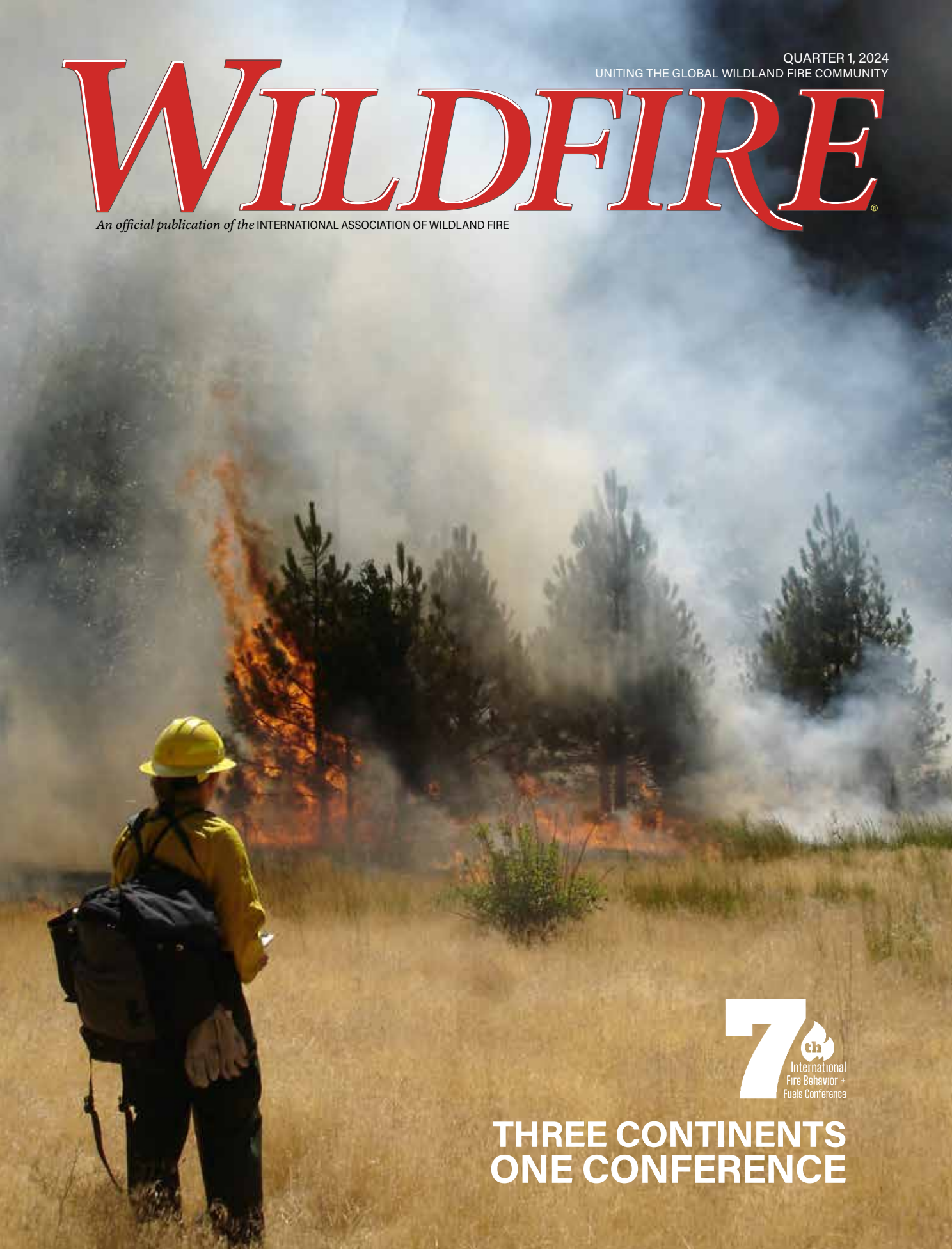
An official publication of the INTERNATIONAL ASSOCIATION OF WILDLAND FIRE



7th International Fire Behavior + Fuels Conference

THREE CONTINENTS ONE CONFERENCE

IAWF NEWS | WIND | SNOW | ECONOMICS | LEADERSHIP

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NEWS AND OPINION

FEATURES

ON THE COVER:
The 7th International Fire Behavior and Fuels conference runs April 15-19 in Australia, the United States, and Ireland. Photo by Kelly Martin.

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INTERNATIONAL PERSPECTIVE

BY LAURA KING

It's a remarkable feat, planning a conference that will run simultaneously on three continents.

The 7th International Fire Behavior and Fuels Conference April 15-19 in Canberra, Boise, and Tralee (pages 24-33) is a global event with dozens of speakers from around the world.

We'll report on the conference(s) in the next issue of *Wildfire* and will bring insight and analysis of the keynote addresses and research presentations.

In the meantime, this issue is one of our most global yet, with in-depth pieces from Chile and Central Kalimantan, Indonesia, along with ground-breaking reports from the United States about snow and wind.

As associate editor Michael Hill writes (page 34), the peatlands of Central Kalimantan are becoming more fire prone, and the region needs international assistance to protect the reserves.

"While these changes in Kalimantan are internal, the funding and support for Indonesia's efforts can come from beyond the region's borders," Hill says. "Indonesia's emerging wildfire issues are global issues due to the potential climate impacts of the massive carbon releases from the peat."

In Chile, efforts have been underway for years to share information and work at a global scale.

As Juan Caamano and Jorge Garcia explain (page 42), with more countries needing international help to manage wildland fires, it's critical that everyone's working from the same guidebook.

"International co-operation should not be based exclusively on sending aerial and / or land resources to the countries that experience wildfires that exceed their response capacity; units that come from different parts of the world must know how to work together in a co-ordinated manner, understanding the needs of local authorities and the scenarios they face, the possible operations to be carried out within the organizational framework, and work procedures of the organization receiving aid – everything that improves and ensures interoperability among responders."

Sharing information is what *Wildfire* magazine does best, and our two research pieces in this issue provide new information.

Susan Dickerson-Lange looks at the effect of snow melt on the popular practice of forest thinning and gap creation to reduce wildfire risk.

"Well-meaning wildfire reduction efforts can unintentionally affect seasonal snowpack . . . by altering the rate and amount of melting that occurs," Dickerson-Lange says.

Using time-lapse cameras and temperature sensors, a research team measured snow storage amounts and snowpack melt rates over three years across a range of elevations and forest densities within the Eastern Cascades. The results are in the story on page 14.

Wind, of course, affects wildland fire in myriad ways.

As Brian Potter, Kara Yedinak, and Joseph Charney write (page 18), "few things can raise more concern on a wildland fire than unexpected or uncertain winds."

At a workshop in May 2023, participants considered concerns, suggestions for possible research projects, opportunities for better or new tool development, and improved educational content about wind for fire management.

Our two regular columnists – Michael DeGrosky, who writes Thoughts on Leadership, and Bequi Livingston, who shares her expertise in our health and wellness section – continue to provide insightful personal reflections that offer knowledge and advice.

DeGrosky's focus in this issue is balance – something for which we all strive but few achieve; his recommendations for a balanced approach to leadership are on page 12.

Livingston's always heartfelt column highlights post-traumatic growth.

"With post-traumatic growth, we change; our lives, beliefs, values, and relationships tend to

deepen, with more authenticity and sincerity," Livingston says. "It's the process of healing through our traumatic stress and grief that we become who we were always meant to be."

Managing editor Laura King is an experienced international journalist who has spent more than 15 years writing and editing fire publications. She is the Canadian director for the National Fire Protection Associaiton (NFPA), works closely with FireSmart™ Canada to help residents build resilience to wildland fire, and has partcipated in the development of the Canadian wildland fire prevention and mitigatgion strategy.

LEARNING FROM OTHERS

BY KELLY MARTIN

It's hard not to notice that counties throughout the world seem to be dealing with unbelievable losses. In 2023: in Canada four firefighters were killed and smoke emissions exceeded the yearly average by almost five times; in Maui, the Lahaina fire killed 100 people; Greece experienced the worst fire season in the last 20 years with a reported 18 people killed; and to start the 2024 fire season, 26 people died in Chile and two people were killed in the largest fire in Texas history.

We have known for some time that we need to think differently about wildfires; now is the time to act. Our collective mindset of requesting more and more resources to suppress all wildfires hoping to achieve a different outcome is limiting our ability to bring in new and novel actions.

There is much discussion in wildland fire circles about the emerging recognition that aggressive wildfire suppression is a contributing factor to increased risks to people, communities, and ecosystems. If we could rewind the clock 100 years or more, we would be living in an environment where fire was just as ubiquitous as droughts, floods, hurricanes, and tornados. Indigenous people learned to live with and adapt to these natural events. Once we walked out of this natural balance, the concept of fire suppression in perpetuity became inextricably linked to requiring more and more funding and resources to suppress more and more wildfires. Now, ever increasing severe wildfires are causing loss of life, property, biodiversity, cultural use of fire, carbon capture and storage.

Integrating wildfire suppression with other known vital prevention and mitigation efforts is proving to be a path forward with a long view to reducing loss of life and propropery and critical resource values. Our future depends on our ability to tip the scale in favor of a more holistic approach to wildfires, which puts more focus on pre-fire and post-fire planning and mitigation. We have little time to waste.

A critical report completed in the United States in 2023, the Wildland Fire Mitigation and Management Commission report, was presented to the US Congress and released to the public as a proactive approach to managing wildland fires. I encourage you to download the report to link opportunities unique to your work and your community (https://www.usda.gov/topics/disaster-resource-center/wildland-fire/

If we could rewind the clock 100 years or more, we would be living in an environment where fire was just as ubiquitous as droughts, floods, hurricanes, and tornados.

commission). Recommendations identified in the report might also apply to broader opportunities in many other countries. Central to the report is reframing our ability to know and understand how to live with fire.

Every year the IAWF hosts international conferences for members to share, learn and renew and form new networks of people working in similar spaces. Our upcoming Fire Behavior and Fuels Conference (page 24), which educates the public and stakeholders about the role of fire in ecosystems and responsible fire practices, is crucial for implementing successful fire management principles. This year the conference runs April 15-19 on three continents: in Tralee, Ireland; Canberra, Australia; and Boise, Idaho, in the United States. I encourage all of you to check out the rich agendas of topics and presenters and maybe we will see you this spring. (www.iawfonline.org and click on events / conferences).

I appreciate this opportunity to thank all the previous presidents of IAWF and each one of you for allowing me this opportunity to serve you and our international communities as the president of the International Association of Wildland Fire for 2024. And thank you to past president Joaquin Ramirez for his outstanding leadership these last two years. For the last six years I have been an active IAWF board member, the last two years as a primary representative on the Wildland Fire Mitigation and Management Commission. This last year my travels have taken me to South Africa for our first ever Women in Fire Training Exchange, and I've recently returned from the Women's Training Exchange in Portugal where we hosted women from 21 counties. I have much to learn from other counties in how they view and implement integrated fire management. These amazing experiences since retiring from my federal firefighting career in 2019 have given me a unique perspective that I longed for during the better part of my adult life. I am excited about the prospects of sharing much of what I have learned and continue to learn and grow with all of you during my term as president this year.

Kelly Martin has been an IAWF board member since 2019, when she retired as chief of fire and aviation, Yosemite National Park, National Park Service, Pacific West Region. Martin began her federal career as a GS-3 with the Apostle Island National Lakeshore in 1984 while attending college and worked her way up through the wildland fire ranks during her 34-year career. Martin is the past chair of two National Wildfire Coordinating Group (NWCG) programs: Fire Environment Committee (FENC) and the National Fire Management Leadership (M-582) course. Martin is a strong advocate for diversity, inclusion and gender parity throughout the wildland fire community. Her most recent efforts include providing leadership for the Women in Fire Training Exchange (WTREX) since 2016.

UNDERSTANDING POST-TRAUMATIC GROWTH

BY BEQUI LIVINGSTON

Have you ever experienced a time when you didn't think things would ever change, that your pain would never end – losing a loved one, or being involved in a challenging wildfire incident – events that shake you to the core? You can't seem to find your way out, until you do. I love the quote from Jurassic Park, that sums it up so well, "Life always finds a way."

One of the challenging aspects of dealing with traumatic stress and grief is that you never feel as though it will end, especially when it's chronic and cumulative. You live in a continuous cascade of stress hormones, keeping you stuck in a state of survival stress; it can feel like an endless abyss at the bottom of the ocean where no light is visible, and you feel as though your life will always be this way.

For many of us, especially those who endured adverse childhood experiences, this abyss can seem darker because it normalizes what life was like growing up – all these emotions and memories that have been stored in our nervous systems and bodies for years, waiting for us to have the wherewithal to feel them. And when we do – WHAM – it's like that last Jenga block being pulled from our foundation, as we crumple to the ground in a clump of messy ash, this firestorm of emotions and feelings catching us off guard, coming with such a vengeance that we don't think we will ever find our way out. We're plummeted, time and time again, into this abyss of traumatic stress and complicated grief, our Jenga block foundation no longer intact.

