

"Uniting Our Global Wildfire Community"
OCTOBER-DECEMBER 2019 - VOLUME 28.5

WILDFIRE®



THE FIRE GLOBE
FIELD JOURNAL
BOLIVIA

PLUS - WHEN WOMEN THRIVE IN FIRE
FIRE SPREAD - RULE OF THUMB

ISSUE DIALOGUE - INTERNATIONAL COOPERATION



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



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WHEN WOMEN THRIVE:

Four panelists and the moderator are one-half of a two-continent panel sharing insights from women's success and challenges in the fire profession.

Photo: Marjie Brown.



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Firefighters facing new challenges in Bolivia are supported by a global team.

Photo: Luisa Alfaro, OFDA-USAID.)

WILDFIRE

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SHARING THE KNOWLEDGE WE NEED

A REFLECTION ON AVIATION USE AND THE WORK OF IAWF



By Alen Slijepcevic

AS THE IAWF BOARD HAS started to publish issues papers, one of which is about fire suppression, I would like to reflect on one aspect that is becoming both an opportunity and a challenge for fire agencies globally, and that is the increased use

of aircraft. Over the last couple of decades, the use of aircraft has significantly increased not only in numbers, but also in size, especially fixed wing aircraft. We have seen an introduction of Boeing 747s and more recently 737s. With the increase in use we are seeing increase of ineffective/inefficient use of aircraft in fire suppression.

I would like to state that I am a great believer in the use of aircraft for fire suppression. Aircraft are an extremely valuable tool that, when used appropriately, significantly add to the overall success of firefighting. For example, their great use and benefit is in an initial attack phase of firefighting to keep fires small while ground crews are coming, supporting backburning

operations, and in asset protection with targeted drops around values at risk if conditions are favorable. However ... and there is always at least one "however."

Before I further discuss the use of firefighting aircraft, it is important to understand the context under which they are operating. Since the late 1990s, we have started to encounter the combined effect of over-reliance on fire suppression, lack of healthy fire regimes across the landscape, and also the impacts of climate change. What does that mean to fuels and fires? Globally, there is more available fuel (vegetation) because of a fire suppression (not allowing natural fires to burn through the landscape), and also at the same time those fuels are becoming drier and therefore more flammable. Increasingly the fire management community experiences fire severity that is impossible to extinguish until weather conditions improve. Fires are burning hotter than ever, even under reasonably mild fire danger conditions. Most fire danger systems around the globe were designed before the end of eighties or significantly earlier. The disconnect we are experiencing on the ground and the signals we receive from fire danger systems call into question their appropriateness for the conditions we now face.

Now, back to the aircraft. The threshold when aircraft stops being effective is normally described as when a fire burns at intensities of 4,000 kW/m or more. In the extreme, aircraft will have some effect on fire behavior up to fire intensity of 10,000 kW/m. Most of forest fires around the world under moderate weather conditions will exceed threshold conditions even if atmospheric conditions are stable.

However, around the globe we are still using aircraft under conditions where we know they will be ineffective. Good fire managers know this. There are countless images seen on TV showing aircraft dropping on fires with pyrocumulonimbus (PyroCB) columns more than 10,000 m up in the air. Images like this perpetuate the fallacy that aircraft can be effective under these conditions. Politicians, media and communities have been "educated" through these images. And if aircraft are not present, regardless of effectiveness, fire managers are questioned on their effort. Research in the US supports that there is no correlation between aircraft usage and fire danger; however, there is a strong correlation in the use of aircraft within the rotation of some Incident Management Teams. The implication is that some IMTs either buckle under pressure and excessively use aircraft as a political/public risk management tool or use aircraft to highlight the importance of their fire

("my fire is more important than other fires" syndrome).

The same situation is replicated in other parts of the world. As climate change accelerates the fire weather and alters the fire regimes, the costs of fire suppression have increased significantly. A good portion of those costs are now spent on aircraft and associated suppressants and retardants. And if nothing changes, those costs will keep rising. But we need to ask ourselves whether these costs are justified and are we returning value to the public. The question is how we change this trend.

So how do we do that? It will take a concentrated effort by researchers, fire managers and organizations such as the IAWF to turn things around and re-educate the public, the politicians and the media. Firstly, we need to become better in collecting data on effectiveness of fire suppression in different conditions (weather, terrain, vegetation type and similar). Secondly, we use that info to build decision support tools that will, as a part of a metrics, consider effectiveness of different suppression strategies and resources as well as the economics of our decisions. The role of IAWF is to facilitate sharing of the existing and new knowledge but also in connecting researchers and operational people. So we will continue to do that through our Magazine, the International Journal of Wildland Fire, and through our conferences.

ON REFLECTION THERE IS ANOTHER STORY that we rarely hear about and that is the story about the true heroes of firefighting - machinery operators (dozer, excavators and graders), as well as our crews that conduct either direct suppression or backburning operations. Without them, there would be no success. So, thank you all for doing such an amazing job. I know that is so rewarding on a personal level and camaraderie is second to none. However, when it comes to public opinion, it is still a thankless job.

For More Information

Stonesifer Crystal S., Calkin David E., Thompson Matthew P., Stockmann Keith D. (2016). Fighting fire in the heat of the day: an analysis of operational and environmental conditions of use for large airtankers in United States fire suppression. *International Journal of Wildland Fire* **25**, 520-533. <https://doi.org/10.1071/WF15149>.

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PICK A NUMBER, between 200,000 and 2 million. Large, seemingly random numbers — yet these partially define a single day, mid-October, amid the hot, dry, windy and fiery parts of California, where some 200,000 people were under wildfire evacuation orders and 2 million were warned of potential black-outs in an effort to prevent new fires ignited by wind-topped power-lines.

A few weeks later, Australia faced fires equally challenging. The problem is not that of one community or state or nation; this is our world.

Which is why this issue of **Wildfire** continues to look across and beyond borders for solutions. So we'd like to make note that not a single article here is possessed by a single political entity — a reflection (not entirely planned) of the current topic of the Issue-Dialogue: "International Cooperation."

- The President's Desk looks at aviation and ground-based firefighters, regardless of what ground we work.
- Thoughts on Leadership — one generation of leadership looks to the next for leadership on global climate action.
- IAWF news and IJWF updates — global.
- Women who thrive — three nations represented, speaking for more.
- Bolivia is served by a seven-nation team.
- The "Rule of Thumb" is based in Australian and Canadian research but applies anywhere.

Perhaps the closing article, focused on the US-based Community Risk Reduction Week, might be a single country's effort ... but can't everyone learn from and apply this approach — any of the approaches here — to help guide our management of fire problems, globally? To better support the 200,000 and 2 million whom we serve. - RS

AN "OH MY WORD!" WORLD LEADERSHIP MOMENT

by Michael DeGrosky

AN INSPIRING YOUNG LEADER WITH THE PASSION, COURAGE AND SOCIAL MEDIA SAVVY TO LEAD A MOVEMENT IN THE 21ST CENTURY

It's been one heck of a year for Greta Thunberg.

In August of 2018, the climate activist sat in solitary protest outside the Swedish Parliament in Stockholm. Just over a year later, many credit Thunberg with raising global awareness of the risks of climate change and holding the rich and powerful to account for their lack of action on it. In December of 2018, Thunberg attended the UN Climate Change Conference in Poland where she both addressed the Secretary-General and made a plenary speech. Thunberg's speech went viral and has been viewed millions of times around the world. In January of this year, she addressed the World Economic Forum in Davos, Switzerland. In September, the UN invited Thunberg to speak at the opening of that body's Climate Action Summit, where member countries who were signatories to the Paris Climate Agreement were expected to strengthen and accelerate their efforts to curb greenhouse gases.

As I write, millions of people, inspired by Ms. Thunberg, have joined the movement known as **The Global Climate Strike**. During the week of the UN Climate Action Summit alone, more than four million people gathered at 2,500 massive, coordinated events in more than 150 countries to urge their

governments to act on local climate issues. Since then numbers have grown to well over 6,000 events in 170 countries. It is possible that this is the biggest environmental protest in history. That's pretty impressive success at leading a global movement. Oh, did I mention that Greta Thunberg is 16?

I'm not here to talk climate change. First of all, that's not the purpose of the column. Second, I figure that fire people understood that climate change was here long before most people in our societies took notice: we get it. I'm here to share my observations of a remarkable leadership moment. Thunberg is a Swedish student who, at the start of the 2018–2019 school year, began spending school days outside the Swedish Parliament, demanding aggressive action on global warming by the government. Soon, other kids around the world joined her protests and Thunberg started giving speeches to government leaders around Europe.

The youth movement called **Fridays for Future** has since spread worldwide and involves hundreds of thousands of schoolchildren and Thunberg has become it's leader. So what have I learned from young Ms. Thunberg about starting and sustaining a movement when institutional means fail us?



Greta Thunberg, leader of "Fridays for Future" and the Global Climate Strike.



Climate Change Week at the United Nations September 23 – 29, 2019 International Association of Wildland Fire Statement

Climate change has already had significant consequences in the global wildfire reality, affecting the citizens as well as the global wildland fire community. Many key issues of importance to the IAWF – including firefighter and civilian safety, fire management expenses, changing weather patterns, natural role of fire, fire regimes and ecosystem succession, as well as the wildland urban interface – all require recognition of the role of climate change.

Globally, we regularly see new reports about the “worst”, “largest”, “most expensive”, and “deadliest” fires and fire seasons. In 2019 and 2018, striking headlines read “Arctic on Fire” (Sweden, Russia, Greenland, Canada and Alaska), and the most expensive and largest fire years were recorded in 2018 in California and British Columbia, respectively, breaking the previous records set in 2017. The Camp Fire (CA, 2018), Attica Greece (2018), Black Saturday Australia (2009), and Portugal (2017) fires were all ranked amongst the top 11 deadliest fires in the last 100 years.

Under current climate change scenarios, fire regimes will change in terms of increases in burned area, severity, fire season length, frequency, and ignitions from lightning. Many parts of the world have already experienced an increase in record breaking temperatures and recurring the droughts that have led to shifts in wildland fire. There is already evidence of climate-driven fire regime change in the Northern Hemisphere upper latitudes with fire risk increasing in non-traditional fire-prone countries. The consequences of human actions are here today, not in some distant future, and these are alarming and, most important, escalating.

The IAWF encourages all countries to emphasize increased international fire training and to implement easier cross-border sharing of professional fire management resources for suppression and prescribed fire opportunities. These will lessen the irrationally heavy burden any single country will have to carry to manage extreme fire seasons. Homes and communities must be better planned and built, so they are increasingly fire resistant and more adapted to natural disasters of all types. Health impacts of fires have long-term consequences, not only those that are immediate from the flames but also those from smoke and toxins, and these must be considered when planning and managing for future wildland fires. Wildfires and smoke do not recognize borders. As the global community tries to manage the new wildfire challenges, it is incumbent on everyone to prepare to support international neighbors in protecting lives and communities from fires and their impacts.

IAWF Vice-President Todd Steelman recently said in *Wildfire* magazine (August 2019) that “Recent extreme weather events have catalyzed public belief in, and concern about, climate change, and boosted public support for government actions to reduce its harmful impacts. This gives us a window of opportunity when conditions are right to make great strides on climate if we are strategic about it.” This window of opportunity requires people having the knowledge and political will to act now. Our global scientific community needs to publicly share knowledge learned about patterns of extreme wildland fire and weather, as well as how climate change is associated with these patterns. Our global fire management community needs to leverage its credibility to share its experiences about how climate change and its role in extreme weather is real playing out in their day to day work environments. Connecting extreme weather events to real on-the-ground consequences can help more people understand how climate impacts are affecting us all.

I’ve written in these pages before about what works to start a movement and, by now, I suspect most Wildfire readers have seen Derek Sivers’ three minute video, *First Follower: Leadership Lessons from a Dancing Guy, or his TED talk How to Start a Movement*. I still call Sivers’ video “the best three minutes you can spend on your leadership development.”

Let’s recall Sivers’ simple lessons from that entertaining video.

1. While leaders often get the credit, it is the first follower who turns the person with the idea into a leader; there is no movement without the first follower.
2. If you are that lonely would-be leader, be public and be easy to follow.
3. Remember to nurture your first few followers as equals; make everything clearly about the movement, not you.
4. We’re told we all need to be leaders, but on any given issue everyone being leaders would prove ineffective; the best way to start a movement, if you really care about something, is to courageously follow and show others how to follow. When you find a lonely would-be leader doing something great, like cutting school to protest in front of the Parliament building, have the guts to be the first person to stand up and join in.

There it is again, that word, that idea ... courage. I know I keep beating the “leadership takes courage” drum but the more I observe leaders, the more I understand its importance. Last issue I wrote about a high ranking elected official who I thought had demonstrated somewhat uncommon political courage, but Thunberg’s courage is of another sort. Put yourself in her place, giving a spur-of-the-moment speech to some of the world’s richest and most powerful bankers, investors, and entertainers while they ate their lunch where, according to reporting by *The Guardian*, she told them “Some people, some companies, some decision-makers in particular, have known exactly what priceless values they have been sacrificing to continue making

The IAWF offered this statement in support of the “Climate Change Week at the United Nations” on September 23, 2019. For the full statement, see <https://www.iawfonline.org/article/climate-change-week/un/>.

unimaginable amounts of money. And I think many of you here today belong to that group of people.” Similarly, in tough remarks to the United Nations Climate Action Summit she made clear that she believed that older generations have burdened her and her generation with extreme impacts, scolding UN delegates, saying “How dare you ... You have stolen my dreams and my childhood.” Remember, you’re 16. Maybe you can picture your 16-year-old self speaking truth to power on the world stage, but I can’t.

Any student of leadership knows that, when one chooses to stand up and speak out against the powerful, that person needs to be ready for some very lonely moments; to be ready to attract unwanted attention, particularly since the emergence of the worldwide web and social media; and be ready to pay a price. And for Greta Thunberg the price is high, as Thunberg is no ordinary teenager and is very open about her Asperger’s syndrome, a milder autism spectrum disorder. Imagine the courage and inner strength it takes to address world bodies, to have your image and words viewed millions of times when you do not emote like most other people and you know that your leadership will bring on media scrutiny and all the meanness imaginable from venal haters including national and international “leaders,” spokespeople and influencers. Publicly, Thunberg has faced that scrutiny and disgusting hatred with incredible grace and poise.

