"Uniting Our Global Wildfire Community"
JUNE 2019 - VOLUME 28.3

WILDFIRE®

THE FIRE GLOBE
FIRE & SCIENCE **IN TURKEY**

FIRE SCIENCE FOR SUCCESS, PART 2
ISSUE PAPER - **SUPPRESSION**

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

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Chief SEAT Pilot
Air Spray, USA
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"Uniting the Global Wildland Fire Community"
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Our Fire Globe

An issue that spans the world -- from a Fire Globe feature on Turkey to updates and photos of a tri-national conference.

ABOVE: A sampling of IAWF logo-wear from the Albuquerque location of the tri-national Fire Behavior and Fuels Conference.

ON THE COVER: Monitoring fire effects in Turkey. Sharon Hood, Aylin Güney, and Coşkun Okan Güney (from left) discuss monitoring post-fire bark beetle attack and survival of burned Pinus brutia.

June 2019 *Volume 28, Number 3*

COLUMNS & NEWS

THE FIRE GLOBE

FIRE ISSUES

Notes on a tri-national conference

The President's Desk this issue is an adaptation of the closing speech for the Sydney, Australia location of the 6th International Fire Behavior and Fuels Conference, presented by IAWF president Alen Slijiepcevic. While focused on the Sydney events, he summarizes the spirit of a conference joining more than 700 professionals on three continents who focused on understanding the key topics of the conference theme, "Fuel of Today, Fire Behavior of Tomorrow."

By Alen Slijiepcevic

On behalf of the IAWF, Bushfire and Natural Hazards CRC and IRSTEA, also our Sydney partners Bureau of Meteorology and New South Wales Rural Fire Service and Office of Environment and Heritage, I would like to thank you all for coming to Sydney and making this conference a big success. Thank you for presenting, chairing sessions, participating in discussion during the day and later on with a glass in a hand. And we offer a special thank you to our international colleagues that made this conference a success. One conference, three locations – it did work, so next time – four locations? Just kidding, since I can swear that Euan Ferguson, David Bruce and I (the Sydney conference organizers) had dark hair on Monday morning. I would also like to thank the exhibitors for their support for this conference. A special thank you to the members of the Steering and Program Committees as without their hard work for more than a year, this Conference wouldn't be possible. For the same reasons I also thank the members of the Organizing Committees in the US and France.

Just to do a quick travel back in time, with apologies in advance that I cannot cover all presentations.

We had a fantastic welcome to country and would like to thank Uncle Brendon for welcoming us.

Then it started with a bang – with Neil Burrows challenging both researchers and operational people to collaborate much more closely. For researchers to work with operational people to understand their needs and for operational people to engage with researcher to define their needs and utilize science to help them become better in fire management. Also, a tip for the Agencies - employ scientists to help you define problems, find solutions, turn your organization into a learning one. The panel discussion was very stimulating and it shows that some problems that we have are more a communication issue than the willingness to work together. And I won't mention reviewers but will put them on notice.

LIVE INTERNATIONAL LINKS

In presentations brought by video link from Marseille, France, we learned of climate history and future as Juli Pausas took us in a journey of 400 million years to explain how climate and fires have shaped plants and the process will continue - what that means to our current knowledge on flora and fauna and how it will look in 100 or 1000 years is a question that we need to turn our mind to, not thinking that we can maintain the status quo. Following Juli, Anne Leadbeater brought us to what is the higher purpose of our work - community and how we need to change our approaches if we want to succeed and gain a social license. Think community recovery needs long before we have need for recovery (hopefully never).

Jen Beverly, in a video link from Albuquerque (US) to Sydney, showed us the issues facing Canada – changing original fuel types by mechanical intervention or beetle infestation so the existing fire behavior models are not working as vegetation structure has changed. In Australia we have similar issues where subsequent severe fires in quick succession, are changing the vegetation composition and a fuel type that we have not enough knowledge about.

Back in Sydney (and video-linked to the US), Jeremy Russell-Smith showed us how it is possible to put together science, cultural values and practices as well as economic benefits together to properly manage fire and provide a great cultural, social and biodiversity outcomes.

And a traditional owners' panel – it was brilliant. Special thanks to all panel members and Steve Sutton who led the discussions with thought, passion and knowledge. Those discussions and afternoon individual presentations have shown us, the agencies, that we are at the begging and have a long way to go in incorporating indigenous knowledge in our practices. However, it is important that we have started that journey with an open mind and willingness to learn and adjust. A massive thank you to all panelists and Steve for openness, passion and honesty.

On the closing morning, with a bi-national, AU-US across-the-Pacific panel focused on "What happens when women thrive – a life and a career in fire," we heard great discussions and personal stories from incredibly smart and articulate female colleagues. The words that come to mind are passion, caring, intelligence, clarity, thoughtfulness but also hurt, sacrifice, self-doubts…. You've heard Mika Peace, men in the room – we think we are better than what we actually are. We need to think more about our biases. We also heard how important the men champions-of-change are in changing culture and providing opportunities for women. And it is scientifically proven that teams with more women perform better. Special thank you to all panelists and moderators.