Equate this to being on a wildfire, where our headlamps show us the way forward in the dark; when they don't work, we rely on our comrades shining their headlamps, helping us find the path. It's the same when dealing with traumatic stress

SMOKEY BEAR IS MY DEFINITION OF RESILIENCE AND POST-TRAUMATIC GROWTH, MOVING FORWARD TO BE THE EMBLEM FOR WILDLAND FIRE PREVENTION WHILE LIVING A HEALTHY, AND PRODUCTIVE LIFE.

and grief; even though our headlamp may not be working properly, and all we can see is the abyss, we rely on others to support us, to walk alongside us, until our headlamp works again. Through this foraging on the dark path, we begin to slowly move forward, and backward, an oscillating dance of healing and recovery that is so common among wildland firefighters.

Yet it's this dance that propels us forward, even when it seems pointless. It's this dance that keeps us looking for the headlamps, even on the darkest nights. And it's this dance of resilience that eventually brings us to a place of post-traumatic growth and healing.

In her book The *Post Traumatic Growth Handbook,* Dr. Arielle Schwartz says, "You have the capacity to be resilient and courageous in the face of difficult life events. You can cultivate a meaningful, purposeful life."

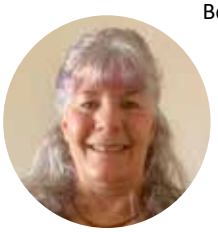
Learning more about post-traumatic growth helps to understand how it applies to adversity in the field of wildland fire. Post-traumatic growth refers to the creation or development of positive changes in individuals after they've experienced highly stressful life events. In wildland fire fighting, every incident is a stressful life event. We see destruction by Earth's fury, yet, Mother Nature always bounces back with so much resilience, and post-traumatic growth. For a minute, maybe you can recall a catastrophic wildfire event that you experienced? Remember how nature bounced back with amazing resilience and post-traumatic growth. "Life always finds a way."

I often think of Smokey Bear when I'm searching for meaning in my pain. Smokey was a young, injured, and orphaned cub found clutching a tree during a large wildfire in the Capitan Mountains in southern New Mexico. His mother had been killed by the wildfire, leaving him to fend for himself until he was rescued by fire crews. Smokey Bear is my definition of resilience and post-traumatic growth, moving forward to be the emblem for wildland fire prevention while living a healthy, and productive life. I have pictures of young Smokey as an injured and orphaned cub sitting on the wing of the small plane that would eventually carry him to safety, ending up in the National Zoo in Washington, D.C. Those photos are reminders that post-traumatic growth and resilience are always possible after traumatic life events. Smokey Bear is the emblem of post-traumatic growth in our wildland world, and how timely, with Smokey Bear's 80th birthday coming up on Aug. 9.

Post-traumatic growth and resilience have similarities but are different. Resilience is the process of adapting in the face of challenging events, whereas post-traumatic growth refers to the positive changes that occur because of challenging events. With post-traumatic growth, we change; our lives, beliefs, values, and relationships tend to deepen, with more authenticity and sincerity. It's the process of healing through our traumatic stress and grief that we become who we were always meant to be. Like Smokey tell us, "Only YOU!"

Only you can remember that resilience and post-traumatic growth will continue as you unwind and unravel your traumatic stress and grief. Only you can find the healing modalities and people to shine their headlamps on our path as you heal. Only you can be reminded that there is always hope in our healing through post-traumatic growth. Only you can be you. Smokey Bear reminds us of that.

One opportunity that might be of interest is a women's healing retreat for first responders April 18-21 at Healing Americas Heroes in southern New Mexico. This is a great opportunity to practice self-care and post-traumatic growth while learning tips and tools that will help to become more resilient. Space is limited and more information can be found at https://bodysensewellness.org/finding-calm-in-chaos/healing-retreats.



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 Specialty for the U.S. Forest Service in Albuquerque, New Mexico. Contact her at bequilivingstonfirefit@mns.com

IAWF WELCOMES NEW BOARD MEMBERS

KELLY MARTIN BECOMES PRESIDENT

Kelly Martin has been an IAWF board member since 2019; she retired in 2019 as chief of fire and aviation, Yosemite National Park, National Park Service, Pacific West Region.

Kelly graduated from Northland College in Ashland, Wisconsin, with bachelor's degrees in outdoor education in 1986 and technical fire management in 1996. Kelly began her federal career as a GS-3 with the Apostle Island National Lakeshore in 1984 while attending college and worked her way up through the wildland fire ranks during her 34-year career.

Her federal wildland fire career spans the National Park Service and the US Forest Service, having worked in six states. She has worked on helicopter modules as an assistant foreman and manager; Redding Hotshot crew in 1991; fuels and prescribed fire crews as a type 1 complex burn boss, fire behavior analyst on type 1 and type 2 teams since 2006; operations section chief and operations branch director since 2014; and held several career leadership positions as a fire management officer (Moab, Utah; Carson City, Nevada; Placerville and Yosemite, California) on complex fire units since 1996.

Kelly is the past chair of two National Wildfire Coordinating Group (NWCG) programs: Fire Environment Committee (FENC) and the National Fire Management Leadership (M-582) course. Kelly maintains a diverse skill set as a field practitioner in prescribed fire and wildfire management focusing on increasing the wise use of applied fire on large fire-adapted ecosystems for forest health and resiliency especially due to drought, tree mortality and climate change.

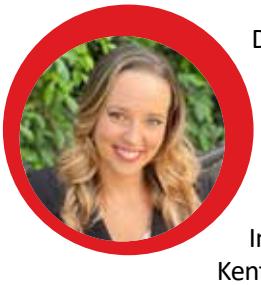
Kelly is a strong advocate for diversity, inclusion and gender parity throughout the wildland fire community. Her most recent efforts include providing leadership for the Women in Fire Training Exchange (WTREX) since 2016; WTREX is a highly successful grassroots program that promotes practical wildland fire skills and networking opportunities for women and men.

Claire Lötter has been the CEO of the Volunteer Wildfire Services NPC, the largest non-profit wildfire firefighting organisation in Southern Africa, since 2021. She completed her MBA in New Mexico after having completed degrees in cost accounting and business administration and, more recently, an applied directorship program.

Claire is recognised for her adept leadership in streamlining and growing predominantly engineering-based organisations and, more recently, turning her skills to the non-profit domain.

Her professional journey has been marked by pioneering efforts, which have served her well in the realm of wildland fire fighting, reflecting a keen commitment to environmental conservation.

As the CEO, Claire has solidified the VWS as the most distinguished firefighting organisation recognised within the non-profit sector. As a privately funded non-profit with more than 350 volunteers spread across four strategically situated bases throughout the Western Cape and growing, Claire is the anchor to aligning the VWS services with strategic partners, which includes the Provincial Disaster Management Centre.



Dr. Amber Lynn Scott is an assistant professor of organizational communication in the Department of Communication, College of Communication and Information at University of Kentucky. She studies organizational communication, group communication and high reliability organizations and teams.

Prior to joining academia, Amber Lynn had a diverse career in media and public relations and served as an active-duty public affairs officer in the U.S. Navy.

Her recent publications have appeared in *Small Group Research, Management Communication Quarterly, Communication Teacher, and Communication, Culture and Critique.*

Dr. Tamara Wall is a research professor at the Desert Research Institute in Reno, Nevada, the co-lead of the Climate Center Group at DRI, and is the lead principle investigator for the California Nevada Adaptation Program (part of the national NOAA-sponsored Climate Adaptation Partnerships/Regional Integrated Sciences and Assessments network).

Tamara has worked extensively with stakeholders in California, Nevada, and other regions of the west in co-produced climate science projects for 12 years.

Her research focuses on qualitative and quantitative social science research in climate information use by stakeholders, understanding the process of climate information dissemination and utilization for climate resiliency and adaptation in natural resource management agencies, and public and agency use of fire weather forecasts and fire behavior/fire danger information.

Tamara has extensive expertise and training in organizational development, facilitation, graphic recording, workshop and meeting design.

Recent work has focused on developing expertise in applying change theory to better support mixed research/practitioner teams address the evolving dynamics among research, social processes, and climate change adaptation actions.

BALANCING ACT

BY MICHAEL DEGROSKY

I subscribe to some online leadership forums, mostly on the LinkedIn platform. There's some very good content and I encounter interesting and valuable thinking there often. There's also a fair amount of silliness; people trying to promote a business, sell a book, or otherwise make a mark, making questionable assertions about what leadership is or is not, what it takes to be a great leader, and so on without much, if any evidence to back up their claims.

Common themes that I find troubling include advocating leading with compassion or strength; needing leadership or management; being the boss or being a leader; valuing education or experience – as if any of these represent mutually exclusive concepts. Understanding leaders and leadership is not about creating contrasts but about exploring balance. In my experience, truly effective leaders have a strong sense of purpose and mission, understand the fundamental truth that all leadership is both situational and contextual, are adaptive, take care of both their people and themselves, disperse leadership and, importantly, achieve balance between providing power and empowering others.

Yes, balance. I have rarely seen hard chargers who are short on compassion succeed long term. In contrast, my experience with very compassionate leaders who are weak on purpose and mission is that they can make people feel warm and fuzzy, but rarely do they serve organizations well. In most contemporary organizations the same people hold positions of authority and are responsible for inspiring and influencing other people with soft power; they are both boss and leader.

Yet, spend even a small amount of time in online leadership discussion forums and you will see would-be influencers confidently getting this reality quite wrong, describing their very positive conception of a leader by contrasting it to their very negative characterization of a boss. This is, of course, a false dichotomy. Neither "boss" or "leader" are descriptions of a kind or quality of person or one's performance; both are roles people play in organizations and both roles are necessary. In many – I would hazard most – contemporary organizations the same people perform both roles simultaneously. One can be a good person or a bad person in either capacity. There are bosses (people who hold positions of authority in organizations) who manage with humility, collaboration and compassion and leaders who are arrogant authoritarians.

One can trace most of the less-than-helpful contrasts, such as between compassionate people-centric leaders and decisiveness or between bosses and leaders, to popular leadership influencers and authors and an insatiable drive to satisfy audiences who like leaders and leadership boiled down into simple, easily digested soundbites and memes. Those simplifications often play on peoples' frustrations with their corporate lives, and that makes them popular and, I assume, lucrative. As a student of leadership who's really interested only in evidence-based practices, what surprises, and often disappoints, me is the engagement that ensues on

I HAVE CONCLUDED THAT MANY CONTEMPORARY LEADERS MAY NOT UNDERSTAND, OR AT LEAST CANNOT ACTUALIZE, WELL-BALANCED LEADERSHIP.

the discussion boards with enthusiastic validation for what are little more than opinions with little, if any, empirical support.

I think people working in wildland fire skew to pragmatism and have little time for "a boss is a bad person and a leader is a good person" triviality in their leadership development journeys. Fire people are on the front lines of climate disruption, protecting communities and helping them adapt, restoring fire to landscapes, often managing in high-risk environments and / or at a high operating tempo, and, given those experiences, many wildfire folks intrinsically understand the balance that effective leadership requires.

From what I have seen in leadership discussion forums, I have concluded that many contemporary leaders may not understand, or at least cannot actualize, well-balanced leadership. I think we should view the popular, corporatized leadership thinking creeping into agencies with fire protection and fire management responsibilities with healthy skepticism. By leaning only into leadership models with strong research support, our agencies will favor leadership embodying a balance of purpose and mission, adaptability, person-centricity, and dispersed responsibility; in other words, balance, because that's what the research supports.

Equally important will be an even-handed approach to how agency leaders, as well as those endeavoring to influence agency leaders and their funders, advocate solutions and use their influence. We are confronting enormous, complex problems across many wildly diverse ecosystems and a bewildering array of governments, politics, land ownership, organizations, systems, land management objectives, and other variables. In the face of climate change, the challenges will only become bigger, more complex, and more widespread with time. The stakes will be high and it seems there will never be enough resources. As agency leaders confront these challenges, I hope to see them – and fuels and fire advocates – balance not only how they lead but what they lead. I am sometimes disheartened when I hear influential voices offering what sounds like parochial, universal solutions to problems that are as varied as the landscapes on which they occur and the communities that are at risk. To that end, effective leadership on these enormous challenges lies not in creating contrasts and competition among solutions; prescribed fire *or* fire suppression, community adaptation *or* fire prevention, Indigenous knowledge *or* that of non-natives. Success will lie in the thoughtful integration of all these approaches and achieving sensible, sustainable balance that produces results.

Mike DeGrosky is a student of leadership, lifelong learner, mentor and coach, sometimes writer, and recovering fire chief. He taught for the Department of Leadership Studies at Fort Hays State University for 10 years. Follow Mike via LinkedIn.

IS WILDFIRE RISK REDUCTION DAMAGING THE WATER SUPPLY?