Finally, I’ve learned from Greta Thunberg that in the era of social media, if one wants to lead a movement, it helps to be a social media ace and expert crowdsourcer. I was only marginally aware of young Greta and her movement until someone I follow began re-tweeting her daily tweets from a 15-day, climate-neutral sailing journey across the Atlantic to attend the UN Climate Action Summit, which served as a demonstration of Thunberg’s declared beliefs of the importance of reducing emissions. I love to brag on wildland fire incident management teams — who can bring a thousand people from all over the country and have them well supported in 24 hours? — but I cannot fathom what it took to mobilize more than four million individual people at 2,500 protest events in more than 150 countries.

So here’s to you Greta Thunberg, an inspiring young leader with the passion, courage and social media savvy to lead a movement in the 21st century. May you live long and prosper!

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



Scholarships announced

PLUS, IAWF ASKS YOU TO
SUBMIT 'FIRED UP' AND
AWARD NOMINATIONS

International Association of WILDLAND FIRE

FIRED UP

The *Fired Up* Feature

Nominate an individual or group you believe is worth featuring in Wildfire Magazine.

Wildfire Magazine would like to publish stories about unique contributions made by individuals and groups to the Wildland Fire Community. The new "Fired Up" feature will highlight those who have made strides in advancing and contributing to wildfire/bushfire operations, mitigation/prevention, training, and research. Contributions can be anywhere from ground-level through administration as long as they are noteworthy or innovative.

We invite IAWF members and the wildland fire community at large to submit recommendations for individuals and groups that deserve to have their stories shared for publication.

We will need justification for recognition, a short bio, and a photo of the individual or group at work (if you have one). All IAWF members, as well as people supporting the global wildland fire community, are eligible to nominate individuals as well as to be recognized.

Visit our webpage for more information or to submit: <https://www.iawfonline.org/fired-up/>.

2019 SCHOLARSHIP RECIPIENTS ANNOUNCED

Each year IAWF awards two graduate-level scholarships typically valued at \$3,000 USD to M.Sc. or Ph.D. students studying wildland fire or related topics. Students submit essays that are evaluated by an international panel of fire experts. One award recipient is chosen for the M.Sc. level and one for the Ph.D. level. The IAWF has been presenting this award annually since 2007.

We are pleased to announce the 2019 recipients.



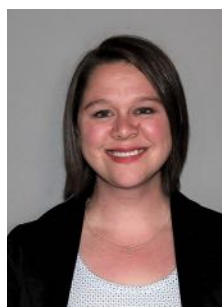
Samuel Hillman,
PhD Candidate,
RMIT University,
Australia

Sam is completing his Ph.D. with the Remote Sensing Centre at RMIT University. Having always had a passion for the outdoors,

Sam graduated with a Bachelor of Environments from the University of Melbourne and a Masters of Geospatial Science from RMIT University before taking up a graduate position with Forest Fire Management Victoria (FFMVic). In conjunction with summer firefighting roles, Sam's work at FFMVic focuses on managing the collection of fuel hazard information across the state. Seeing a growing need to invest in new technologies for efficient hazardous fuel data collection, Sam has returned to further study while continuing his role with FFMVic part-time.

Sam's Ph.D. project explores the use of innovative methods for estimating below canopy forest structure for fuel hazard assessments. More specifically, the research investigates the utility of image-based and LiDAR point clouds derived from terrestrial and airborne sources to describe the cover, height, and structure of below canopy vegetation.

Sam enjoys working with fire scientists and practitioners across Australia to improve the utility of this research. He is currently based in North America collaborating with research partners at the Rocky Mountain Research Station in Missoula, Montana and the University of British Columbia, Vancouver to test these technologies outside of Australian forest systems. He is passionate about connecting innovative research to operations and believes that transitioning to a 3D paradigm will allow more accurate quantification and characterization of fuel, leading to improved operational and ecological decision making.



Megan Rennie,
Master of Science
Candidate,
Atmospheric
Sciences. University
of Nevada, Reno.

Megan completed her bachelor's degree in Atmospheric Sciences with a minor in Mathematics in 2018 at the University of Nevada, Reno. She is working on her Masters in the Atmospheric

Sciences program with a certification in Renewable Energy from the College of Engineering. Megan has always had an interest in aerosols and their interactions with the atmosphere. Megan presently works as a graduate research assistant in the Division of Atmospheric Sciences at the Desert Research Institute where she performs open combustion in the laboratory, measuring the chemical and optical properties from the aerosols that are emitted. She is studying burning emissions of invasive species of the U.S. Intermountain West, where more frequent wildland fires are changing the landscape ecology.

2020 IAWF AWARD NOMINATIONS

The IAWF invites you to nominate some very deserving folks for these prestigious, annual awards. The recipient does not need to be an IAWF member to receive an award. If you've nominated someone in the past and they were not selected as the recipient, please do not hesitate to re-nominate them. At times we have numerous stellar nominations however are only able to select one person per award.

The nomination deadline is December 2, 2019. Awards will be announced and/or presented at one of our 2020 IAWF conferences.

Ember Award for Excellence in Wildland Fire Science: The Ember Award recognizes sustained achievement in wildland fire science. The name 'Ember' was chosen to reflect the fact that research and science often move slowly, and the benefits or impacts may not be apparent for years or more.

Firebreak Award for Excellence in Wildland Fire Management: This award was established to honor achievements and excellence in the management of wildland fire programs. It recognizes an individual who has made lasting contributions in program management and inspired others through their creativity, innovation, leadership, application, guidance, and communication in response to challenging and controversial wildland fire management issues

Early Career Award in Fire Science: This award recognizes a promising early-career professional who has demonstrated outstanding ability in any field of wildland fire science. Early career is nominally taken to include professionals who are under 40 years of age when nominated.

Early Career Award in Fire Operations: This award recognizes a promising early-career professional who has demonstrated outstanding ability in any field of wildland fire operations. Early career is nominally taken to include professionals who are under 40 years of age when nominated.

Visit our webpage for details and submission information: <https://www.iawfonline.org/awards/>

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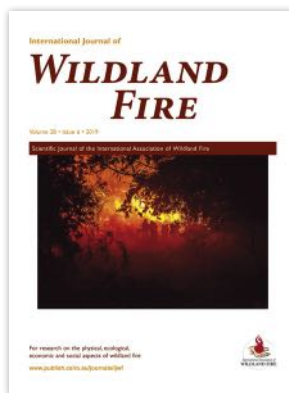


NEWS FROM IJWF - THE WILDLAND FIRE SCIENCE JOURNAL

A new IJWF committee chair and editorial team news

The International Journal of Wildland Fire (IJWF) is published by CSIRO on behalf of the International Association of Wildland Fire.

IJWF publishes new and significant articles that advance basic and applied research concerning wildland fire. Published papers aim to assist in the understanding of the basic principles of fire as a process, its ecological impact at the stand level and the landscape level, modelling fire and its effects, as well as presenting information on how to effectively and efficiently manage fire. The journal has an international perspective, since wildland fire plays a major social, economic and ecological role around the globe. All IAWF Members have free online access to IJWF.



Stefan Doerr holds a Diploma (MSc) in Geography (with Botany and Geology) from Universität Tübingen (Germany). His PhD (Swansea University, UK) was on the effects of forest fires on hydrological processes. He has investigated the environmental impacts of wildfires in Europe, Australia, and North America. He is currently Professor of Physical Geography at Swansea and has held recent collabora-

tive research positions at the CSIRO in Canberra (Australia), Universitat de València (Spain) and the US Geological Survey (Denver, USA), which focused on the relationships between fire severity, fire frequency and post-fire responses of burned terrain.

Thanks to our great IJWF team.



EDITORS-IN-CHIEF

Susan G. Conard holds a BA in environmental studies from Antioch College and MS and PhD degrees in ecology from the University of California, Davis. She worked as a fire researcher and research project leader with the US Forest Service from 1983 to 1996. From 1996 through 2008 she was the Forest Service National Program Leader for Fire Ecology Research. She currently

holds an Affiliate Faculty position at George Mason University and is an Emeritus Ecologist with the Forest Service Rocky Mountain Research Station. She is a past president of the International Boreal Forest Research Association, and a Fellow of the American Association for the Advancement of Science (AAAS).

Her research has focused on integration across scales and disciplines, fire regimes and fire effects, fire behavior, application of remote sensing, and interactions of fire with climate, with primary focus on forests and shrublands of western North America and Siberia. Dr. Conard has been co Editor-in-Chief of International Journal of Wildland Fire since her retirement in late 2008. She has over 75 publications, and over the past 10 years her publications have received an average of about 150 citations per year based on Google Scholar.



PUBLISHER

Jenny Foster graduated from the University of Melbourne with a Ph.D. (synthesis and biological activities of analogues of compounds with anti-cancer properties). During her time there she was heavily involved in teaching chemistry to undergraduate students, with a particular emphasis on demonstrating practical lab work to students with English as a second language, and intensive demonstrat-

ing to students undertaking first-year science as a second attempt.

She is passionate about communication within science, and believes the need for good research to be effectively communicated to other scientists and to the general public. This led her to seek employment as a communicator, and she has been working in the publishing industry since 1995.

She currently holds the position of Senior Journals Publisher at CSIRO Publishing, where she manages seven journals, including IJWF, and oversees the strategic direction and developments within the Journals Publishing team. She also holds a position on the Senior Management team at CSIRO Publishing, where she contributes to overall business development and strategy. Her current projects include developing pathways towards Open Science, increasing diversity and inclusion in our publishing programs, and developing efficiencies in pre- and post-acceptance workflows.

She is a member of the Scientists in Schools program, where she voluntarily assists high-school students with disabilities or English as a second language. She loves to write, and is a regular contributor to various science magazines.

A true science dork and cat-lover, she enjoys life with her husband and their four (sometimes) fabulous children, and has much interest in all things historic. She believes that the future of science rests with the youth of today, and is grateful to have a job which allows her to interact with so many remarkable scientists.

ASSOCIATE EDITORS:

The panel of Associate Editors is international in scope and will be strengthened by addition of new members from time to time. The panel is responsible for oversight of manuscripts in specific subject areas within the broad fields related to wildland fire. For a full list please visit <http://www.publish.csiro.au/wf/EditorialStructure>

EDITORIAL ADVISORY COMMITTEE CHAIR



Steve Miller, IAWF Board of Directors, recently accepted the chair of the Editorial Advisory Committee. He is the Regional Director, Fire and Aviation, USDA Forest Service Region 9 (Eastern Region) in Milwaukee, WI. Miller graduated from the University of Wisconsin Stevens Point with a degree in Forest Administration in 1985, and Masters

in Ecolcal Restoration from the University of Florida in 2016.

He has since worked for a private forestry consultant, the USDA Forest Service, Texas Forest Service, and Florida Division of Forestry and recently retired as the Chief of the Bureau of Land Resources for the St. Johns River Water Management District. Steve was responsible for directing a multiple use land management program on over 600,000 acres. Most of the lands SJRWMD manages require fire on a 3 to 5-year interval to sustain them ecologically, so prescribed fire is a major part of his duties. Steve is active in the North Florida Prescribed Fire Council, serving on the steering committee since 1992.

Steve's newest position is with the USDA Forest Service as the Regional Director of Fire and Aviation in Region 9. He served on the 1998 Governor's Task Force on Wildland Fire, Florida Forestry Blue Ribbon Commission, the Florida Georgia Fire Summits (I & II) and is a current member of the Florida Forest Council. He has feet firmly planted in both fire camps (suppression and prescribed fire) and is qualified as and ICT2, OSC2 and an RXB1. He is committed to preparing the next generation of land/fire managers, he regularly travels to teach NWCG classes, and is currently serving as an Adjunct Instructor for the University of Florida. Steve and his wife are parents of two adults; one of whom is a second-generation forester and fire manager.

For a full list of staff and editors, see <http://www.publish.csiro.au/wf/EditorialStructure>

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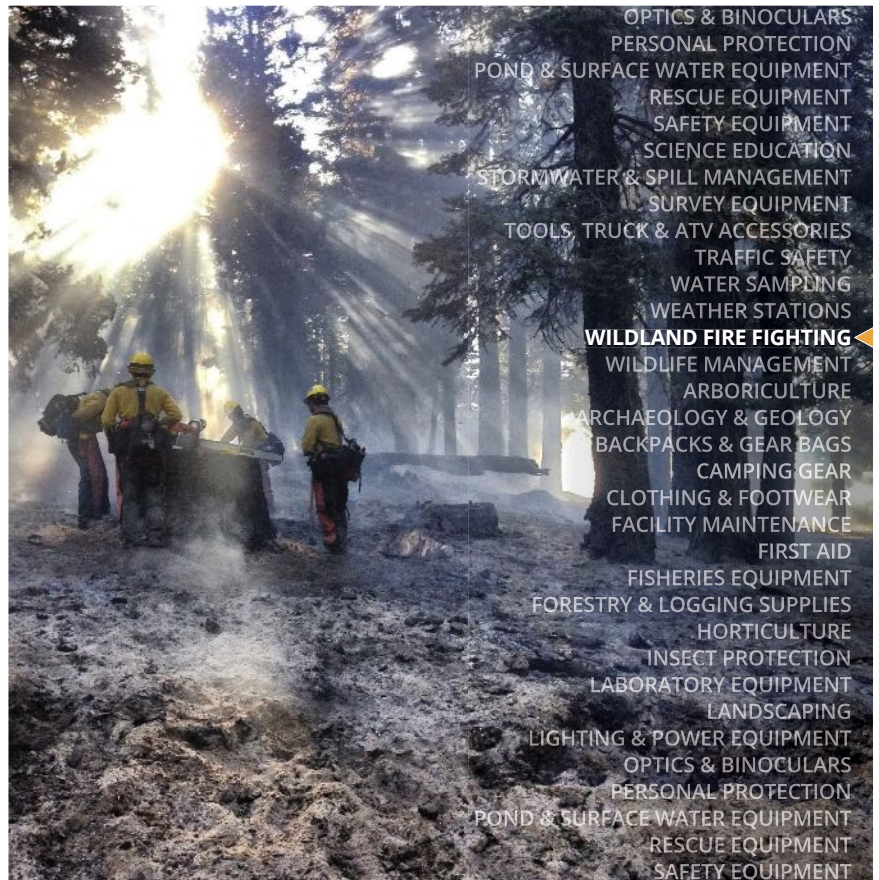