MELDING FOREST MANAGEMENT PRACTICES WITH HEALTHY SNOWPACK MELT

BY SUSAN DICKERSON-LANGE

Forest thinning and gap creation are proven tools for reducing wildfire risk. As the climate warms, this practice is growing more common in the United States, particularly in the west. According to the National Interagency Coordination Center (NICC), in the 13 westernmost states, more than 20,000 wildfires burned approximately 5.8 million acres (2.3 million hectares) in 2022 alone.

Well-meaning wildfire reduction efforts can unintentionally affect seasonal snowpack, however, by altering the rate and amount of melting that occurs. This is driving research in the Eastern Cascades region of Washington state to study these impacts and seek solutions that reduce wildfire risk without negatively impacting the snowpack that provides summer soil moisture to forests and feeds lower-elevation water systems in warmer months.

WILDFIRE REDUCTION AND SNOWPACK RELATIONSHIP

Forest thinning and gap creation are designed to improve overall forest health by reducing the risk of wildfires, promoting biodiversity and enhancing the growth and quality of the remaining trees. Forest thinning involves selectively removing trees or vegetation, while gap creation deliberately produces openings in the forest canopy.

These forest-management strategies are generally approved of by a wide spectrum of stakeholders, including environmentalists, government agencies and fire prevention experts.

The effect that these forest management techniques have on the volume and timing of snowpack melt is less studied and understood; this is important because snowpack plays a crucial role in regulating water supply in many regions, especially in mountainous areas. The snowpack serves as a natural reservoir that provides water

Temperature sensors ready to be deployed to measure snow presence by recording ground temperature.

Timelapse camera deployed in a tree to measure snow depth at a three-hour timestep.

Susan Dickerson-Lange checks camera data during the snowmelt season at Snoqualmie Pass, Washington.

supply for forests, agriculture, fish, drinking water and hydropower generation during the spring and summer months.

The forest canopy acts as a sort of umbrella, dictating how much snow reaches the ground, and the amount and frequency of sunlight that shines on the snow. As a result, forest-management techniques that decrease the number of trees and create gaps in the canopy could change the volume of melting snow that flows to lower elevations, as well as the timing of water delivery. With so much depending on a reliable, plentiful snowpack runoff, and the warming climate projected to reduce the Eastern Cascades' snowpack by 50 percent over the next seven decades, understanding the relationship between forest management and snow melt becomes critical to building climate change resilience.

This is the basis of a recent three-year study conducted by researchers from science and engineering firm Natural Systems Design + Coastal Geologic Services, along with The Nature Conservancy and the University of Washington. The study's results are informing forest-management planning efforts under development by the Washington State Department of Natural Resources.

METHODOLOGY, RESULTS AND CONCLUSIONS

Snow research in different regions of the American West, including maritime sites in Western Washington and Oregon, and sites in the Intermountain West such as Utah, Colorado and New Mexico, report varying levels of snowpack duration and melt acceleration in response to forest-thinning or harvest. Because the Eastern Cascades region represents a transitional zone between maritime and continental climate conditions, this study fills a data gap in characterizing the relationship between forest density and snowpack.

Using time-lapse cameras and temperature sensors, the research team measured snow storage amounts and snowpack melt rates over three years across a range of elevations and forest densities within the Eastern Cascades.

The study's findings demonstrate that forest-snow relations in this transitional climate zone are a blend of the observed effects in the maritime climate zone to the west and the continental climate zone to the east. The results suggest that forest thinning intended to improve forest health and wildfire risk is unlikely to exacerbate the hydrologic impacts of

Example of a time lapse photograph in the Cle Elum River watershed, Washington; note three measurement poles visible in the frame.

Recently burned forest in the Entiat River watershed, Washington, where snow data were collected for the study.

Setting up remote instruments in a recently burned forest in the Cle Elum River watershed, Washington.

climate change. However, reducing forest density in this climate zone via thinning or canopy-gap creation may increase overall water balance (i.e., water quantity) to some degree, but has a lesser effect on the timing of water availability.

A key exception was recorded at one lower-elevation, north-facing site where snow storage duration was substantially longer in the forest gap compared to the nearby dense forest. This indicates that the aspect, or topographic direction, that a snowpack location is facing may be a primary driver of how forest thinning influences snow storage magnitude and duration in the transitional climate zone.

In light of these findings, forest thinning and canopy gap creation in north-facing forests may offer the best opportunity for extending snow storage duration and influencing the timing of water availability when implementing forest-management strategies in the Eastern Cascades and similar transitional zones. Collaboration is ongoing with the University of Washington and The Nature Conservancy to further test this idea and extend results to higher elevation forests, and with the Washington State Department of Natural Resources to consider applications of this study.

Susan Dickerson-Lange, PhD, PHG, is principal hydrologist with Natural Systems Design and Coastal Geologic Services (NSD + CGS), a firm with three offices in Washington state that provides river, coastal and basin science, and engineering services. Dickerson-Lange is particularly interested in understanding and quantifying anthropogenic impacts to watersheds and evaluating strategies for restoration and adaptation, and she is the lead author on several publications related to climate change, forest hydrology and geomorphology.

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MEASURING WIND

CREATING NEW MODELS TO GAUGE IMPACT ON WILDFIRE

BY BRIAN POTTER, KARA YEDINAK, AND JOSEPH CHARNEY

Few things can raise more concern on a wildland fire than unexpected or uncertain winds. Wind is a primary driver of fire spread in wildland fires, whether wildfires or prescribed burns. Unanticipated fire spread or spotting can result from unexpected changes in wind speed or direction, a change in the timing of a predicted shift, or unexpected variability in wind speed and direction along an active fire front.

Wind played a key role in the escape of the Las Dispensas prescribed burn in New Mexico, which became the Hermits' Peak fire in early 2022. In response to that escape, the US Forest Service conducted a review of its prescribed burning practices. Wind came up often in discussions by the review teams and featured in several recommendations in the final report. These discussions prompted questions about how wind is measured and modeled, and how scientists and operational meteorologists communicate that information to prescribed fire practitioners. Similar questions have been raised by fire behavior analysts and meteorologists working on wildfires.

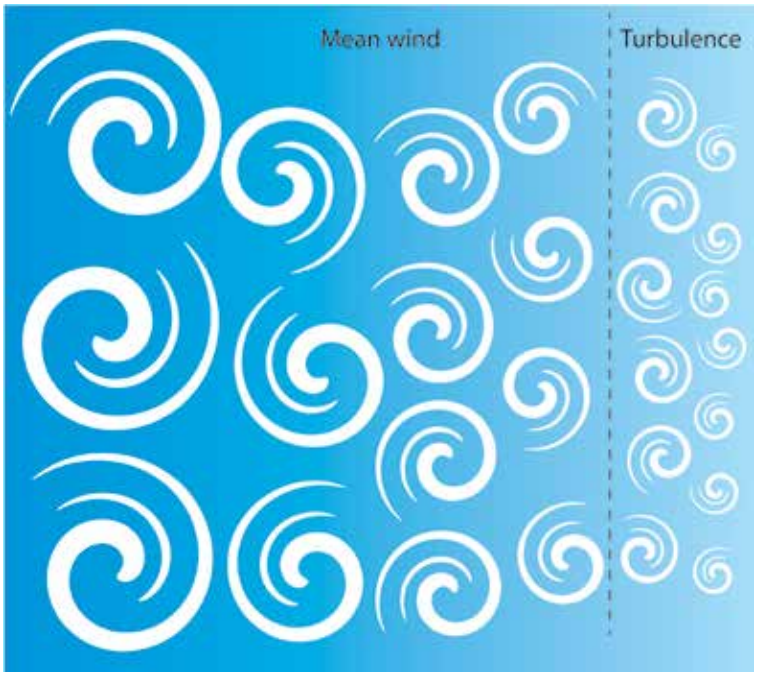
In May 2023, in Minneapolis, Minnesota, there was an informal workshop on wind measurement and modeling for wildland fire. Attendees included research meteorologists, operational forecasters from the National Weather Service and National Predictive Services, and academic meteorologists.

The workshop's goal was to begin exploring:

- how we measure wind for fire
- how we model the impact of wind on fire
- how to interpret numerically modeled winds in the context of fire and observed winds
- whether current practices adequately meet the needs of fire practitioners, for both prescribed fires and wildfires
- whether those practices could be improved, even if they meet current needs.

What follows are examples of concerns raised during the workshop, suggestions for possible research projects, opportunities for better or new tool development, and improved educational content about wind for fire management. The ideas and examples range from the rather philosophical to the highly pragmatic. Because of the nature of the discussions, no idea came from one specific person, and we consider the examples to be community brainchildren. We use "fire management" to refer to both prescribed fire and wildfire situations. If a point applies only to one, we will note that. References to tools and systems are U.S.-centric, but the concepts are intended to apply globally.

OPERATIONAL ANALYSTS AND RESEARCH SCIENTISTS SPEND A GREAT DEAL OF EFFORT IMPROVING FIRE BEHAVIOR MODELS. YET THOSE IMPROVEMENTS ARE LESS EFFECTIVE IF THE WIND INFORMATION THEY RELY ON IS UNREPRESENTATIVE OR POORLY DEFINED.



How we choose to measure and report wind speed determines what is "mean wind" and what counts as turbulence or gusts. Photo credit: © lukeruk / Adobe Stock

SCALES OF TIME AND SPACE, TURBULENCE VERSUS MEAN

Louis Fry Richardson, the physicist behind the Richardson Number, wrote: "Big whirls have little whirls, that feed on their velocity. And little whirls have lesser whirls, and so on to viscosity."

All wind is a whirl of air on some scale. We can characterize whirls of different scales by averaging wind measurements over a specific time period. A long period average is more representative of larger, longer duration whirls, and the longer the averaging period, the less it reflects the smaller whirls. However, the variability of the winds around that mean reflects the smaller whirls. Hence, the period of averaging determines what constitutes mean wind, and the variability we call turbulence or gustiness. To the best of the knowledge of those at the workshop, current meteorological practices for averaging periods are based on historic maritime, modern aviation needs, and instrument design limitations.

The choice of averaging period is critical, but it's not something often considered or discussed. Both the mean wind and the turbulence are important, but in different ways. If the averaging period is very short, the average wind will change quickly, perhaps too quickly for actual use of the information. Fire crews cannot change plans every five minutes based on new wind estimates – even the volume of that information would be detrimental. If the averaging period is very long, it may fail to capture changes (such as gusts or shifts in direction) occurring on time scales that matter for managers. Once-a-day wind values, for example, would be useless and uninformative for most management decisions. For fire applications, the averaging period should reflect the time and space scales of physical fire processes and fire management activities. Exploring the question of the "right" scales for averaging for fire management decisions is one area for research.

MEASURING WIND

The question, "How do we measure the wind?" is guided by those scale considerations. Even within the scope of fire management, different measures are appropriate for aviation, surface fire spread, canopy spread, spotting distance, and smoke dispersion. Considering only surface fire spread, to illustrate further, several factors matter: height of measurement; sampling period; sampling frequency; gust characterization; and perhaps others. Remote Automated Weather Stations (RAWS) report a 10-minute average of six-second samples and a gust speed based on the maximum six-second sample from the previous hour. That convention is based on the limitations of decades-old anemometer designs,

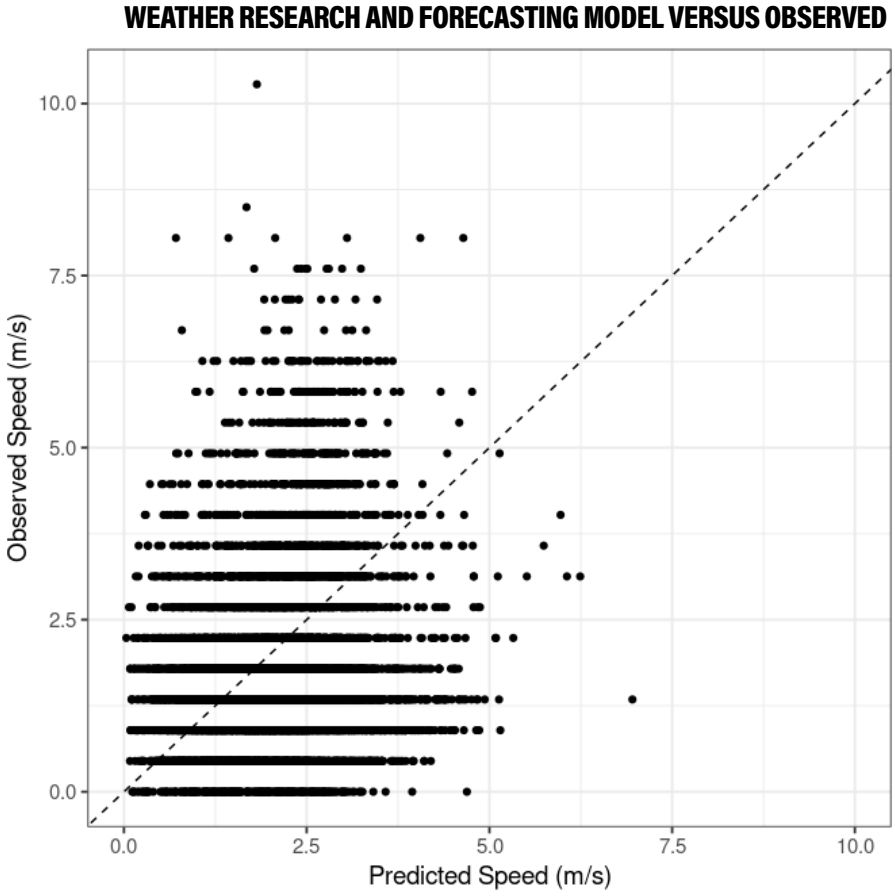


Figure 1
Observed wind speed from the First Butte Remote Automated Weather Station in Washington state plotted with the University of Washington's four-kilometer grid daily weather forecast wind speed for that location. Data are shown for all hourly observations and forecasts in April and May, 2016-2020.

Image credit: Natalie Wagenbrenner, US Forest Service

and there are numerous new instruments available that could be more helpful for fire management, such as sonic anemometers.

If this wind information will be used in a fire spread model (such as BEHAVE), we should ask if 10 minutes is the best averaging period to represent a quasi-steady state wind to drive that spread. Does the appropriate averaging period differ for simpler, single-layer fuels like grass, versus multi-layer, heavier fuels like a forest with an understory and a separate canopy? How long does a lofted ember get carried by the wind, and is it closer to the gust period or the averaging period? Overall, can one mean wind speed and direction, and one gust speed answer all these questions to the needed level of accuracy? Are there better ways to represent wind, besides a mean and a measure of gust speed? How large an area can reliably be represented by one observation location, and what factors determine that?

WIND-BASED FIRE QUESTIONS AND CALCULATIONS

Logically, many fire behavior tools rely on wind speed and direction as input variables. All the Rothermel-based tools, such as BEHAVE, FARSITE, and FSPro rely on wind speed to compute rate of spread and sometimes spotting distance. The wind used for rate of spread can be eye-level, 20 feet, or 10 meters above-ground, any of which are supposed to be adjusted to midflame height. The physical spotting process and any spotting computations depend on wind speed at and above the height from which the ember was released, often considered canopy height, where winds would affect ember transport. Some of these tools only use mean wind for their computations, but practitioners sometimes apply estimated gust speeds, to assess what could happen under those conditions.

Using these tools often requires the analyst to apply a more or less ad hoc wind adjustment factor (WAF). WAFs convert a measured or forecast wind at some height to an estimated midflame wind speed for fire spread models; they represent the effects of differences in height between midflame height and an observation or model forecast height, the influence of vegetative structure, and the role of terrain sheltering. Most common WAFs are

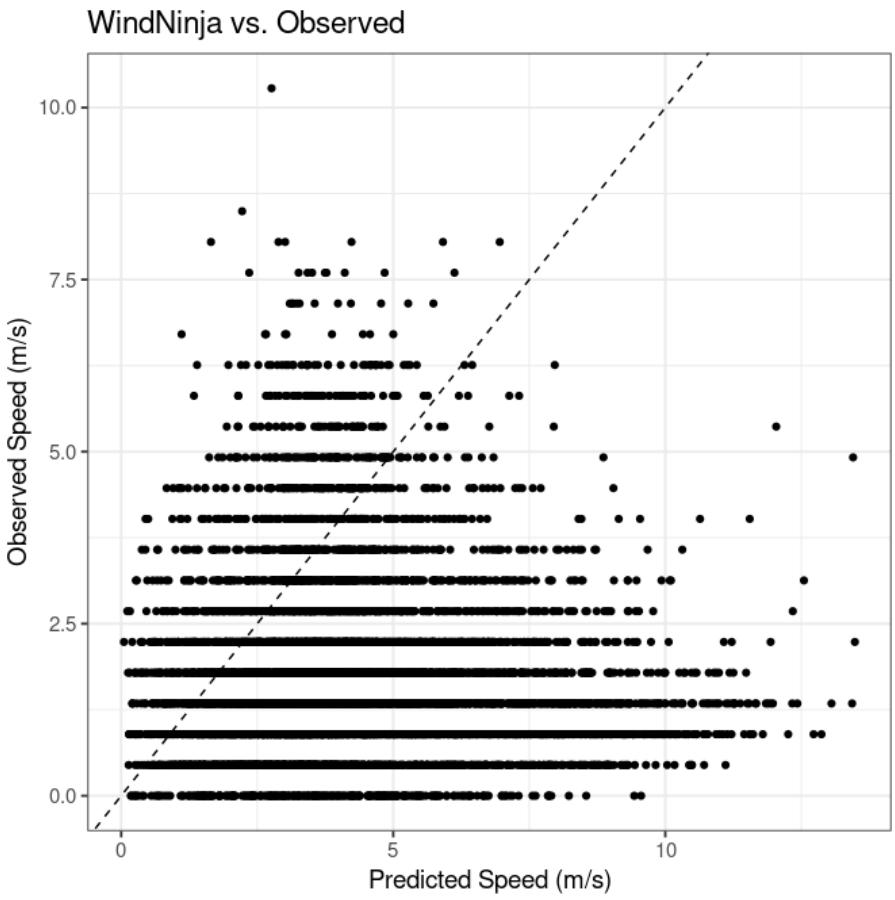


Figure 2
Observed wind speed from the First Butte Remote Automated Weather Station in Washington state plotted with WindNinja downscaled wind speed for that location, based on the University of Washington forecast data in the previous plot. Data are shown for all hourly observations and forecasts in April and May, 2016-2020.

Image credit:
Natalie Wagenbrenner,
US Forest Service

between 0.2 and 0.6, with single-digit precision. Does wind need to be any more precise? What are the consequences if a user selects 0.4 but a value of 0.5 would have been equally or more valid?

We have framed these questions in the context of existing tools and mental models of wind-fire interactions. There are many new tools being developed, or that could be developed, if we build newer mental models. Those models need to be consistent with the time and space scales of fire management and fire physics, as noted earlier. And sampling intervals for observations to feed these tools must be consistent with those scales, processes, and needs. The tools can also exploit the significant advances in technology that have occurred since the existing tools and models were first developed.

MODELING WIND

Most weather forecast models operate on a grid, with a fixed spacing between the center of the grid boxes. This spacing can be anywhere from about 0.5 miles to 30 miles (1 km to 50 km), depending on the model. The wind speed and direction at any location and forecast time are, in simplistic terms, the values necessary to conserve mass and momentum in that cell and among its neighbors. They are essentially averages over the entire volume of that cell at a given moment in time.

As such, they are not always representative of the wind at a given point within that cell (Figure 1) at a given instant. Because of cell size, model wind speed and direction change much more slowly over a few seconds or minutes than do observed wind speed and direction at any point in the cell. Downscaling – finding a reliable or robust conversion relationship between a cell and a point – is not straightforward.

Comparing a collection of synchronous values from the cell and the point can sometimes provide a statistical relationship, but as illustrated in Figure 1, that isn't always successful. Some downscaling methods, like WindNinja, seek to use faster, simplified versions of the same physical laws used in more complex weather forecast models but they are not always successful at this either (Figure 2).

Operational analysts and research scientists spend a great deal of effort improving fire behavior models. Yet those improvements are less effective if the wind information they rely on is unrepresentative or poorly defined. Fire and smoke applications are sensitive to wind variations on spatial and temporal scales that are not always represented well by conventions developed to support maritime or aviation needs or dictated by instrument design and limitations.

Some fire behavior analysts and operational meteorologists are already aware of one or more of the issues outlined above; they have work-around solutions that only they know, which improve upon the standard systems. Other fire practitioners may have no idea how weakly wind forecasts or observations relate to what they will actually see on a prescribed fire or wildfire.

While we can never eliminate the need to interpret modeled winds as they relate to the real world, and we will certainly never replace direct personal experience, there are definitely areas in which research can decrease the amount of guesswork needed to render wind forecasts useful for fire management. We can also improve how we teach students of fire about wind forecasts and observations. There is a clear opportunity to reframe wind more suitably for wildland fire concerns and to use modern technology and computational resources to optimize what models and tools we make.

Revisiting definitions of wind and gusts with fire and smoke in mind will help clear the path toward future advances and successes. Hopefully, the thoughts presented here will spark conversations among practitioners and scientists about wind, and perhaps some new ideas or tools to fill in these knowledge gaps.

WORKSHOP PARTICIPANTS

The participants at the Minneapolis workshop included the authors and the following: Andrew M. Chiodi, Cooperative Institute for Climate and Ecosystem Studies, University of Washington, and National Oceanographic and Atmospheric Administration, Pacific Marine Environmental Laboratory, Seattle, WA.; IAWF board member Scott Goodrick, USDA Forest Service, Southern Research Station, Athens, Georgia; Mike Griesinger, National Weather Service Forecast Office, Chanhassen, Minnesota; Nick Nauslar, fire science and operations officer at the NOAA/NWS Storm Prediction Center, National Weather Service, Boise, Idaho; Christoper Rodell, University of British Columbia, Vancouver; Julia Ruthford, USDA Forest Service Fire and Aviation Management Northern California Coordination Center, Redding; Alan Srock, St Cloud State University, St. Cloud, Minnesota; Natalie Wagenbrenner, USDA Forest Service, Rocky Mountain Research Station.

Brian Potter is a research meteorologist with the US Forest Service, studying fire-atmosphere interactions for the US Forest Service since 1994. He serves on the National Wildfire Coordinating Group's Fire Weather Subcommittee, the Interagency Wildfire Air Quality Program's Air Resource Advisor Teaching Cadre, and the Pacific Northwest Region's Teaching Cadre for Advanced Fire Behavior Calculations. Potter was a member of the USDA Forest Service National Prescribed Fire Program Review team. His past research has focused on atmospheric processes associated with wildfire growth, and his current research continues that, but focuses increasingly on weather needs for safe and successful prescribed burning.

Kara Yedinak has been a materials research engineer with the USDA Forest Service since 2018. Yedinak has a background in physics and engineering science, and an interest in investigating the fundamentals of fire science across a wide range of applications. She works in the field, as well as in the laboratory. Yedinak's research interests include fire acoustics, fire-vegetation-atmosphere interactions from millimeters up to hundreds of kilometers, plant and soil response to wildland fire, the application of chaos theory to fire propagation, and community-scale fire science in the wildland urban interface.

Joseph Charney has been a research meteorologist with the USDA Forest Service since 2001. As a research scientist, Charney uses numerical weather prediction models to study how weather conditions affect fire activity and smoke dispersion and investigates fire-atmosphere interactions at scales ranging from a few meters up to thousands of kilometers. Charney has served on the Fire Weather Subcommittee of the National Wildfire Coordinating Group (NWCG), and currently serves as executive secretary for the Interagency Council for Advancing Meteorological Services (ICAMS) Working Group on Fire Weather.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FUEL, FIRE AND SMOKE:
EVOLVING TO MEET OUR CLIMATE CHALLENGE

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CANBERRA, AUSTRALIA

BY TREVOR HOWARD

The 7th International Fire Behaviour and Fuels Conference to be presented by the IAWF in Canberra from 15-19 April is just around the corner, and what better place to explore the conference theme, Fuel, fire and smoke: evolving to meet our climate challenge?

Indigenous people were the first stewards of that country which they managed sustainably for thousands of years by judiciously applying fire. In more recent times, fire science has flourished in Canberra since the pioneering work on fire behavior by the late Alan McArthur and others. Bushfires have also left their mark on the city, community and country with losses and lessons from 2002 still relevant and talked about today. The Canberra conference provides an opportunity to reflect on the past, share new knowledge and insights, and envision a better future.

The event will bring together an impressive lineup of keynote speakers covering fire and climate change, wildlife ecology and conservation, and the management of forests and rangelands.

Keynote speakers: Dr. Dean Yibarbuk, a senior traditional owner from northern Australia, sharing experience and wisdom from places where Indigenous and western knowledge are coming together in managing country, maintaining culture and language, and supporting communities and livelihoods through the carbon economy.

Dr. Dan Pronk, a veteran medical doctor with a military special operations background, who will provide valuable insights into improving firefighter wellbeing and resilience to better prepare fire practitioners and managers for thriving in a more complex, dynamic, and challenging environment.

A live stream from the Boise, Idaho, Fire Behavior and Fuels location with the U.S. Fire Administrator Dr. Lori Moore-Merrell, who has 37 years' experience in fire and emergencies and public administration, and career highlights including 26 years as a senior executive of the International Association of Fire Fighters and serving as a doctor of public health on the Biden-Harris transition team conducting an agency review as part of its COVID-19 response planning.

The conference program offers delegates access to a wealth of research from a diverse pool of authors. Program categories include: innovation; national fire systems; fuel characterization; fuels and fire behaviour; operations and management; risk modelling; weather and climate; emerging technologies; cultural perspectives and human dimensions.