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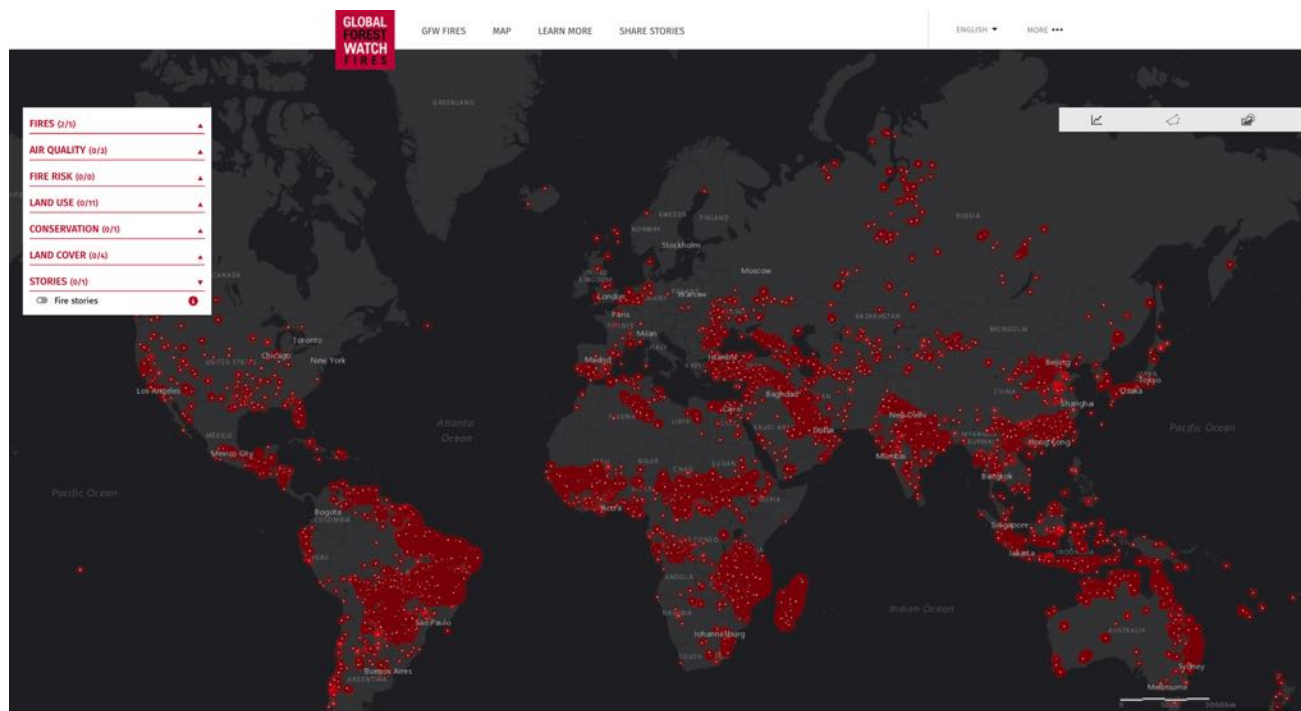
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A conflagration of fires, November 13, 2019. Fires not to scale yet wildfire seems to be a boundary-crossing off-the-scales issue. Which leads to the questions in this dialogue: what is our role as an international organization and profession?

<https://fires.globalforestwatch.org/map/>

IAWF WILDFIRE ISSUE-DIALOGUE

INTERNATIONAL COOPERATION

This is the fourth in a series of Issue-Discussion Papers offered by the board of the International Association of Wildland Fire with the goal of framing and engaging a dialogue on the key issues our profession faces today and in the future. This dialogue focuses on international cooperation as a mechanism to face our global fire challenges and asks, What can we learn from our existing international fire exchanges and what approaches will future fire challenges require?

This issue-dialogue paper builds on the observations and discussions of the prior papers: Extreme Fires (April 2019 - <https://www.iawfonline.org/article/iawf-issue-paper-extreme-fires/>); Changes in Fire Suppression Tactics and Strategies (June 2019 - <https://www.iawfonline.org/article/issue-paper-changes-in-fire-suppression/>); and Competing Priorities and Demands (August 2019 - <https://www.iawfonline.org/article/issue-paper-competing-priorities-and-demands/>).

BACKGROUND

The purpose of this paper is to stimulate discussion among IAWF membership and the broader fire community about what it means to be an international organization, and why it is a value worth pursuing.

In some cases, we have responses to the questions posed below. In all cases we hope to provoke ideas and insights as part of a broader discussion among the international wildfire community.

Concepts to consider include:

- International is the first word in our organization's title.
- International is implicit in our Diversity and Inclusion Policy:

Becoming a diverse and inclusive organization will enable the International Association of Wildland Fire to learn from others, grow our understanding, and find new ways to address, understand and implement solutions to complex problems.

As a measure of success in diversity and inclusion the IAWF has set itself the following goals in relation to international:

Our Direction - Now and for the Future

Beginning immediately, we will strive to achieve:

- Geographic diversity within the membership, Board members and all other IAWF activities.
- Greater inclusion of other underrepresented groups (age, Indigenous, disability, etc.).

We will implement this direction by:

- Actively encouraging and proactively seeking membership from all parts of the globe. (See <https://www.iawfonline.org/about-us/>.)
- Actively encouraging and proactively seeking members from all different professional backgrounds within the global fire community. (See <https://www.iawfonline.org/diversity-inclusion/>.)

KEY QUESTIONS FOR IAWF MEMBERSHIP

What does it mean to be an “international” association?

- How do we think bigger, past the immediate problem or crisis?

Why is being international something to pursue?

- “All fires are local” vs. “What’s happened to you has already happened somewhere else.”

Response: We need to better share knowledge and experience. We need to overcome the idea that we are unique. We need to identify the common concepts across international borders – for example weather dynamics, vegetation types, bird and animal habitats. It is important to identify what is specific to your problem versus what is common about your problem. We can all learn from both aspects. What’s happening to you has probably already happened somewhere else and there lies the potential for cooperation internationally. Climate zones are changing the habitat, species and the fire zones, and in turn changing the populations and landscapes potentially impacted by fire.

What have we learned from international cooperation and exchange?

- What are the similarities and differences?

Response: We learned that we have very similar needs when it comes to IT systems, however we continue to develop those in isolation. Most systems are considered to be “sunk” investment and as such many agencies may be comfortable in sharing those to others free of charge. **Response:** We have already learned much from each other during exchanges and have brought back new ideas and systems, which have been implemented.

Which countries/regions are most appropriate for global wildfire network?

- What resources are needed to make this happen?

What are the most appropriate areas for international cooperation and what are the challenges involved?

- Suppression – dealing with longer seasons, scarce resources, compatible skills, rising costs.

Response: There is no jurisdiction in the world that has enough resources – alone -- to deal with their wildland fire suppression issues into the future.

Response: Suppression exchanges have been occurring globally for more than two decades. Strong support during fire seasons has also been happening internally in North America and Europe. From the year 2000, suppression support exchanges occurred on a regular basis between Canada, United States, Australia and New Zealand. More recently, South Africa provided ground crews to Canada.

A number of questions arise from these exchanges including:

- Is this enough?

- What will happen with ever extending lengths of fire seasons, and overlapping fire seasons?
- Should we have mobile and global suppression resources that can respond based on where the potential risk is and forecasted fire activity?
- Where globally should suppression support be extended to – what are the other countries in most need?
- Knowledge/training/research – shared insights, better ways of working, avoiding repeating errors, safe working environments.

Response: There are some examples of sharing materials but overwhelmingly we have differences in a way we train people across the globe. One example of successfully applying the same curriculum and training is a leadership course conducted by a private provider from the US that delivers training courses in the US, Canada and Australia. This allows for faster and better integration when it comes to suppression deployments.

International networks – what are they, what is their value, how to maintain and build?

Response: We have a strong program of regular conferences that enable us to share learnings internationally. These include the Fire Behavior and Fuels conference in three countries in 2019, plus other conferences either managed by the IAWF directly or supported indirectly like Wildfire Brazil 2019. The IAWF has links with other like-minded groups with similar interests but in different parts of the world – these include, but are not limited to, the Bushfire and Natural Hazards CRC, the National Fire Protection Association, California Fire Exchange, Pau Costa, Lessons Learned Center, Association for Fire Ecology (AFE), international aviation, Fire Chiefs, etc.

Many online resources — websites, social media groups, webinars — connect the wildfire community across borders and time zones. These are effective, low cost, high participation platforms that complement the more intensive face to face activities. IAWF’s International Journal of Wildland Fire and Wildfire magazine are well established and respected publications with international content, authors, topics and editorial committees/editors. Both exist to promote wildfire science and knowledge internationally for researchers, operational staff and government organizations.

BACKGROUND

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WHAT HAPPENS WHEN **WOMEN THRIVE** *A Life and a Career in Fire*

Thoughts From Personal Experiences – a synopsis of information presented at a Joint Panel Discussion at the 6th International Fire Behavior and Fuels Conference, Albuquerque, NM, USA, and Sydney, Australia.

By *Tami Parkinson* (USDA Forest Service), *Tamara Wall* (Desert Research Institute) and *Tom Zimmerman* (Past-President, IAWF)

EDITOR'S NOTE: This is a synthesis of a two-hour, multi-nation panel discussion featuring the stories and insights from women working in wildland fire and bushfire. To view the entire video of the discussion, visit IAWF's Vimeo channel at <https://vimeo.com/344849805>.

THE WHY AND WHO OF THE PANELS

Across the globe there are low numbers of women working and participating in wildland fire management. The reasons why this is the case are many – some historical, cultural, or political. Despite widespread commitment in recent years to improve diversity and inclusion, many organizations are slow to change their ways of doing business and reasons for this are not clear. By slowly or not striving to improve diversity, they miss out on the benefits that flow from having a more diverse workplace. These benefits lead to more innovation, reduced turnover, and wider access to top talent. An article published by the New York Times from a research project at MIT identified three characteristics defining the smartest teams

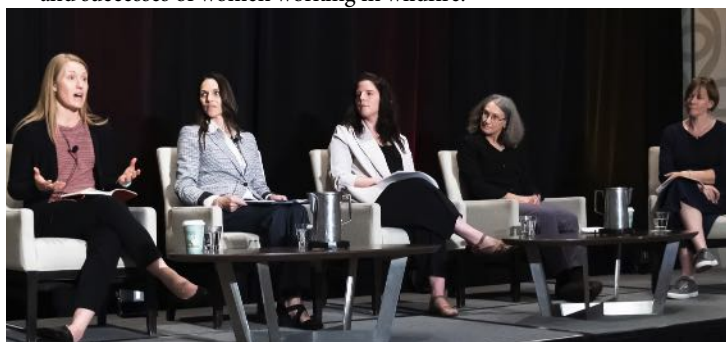
- Quality and scope of team discussions – team discussions being open, equal, and not dominated by one or two people,
- Emotional state – team members have increased ability to measure emotional state from images with just the eyes visible, and
- Team composition – highest performing teams were composed of more women than men. The article can be found at: <https://www.nytimes.com/2015/01/18/opinion/sunday/why-some-teams-are-smarter-than-others.html>.

The International Association of Wildland Fire (IAWF) has markedly reinforced its position on diversity and inclusivity over recent years. As part of these efforts, IAWF wants to provide renewed attention and increase members' and others' awareness to these issues. As a global

communication leader in wildland fire management, IAWF has unique opportunities to center attention through published documents and at IAWF events such as conferences.

The 6th International Fire Behavior and Fuels Conference was conducted in April 2019 at three locations simultaneously: Albuquerque, NM, USA, Sydney, Australia, and Marseille, France. This conference provided an opportunity to share information between locations, reach a large number of participants in more than one location around the world, and continue communication on these issues. A moderated panel discussion titled "What Happens When Women Thrive – a life and a career in fire" was presented and shared between the Sydney and Albuquerque sessions.

The moderators' questions and panelists' responses were shared via live streaming that connected the two locations in a single theme -- to explore the challenges and successes of women working in wildfire.



North American participants (left to right above) included:

Annie Benoit – United States Department of Agriculture (USDA)
Forest Service, National Wildfire Coordination
Group (NWCG) Training Specialist

Maria Sharpe – Canadian Interagency Forest Fire Center (CIFFC),
Fire Science and Information Manager

Michelle Walker – (formerly Ryerson), Bureau of Land Management,
Idaho Deputy State Director

Deanne Shulman – Retired USDA Forest Service – International Programs;



AUSTRALIAN PANELISTS (LEFT TO RIGHT ABOVE) INCLUDED:

Mika Peace – Research Scientist, Bureau of Meteorology;
Allison Donovan – District Manager, Parks and Wildlife Services,
 Department of Biodiversity, Conservation and Attractions;
Erika Lind – Prescribed Fire Planning Officer,
 Forest Fire Management Victoria
Bronnie Mackintosh - Training
 Officer, Fire and Rescue New
 South Wales, Australia

These panelists brought a range of career experience including early, middle, late, and retired career tenures and complimented each other in the breadth of their experience as well as representing international experiences. This diversity of participation with the panelists in Australia and North America provided similar but different stories to tell, regarding success, failure, hope, and ambition.

Panel facilitators included Tamara Wall, Desert Research Institute and Tami Parkinson, USDA Forest Service in Albuquerque and Bronnie Mackintosh, Training Officer, Fire and Rescue New South Wales, Australia on the Sydney side (both of whom are on the far right in the respective photos).

This synthesis of the panel provides background on the topics discussed and a synopsis of panelist answers, experiences, and interactions. To focus on their collective experience and insights, panelists are quoted or paraphrased in the bulleted paragraphs but not identified by name. The online video of the panels (<https://vimeo.com/344849805>) allows viewers to identify specific speakers and follow along with the dialogue.



The panel discussion opened by framing questions within the context that women and men both bring complementary but different skill sets and perspectives to problem solving and communication within a team environment. The discussion focused on the value of the skills, perspectives, and successes that can result when women thrive in their fire careers.

STORIES OF STRENGTHS AND SKILLS

Imagine you are meeting with a new supervisor, and he/she asks you what strengths/skills you feel that you bring to the team that will support the team's success? What story or example from your past experiences would you use to describe this?