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7th International Fire Behavior + Fuels Conference

Poster sessions in the exhibition area will give delegates and presenters opportunities to network and discuss research and the day's sessions. The exhibition will also showcase products and services of particular interest to the wildland fire community.

Optional pre-conference workshops held on the Monday will include ember modelling and impacts, and fire weather intelligence for the future, while field trips on the Friday will take participants on a journey involving laboratory demonstrations or prescribed burning for conservation and bushfire mitigation in the landscapes of the Australian Capital Territory.

This IAWF conference in Canberra is about people and places. The Realm Hotel is an outstanding venue within the Parliamentary Triangle; the area is a place of history and proximity to the landmarks and heritage of the national government. Rather than a sit-down dinner, the main social function will be cocktails at the National Press Club, a venue with a rich history of connecting people with eminent speakers including visiting heads of state and other international figures, leaders in religion, literature, science, innovation, and industry, as well as Australian prime minsters throughout the decades.

The organizing committee encourages you to secure your place soon at this rare gathering of the wildland fire community in Australia, as places are limited! To register, visit canberra.firebehaviorandfuelsconference.com/.

CANBERRA HIGHLIGHTS

SPEAKERS

Dr. Dean Yibarbuk, a senior traditional owner from northern Australia, shares experience and wisdom from places where Indigenous and western knowledge come together in managing country, maintaining culture and language, and supporting communities and livelihoods through the carbon economy. (Livestream to Tralee.)

Dr. Lachlan McCaw joins the Canberra conference to celebrate fire-management achievements Centre for Excellence in Antarctic Science over the past 40 years. McCaw has more than four decades experience in bushfire science and management with a focus on fire in forest, woodland and shrubland ecosystems of southern Western Australia. His experience includes conducting bushfire experiments, reconstructing the behaviour of significant fires, and leading the planning function for incident management teams at major fire events.

Sarah Legge is a professor of wildlife conservation at Charles Darwin University. She has managed large-scale fire management programs in the northern savannas and worked on the biodiversity impacts of fire in the tropics, the desert, and the eastern forests. Legge was a member of the Wildlife and Threatened Species Bushfire Recovery Expert Panel after the 2019-20 Black Summer megafires. Legge's keynote will focus on wildlife conservation.

Nerilie Abram's keynote will focus on the impact of the climate variability on dangerous fire weather in South-East Australia. Abram I s a paleoclimate scientist, with research expertise covering natural climate variability and human-caused climate change impacts from the tropical oceans to Antarctica. She is currently Professor of Climate Science at Australian National University and deputy director of the Australian Centre for Excellence in Antarctic Science and deputy director for partnerships at ARC Centre of Excellence for 21st Century Weather.

Dan Pronk is co-author of The Resilience Shield and former special operations doctor. Pronk studied medicine on an army scholarship and after graduating moved quickly into special operations following successful completion of the SAS selection course. He served four tours of duty in Afghanistan and was awarded the Commendation for Distinguished Service for his leadership in action on his second tour. Upon discharge from the army, Pronk completed an MBA and has since held medical leadership roles. The Resilience Shield presents resilience as a dynamic, multifactorial, and modifiable construct.

FIELD TRIPS

CSIRO NATIONAL BUSHFIRE BEHAVIOUR RESEARCH LABORATORY TOUR AND DEMONSTRATION BURN

The CSIRO National Bushfire Behaviour Research Laboratory is home to its Pyrotron and its 11 metre-tall vertical wind tunnel.

PRESCRIBED BURNING TOUR OF THE ACT, PRESENTED BY ACT PARKS AND CONSERVATION SERVICE

8AM – 3PM (Full day field trip)

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BOISE, IDAHO, UNITED STATES

BY DAVID SHEW

The 7th International Fire Behavior and Fuels Conference in Boise will be held at the Boise Convention Centre in the city center. Boise was a natural selection for the U.S. location, with many wildland fire agencies and organizations located there.

The conference kicks off Monday, April 15, with three workshops at the Boise Centre and one off-site at the Wildland Firefighter Foundation: Gathering user input for long-term fire weather outlooks; Challenges and opportunities for wildland fire workforce reforms; Communicating the shift in wildland firefighting: Reframing our communication practices to match the effective wildland fire management; and Proactive near real-time data science for avoiding climate- disasters – the linking of fire-fuels-human behavior for actionable, proactive outcomes.

Monday evening we will welcome U.S. Fire Administrator Dr. Lori Moore-Merrell as our first keynote speaker. Dr. Lori's presentation will be streamed to Australia.

Other keynote speakers include: Dr. Mark Parrington, senior scientist in the Copernicus Atmosphere Monitoring Service Development Section, European Centre for Medium-Range Weather Forecasts, and Dr. Joseph Wilkins, assistant professor, Department of Atmospheric Science, Howard University, who will present in Tralee and stream to Boise.

Dr. Dean Yibarbuk, a senior traditional owner from northern Australia, will share experience and wisdom from places where Indigenous and western knowledge are coming together; he will join us live from Australia.

Dr. Mark Finney, research forester, Missoula Fire Sciences Laboratory will give us a hard core fire behavior and fuels talk, a must for this conference.

On Thursday, April 18, the panel on the 2023 Canadian wildfire season will include Ellen Whitman, forest fire research scientist, Natural Resources Canada, Northern Forestry Centre; Piyush Jain, research scientist, Natural Resources Canada, Northern Forestry Centre; and James Whitehead, Engagement Analyst, Simon Fraser University, Centre for Dialogue – Mitigating Wildfire Initiative

Tuesday, April 16, and Thursday, April 18, the program is packed with more than 165 presentations on topics such as fuels and technology, technologies and approaches, operations and management, extreme fire behavior, smoke, weather and climate, cultural perspectives, and risk/human dimension. In addition, our poster session with more than 45 presentations.

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On Wednesday, April 17, we will host six field trip options and three additional workshops: Development and availability of spatial burn severity data through the USGS/USFS Burn Severity Portal; Decolonial community-led forest fire research methodology; and The interagency ecosystem lidar monitoring program (IntELiMon): Working with managers to improve fuels, ecology and forestry monitoring using lidar.

We will offer many opportunities for student guests, including a mentoring program, a career resources workshop, a career fair, and tons of other fun activities.

Giving back through community service, volunteer work, and philanthropy has a positive impact on individuals and the community as a whole. The IAWF has partnered with the Ronald McDonald House in Boise to give back to our host city. Guests can donate online before the conference or bring items on the organization's wish list.

The exhibit hall will be the centerpiece for networking and will be bustling with booths, the sponsor showcase stage, the poster presentations – and the always anticipated chair massages!

BOISE HIGHLIGHTS

SPEAKERS

U.S. Fire Administrator Dr. Lori Moore-Merrell has 37 years' experience in fire and emergencies and public administration. Career highlights include 26 years as a senior executive of the International Association of Fire Fighters and serving as a Doctor of Public Health on the Biden-Harris transition team conducting an agency review as part of its COVID-19 response planning. (Livestream to Tralee.)

Dr. Mark Finney, research forester, Missoula Fire Sciences Laboratory will provide a hard-core fire behavior and fuls talk, a must for this conference.

FIELD TRIPS

NATIONAL INTERAGENCY FIRE CENTER

The nation's federal wildland fire community is a large and complex organization. The National Interagency Fire Center, or NIFC, is home to the national fire management programs of each federal fire agency located here – the Department of the Interior's Bureau of Indian Affairs, Bureau of Land Management, National Park Service, and U.S. Fish and Wildlife Service along with the U.S. Department of Agriculture's Forest Service. Additional partners include the National Association of State Foresters, the U.S. Fire Administration, the National Oceanic and Atmospheric Association's National Weather Service, and the Department of Defense. Working together, these partners provide leadership, policy oversight and coordination to manage the nation's wildland fire programs.

The 55-acre NIFC campus encompasses many different wildland fire management activities, including firefighting equipment refurbishment, aircraft ramp operations, aircraft retardant tanker operations, information technology, training and development, logistics, as well as administrative functions serving the wildland fire management mission and other all hazard management.

The tour will include a walk around campus and stop at the following: the National Interagency Coordination Center (NICC), the National Interagency Incident Communications Division (NIICD), the Remote Sensing Fire Weather Support Unit (RAWS – Remote Automatic Weather Stations), the Great Basin Cache, the Great Basin Smokejumper Base, and end at the Wildland Firefighters Monument.

IDAHO FIREWISE GARDEN

Idaho Firewise staff will discuss the home ignition zone concept and how to create survivable space that reduces the risk of wildfire damage to the home. Staff will cover the principles of flammable materials reduction, water conservation and maintenance techniques, and how to create Firewise landscape zones. Plants to avoid will be discussed as well as those that are more fire resistant and where to use them. Many of these plants are native to the Intermountain West and appropriate for low water use gardens.

WARM SPRINGS MESA PROJECT

The Warm Springs Mesa project in Boisie encompasses 7.4 acres within a privately owned and maintained parcel within the Warm Springs Mesa Neighborhood Association. In 2016 the Table Rock wildfire burned more than 2,000 acres adjacent to the neighborhood and sparked discussions on wildfire mitigation, fire hardening landscapes, reducing hazardous fuels, and restoring open spaces for fire resiliency. The field trip will allow for active discussions on the challenges encountered for the implementation of wildfire mitigation projects within the WUI environment and includes a walking tour of the project and multiple stops for discussions and observations.

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TRALEE, CO. KERRY, IRELAND

BY CIARAN NUGENT

The 7th International Fire Behavior and Fuels Conference in Ireland will be held at The Rose Hotel in Tralee, Co. Kerry, the largest town in south-west Ireland. Participants will fly into Dublin, and take the scenic train ride south to Tralee, or arrive direct to Kerry Airport from connecting airports in the UK, Spain and Germany. Nearby Cork Airport offers direct connections to Amsterdam, Bristol and a variety of Spanish, UK, Croatian and Portuguese airports.

The conference location right on the shore of the Atlantic Ocean, and surrounded by rugged, fire-prone coastal landscapes, is ideally placed to inspire conversations around fire and fuels management in temperate regions on both sides of the North Atlantic. The conference is intended to provide opportunities for future transatlantic exchange, with keynote speakers selected to address pertinent issues and current challenges affecting the fire community on both sides of the Atlantic.

Monday will begin with workshops: Trans-Atlantic Lesson-Sharing; Forest Fires affecting tourist areas in the Atlantic region; Exploring Wildfire Education through a Puppet Show with Burning Landscape Models; Traditional Fire Use in Atlantic Landscapes; and the emerging issue of wildFire on contaminated lands and conflict zones.

Throughout the event, keynote speakers will address current challenges and opportunities affecting landscapes and land management around the North Atlantic and Arctic regions, particularly in relation to smoke-emission issues and impacts of fire on Indigenous communities in affected areas. These keynote areas are further echoed throughout the conference programme.

Edward Alexander, co-chair, Gwich'in Council International, will address current fire issues affecting indigenous Arctic communities. Dr. Mark Parrington, senior scientist, Copernicus Atmosphere Monitoring Service Research Department, European Centre for Medium-Range Weather Forecasts and Dr. Joseph L. Wilkins, assistant professor, Howard University, will discuss trans-Atlantic smoke issues and the implications for climate, fire management practice and the future direction of large-scale fire events in North America and their impacts on communities and environments further afield.

The issue of wildfire management in current and former conflict ones has been a long-standing issue in various parts of Europe, for historical reasons, and has recently been brought into greater focus by events in Ukraine. Alexander Held, senior expert at European Forest Institute, will lead a discussion on this issue and highlight current challenges and responses.

Conceicao Colaco, Juliane Baumann, founder of Brandherde, and Jennifer Fawcett, extension associate, North Carolina State University,) will highlight the important role of traditional land management practices, including traditional fire use by local communities on both sides of the Atlantic.

A field visit to surrounding landscapes will showcase typical North Atlantic vegetation, folklore, ecology

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and fuels management and traditional land management practice that is reliant on fire use in an increasingly challenging regulatory and climatic environment, and a demonstration of existing approaches to emerging wildfire management and suppression challenges by Irish fire authorities and relevant agencies.

Steve Miller, director, fire and aviation management, US Forest Service, eastern region, will help close the event and assist participants in a post-conference review and synthesis of learnings, perceived knowledge gaps for future focus, and potential next steps for development and exchange on both sides of the Atlantic.

The working conference will take place alongside a series of related cultural, artistic and social events aimed at enabling and cementing enduring working relationships between participants.

TRALEE HIGHLIGHTS

SPEAKERS


Dr. Mark Parrington, senior scientist in the Copernicus Atmosphere Monitoring Service Development Section, European Centre for Medium-Range Weather Forecasts, and Dr. Joseph Wilkins, assistant professor, Department of Atmospheric Science, Howard University. (Livestream to Boisie.)

The issue of wildfire management in current and former conflict ones has been a long-standing issue in various parts of Europe, for historical reasons, and has recently been brought into greater focus by events in Ukraine. Alexander Held, senior expert at European Forest Institute, leads a discussion on this issue and highlight current challenges and responses.


Jennifer Fawcett, extension associate, North Carolina State University, and Juliane Baumann, founder of Brandherde, will highlight the important role of traditional land management practices, including traditional fire use by local communities on both sides of the Atlantic.

Steve Miller, director, fire and aviation management, US Forest Service, eastern region, will help close the Tralee conference and help participants in a post-conference review and synthesis of learnings, perceived knowledge gaps for future focus, and potential next steps for development and exchange on both sides of the Atlantic.

FIELD TRIP

A visit to surrounding landscapes will showcase typical North Atlantic vegetation, folklore, ecology and fuels management and traditional land-management practice that is reliant on fire use in an increasingly challenging regulatory and climatic environment, and a demonstration of existing approaches to emerging wildfire management and suppression challenges by Irish fire authorities and relevant agencies.

BURNING WEATHER ISLAND

KALIMANTAN WILDFIRE ECOSYSTEM REQUIRES GLOBAL SUPPORT

BY MICHAEL HILL

The peatland ecosystems of Central Kalimantan are transitioning from wildfire resistant to wildfire prone; with the potential huge release of carbon from burning peat stocks, it's time for local and global actions to better protect these lands and communities.

As someone who has visited and observed wildfires in Indonesia for more than 20 years, I've witnessed the increasing loss of forest ecosystems and recognize the potential for constructive international assistance.

Sebangau National Park firefighters moving fire equipment on the fire ground. Photos courtesy of Sebangau National Park

In Indonesian, Kalimantan refers to the whole island of Borneo (the third largest in the world), while in English it describes just the 73 per cent of the land mass located in Indonesia, containing about 70 per cent of the island's population. Kalimantan covers 554,150 kilometers divided into five provinces and the non-Indonesian territories of Borneo, Brunei and East Malaysia.

The meaning of the name Kalimantan – originally Kalamanthana – is burning weather island, referring to the very hot and humid climate.

Kalimantan is home to many cultures; the Dayak, or people of the interior, are Indigenous and have long The peatland ecosystems of Central Kalimantan are transitioning from wildfire resistant to wildfire prone; with the potential huge release of carbon from burning peat stocks, it's time for local and global actions to better protect these lands and communities.

The smoke produced by burning peat is particularly hazardous. Besides its climate-warming carbon content, peat smoke contains toxins and other particulate matter, and in Indonesia, it is now being measured during times of wildfires as air pollution.

A volunteer firefighter with firefighting patrol boats on a fire in the Sebangau National Park, Central Kalimantan, Indonesia. District level volunteer firefighting brigades in Central Kalimantan are locally known as Masyarakat Peduli Api, or MPA firefighters.

The Dayak historically used landscape fire in their agricultural practices to clean up land for slash-and-burn farming. This system of using fire to clear farming plots in the rotating system of land use allows for conservation; preselected areas or fields are used for a predetermined number of years before being allowed to go back to nature to recover fertility, while another field is cleared by cutting and burning to be ready for planting until its fertile cycle is complete. Then another field is cleared, and the small scale of slash-and-burn continues as the land recovers after farming.

This system of rotating agriculture and wildfires to clear land has been culturally important. The Dayak use of fire for cleaning and clearing was extremely controlled historically, with organized groups using pre-constructed fire breaks and advance planning to consider predicted winds and fuel conditions.

The Dayak have been masters of using fire as their tool to clear their forest lands. However, cultural, modernizing, and competitive economic forces have brought changes which, during a severe dry season, can quickly transform some areas of the Indonesian part of this island into a thick smoke-filled hazard, lasting months and impacting the surrounding islands and even the cities of Indonesia, Singapore and Malaysia.

Recent changes in vegetation and culture have swung the Dayaks' historic mastery of fire in Kalimantan out of balance. The Dayak people are no longer the only Indonesians who live in the interior of Kalimantan where the rainforests long acted as a moist blanket to keep out fires or retard fire growth. Also, within Dayak culture, changes are taking place as the people join the wave of progress brought by globalism sweeping the world which, as a by-product, disconnects us from the natural world and our hands-on, sustainable practices. The landscape is being modified and fire use has fallen outside of its traditional Dayak checks and balances.

While most of the fires in Kalimantan are human-caused, the fire origins are complex. Many past fires arose from the fact that land ownership claims in Kalimantan historically have been legally proven with the use of applying fire to land for cleaning, thus establishing legal usage. Other blazes are ignited by accident or by fishermen to attract more fish or drive away mosquitos, or fires are lit by hunters to attract wildlife, and myriad other reasons.

Sebangau National Park firefighter moving used fire hose across fire ground. Photos courtesy of Sebangau National Park.

But in recent years, during extra hot and dry seasons, when fires do get started in what may now be often lighter fuels, they can spread quicker and carry their flames into forest areas, or even the swamp peat forests. And once the peat layer below ground is alight, it will burn underground down to the water table and then move laterally beneath the surface, consuming important thick layers of organic decaying peat matter.

These blazes can become huge subsurface peat fires with their flames not visible until they occasionally climb up to the surface to consume vegetation. But the heavy smoke from these peat fires, referred to locally as smog / haze, will have local, regional, and global impacts. The Dayak historically did not apply fire to the forest where there were peat layers beneath it, as they were burning for their agricultural fields and they knew their crops would not grow in the peat region.

Peat swamp fires on Borneo are unique for wildfires because the peat itself, created from countless generations of falling then decaying forest organic matter, has been built up into massive locked-up carbon stores — and these peat stores burn underground as a slow smolder, releasing heat and smoke to the surface. These thick carbon stockpiles begin to release their carbon when the peat swamplands they are part of, are dried by drainage canals created to open lands for timber harvest, home building and other uses. If this dried peat is then consumed by fires, the huge pool of stored carbon that had been safely locked away will be released into the atmosphere, causing global concerns for air pollution and climate change.

The smoke produced by burning peat is particularly hazardous. Besides its climate-warming carbon content, peat smoke contains toxins and other particulate matter, and in Indonesia, it is now being measured during times of wildfires as air pollution.

Kalimantan fires became an international concern in 1997 when a massive man-made ecological disaster took place in the peat forests, and since, due to that disaster's compounding effects, additional new, dry-season peat fires have created an accelerating cycle of fires, peat loss and flooding.

Peat's organic matter, laying below the surface in a swamp forest, has long played a role as a natural sponge; the small per cent of its decaying matter is able to soak up to nine times its size in water. This layer of peat acts as an absorber to dampen the effects of seasonal flooding river systems. However, now with large areas of peat lost due to wildfire seasons in 1997, 2015 and 2019, the summer dry seasons are followed by rainy seasons and large flows of water are draining from the damaged peat lands into Borneo's river systems to the sea, leading to much human property loss and misery along the way.

Protecting the remaining peat beneath the swamp forests has become a priority in Central Kalimantan for those understanding the issue, and over the last 20 years, people have been adapting to this situation. Groups of people in Central Kalimantan have been organizing into volunteer fire militia and paid fire forces, poised during dry seasons to fight the flames. New tactics and techniques are being experimented with the help of Japanese, Indonesian and English scientists, and in 2015, there was an international effort to assist in battling many wildfires. Indonesian law enforcement has also been activated to target illegal burners with stiff maximum penalties of up to 15 years in prison and 15 million Indonesian Rupiah in fines.

Internationally, an agreement among Southeast Asian nations has been developed to assist during times of high fire activity, though there are still very real needs for which international assistance would be greatly

appreciated and valued globally by reducing the peat fires and their massive carbon releases.

Indonesia is still adapting to the emerging wildfire issues in Kalimantan, and as such, has so far developed only limited capabilities, with a particular need for shared technology in fire detection and wildfire response equipment. Many other fire-prone areas of the world have developed and routinely share these types of technologies, and Indonesia should be added to this group. Indonesia has unique firefighting technology advances to share such as locally developed fire response systems and cloud seeding.

Aircraft dropping water on vegetation has been found to have limited effectiveness on peat fires, and therefore these fires are fought from beneath the ground. The priority is to find a water source on a peat peat nearby; this water source must be safely away from the fire to prevent it from burning and is usually found by drilling down as if through the ice on a frozen lake.

Using an augur to bore beneath the peat to find the water table, crews will tap into the water with a firefighting water pump and install a series of pipes and hose to carry the water to firefighters, who spray it where needed to cool the flames. These firefighting pumps and their draft drill holes are strategically laid out and are manned with crews across the path of wildfire or in its wake, depending on members of the responding agency to be anchor points and working outward with their cooling water while supporting each other. This is hard work, Kalimantan style, but necessary.

Indonesians are also experimenting with Japanese-developed soap agents that can be injected underground into the peat to extinguish flames, and the Air Force is using weather modification by cloud seeding to create rain. It is truly a fascinating time of change and adaption for wildfires and Kalimantan.

While these changes in Kalimantan are internal, the funding and support for Indonesia's efforts can come from beyond the region's borders. Indonesia's emerging wildfire issues are global issues due to the potential climate impacts of the massive carbon releases from the peat.

Better protection of the peat reserves could be accomplished by a change of local land ownership laws to allow for proof of ownership to be legally established in new ways, thereby supporting long-term management, conservation and restoration. Instead of the historic local use of fire to clean property, incentives could be created toward fire prevention. Tree planting could be transformed into legal proof of land ownership instead of clearances. Indonesia has huge stockpiles of reforestation funds at the government level, and some of these funds could possibly be invested into bank loans to assist in these efforts and for program development (and local hiring, and training for local landowners).

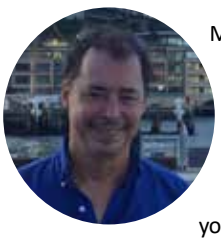
Water-canal damming is being undertaken to allow the saturation of dried out peat soils; these efforts could be greatly assisted by the international community, and as an essential by-product of healing these soils begin to return more of Kalimantan's fire-resistant blanket of forest with the added benefit of also assisting in the fire protection of its peat lands.

My understanding is that the damage to the peat lands over the past 20-some years is immense; however, to protect the remaining peat lands and their carbon sinks would require only strategic forest replanting above the damaged areas, such as along waterways once their area's water levels are again raised from canal damming,

Kalimantan's El Nino dry season fires, especially in the peat swamp areas, have the potential to affect the world's climate with their associated huge carbon releases and for this reason alone, Kalimantan and Indonesia should be offered more support internationally in their efforts to help to protect the remaining peat swamp forests.

Kalimantan may be an island that seems isolated and far away, yet when the peat fires burn they impact us all with their carbon releases, whether we can see the smog or not.

Learn more about Kalimantan's wildfires, nature, and the Dayak culture on Michael Hill's YouTube channel, Talking Wildfires with Michael Hill.



Michael Hill began this journey in the 1980s as an American wildland firefighter, and across his career worked as a hotshot and smokejumper firefighter. For many years Hill has been, and still is, deeply interested in Indonesia's wildfires. He serves as an associate editor for WIldfire magazine and hosts a YouTube channel at http://www.youtube.com/@TalkingWildfireWithMichaelHill.

CAMPS VERSUS HOTELS

A POTENTIAL COST-SAVING SCENARIO

BY JEFFREY MORISETTE, P.J. TILLMAN, DAVE LUCAS, KEITH PLAGEMANN, NATALIE COOPER, AND DAN DALLAS

Anyone who enjoys camping and travel knows that money can be saved by camping instead of staying in a hotel. These days, it is hard to find a hotel room for under $100 per night, meanwhile a campsite goes for well under $50. However, this calculus changes significantly for staff on an incident management team (IMT) evaluating lodging options during a wildland fire – a team that requires considerable daytime office space requirements.

In addition to sleeping and meals, many IMT functions are dependent on reliable internet and other basic office amenities. Building those capabilities into a remote camp is expensive and makes for a less reliable office (not to mention less comfortable).

There is quantitative evidence that using local hotels and office spaces can be more cost effective than the more traditional approach of setting up temporary living and office quarters in a fire camp for a Type 1 IMT on assignment.

For three recent incidents – Devil's Knob in Oregon in September 2021, Tamarack in California in August 2021, and Lowline in Colorado in August 2023 – we compared costs for setting up temporary living and office quarters and the more novel approach of staying in nearby hotels, getting meals from restaurants or grocery stores using a standard per-diem allocation, and using a local facility for the meetings and day-to-day operations of the IMT.

The pandemic forced IMT staff to rethink traditional arrangements, changed the standards for fire incident logistics, and pushed teams to explore new approaches. Leaders of the Rocky Mountain Incident Management Team 1 met this challenge by encouraging their logistics team to explore alternatives for setting up camp and the incident command post. In response, the team adopted a fixed facility approach when available. The fixed facility approach involves finding an existing local facility in proximity to both a town and the fire camp with enough room to set up a command post, a steady power supply, internet, and bathrooms. In the evenings, IMT operations staff stayed in local hotels and procured meals from local establishments with a standard daily allowance. Given the right circumstances, this innovation, which we evaluated in terms of cost-effectiveness, offers a new model for incident command posts with several additional benefits.