- "I was working with international programs at the time, and giving a presentation to India regarding ICS and how it could improve their disaster response system. I submitted a proposal to USAID, an international support agency for the US government. The project was generously funded and still is to this day for international training involving the Incident Command System (ICS). I was given the creative license to pull this together and the results are such that the USDA Forest Service is still very actively involved in teaching ICS to other countries. This initial project had 44 people involved, for many this was their first exposure to countries with less resources and infrastructure to respond to disasters. Not only did we help the receiving units with ICS training, but our own people came home as changed professionals – humbled."
- [Some observations of what a woman manager brings to fire]: "Building connections and providing a sense of purpose to the people you are working with or supervising, regardless if it is the first day or the 30th day. Welcoming people to your patch or unit; realizing they are there to contribute to the event that brought them there and treat every moment you can as a teachable moment. Relationships in an office setting can be built over months of time; on the fireline these relationships are being built within minutes. Remembering that working as a leader sometimes a smile or a laugh can go a long way to improving crew morale."
- "I was the fire manager on my unit and there was a fire on the neighboring district which we sent suppression support to assist with the incident. Not long after the crew arrived at the incident they were burned over – of the four injured two were from my unit – there was one fatality and the other had 3rd degree burns over 25 percent of her body and she spent her 25th birthday in the hospital. My unit resides within a community of approximately 500 people, the injury and fatality significantly impacted this community. Despite being a fire manager with solid operational skills, I also brought soft skills to the situation – I used these soft skills a lot, listening to my staffs and the community, in addition to having empathy and compassion for those affected by the tragedy. This event has helped me recognize and develop relationships within my organization, to gain the capability to draw upon others' strengths, learning humility and how to learn from others, and confidence in promoting my own skills and strengths to compliment the organization. These relationships will foster trust and authenticity, providing the structure for a strong team environment."
- "When I was ready to embrace having a family in addition to working in fire, I communicated my intentions with my

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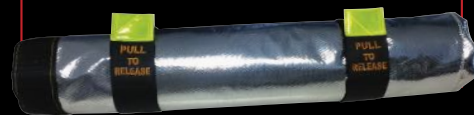
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leadership and was candid about my limitations. Given the limitations for operational activities I found other ways to be involved and support the efforts while managing my personal life and changing expectations. Communicating that I was willing to give 110% to the organization when things were busy but I had limitations and that might support activities would be a different than what they once were."

CAREER DECISIONS

What was a decision you made that had important outcomes for your career, and was this a difficult decision to make?

- "I was trying to become a burn boss but our opportunities were minimal due to other environmental factors, so I opted to look for bigger and broader opportunities internationally when I found the "Women in Trex prescribed fire training" in California. I packed my bags and flew across the ocean to participate in this program, I was nervous and scared to embark on the adventure. Participation in this program helped me in many ways, obviously helping me obtain the qualification, but also working with other strong and smart women in fire. Seeing and working with female leaders provided leadership growth for other up and coming women nationally and internationally."



- "When making the decision around children, you seek to maintain your career while balancing the calls of being a mom. There was an overriding feeling that I had to work full time to maintain the commitment to fire,

to status rosters, and other fire duties, while balancing the duties that come with being a mother – nursing, nurturing and home time. After working full time as a fire manager and balancing the call of duty with work and motherhood I look back and recognize that just because we have done things one way in the past doesn't mean we can't do things differently as an organization in the future, such as being open to flexible work schedule, shared positions or other creative ways to meet the obligations of work and the balance of family."

- "I was to a point in my career where I wanted to go back to school for an advanced degree in fire weather and fire behavior after working as an operational meteorologist around the country. This was a big decision to make for me personally, but the people who supported me helped make the decision easier. Two years into the advanced study I had my first child, this was a tipping point for me, to stay on course or do something different now that my energies would be pulled again in another direction."



"Again, my peers, colleagues and supervisors supported my advanced education all the while balancing a young family. It is important to note that when your colleagues and supervisors believe in you, it helps you believe in yourself. Research around this topic indicates that with all things being equal women will typically rank their capabilities

lower than males. The support from supervisors, peers and colleagues can really help women gain the self-confidence to compete and showcase their skill sets for various positions. "

CHALLENGES AND BARRIERS FOR WOMEN

Challenges you faced in your career that were barriers because you are a woman.

- "This is tricky because it can be subtle and accumulative over time. Working as a supervisor of project crews and frontline crews I hear little things or comments about a person's size or abilities to run a chainsaw, to name a few. As a young person coming into the organization there is typically a lot of chatter that a person has to have so much experience, and be a certain way to compete for some of the higher-level jobs. The innuendos and commentary tend to have an effect on the young aspiring people within an organization who don't necessarily want to raise their hand for additional duties due to the peer banter in the underground."

"It took me a very long time to put my hand up because of this same feeling. Up until that point I really didn't feel as though I was fully contributing, instead I was trying to blend in and not be the object of the banter. I encourage others to be aware of the impact of language and comments that happen in our workplaces as subtle as they may seem. They can have a negative impact on our personnel, the accumulation of such comments can later lead to the chip on the shoulder and potentially hamper a person's long-term career. We all need to play a role in calling out the subtleties that occur within the workplace despite it feeling uncomfortable."

- "We all have an unconscious bias, I encourage you to challenge yours. Unknowingly we may be setting people for a skill set based on gender, size, or other factors and these may not be the skills needed to round out the organization. In Australia there was an example where men and women within the fire organization rotated around the "state" working for different supervisors to be exposed to styles and leadership qualities. The intent was to cross train everyone for operational and administration duties so as positions opened up within the organization there would be a deeper more qualified applicant pool. An evaluation was completed on this type of process and it showed that across the board men were accomplishing their operational qualifications but weren't gaining administrative skills, and exactly the opposite was occurring for women. It didn't matter what district these folks were working in, who they were working for or other factors. The bottom line was an unconscious bias that played into how we view and capitalize on peoples' abilities and skills."

"This affected our organization when we were looking to fill positions with operational qualifications. Due to the unconscious biases, the men were more qualified operationally and the women were better qualified for the administrative type positions. We all play a role with unconscious bias, it is something to keep in perspective and evaluate frequently to make sure the actions being taken are fair and equitable."

- "Breastfeeding in the workplace – this is an uncomfortable topic for a lot of people. How can we provide support or continued support of new families trying to balance work and parenthood? Family balance isn't all on the female – males are juggling childcare and trying to manage shift work or being engaged at all hours of the day that may or may not fit "normal" childcare options. How do organizations truly support the family/work balance issues regardless of gender?"
- "I have had to manage my fire career with parameters, it is a delicate balance to maintain and obtain fire qualifications – trying to take on fire assignments and balancing my personal life schedule with my husband who is also a primary fire fighter with a very unpredictable schedule. I have

had to make hard choices – but these were my choices and I recognize that and remember that when there is a perception of unfairness. I have chosen to live in certain areas, not moving every few years to climb a career ladder, carefully coordinating my availability for a fire assignment so I have childcare covered with my husband and supporting fires at the same time. There have been times in the past where I have made logistical arrangements to have my mom provide the childcare, so she could bring my daughter to me on a fire assignment to see mom, but also to see the line of work I do.

"As a woman in fire with children and a husband as a primary firefighter you have to be creative to make things work. It isn't going to be a "typical" experience and things are never going to be the "perfect" balance - kids, work, and fire assignments (for either parent). I have come to realize that "perfection" is in the eyes of the beholder and it is all a balance – what works for us, may or may not work for others in our same situation."



- "I made a decision early on that I wanted to be the head of Alberta Wildfire. I never navigated my career to get to that point necessarily, instead I took jobs I really enjoyed, and took advantage of many opportunities. There was a point in my career when I was being overlooked to help fill in as acting manager. I asked my supervisor why that was the case. The response was that he didn't think I had the skills to perform the job. I moved on from that conversation but it made me reflect on the situation – coming out of school we can all be pumped up about going into the "real" world and making changes or differences but we all have unconscious bias that comes into play that can either be positive or negative. Embrace these bumps or changes as learning opportunities and don't let them get the best of you."
- "I worked for the USDA Forest Service for 37 years. My first 12 seasons were operational positions – engines, hotshots, and smoke jumper. I had a degree in forest management and was coming to a point where I wanted to move into more of "management." I was encouraged to put in for a battalion chief position by my former hot shot superintendent – I got the job in the early 80's. The job was bittersweet, no longer was I traveling the country seeing

incredible places. Now jump forward nine years and I am applying for the next position – district FMO – I have been a model employee, received lots of awards and recognition, and I was overlooked for this position for a lesser qualified male employee. I filed an EEO complaint to look into the case – I would advise not trying this at home, not an easy experience or ordeal. The transition from model employee to one that is ostracized and marginalized at the district and at various meetings was a difficult time for me. There was an opportunity to help International Programs coordinating with Mongolia and Indonesia on fire assignments – enhancing partnership opportunities and providing technical expertise as needed. All the while my EEO complaint was being reviewed. The EEO complaint was resolved in my favor – after three long years, International Programs created a position for me and that is where I finished out the remaining 14 years of my career.

"I don't know if I would have made this leap to a different program without the painful experience that pushed me to consider other opportunities. Looking back, it was the best thing that could have happened, but I wish I could have figured that out prior to going through the painful, humbling process of an EEO complaint. In my new position I was challenged to develop international partnerships and bring teams of people overseas to assist with training and sharing of knowledge. It was an amazing experience."

- "My challenge was I started working for the USDA Forest Service in 1974, and the span of my career coincided with the integration of women into the agency to positions beyond administrative duties. I was the first female in a number of positions and at that time there was a feeling that I certainly wouldn't come back for a second or third season – but I did. Sexual harassment was commonplace – I recognized it for what it was and I still worked in this environment; I do have to acknowledge I was never physically assaulted but the verbal and hostile work environment was rampant.

"There is a saying that if 'they go low you go high.' Instead I went lower and they went even lower and so goes the story. Throughout my career I felt as though I had to prove myself, and be equitable with all of the things the guys could do – physically and mentally. I was trying to balance the stereotype that women are physically weaker and cannot handle the physically challenging work environment."

QUESTION FROM THE AUDIENCE:

Reflect on the pressure you may have experienced, internally or externally, to masquerade as a man, particularly in an operational environment.

- "I would hang out with the men and avoid hanging out with the women due to the femininity and the perception of lack of strength. I covered up my feminine side to be 'one

of the guys.' My turning point was when I started seeing the younger generation coming up and they were putting on a "cover" at work to integrate into the work environment but after work I could see these same women as bright, courageous, and energetic people. This emphasized to me that we as leaders need to be comfortable just being ourselves, who we are and being okay that we "aren't" one of the guys. It took me eight years to come to terms with this thought of being happy with who I am."



ADVICE FOR A YOUNG FEMALE FIREFIGHTER

SHORT ANSWERS:

Imagine you are working one afternoon with a young female firefighter and she asks you for advice about having a career in fire and juggling life with those responsibilities. What is the best advice you would give her?

- "Make sure you build a support network outside of the fire family, maintain friendships outside of the workplace, and stay connected to hobbies. It is so easy to be available to take the next fire assignment or standby to gain the experience and time in for the next leadership position. If you don't balance your personal life and wellbeing there is a high potential for burnout."
- "Do what you love. Most of us are in this line of work because we like it. Never sell yourself short, accept opportunities and don't sell yourself short that you got the position just because you are a female. Recognize that you are being offered the opportunity because you do have skills and someone is recognizing that you have the ability to perform the job."

- "Recognize that a career is more than just a job, it is about continually learning for yourself and going one step further to share that knowledge with others. Additionally, it is very important to take care of yourself, be sure to maintain your physical and emotional health, making time for yourself. By making time for yourself I am referencing getting exercise to stay balanced physically and mentally. Women, in general, need friendships both professionally and personally to be balanced."
- "Be flexible and keep your options open as one never knows what life will throw your way, it is important to be adaptable and flexible. There will always be change, it could be in your personal life with illnesses, babies, or it could be associated with work and changes with supervisors, or bigger organizational changes – keeping options open will be beneficial in the end."
- "Follow your passion, be yourself, demonstrate your unique skills, be flexible and open to learning and sharing."
- "Early in your career it is important to remember that it is a marathon and not a sprint. Maintaining work life balance is important as you work through life. There are lessons learned along the way and we can let them define us or we can turn these events around to help develop and maintain a better fire program. As a survivor of the South Canyon Fire, I could have let that event define me, instead I have grown from that horrible experience to help make a better fire program."
- "There are many nuances within fire management and roles or skills that are overlooked. Keep an open mind, talk to people in various positions, find a mentor that you can work with and say yes to opportunities as they come up."

BETTER SUPPORT FOR WOMEN WILDLAND FIREFIGHTERS?

How can fire management institutions better support women and women wildland firefighters –



as if there is one policy, behavior change or support element that would have impacted you the most.

- "It is more about behavior for fire managers. We know what we have to do when there is a high tempo and we have a job to do. But when we are at a slower tempo – to allow for flexibility in the workplace can go a long way regardless of the gender of the workers. Leaders within the organizations can make a choice to set an example for their peers and subordinates or staffs to take time off to run kids to the games, stay home with sick kids or juggle other parental duties."
- "[To]" emphasize the benefits of mentorship early in one's career, and have the agencies buy off on the need to have this as an "official" type program to help provide guidance."

CLOSING THOUGHTS

The panel was well received at both conference locations and provided a wide-ranging and comprehensive look at how women can thrive in wildland fire management. Women have thrived in fire over the years, but numbers of successes were limited, personal sacrifices were necessary, struggles required strong character and endurance and were not easy, and management support, while highly variable, was mostly minimal.

Barriers, both internal and external, have existed for decades and change is needed. Gender diversity should be embraced and endorsed as it is widely known that this can only strengthen organizational teams, increase capabilities, expand limits to strategic thinking, and provide opportunities for increased morale, productivity, and personal and professional growth.

Management support and clear evidence of this is vital as young people are very impressionable and one comment can make or break a big decision either to go into fire or not to. Identifying individual strengths as well as weaknesses, focusing on strengths and complimenting weaknesses will help build a very powerful team and support individual growth.

IAWF supports advancement of gender equity in all wildland fire management activities. We are actively seeking to identify issues in the wildland fire community and take actions to change the culture, thinking, practice, and outcomes to create the most effective working environment possible. Diversity will and must continue to garner greater importance. This only makes us better at what we do and strengthens professional wildland fire management.

IAWF thanks these women who served as panelists and facilitators. We recognize how important their experiences are for others and how much effort they have expended during their careers to thrive in wildland fire management. They are truly role models deserving our appreciation for their personal sacrifices and groundbreaking careers.

TO VIEW THE PANEL PRESENTATION

Visit <https://vimeo.com/344849805>.

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THE 3RD INTERNATIONAL

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smoke

SYMPOSIUM

**RALEIGH, NORTH CAROLINA AND
UNIVERSITY OF CALIFORNIA, DAVIS, USA**

The 3rd International Smoke Symposium will bring together researchers from the atmospheric sciences, the ecological sciences, health sciences, mathematicians, computer sciences, climatologists, social scientists, and others to discuss the complex issues of smoke and identify knowledge gaps and opportunities for innovation and development. The Symposium will be held in Raleigh, North Carolina with a satellite location at UC Davis Convention Center. The Symposium will be a hybrid, which combines in-person and streaming presentations.

CALL FOR PRESENTATIONS - DEADLINE DECEMBER 20, 2019

Building on the previous two successful editions, this symposium is a venue and international nexus for sharing the latest developments in research, management, and policy around the important topic of wildland fire smoke from wildfires, rangeland fires, and prescribed burns.

This symposium is targeted towards researchers and practitioners with expertise in a range of wildland fire smoke topic areas including: air quality monitoring and/or regulation, land management, fire responders, extension mechanisms, public health, fire weather, climate change and forecasting, among others.

We are seeking Oral Presentations and Poster Presentations for both the Raleigh and Davis venues on topics listed below. In addition to a full suite of scientific talks, ISS3 will debut a feature set of Ignite Talks aimed at a broader audience and made available via the web.

CALL FOR WORKSHOPS - DEADLINE NOVEMBER 25, 2019

The workshops will take place on Monday, April 20, the day preceding the 3rd International Smoke Symposium (ISS3). The purpose of the workshops is to provide a forum for researchers and practitioners in wildland fire, smoke management, public health, and air quality management to discuss and exchange interests on defined topics. We view these workshops as an opportunity for knowledge and technology transfer.

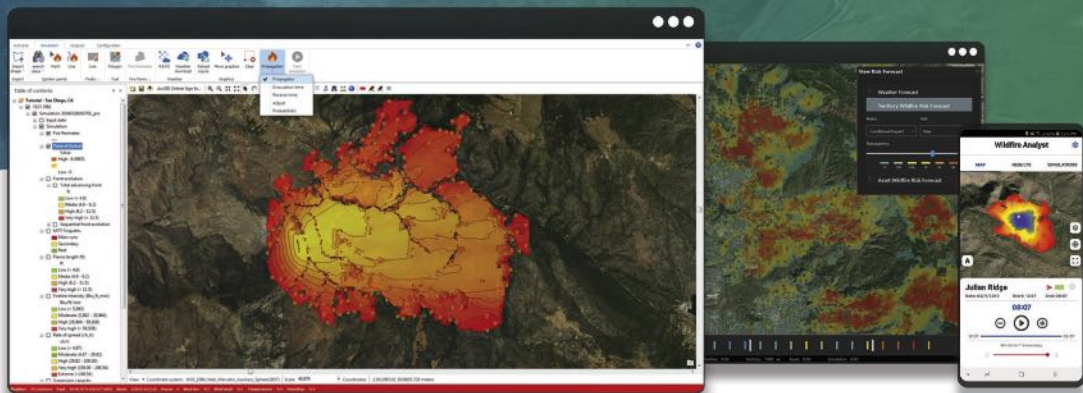




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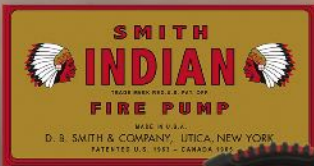
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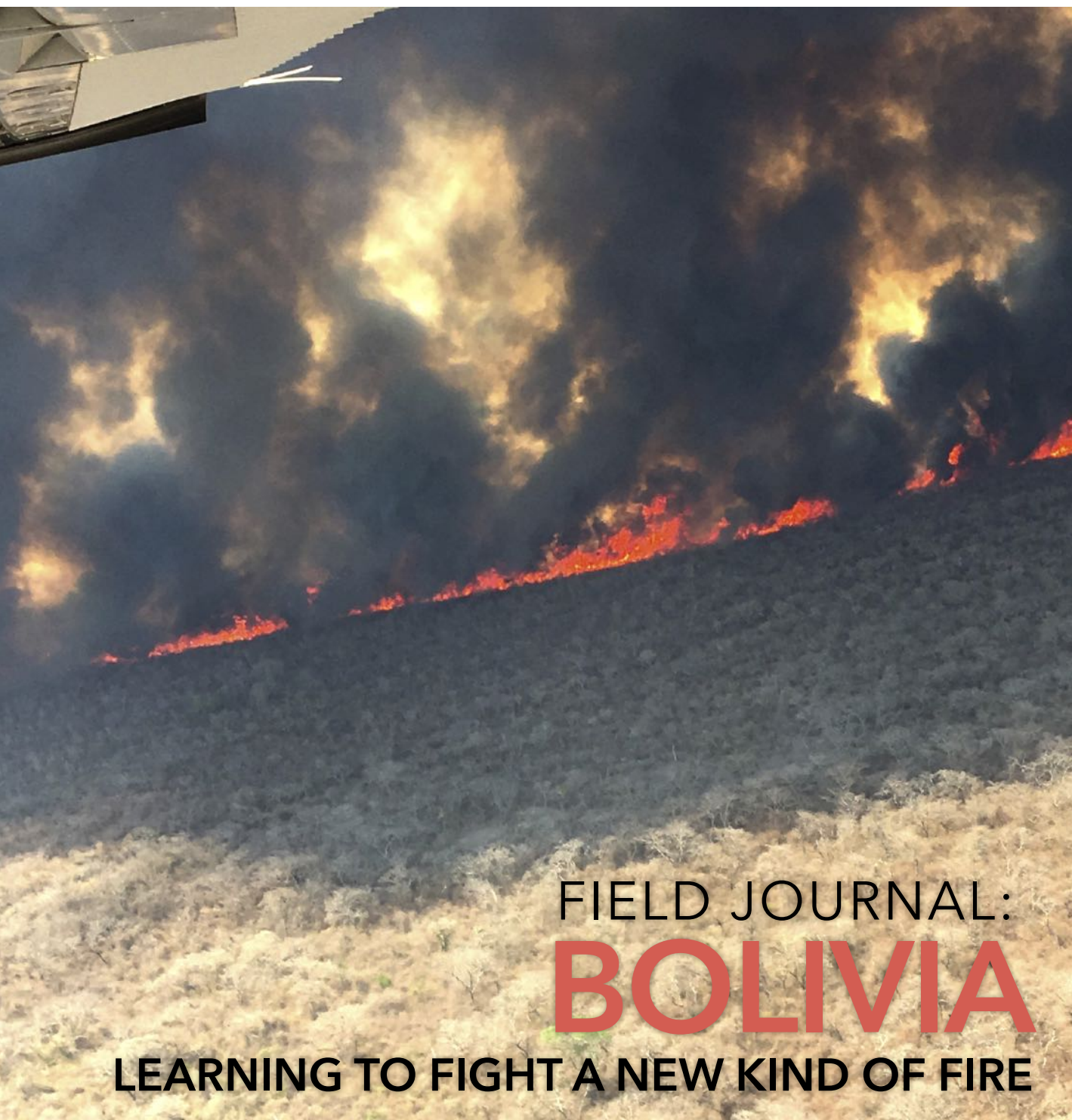


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FIELD JOURNAL:
BOLIVIA
LEARNING TO FIGHT A NEW KIND OF FIRE

*Analyzing and acting on extreme wildfires in Chaco
(Bolivia) and Cerrado (Paraguay) ecosystems.*

HOW A KNOWLEDGE NETWORK EVOLVED INTO A VIRTUAL INTERNATIONAL TEAM TO SUPPORT OPERATIONS IN THE FIELD.

*By a seven-nation team that included ... Marc Castellnou,
L. Alfaro, M. Miralles, D. Montoya, B. Ruiz, T. Artes, L.
Besold, J. Brull, F. Ramirez, M.A. Botella, F. Martins, M.
Bachsficher, J. Vendrell, M. A. Botella and S. Purdy.*

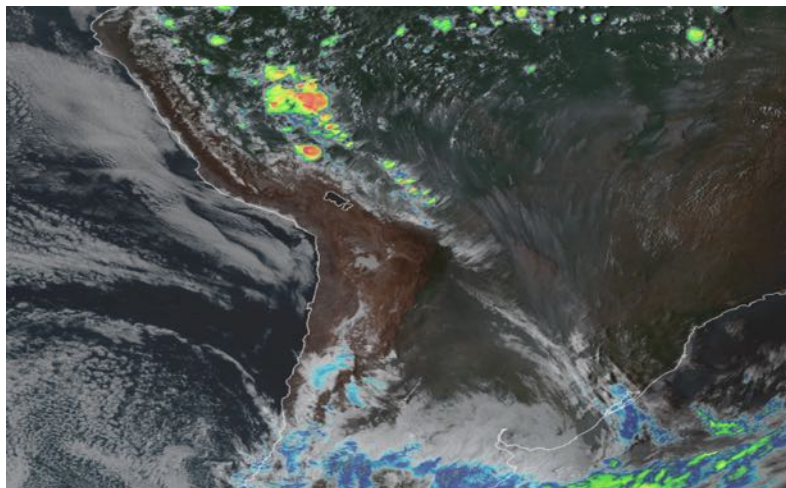


Fig. 1. Fires burning across the South American continent on the afternoon of August 8, 2019 (RAMMB / CIRA @ CSU)

AUGUST 20, 2019: FIRES IN EL CHACO OBSERVED BY SATELLITE

IN THE DRY JUNGLE, A “NORMAL” DRY YEAR sees larger fires. In the middle of August 2019, the news of the fires in the Amazonia, and especially of the fires in Bolivia, caught our attention. There was much discussion about how important they were and how normal the situation was compared with previous years. The analysis of the area's fire regime clearly shows conflicts linked to socioeconomic dynamics, where deforestation and land use clashes with the interest in preserving vast ecosystems, especially the rainforest.

The Chaco or Cerrado, a dry jungle, has much more historical fire presence than rainforest and GWIS data quickly confirmed this vision. Without entering into a deeper analysis of causality and the socioeconomic phenomenon that pushes it, we understood that we are facing the normal burn season or “chaqueo.” This year, 2019, without being a dry year, has similar numbers as the average when looking at ignition points, but the surface affected is being much higher. Although it is the annual anthropic fire regime, the higher average temperature is creating more

intense fires and therefore the size increases as it is more difficult to limit them or that they become extinct during cooler nights.

The clear shot of Sentinel 2, with several pyrocumulus (PyroCu), over Chiquitania (Bolivia) on August 18 attracted our attention for extreme events, as well as that of several pyrocumulonimbus (PyroCb) monitoring groups in different social media. (PyroCu: “A cumulus cloud formed by a rising thermal from a fire,” may transition to a PyroCb: “An extreme manifestation of a pyrocumulus cloud, generated by the heat of a wildfire, that often rises to the upper troposphere or lower stratosphere.” See <http://glossary.ametsoc.org/wiki/Pyrocumulus> and <http://glossary.ametsoc.org/wiki/Pyrocumulonimbus> for definitions.) After the event of Argentina in 2018, this was the second PyroCb seen in modern times in South America, although within the group we consider it is the third, with “Las Maquinas” in Chile (2017) as a PyroCb night phenomenon. We were setting up an observation/learning agenda for these 2019 fires. We needed to learn more to understand these pyro-atmospheric events in South America.

Fig 2. Burned area and number of fires in Bolivia annually from 2001 to 2018. Initially, 2019 does not yet stand out but marks a change in the trend -- and with the long season ahead it threatens to look like 2010 (by GWIS, 1st September 2019).

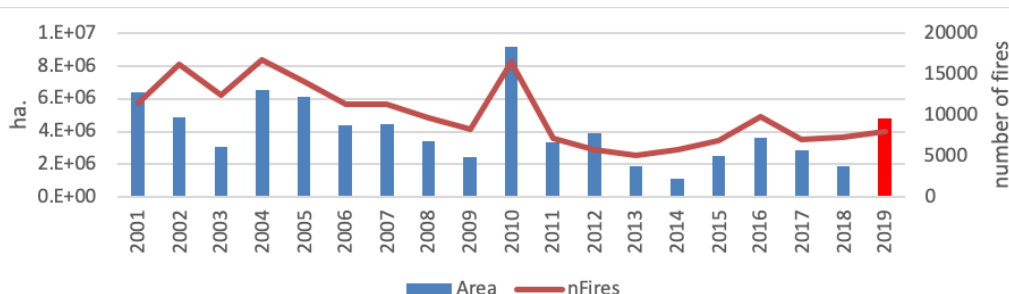




Fig 3. Sentinel 2 image over Roboré Fires on August 18, 2019 (Sentinel Playground).

AUGUST 25, 2019: SHAPING A TEAM AND IDENTIFYING TOOLS

- Tool for risk, statistics and hotspots <https://gwis.jrc.ec.europa.eu/>
- Tool for using GOES 16 images <https://rammb-slider.cira.colostate.edu/>
- Tools to work with GFS model and soundings <https://www.tropi-caltidbits.com>
- Tools for Sentinel 2 images <https://www.sentinel-hub.com/explore/sentinel-playground>

The alarm was flashing red again. It was the second PyroCb in the same area. There was a lot of noise on the subject in social media, since we had gone from seeing two PyroCb in 10 years in South America to seeing two more in a single week. We were in contact with Argentina where Luis Besold shared the reality of the year in the area. Quickly from Chile, Europe and the USA a virtual working community was established to follow and evaluate the situation, with an initial objective of validating knowledge and learning through the observation of the phenomenon.