The cost comparison comes from the Rocky Mountain team, which calculated estimated expenses for the traditional camp set up and the fixed facility approach for each of the three fires. Traditional camp accommodations include everything from a land-use agreement to temporary housing, water-based infrastructure for personal hygiene and human waste, make-shift office structures, supplies and internet, an introduced energy source (i.e., generator), meal catering services, and lighting. Unlike the traditional camp approach, a fixed facility does not require assembling all the structures, services, and other accommodations. Instead, using hotel accommodations involves a shorter list of needs and preparations: hotel lodging; payment for use of office facilities; per-diem payments for meals at local restaurants; and the cost of a clerical trailer.

In evaluating this cost comparison, three considerations are worth noting. First, if the IMT staff are co- located with the traditional camp, the marginal cost increases; that is, per-person costs do not go down by having another 65 to 80 people residing full time at the fire camp. The cost to support a larger IMT staff at a camp requires additional land, showers, handwash facilities, porta-potties, light towers, water trucks, and

other amenities. While some of these support items and associated costs are shared with other incident operations staff, typically these practical and logistical resources are required in addition to the supply allocated for operations. Sometimes IMT staff end up at a camp location separate from the operational camp.

Second, catered meals – hot breakfast, high-calorie sack lunch, and hot dinner – are specifically designed for firefighters; this costs approximately $80 a day per person. For the three locations, the meals and incidental expenses portion of a per-diem allowance – which is a fixed amount for U.S. federal employees and depends on location and relative cost of living – was always lower than a day's worth of catered meals.

Finally, it is resource intensive to create a functioning office at a remote field camp. There are significant set-up costs for yurts or trailers. There are additional costs for the required power, internet, and copiers. On the other hand, many costs of setting up a remote incident command post are almost entirely avoidable when the IMT works from an existing facility compared to constructing its own remote office space. For example, IMTs on the Tamarack and Lowline incidents used local schools, which were relatively inexpensive, provided sufficient space, and came with internet, copiers, desks, and meeting space. During the Devil's Knob incident, a hotel casino's conference rooms were used. Using the fixed facility approach, IMT staff cumulatively saved more than $100,000 on these three incidents.

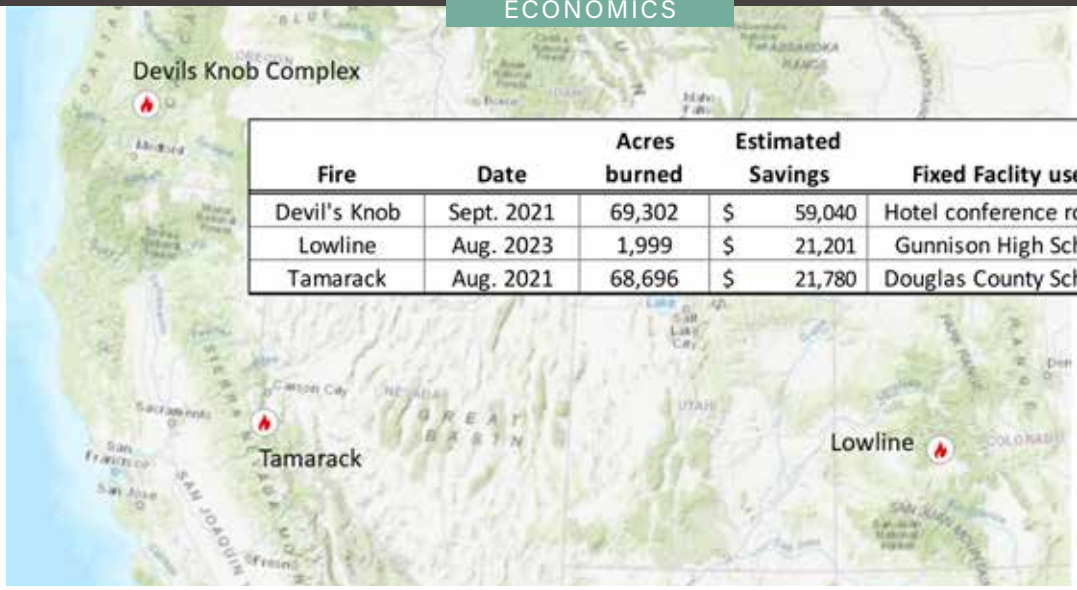
While some incidents may be too remote to access fixed facilities and / or the community may not be as willing to accommodate an incident command post, the magnitude of potential savings makes it worthwhile to explore this option. These savings are especially important in the case of a fire with multi-agency responsibility, in which a local fire district can apply the savings to fire suppression and rehab activities.

In addition to the clear financial savings, the fixed facility approach offers a slew of potential secondary benefits to the local economy, relationships between the IMT and local community members, and conditions favorable to human health and safety. In the three case studies, the IMTs working with the local school systems built relationships with school district employees, which forged a stronger sense of community and solidarity during the wildfires. Furthermore, when IMT staff are on a per-diem meal and hotel allowance, they put revenue and tax dollars into local communities, resided in local hotels, and patronized local restaurants, grocery stores, and convenience stores for the duration of the assignment.

The fixed facility approach offers considerable benefits to human health and safety. According to the Medical Health and Public Advisory Team current wildland fire medical and public health guidance advises fire managers to do the following: "Reduce cumulative fatigue that may be present – especially later in the fire season. Rest and proper nutrition should be prioritized for each operational period" and "rigorous sanitary and personal hygiene practices are important for reducing the transmission of infectious diseases." Hotel lodging is temperature controlled, smoke-free, and allows for adjustable levels of darkness. Hotel rooms make it easier to social distance, get a good night's sleep, and maintain good personal hygiene compared to traditional incident command post camp locations. In turn, these conditions may help prevent losses to IMT capacity caused by infectious disease, which can otherwise stress an already taxed system of human resources.

In addition to the variety of benefits outlined above, there are some potential caveats when weighing the traditional camp versus the fixed facility approach. While hotel and daily allowance rates were favorable at the three fires, they may be higher at other locations. But, most likely, so, too, would be the expenses related to setting up the incident command post in a traditional camp. Also, the cost calculations presented here are contingent upon having a fixed facility available to use. Fall deployment might make it infeasible to use schools; however, churches, non-profit organizations, community centers, community organizations, and even for-profit locations with underutilized office space (such as hotel conference rooms) could all be considered. Another factor to keep in mind is the need to minimize the distance between fire camp and operations and the incident command post. In some cases, the fixed facility model may not be the better option if the footprint of the fire imposes long distances between the incident, firefighter camps, and the nearest local communities. For the three examples, that distance did not present any limitations on the IMTs to work from fixed facilities.

The main goal of any incident command team should be to put resources where they are needed. There are good reasons for all responders involved to be close to the incident, including IMT staff. But if local hotels and temporary office space allow for that proximity,



Fire	Date	Acres burned	Estimated Savings	Fixed Facility used
Devil's Knob	Sept. 2021	69,302	$ 59,040	Hotel conference rooms
Lowline	Aug. 2023	1,999	$ 21,201	Gunnison High School
Tamarack	Aug. 2021	68,696	$ 21,780	Douglas County Schools

Table 1 Graphic by Brad Pietruszka.

permitting IMTs to utilize that option can not only cut costs but improve reliability of IMT functions, contribute to the local economies, build relationships with local communities, and increase on-site safety by reducing the risk of exposure to smoke and infectious disease.

While table 1 is not a comprehensive assessment or a statistically representative sample of incident management teams / incident command post locations and their respective costs and benefits, it does point to the utility – and arguably, the responsibility – of considering the fixed facility option. This cost comparison also suggests that a more comprehensive assessment might be worthwhile. Given this experience, we encourage agency administrators on fire incidents to explore venues within their communities that could support an incident command post, should the need arise. Establishing a list of potential options for office space within communities in proximity to their jurisdiction would be a proactive step that could lead to positive community engagement, potential cost savings, and healthier IMT deployment.

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David Lucas works for the U.S. Fish and Wildlife Service as the refuge manager overseeing its Colorado Front Range national wildlife refuges. He has almost 30 years' experience working in public lands management and within the wildland firefighting community. He has served on incident management teams for many large wildfires, the Deepwater Horizon oil spill, countless hurricanes, and recently to support the 2023 Canadian wildfires

Keith Plagemann started his firefighting career in 1996. He has also served as a certified Paramedic since 2003. In 2013, Plagemann was promoted to captain for Unified Fire Authority (formerly Salt Lake County), and joined the Rocky Mountain Type 1 Incident Management Team. He is a member of Utah Task Force 1 and has deployed to many hurricanes and tornadoes. His experience spans from structure fire fighting and EMS to FEMA urban search and rescue.

Natalie A. Cooper works at the Rocky Mountain Research Station in Fort Collins as a science delivery specialist for the human dimensions science program. She has a PhD in human dimensions of forest resources and conservation with a focus on science communication and conflict in natural resources management.

Dan Dallas is the renewable resource director for the Rocky Mountain Region of the US Forest Service. He has more than 30 years' experience in various land management positions and is incident commander for Rocky Mountain Type 1 Incident Management Team. He specializes in the application of risk management theory in the context of land management and fire management operations.

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COLLABORATING IN CHILE

PROGRAM IS KEY TO INTERNATIONAL CO-OPERATION

BY JUAN CAAMAÑO AND JORGE GARCÍA

Wildfires globally have changed and will continue to do so, partly because of extreme weather events and increasingly longer periods of fuel availability. Scientific forecasts indicate that the incidence of large wildfires will worsen due to a warmer and more energetic atmosphere.

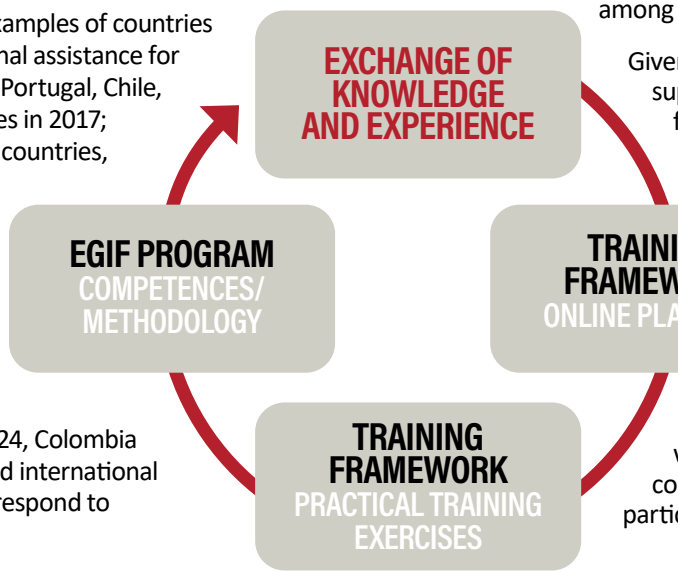
Recently in many parts of the world wildfires have become extremely complex emergencies that have threatened lives, infrastructure, and natural ecosystems. Many of these wildfire emergencies also occur simultaneously, often exceeding response capabilities. Changes in the timing, complexity and intensity of wildfires increase demand for international resources to complement national efforts.

There are several examples of countries requiring international assistance for large wildland fires: Portugal, Chile, and the United States in 2017; Northern European countries, South Africa, and the United States in 2018; Bolivia in 2019; Australia, Argentina and the United States in 2020; and Chile, Greece and Canada in 2023. So far in 2024, Colombia has already activated international aid mechanisms to respond to wildfires.

These emergencies that require international aid underline the need to improve co-operation among countries to respond to large and complex fires that spread over significant areas and last for weeks.

International co-operation should not be based exclusively on sending aerial and / or land resources to the countries that experience wildfires that exceed their response capacity; units that come from different parts of the world must know how to work together in a co-ordinated manner, understanding the needs of local authorities and the scenarios they face, the possible operations to be carried out within the organizational framework, and work procedures of the organization receiving aid – everything that improves and ensures interoperability among responders.

Given the increasing need for international support, it is necessary to go one step further and create exchange programs between wildland firefighters from different countries to generate trust and ensure interoperability; the backbone of these programs is the transfer of experience and knowledge around management of large wildfire events. The exchange of working procedures can lead to better co-ordination and collaboration among participating firefighting forces.



Conceptual diagram of the knowledge and experience exchange project EGIF (Equipo de Gestión de Incendios Forestales in Spanish, or Wildland Fire Management Team), sponsored by the National Forestry Corporation of Chile (Corporación Nacional Forestal, CONAF) and co-ordinated by the Pau Costa Foundation. Source: CONAF/Pau Costa Foundation.

A simulated wildfire scenario on a digital sandbank. August 2023. Source: CONAF/Pau Costa Foundation.

Organizations participating in the EGIF 2023 Equipo de Gestión de Incendios Forestales (EGIF) program in Chile. Source: CONAF/Pau Costa Foundation.