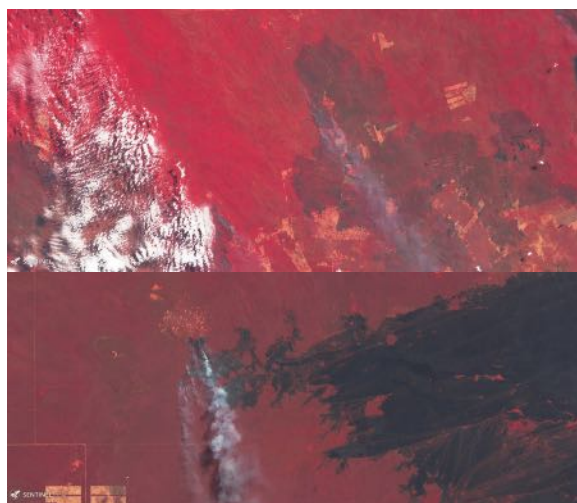


Fig 5a, 5b. Fire in Concepción, low intensity, burning understory (top). Fire in Roboré, high intensity and severity. (Sentinel Playground, 09/07/2019).

AUGUST 28, 2019: STARTING THE LEARNING PROCESS

Webinar link: <http://bit.ly/2kDMHd7>.

After the assessment of what happened on August 18 and 25, a webinar was convened for the fire service in Catalonia, with the participation of some other European areas, in order to explain and clarify, beyond the media noise, what was going on with the big fires in the Chaco area and what we were looking at. The webinar was shared online through Pau Costa Foundation network and served to focus the issue, reduce social alarm and give criteria to the European fire brigades. But especially it served to frame the ability to understand the

pyroconvective processes ongoing in Bolivia, testing the skills learned after confronting the episodes of Chile and Portugal in 2017. This is what worried and moved us into this project: to test our skills and go deeper in our understanding.

Beyond the voices of “crisis” from Europe or, on the contrary, data from many observatories demonstrating that we were on a “normal” or “slightly accelerated” trajectory, what was found is that the PyroCb convective capacity of these fires was new in the area (they had not been detected since we have satellite data on the area). Indeed, the huge perimeters created by these firestorms, with a whole dry season ahead, would be ready to repeat the pyroconvective process as soon conditions will allow it.

News coming from the area told us that they were still not aware of these processes taking place. Thus, we moved ahead to get in contact with teams on the ground.

Informal team members who worked the 60 days the fires were active.

		Member	Country	Institution	Role
Action / Eyes on the ground	Main source	Luisa Alfaro Dany Montoya	USA	OFDA	In the field, real fire monitoring, satellite observations validation and forecasts. Fly daily to validate observation and heights of smoke plumes. Transform forecasts into action in the field.
	Support	Luis Besold,	Argentina	UN Team in Bolivia	Share reality of the area through Argentine teams and join UN team in Bolivia.
Eyes in satellite and forecast models	Analysis and report	Marc Castellnou, Marta Miralles, Borja Ruiz	Spain	GRAF BombersCAT	Reports writing. In contact with UN, EUCP and OFDA team Analysis of PyroCu and PyroCb in the area using GOES 16 compared to GFS skew-t and GWIS index.
	Information analysis	Jordi Brull Jorge Saavedra Fernando Ramirez	Chile	CONAF	Source of observation data. Collaborate in assessing the potential of PyroCu and PyroCb
		Tomas Artés	Italy	JRC EU	Management of the data in the GWIS database. Development of the experimental index of fire convectivity
		Scott Purdy	USA	SJSU Fire Lab	Source of meteorological observation data. Share the assessment of PyroCu and PyroCb phenomena
Support info		Camille Stevens-Rumann	USA	CSU	Aridity data analysis in the area
		Mercedes Bachfscher	Argentina		Work on fire severity mapping in GIS with Sentinel2 data
		Miguel A. Botella	Spain	UT 602 Generalitat Valenciana	Share assessment of PyroCu and PyroCb phenomena
		Jordi Vendrell	Spain	Pau Costa Foundation	Network host supporting the team

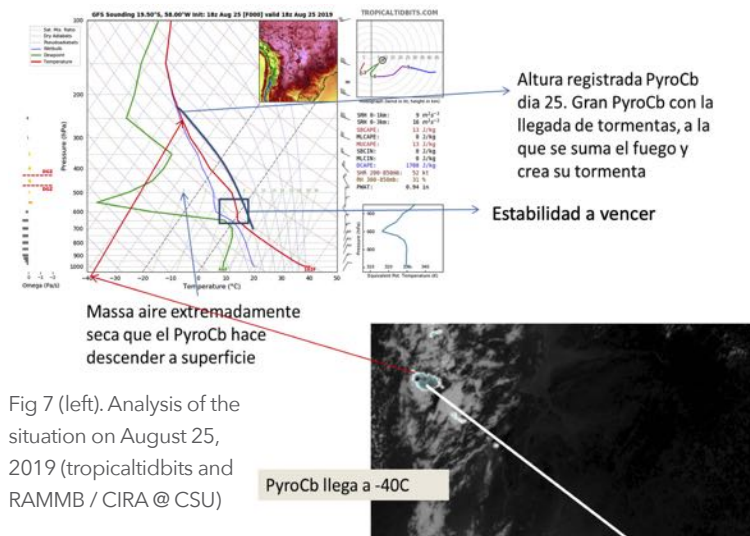


Fig 7 (left). Analysis of the situation on August 25, 2019 (tropicaltidbits and RAMMB / CIRA @ CSU)



Fig 8a.. Images of professionals and volunteers working the fires during the first days of September in the Rorobé area (Alfaro, L. OFDA-USAID).

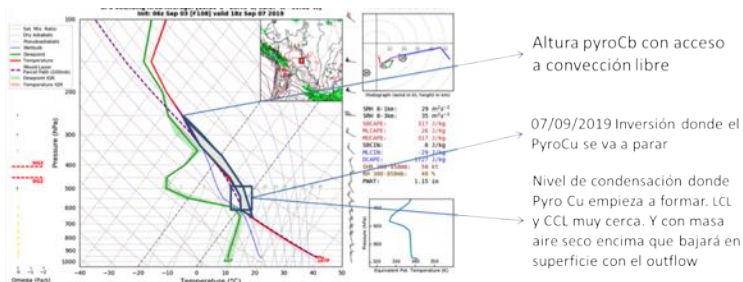


Fig 9. Analysis of potential transition from PyroCu to PyroCb on September 7, 2019. On September 6 it was possible, but it was on the 7th when it was most likely. Figures extracted from the reports. (tropicaltidbits)

SEPTEMBER 3, 2019: GETTING INTO AN ASSESSMENT PROCESS

At that moment different teams were being deployed to meet the demand for international help. UN and EUCP were the closest ones, all of them with known people. All of them demanded increased situational awareness and intelligence of the fires and advice on the convective phenomena. According to those needs we intended to start making forecasts, using the tools available, to inform teams deployed about extreme fire behavior in case events like those of 08/18 or 08/25 could be repeated.

In this process of informing Luis Besold (already with the UN team in the field) and preparing support for EUCP teams, we contacted Luisa Alfaro and Joaquin Montoya of the OFDA, also deployed in the site. This allowed us to receive good feedback from the field, of what was really happening, so our forecast could be confronted with reality and adjusted. They become our eyes on the ground to validate forecasts and observations of convective processes; meanwhile we became their eyes on the models and the satellite monitoring of the events.

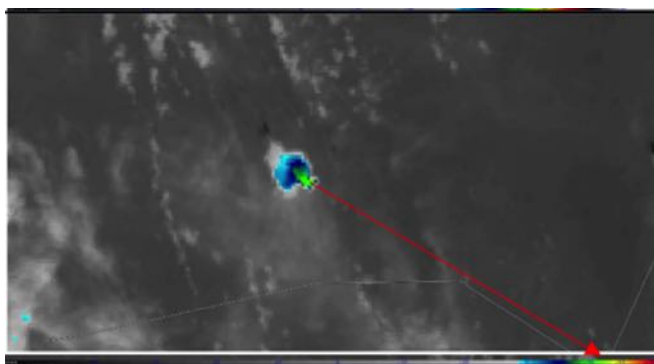
Being on a fireline makes it difficult to specify column height and observe the “overshootings” of the PyroCb. Nevertheless, satellite evaluation without field observation makes understanding the real phenomenon difficult. Joining efforts creates a win-win situation between two teams, with both needing to monitor, learn and predict the processes on an operational scale, beyond the scientific study.

The information we were providing was initially under discussion due to the believe that this PyroCb type event was not happening there. To locals it seemed the situation was just a combination of several number of ignitions and hot weather. They insisted that fires were “normal,” and Bolivia had a long history of extensive fires in campaigns such as 1999 or 2010, with 3 million of hectares burned and PyroCu phenomena observed. Deployed teams did not yet believe the fire storm would happen again and doubted if it really was the driving force changing the intensity of the fire.

SEPTEMBER 4, 2019: 1ST REPORT FOR POSSIBLE SEVERE EVENT AND PYROCB LIKELY

First situation forecast reports were issued on September 3-4 for September 6-7. The situation of dry north wind and high temperatures was repeated, like on August 17 and 18. The sounding showed, among other data, high instability on the surface as well as inversion over condensation level. It was a clear situation that allows PyroCu processes to happen and we warned that on September 7 a more-than-probable PyroCb would again occur.

Fig 10. PyroCb on September 7, 2019 -- bigger and more powerful (RAMMB / CIRA @ CSU).



SEPTEMBER 7, 2019: TRUST ESTABLISHED; WE WERE DEEP INTO OPERATIONS!

The PyroCb was big and intense. We were all in shock; it was predicted, but it was happening in front of us and we could monitor it step by step. Fire fronts were delivering a sustained rate of spread (ROS) of 7 Km/h under the third PyroCb of the month, much more powerful than that of August 18. It was a giant PyroCb without extra moisture, but strong winds and in the top it's temperature drops to -53 Celsius according to the Goes16 image.

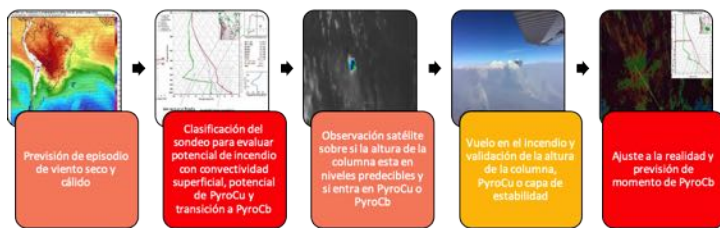
Suddenly a team that monitored and reported from far away the situation, based on models and satellite data, was integrated with and vital for those who actually were in the field and needed analysis to understand what was happening, how it was happening and what to expect. We became a team with a difficult reality since some of us were looking at what could happen to inform those who were really going to live what would happen, but without being able to observe it in its entirety. However, it was also a special moment, being 9000 km far from the fire and feeling a part of the operational effort. They had overcome the reluctance to claim this was more than a fire campaign as usual and it was understood that we were in a campaign where climate change was altering the type of fires through firestorms or PyroCb.

Then a clear explanation of what was going on was shared with locals and officials, and a work methodology was established to keep monitoring from the distance adjusted to real events. We mixed real observation, with satellite observation and with model forecast interpretation.

Fig 11a, 11b. (middle) Fire fronts with high instability and the beginning of the PyroCb growth on September 7 (Alfaro, L. OFDA-USAID).

A new report on September 7 confirmed the window of operations for the next days. Due to the situation, firefighting could move a step ahead and heavy machinery, technical fire use teams, ICS implementation and international assistance was ordered. The main decision was to move ahead from direct attack and plan tactics with a 2-3 day time frame. The ability to forecast and the inability to follow the fire directly was accepted. It was too extensive and intense a fire – not a classical fire any more, burning slowly as it extended into the forest in the Chaco. Now we faced a fire with hundreds of kilometer-wide fronts that had already gone through three PyroCb events creating extreme behavior. Only long-term planning and work would be effective in minimizing the effects of a fire that could only be extinguished with the rainy season. Being able to show what was going on and show credibility allowed teams to move on and into long-term ICS planning.

Fig 12A. Planning meeting under the ICS structure in Roboré. (Alfaro, L. OFDA-USAID).



SEPT. 10, 2019: PYROCU TRACKING DYNAMICS

A workflow (Fig 13 above) was established to mark in advance the possibility of extreme phenomena and allowed teams to plan in the long term, working with tactics and large-scale maneuvers in advance. At the same time a routine of validation and adjustment of forecasts was established to maintain the observed reality as an element of adjustment of the entire forecasting process (Fig. 13). This routine was based on observing the satellite for validity of column heights and fire extension, while that information was certified with observation flights of the columns, thus adjusting the validity of the forecast and satellite information. Real-time field observation added robustness to the process.

There was a need to translate this information about PyroCu and PyroCb processes to operational decisions. We worked on differentiating the days based on extreme typology of convective process (Fig 14) and the series of indicators that allowed us to understand what each of these three situations meant (Fig 15). It was a simple scheme but more than enough for a process of monitoring and strategic advice. It was about translating complex processes to verifiable information of reality, making it available in order to guarantee operational decisions for teams in truly remote places and without the ability to relay in their observation and monitoring efforts. They had to feel a measure of the pyroconvective forces and the resulting efforts that would be needed.

Operational implications of the types of connectivity.

Without PyroCu Situation	With PyroCu Situation	With PyroCb Situation
The fires are governed by the meteorology of the area. The fire may show spotting, but it is predictable by the weather and responds to it 100%.	The convective plume generates indraft and accelerates the winds that push the fire. The column draws dry air in height above the fire. The level of fire activity and spread by spotting is accelerated. The fire is predictable in pattern and direction by the weather, but the fire behavior is altered and increased by the <u>pyroCu</u> . We enter the range of extinction incapacity.	The transition from <u>PyroCu</u> to <u>pyroCb</u> increases the height of the plume. This multiplies the surface wind speed by factor 4 to 6 each time the height is doubled. The same effect of <u>pyroCu</u> is magnified (dry surface air, strong winds, multiple spotting). But the <u>pyroCb</u> creates the downdraft by freezing its cloud top, creating fresh and dry air fall over the fire, expanding it erratically at high speeds. In Portugal 2017 this implied a jump of 1.7 km/h to 18 km/h. They are situations of high risk of accident and extinction incapacity.

Operational problems from growth of PyroCu to PyroCb, linked with indicators.

Operational Problem	Moment it appears	Indicators
Wind acceleration	Indraft <u>pyroCu</u> Indraft <u>pyroCb</u> Downdraft <u>pyroCb</u>	Condensation cloud over the plume
Acceleration pulses	Mature <u>PyroCu</u>	Different smoke "donuts" in the convective column
Widening flanks and accelerating them	The convective flanks with the indraft create rotors that run along the flank	Scattered flank smoke forms columns that show rotation
Extreme and erratic winds	Micro-downdraft of the <u>pyroCu</u> and downdraft proper of the <u>pyroCb</u> that begins to precipitate	The indraft stops and begins extreme winds out of the fire
Direction changes with extreme wind and erratic	Large-scale downdrafts and <u>PyroCb</u> collapse	The vertical smoke plume collapses on the fire with extreme erratic winds

SEPT. 12, 2019: NEW REPORT, GOOD WINDOW TO WORK

There was a good weather window to work on September 12 and ahead. The tactical opportunity was identified out until September 15-16, when a dry north wind would bring back extreme conditions. A comprehensive follow-up of the evolution of the previous days began and we recommended investing efforts to contain the current queue fronts, since those were the ones that would become head fronts later, especially heading to Paraguay. Fig. 16a, 16b. PyroCu on the extensive fronts approaching the border of Paraguay on September 16 and the same moment observed by the GOES 16 satellite (source Alfaro, L. OFDA-USAID and RAMMB / CIRA @ CSU).



SEPT. 16-19, 2019: WINDOW CLOSING, ONLY MORNING AND NIGHT WORK, PYROCU AND ROTORS

As forecast, the different fires re-created extreme behavior. The growth of the predicted PyroCb stopped halfway to the top due to wind shear. Even so, these were days of extreme fire activity moving south, and extreme tension. From a distance we were glued to the satellite image by monitoring the Cloud top and the T^a of the cloud, as well as the actual surveys and their updates. It was recommended to remove people from the fire zone, as fire behavior was erratic with important observable downdraft. The fire was maintained with unstable behavior, with PyroCu and gusty winds due to the mixing (entrainment) of the PyroCu with extremely dry air with a large DCAPE. September 16 and 19 were the worst days, with a break in between. It was still only possible to flank the fire.

SEPTEMBER 22-24, 2019:
AFTER A TWO-DAY BREAK,
A NEW RED ALERT

After two days break, situation was becoming conditionally unstable and therefore with potential to repeat the jump from PyroCu to PyroCb that had not occurred since September 7. From September 22-24, a trend appeared for more and more PyroCb likely atmospheres (Fig 17). The surface layer was highly unstable, allowing rotors on the flanks, and the condensation height had the necessary humidity. To this we must add that the inversion above condensation level was diminishing every day. September 23 was an intense day but the dispersion by high-level again inhibited the jump to PyroCb, like it did on the 16th. The evolution was followed closely, and it was recommended to stop operations in those late hours. At night, stability set up until the following noon, which made the work safe, but not between 1400 to 2200. The units were already building large lines with bulldozers to compartmentalize the entrance to Paraguay and to widen the flanks.

Fig 18. Summary of the evolution of commented factors for the possibility of transition to PyroCu and PyroCb. Every day we have worsened, although the initial forecast was that 22th would be the worst day. Reports were issued on the 19th, 22nd, 23rd and 24th, adjusting the forecast.

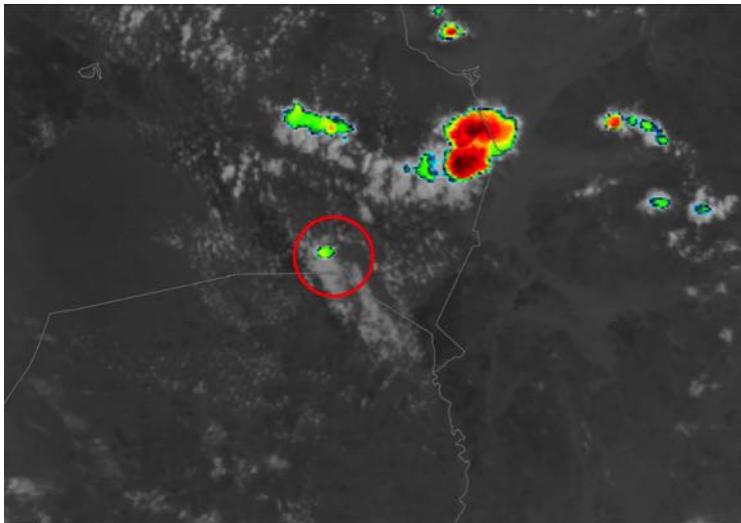
Fig 19. Latent fire perimeters from September 7-8 supported fire growth by sunset in the border area of Bolivia and Paraguay. The wind took the column and turned it as it rose, leading to firew with superficial instability and extreme behavior. The PyroCu formed very far from the flames and fires with superficial instability and extreme behavior (Alfaro, L. OFDA-USAID).

SEPTEMBER 24, 2019:
FOURTH PYROCB ... OVER-
SHOOTING WITH THE HUMID-
ITY, LIKE AUGUST 25

Finally, on September 24, a mid-afternoon process was observed again. A new PyroCb “boiled” and popped-up. We observed it simultaneously from Italy, USA and Spain in real time. As on August 25, the increase of humidity triggered the transition from PyroCu to PyroCb. There was no one on the ground and the rain that came after gave everyone a rest -- the ones operating on the field and those who, from the distance, followed the events and tried to predict.

Fig 20. Satellite image of the PyroCb growth process of 24th. This reading confirmed the cloud T^a and the height, which coincide with the forecast of the skew-t (source RAMMB / CIRA @ CSU).

DAY	EXPECTED SITUATION
SEPT 21	Surface instability Several layers stability, more powerful above condensation level Air in height very dry but above entrainment with PyroCu
SEPT 22	Surface instability Multiple layers inversion Inversion layer above weaker, but significant condensation Dry air at height very available for entrainment with PyroCu Less moisture in the middle and surface layers
SEPT 23	Surface instability Multiple weaker inversion layers Inversion layer above weaker, but significant condensation Dry air at height very available for entrainment with PyroCu More moisture in middle layers
SEPT 24	Surface instability There are no multiple inversion, only neutral moments Inversion layer above weaker, almost insignificant condensation More moisture in middle layers





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SEPTEMBER 25-28, 2019:**RAIN, A BREAK AND BACK TO PYROCU**

The rains had served to give a rest of two days. But the heat continued, and the north wind returns. The fires once again overcome the extinction capacity and we prepare for the episode from September 29 through October 2. Looked like it could be the last. A new report was issued on the 28th.

Fig 21. After the rain episode of September 25, there was little activity, but on September 28 the fires burnt across the landscape again with intensity and raised columns that reached the level of condensation (Alfaro, L. OFDA-USAID).



Mapa con perimetros de crecimiento
Incendio Roboré, Bolivia, 2019

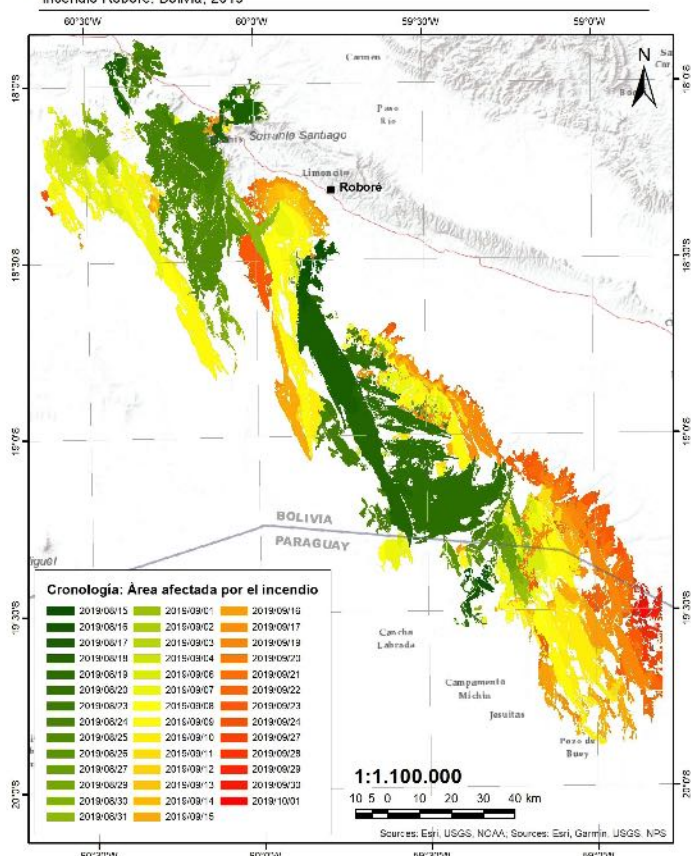


Fig 22. Final perimeter of the fire on September 25, 2019. Mercedes Bachsfischer, Sentinel hub.

SEPTEMBER 29, 2019:**WHAT WE LEARNED AND FUTURE CHALLENGES**

The reality of the fires in the Chaco ecosystem has changed. We have seen a month of extreme intensities and extreme behavior not seen before in the area, which have been repeated up to five times.

This reality, in a non-dry year, is attributed to the constantly higher temperature, dry periods and climate change. In the following months, we will have to understand what it means for these ecosystems and for the protection of the Chiquitania forests. The tools to face this change are based on knowledge, and it is necessary to put knowledge in all the units that face the fires, because these fires have arrived as the new normal.

The useful tools we use for remote detection and observation of fire events and burned surface calculation, such as EFFIS or GFMC, are still good to maintain monitoring activity but are at a superficial level for these new events. We have to evolve tools that allow a network analysis, to build a "global brain" that will help us assess and guide operational planning in the immediate and long-term time frames.

We have learned that willingly coordinated and verified monitoring -- eyes in the field and eyes in the data -- allows robust advice to those in the field making decisions while catalyzing accelerated learning for everybody.

The tools and the teams available today allow us to make the leap to this global collective brain -- where "the more we feed it, the more it brings back to all."

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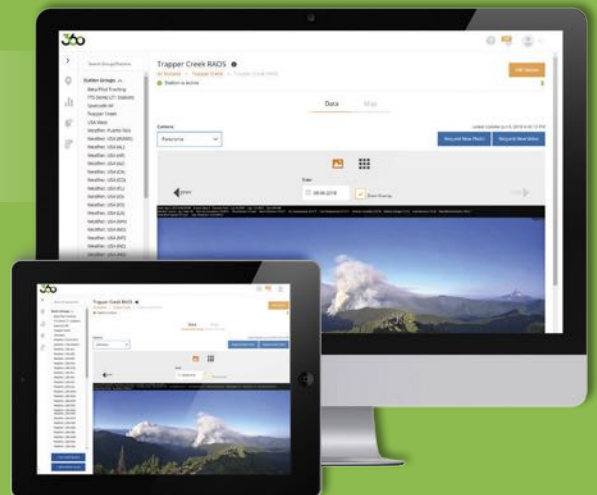
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A RULE OF THUMB FOR ESTIMATING A WILDFIRE'S FORWARD SPREAD RATE

WHEN WIND DRIVES A FIRE,
THIS APPROACH PROVIDES A QUICK,
STRAIGHTFORWARD AND
USER-FRIENDLY METHOD
TO PREDICT FIRE SPREAD.

By Martin E. Alexander and Miguel G. Cruz

Driven by strong winds, the Reedy Swamp Fire burned into the coastal town of Tathra, New South Wales, Australia on March 18, 2018, destroying 64 homes. No lives were lost.

Photo by Katrina Walsh.

Heuristic approaches to problem solving, commonly called rules of thumb, employ practical, quick, and in the moment methods that are not intended to be strictly accurate or reliable in every situation but sufficient for most decision-making situations, especially when there is insufficient time for a detailed assessment (Tversky and Kahneman 1974). We have devised a rule of thumb for obtaining a first approximation of a fire's spread rate that wildland fire operations personnel may find valuable in certain situations (Cruz and Alexander 2019; CSIRO 2019). It is based on the premise that under certain conditions wind speed is the dominant factor in determining a wildfire's forward rate of advance.

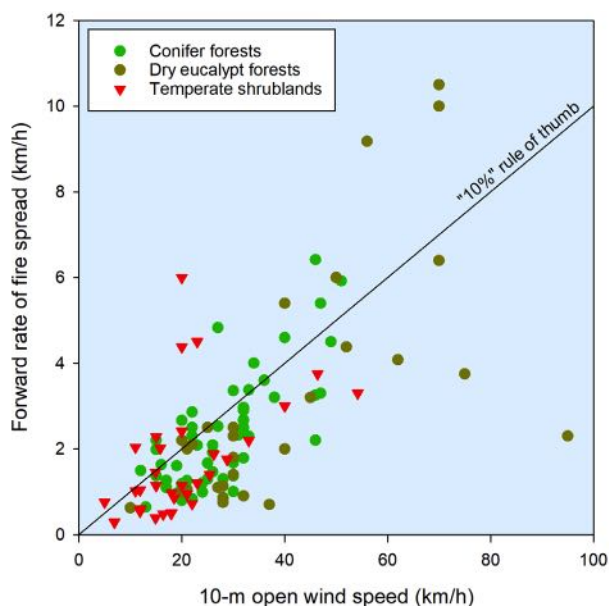
WHAT IS A RULE OF THUMB?

The term or phrase rule of thumb refers to a principle with broad application that is not necessarily intended to be particularly accurate. It often refers to an easily learned and easily applied procedure or standard based on practical experience rather than theory.

Rules of thumb have been used in wildland fire management and science for at least 80 years (Mitchell 1937). They are not just restricted to fire behavior.

ANALYSIS OF WILDFIRE CASE STUDY DATA

The published spread rates associated with 118 high-intensity wildfire runs that have occurred in temperate shrublands, Australian dry eucalypt forests, and North American conifer forests as derived from case studies were compared to the average wind speeds observed at a 10-m (33-ft) height in the open, a World Meteorological Organization standard for surface wind measurements. The rates of fire spread and corresponding wind speeds ranged from 0.29-10.5 km/h (0.18-6.5 mi/h) and 5-95 km/h (3-59 mi/h), respectively. This comparison eventually led us to the realization that a simple linear relationship exists that can serve as a suitable model or guide for very quickly estimating a wildfire's forward rate of spread, independent of the fuel type(s) considered.