This idea is not new and has been implemented for decades in the military and civil security. With this idea of sharing and exchanging knowledge, experiences, and work methodologies in mind, the international program EGIF (Equipo de Gestión de Incendios Forestales in Spanish, or Wildland Fire Management Team) was born, sponsored by the National Forestry Corporation of Chile (Corporación Nacional Forestal, CONAF) and co-ordinated by the Pau Costa Foundation.

EGIF FRAMEWORK

The EGIF program is part of a broader project to exchange experiences and knowledge led by Corporación Nacional Forestal and developed jointly with the Pau Costa Foundation. The project aimed to grow and evolve CONAF's wildfire management through the creation of a training framework for its firefighters and technical staff.

Two phases were designed; first, the creation of a training framework that gathered all the knowledge of the foundation's network and CONAF on forest fires management and response. In addition to the creation of an online platform that collected all the theoretical knowledge, exercises and simulations were organized, through which participants could put the acquired knowledge into practice and develop skills and aptitudes for the positions they will perform.

During this stage of the learning process, the use of simulated real-fire scenarios allowed students to practice the competencies defined in the training framework for the position for which they were training.

The experience gained during the response phase in a real wildfire cannot and should not be replaced, but through different training methodologies (digital sandboxes, real fire workshops, drills, tactical decisions exercises) real situations that arise in wildfire emergencies can be simulated and provide an environment through which participants can gain confidence and improve leadership and teamwork capabilities.

A second phase needed to be designed to introduce changes to working procedures and the methodologies use in the decision-making process with the new vision, knowledge and methods acquired through the training framework. The idea was to use real scenarios of wildland fire emergencies for exchange and support the implementation of new decision-making processes, and new methodologies for analysing wildfires and operations. This is how the EGIF program was born, a program that would generate an international multidisciplinary team of wildfire professionals who would work together during the forest fire season in Chile to exchange visions and improve working procedures during a real wildfire emergency around certain thematic areas identified as priorities by CONAF. These were:

- Analysis of wildfire behavior
- Operations (use of technical fire and emergency organization)
- Aerial co-ordination
- Human factors

Between the two editions of the EGIF program that have been carried out in Chile, some 70 professionals from five countries belonging to 10 organizations have been mobilized, becoming a benchmark program in the exchange of professionals before, during and after the wildfire emergency.

Probe launch on the right flank-tail of the Quilmo wildfire shown on Feb. 2, 2023. Source: CONAF/Pau Costa Foundation.

STRUCTURE AND FUNCTIONS

During Chile's 2023 fire season, the functions entrusted to the EGIF team were:

- Increase the capacity to predict the risk and behavior of wildfires through joint work with the CONAF analysis unit.
- Support the incident command, and the operations and planning sections during the development of a wildfire in the decision-making process and in the design of efficient and safe strategies by anticipating the evolution of the wildfire.
- Advise on the co-ordination of the aerial operations through the development of the air tactical supervisor position.
- Advise and implement the human factor program for CONAF staff.

The EGIF team was structured into different areas and work cells, which allowed it to perform the functions simultaneously and in a co-ordinated manner, optimizing resources, efficiency and safety.

The analysis cell aimed to put into practice different approaches on how to understand, anticipate and explain the behavior and propagation of a wildfire, consensually creating an analysis methodology based on the best practices of the participating organizations inside the EGIF. For this, the guides developed in the European project Advance Fire Analysis Network (AFAN) about remote and on-site wildfire analysis methodologies were used as a reference.

The structure of the analysis cell was designed to obtain and analyse real-time information about a wildfire, being made available to the incident commander and the analysis section.

This structure, already tested in the previous edition of the EGIF program, provided the system with greater intelligence capacity to improve decision making in command posts. This was possible because, thanks to EGIF, a consensual and orderly methodology for data collection and subsequent analysis was established.

During the 2023 edition, the analysis cell had the opportunity to study the fire-atmosphere interaction in pyro-convection processes. The objective was to collect atmospheric data and data from the vertical profiles outside and especially inside the convective column of the fires, intending to validate the convection models within the analysis of wildfires. It was therefore about expanding knowledge about the interaction between atmosphere and wildfire.

The operations cell was designed to improve decision making in the operational field and the correct implementation of the Incident Command System (ICS) during the emergency.

This cell comprised two work areas with specific functions: the aerial operations area's main function was the creation of the air tactical team belonging to CONAF. For this purpose, aerial operations managers with extensive experience travelled from Spain to train and guide future CONAF supervisors.

The ICS / operations area was tasked with assisting in the implementation of the ICS during the emergency and advising on strategies and tactics according to the fire analysis and available resources.

Meetings with Spanish personnel deployed to the fires in Chile through the European civil protection mechanism. Source: CONAF/Pau Costa Foundation.

Finally, the human factor area was established to create the first team of psychologists for wildfire emergencies, to help implement work procedures for extinguishing wildfires and identifying the areas of improvement in everything related to the human factor (communication, co-ordination, teamwork, leadership, motivation, and emotional management).

Through the creation of this team of psychologists, EGIF promoted a program to encourage safety and operational effectiveness, focusing on the most important and vulnerable part of the system – the people and work teams, or the human factor.

WILDFIRE SIMULTANEOUS EVENTS

During the 2023 edition, EGIF provided its services in six regions of central Chile: Valparaíso, Metropolitana de Santiago, Libertador General O'Higgins, Maule, Ñuble and Biobío. The program was activated for a total of 29 wildfires recorded in the region.

On Feb. 1, EGIF decided to move to the Ñuble region, as a result of the atmospheric configuration that was about to unfold throughout the central area of the country, which brought with it strong dry winds from Argentina, which led to considerable increase in temperatures and a marked decrease in relative humidity.

The fire risk index for the following days increased significantly; any heat source would have a high probability of igniting a wildfire, which, added to high loads of available fuel and easterly wind from the Andes, established a fire environment conducive to large wildfires. The probability of this event was very high and therefore justified the transfer of the EGIF team to the Ñuble region.

Upon arrival, the Ñuble region was already showing fire activity, with three active fires throughout the region that day.

On Feb. 2, the meteorological conditions worsened, presenting very low relative humidity and reinforced wind of the S component (SW-S-SE) with gusts in the early and late hours of the day exceeding 40-50 kilometres per hour. This was the day on which the simultaneous episode began, with multiple fires in the regions of Biobío and Ñuble mainly that developed convective behavior, very high propagation speeds and spot fires at hundreds of meters.

On Feb. 3, the general wind situation changed to a SE component. The movement toward the south of the "coastal low" (low pressure from the Pacific Ocean) further reinforced the entry of the dry and warm wind from the Argentine pampas.

As the coastal low moved further south, the night of Feb. 3-4 caused the most significant growth of the fires in the regions of Biobío and Araucanía.

During the simultaneous episodes in the regions of Maule, Ñuble and Biobío more than 200,000 hectares burned between Feb. 1 and the early hours of Feb. 4. In the Santa Ana fire, more than 100,000 hectares burned in less than 48 hours.

On Feb. 4, weather conditions improved, and the fire growth rates decreased considerably, despite the hundreds of kilometres of perimeter that were still active that day.

This dramatic event motivated EGIF to fully focus on the response, maximizing the analysis and aerial operations structure that was already deployed on the ground.

Moments of international collaboration in the Santa Ana fire, Concepción. Source: CONAF/Pau Costa Foundation.

The deployment of this type of analysis unit in an extreme fire event means being able to have a global vision of the entire event and leaving behind the multiple local perspectives from the regions and incident command posts deployed on the different fires.

EGIF proposed to address the simultaneity by dividing the scenario into various fire complexes and treating each one as a single incident, with an incident commander who had a vision of the overall scenario at a macro level and with clear strategic and tactical objectives.

Work priorities were passed for each of the identified complexes and deeper analyses were carried out on the most notable fires, such as the Santa Ana´s.

AID FOR INTEGRATION AND COORDINATION

During the stay of the EGIF team in Chile and because of the fire simultaneity that began on Feb. 2, the Chilean government decided to request international aid from neighboring countries and activate the European Civil Protection Mechanism.

Members of the EGIF team are part of this European solidarity response mechanism, and European organizations from countries such as Spain and Portugal that responded to the request from the Chilean government had fire experts within the EGIF team. In such situation, the CONAF requests the EGIF team to facilitate the coordination and integration of the international teams deployed to the scene of operations, especially the teams coming from Europe.

Once the activation of the European Civil Protection Mechanism was known, EGIF sent the most up-to-date information possible to the Emergency Response Coordination Center (ERCC) through the reports that the analysis cell compiled daily. This meant that the ERCC, whose mission is to coordinate international aid from Europe, had up-to-date and relevant information about what was happening on the ground and short-term forecasts. This information allowed the ERCC to select the optimal type of resources and equipment to offer to the request for help from the government of Chile.

Once the requested resources arrived in Chile, communication channels were opened with the European teams, with the aim of continuing to provide updated information.

The EGIF team also played an important role in facilitating the coordination of international resources deployed mainly in the Santa Ana fire, in the Biobío region. The team promoted the integration and coordination of resources from Mexico, Argentina, Spain and Portugal by facilitating planning and operations meetings among all the participating organizations.

The EGIF program has undoubtedly generated trust among the organizations that have participated in it, allowing professionals from different areas of expertise to exchange views and ideas before, during and after the emergency. Following the famous phrase “train as you perform, perform as you train” the EGIF program was designed. Thanks to CONAF for promoting this program and for trusting the Pau Costa Foundation to lead it.

Juan Caamaño works as head of the training and operations area of the Pau Costa Foundation. He started his career as a wildland firefighter in 2000 and since then has worked with multiple organizations in Spain and abroad, always linked to operations. Caamaño has an MSc in forestry engineering and since beginning his career has been involved in training and the design of new learning methods to improve respond capacities.

Jorge García Rivera has a degree in forestry engineering and masters in forest fires. He has worked for many years as helitack crew leader for the Spanish government and as member of the prevention teams called EPRIF, executing prescribed burns for the reduction of fire risk and the creation of pastures for livestock farming. Now currently is works in operational and training with Pau Costa Foundation.

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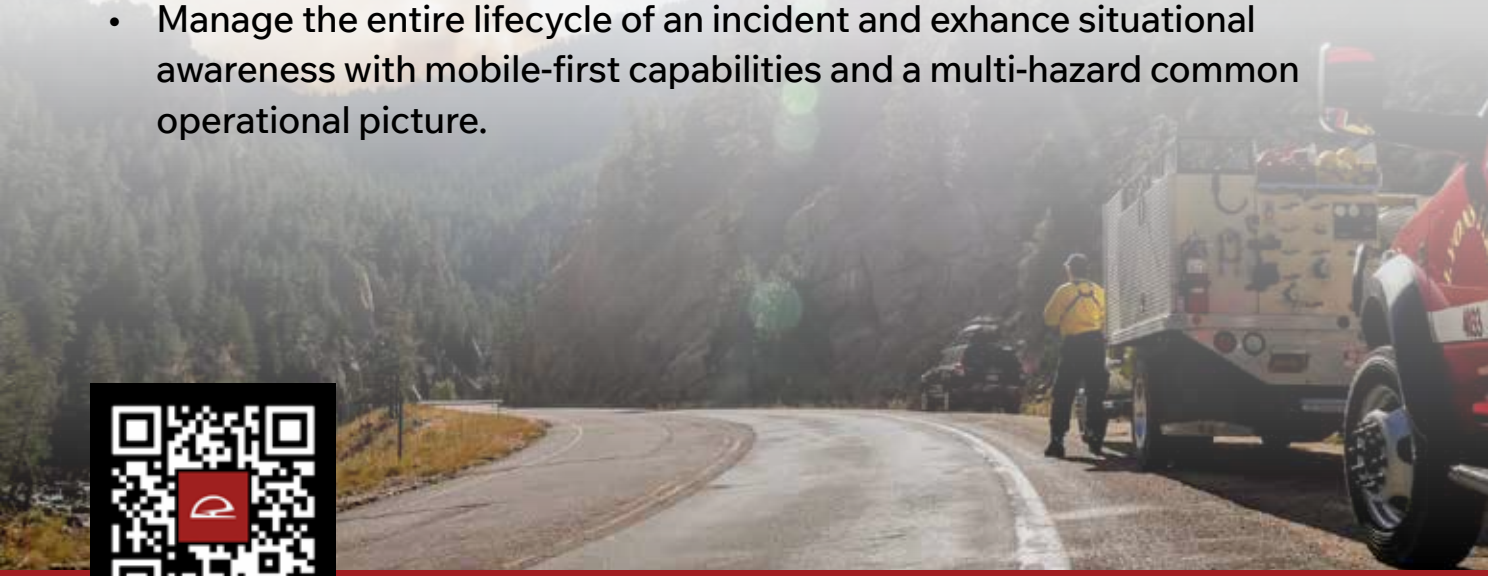

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