QUICK MENTAL MATH

The resulting rule of thumb can be given as a simple expression that lends itself to an easy calculation. A wildfire's forward rate of spread (R) can be estimated as follows:

$$R = 10\% \text{ of the average 10-m open wind speed}$$

One should note that the rule of thumb is independent of the unit system used, as the R is expressed as a fraction of wind speed and is thus independent of the units. For example, for an open wind speed of 30 km/h (19 mi/h), $R = 3$ km/h (1.9 mi/h). Aside from being the units of choice to express wind speed for fire management applications, km/h and mi/h are particularly suitable for envisioning fast-moving wildfires spreading across the landscape for a period of hours.

In cases where wind speed is measured or estimated at a height other than the 10-m (33-ft) open standard, a correction or adjustment needs to be made. For example, it is customary to report wind speeds for fire management purposes in the United States at a 20-ft (6.1-m) open height. To convert measured or forecasted 20-ft open winds into 10-m open winds, multiply the 20-ft wind speed by 1.15 (Andrews 2012).

Rule of Thumb

applied to 20-ft open wind speed standard
as used in wildland fire in the United States

20-ft wind (mi/h)	5	10	15	20	25	30	35	40	45	50
Rate of spread (mi/h)	0.6	1.2	1.7	2.3	2.9	3.5	4.0	4.6	5.2	5.8

HOW WELL DOES THE RULE OF THUMB WORK?

One will certainly ask: how good can such a simple rule of thumb be at predicting a wildfire's forward rate of spread? The rule of thumb was found to work best for wildfires spreading in dry fuel conditions (i.e., fine dead fuel moisture contents less than 7.5%) irrespective of the wind speed. Under these conditions, the average percent error varied between 42 and 54%, an error range equivalent to what would be obtained using operational fire spread models for shrublands, eucalypt forests and conifer forests. It was also found that the relationship was valid for wildfires burning in some insect-killed forests. How is it possible that such a simple relationship performs so well over a broad range of fuel characteristics and under burning conditions considered by some to lead to unpredictable fire behavior? One plausible explanation is that as fuel moisture decreases below some critical level and the energy released by the flaming front increases, the wind speed is presumed to explain most of the variability in a wildfire's forward rate of propagation.

The rule of thumb was found not to be applicable to grasslands. Its use in such a fuel type will result in a substantial under-prediction of fire spread rate.

Scatterplot graph of 118 fires that led to the 10% rule of thumb. <https://research.csiro.au/pyropage/wp-content/uploads/sites/17/delightful-downloads/2019/06/CSIRO-PyroPage-Issue-23-Bushfire-ROS-rule-of-thumb.pdf>

CONSIDERATIONS IN APPLICATION

Predictions of wildland fire behavior invariably involve assumptions. The principal assumptions and limitations in applying the rate of spread rule of thumb are:

- It is applicable to large, multi-hour wildfire runs.
- The wildfire is spreading on level to undulating terrain in either conifer forest, dry eucalypt forest and/or shrubland fuel types.
- The effect of spotting in determining the overall fire spread rate is implicitly accounted for.
- There are no appreciable barriers to fire growth; any existent ones are overcome by spotting.
- The 10-m open wind speed is either a measured or forecast value or represents an estimate based on using the Beaufort Wind Scale (NWCG 2018, p. 72; Taylor and Alexander 2018, p. 25).
- The rule of thumb works best when fine dead fuel moisture content is low (i.e., less than 7.5%). Its use under moister conditions will result in an over-prediction bias.
- Expect the rate of spread prediction to have an error interval of up to $\pm 50\%$ of the observed rate of spread at best.

In practice, a wildfire's projected forward spread distance will be determined from multiplying R by the duration of the run. Again, a little mental math is required. The forecasted weather coupled with local knowledge will play a crucial role in determining the time element to a fire spread distance prediction.

WHEN TIME IS OF THE ESSENCE

Forecasts of wildfire spread into wildland-urban interface areas are of critical importance in alerting members of the public of the potential threat. Consider for a moment the recent past, with catastrophic wildfire events involving unprecedented numbers of fatalities amongst the general public in disparate places such as Australia, Chile, Greece, Portugal, Russia, South Africa and the USA. Could a simple rule of thumb like the one described have provided a better appreciation of the fire propagation potential and averted the magnitude of the tragedies that ensued in terms of the loss of life? The rule of thumb could assist emergency response officials and the public to more quickly prepare for wildfire and to provide an early-warning fire spread prediction tool until more in-depth analyses and fire behavior forecasts become available.

Under the Plume: View of the early stages of the Kilmore East Fire in central Victoria, Australia on February 7, 2009. Fanned by strong winds, it burned over 100,000 hectares (247,000 acres) and claimed the lives of 119 people within 12 hours of ignition. CSIRO file image.



ON A CLOSING NOTE

Fire behavior prediction is commonly regarded as both an art and a science. Predicting a wildfire's behavior is always filled with uncertainty due to modelling assumptions and input accuracy. The rate of fire spread prediction from the rule of thumb described in this article should be viewed as a general estimate with a certain range in variability about the mean value as shown in the scatterplot. We believe that regardless of how simple the rule of thumb is, it represents a reliable tool for quickly approximating a wildfire's forward rate of spread when there isn't time to use other more complex fire behavior prediction methods.

AUTHORS' NOTE

Thanks to Kelsy Gibos, Wesley Page and Dave Thomas for their comments on and help with an earlier draft of the article.

This **"Rule of Thumb"** article draws upon and illustrates the continuing value and role of empirical-based fire behavior research in wildland fire management, as contained in Cruz and Alexander (2019).

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The two of them have been cooperating on various projects for the past 22 years.



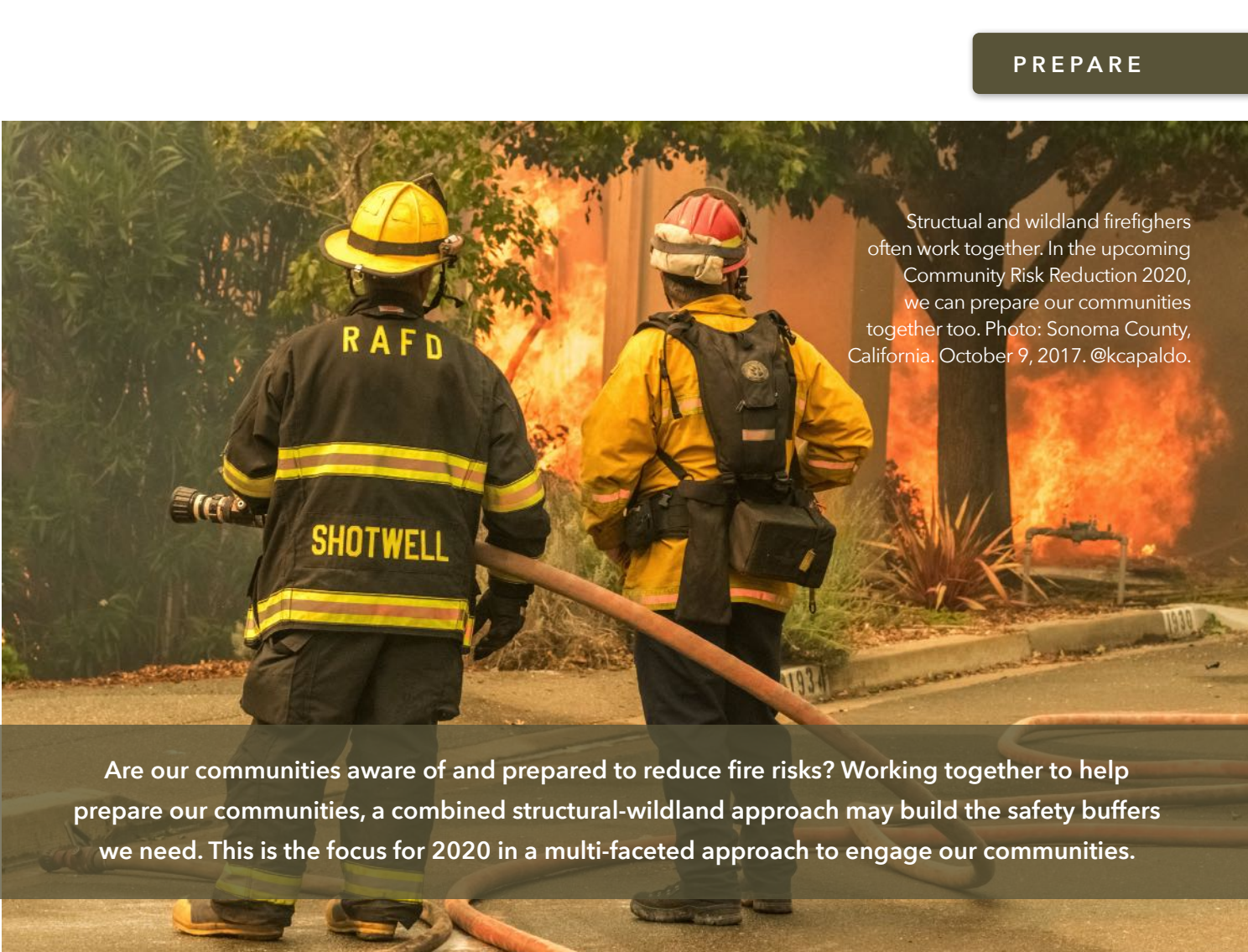
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Structural and wildland firefighters often work together. In the upcoming Community Risk Reduction 2020, we can prepare our communities together too. Photo: Sonoma County, California. October 9, 2017. @kcapaldo.

Are our communities aware of and prepared to reduce fire risks? Working together to help prepare our communities, a combined structural-wildland approach may build the safety buffers we need. This is the focus for 2020 in a multi-faceted approach to engage our communities.

COMMUNITY RISK REDUCTION WEEK 2020

Structural and wildland firefighters serve together in reducing community risk

By Kathy Clay

What is the difference between a structural firefighter and a wildland firefighter?

When it comes to Community Risk Reduction (CRR) there are no differences! Aimed at building awareness for the US Fire Service (with application globally), CRR Week 2020 presents opportunities for the entire fire service to work with their communities in understanding and reducing community risk.

In celebration alongside Martin Luther King Day (also noted as a national day of service), CRR Week launches and runs from January 20 - 26, 2020.

"This week-long program will help everyone in the fire service better understand Community Risk Reduction," stated

CRR Week Leader Ed Comeau, "and will bring the 5 Es -- Education, Engineering, Enforcement, Economic Incentive, Emergency Response -- to the fire service vocabulary when thinking about risk reduction in their communities."

Although this national event will largely focus on the fire service from a structural firefighting angle, the wildland world can embrace this week as well. Using the week to highlight wildland fire and the ways to use the 5 E's will be an effort many of us will deploy.

Historically, the wildland world has been quite effective in Education. Smokey Bear single handedly put out so many fires, we now have unintended consequences of overgrown



See <https://strategicfire.org/crr> and <http://crrweek.org>, for a guide on stating a local CRR week and a model proclamation in support.

There are positive and negative Economic Incentives to motivate fuel reduction in neighborhoods. Grants offering financial assistance in fuel reduction and are a popular choice here in Teton County. Often these grant funds are matched by the homeowner. Examples of a negative economic impact include fines for burning when conditions are dry and fines to homeowners not willing to improve defensible space.

Emergency Response is the world in which we live. Enhancing response times to become more effective in quick suppression of the wildland urban interface fire, involves every one of the E's. There are very few types of emergency responses that are as harried and frantic as initial attack on a wind driven wildland fire in the midst of town. Building as many emergency response preplanned factors into these critical initial attack moments, improves firefighter and civilian safety, provides quicker response and reaction times – better protecting life and property. Preplanning for emergency response includes, for example, educating homeowners on the value of fire resilient homes with good defensible space, providing turnaround space for emergency vehicles at the home, educating planners to the need of two ways out of subdivisions, educating the public to prevent the wildland urban interface fire while understanding the importance of fire on the landscape, and community awareness of evacuation notice and actions.

The 5 E's are as important for the wildland world as for the structural firefighting world. Although the snow will be falling for some of us and we might be shivering with below zero temperatures, those of us in the wildland world need to be sure to have a voice and use this CRR Week as a platform for building a safer environment for all of us in the wildland urban interface. Summer will be right around the corner!

forests, heavy with fuel. Thanks to Smokey's efforts, re-educating the public on the value of fire on the landscape is ongoing. Education for homeowners when building resilient homes, hardening existing homes, and understanding defensible space is a critical component in the wildland urban interface. As homeowners comprehend the changes they can make, firefighters will have safer conditions around homes and fewer homes will be lost in wildland fires.

Engineering in the wildland world brings advances in technology such as fire prediction tools, giving Incident Commanders critical fire data for enhanced command decisions. Ongoing research studies the effects of wildland fire smoke on firefighters and examining methods to protect firefighters on the line. From Kestrels for monitoring weather, unmanned aerial vehicles (drones), FLIR vision sensing, improved fire shelters – engineering brings enhanced safety, increased situational awareness, and better fire forecasting benefits everyone in the wildland urban interface – from firefighter to homeowner.

Using a hammer is sometimes necessary and Enforcement often plays an important role in the wildland urban interface arena. Human fire starts are preventable and in fire restrictions, these human starts can be investigated so the perpetrator will be held liable for fire costs. Here in Teton County, Wyoming, a wildland fire caused by fire extension from a burn barrel awarded the largest federal payback from a homeowner to the government in history. And there are few finer ways to get the public's attention than to hold someone accountable for an escaped fire. As wildfires continue to destroy communities, stricter enforcement of defensible space will hold homeowners accountable for not taking positive steps in reducing fuel loads on their property. These enforcement measures have been taken in California for many years and are proven successful mitigation efforts to enhancing defensible space within communities. As homeowners realize their neighbor's lack of defensible space could burn down their home, enforcement will be an important tool in protecting wildland urban interface communities.

ABOUT THE AUTHOR

KATHY CLAY

is Fire Marshal and Battalion Chief for Jackson Hole Fire, Wyoming, USA, and an IAWF board member since 2013.

She serves the fire world promoting fire and injury prevention, works with new and existing structures to ensure code compliance, investigates structure and wildland fires, provides command on emergency incidents, and maintains EMT certification for medical first response.





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