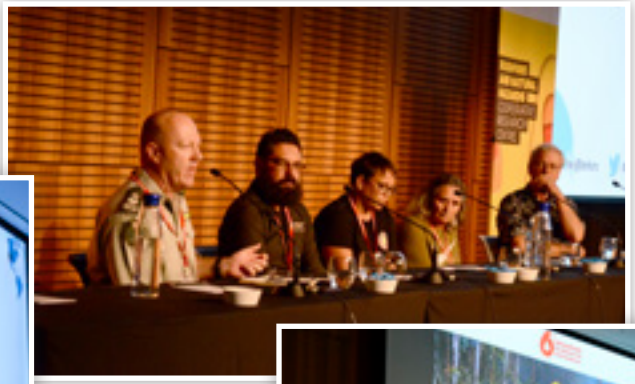
SUCCESSFUL TEAM-BUILDING

The numbers of the Sydney location of the conference – which are echoed in the other sites – tell the story of our successful team-building that occurred here. Together, we include:

- 336 delegates from all Australian states and 12 countries.
- 34% female participation.
- Sectors participating included Fire and Emergency Management (153 participants), Land Management (60), Universities (69), Government (17) and others, including exhibitors (35).
- Six keynote speakers – including one live from Marseille, one from Albuquerque.
- Three panels – 23 speakers, including four that were shared live with Albuquerque.
- Speakers – 88, plus 5 PhD Three Minute Thesis presentations.
- Attendance at two workshops held before the conference and two field trips afterwards.

IAWF is organizing a Smoke Symposium next year in US. You will be able to find more details on the IAWF website that you, as new members, will now visit at least once a month. Hopefully you will maintain your membership and get involved with the work of the IAWF through committees, writing for the Wildfire Magazine, publishing in or referencing the work in the International Journal of Wildland Fire (IJWF), and getting engaged in mentoring program that you will find more info on the IAWFonline.org website.

Once more thank you all for making this conference – in each of its three locations — a great success.



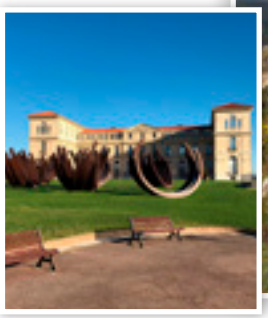
The cultural burning panel revealed the differences in Indigenous burning practices from across Australia.

The Welcome to Country is always a highlight of conference openings in Australia. This one came with a music lesson on the didgeridoo.

The Sydney conference was opened by IAWF President Alen Slijepcevic.

The is what can happen when women thrive - inspirational and moving stories on careers in fire from Sydney (foreground) and Albuquerque (screen in background).

The Blue Mountains, west of Sydney, was a spectacular setting for a post-conference field trip.



The beautiful Marseille venue - Palais du Pharo

Field tour to the site of the 2016 Calanque Fire

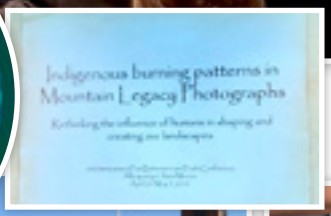
Translation tech in action

Happy travelers on the boat trip in Calanques National Park between Marseille and Cassis

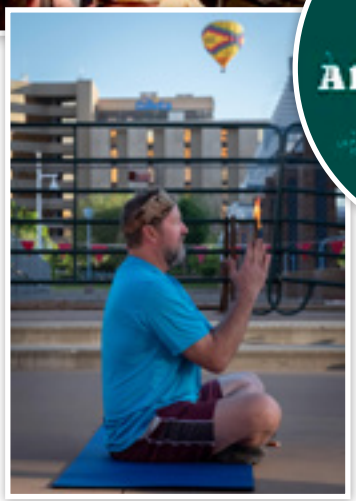
Conversations, connections, and chandeliers

A field tour stop at the site of the 2016 Rognac Fire northeast of Marseille.

Joe Stutler and Tom Zimmerman discuss fire program development in an increasingly complex fire environment at the Albuquerque location of the 2019 Fire Behavior and Fuels Conference.



Title slide from Rick Arthur's presentation on historical indigenous burning patterns.



Attendees were nourished daily with delicious New Mexico fare, opportunities for massage, and yoga classes with our own Johnny Stowe, Heritage Preserve Prescribed Fire Manager with the South Carolina Department of Natural Resources.

Susan Pritchard, Roger Ottmar, and Bob Keane enjoy some New Mexico morning sun at the Plaza Breakfast.

Transitions. **In fire briefings,** we often warn of the changing risks as we move into or out of complexity, from one form of management or communication, or when we change roles or tactics, or when the fire itself is more likely move between routine and extreme, Our shorthand for this is a cautionary word – "transitions." During transitions we're more likely to oversimplify the jumble. We throw more people, tools and tactics against the fire and the risk of bad results multiplies.

The lessons learned from transitions are on our mind – 25 years ago, on July 6 1994, 14 firefighters died when the **South Canyon Fire** blew up on Storm King Mountain in western Colorado. The fire transitioned and strategy and leadership and lives succumbed to physics. There will be a memorial on the mountain, and we remember those who were lost and who survived – on South Canyon, Thirty Mile, Dude, Yarnell, and all the other fire tragedies – in part by renewing our commitment to manage fire for firefighter and public safety.

Transition risks have parallels beyond fire management. Today, some seek to face our changing global risks by falling into the transition error of tunnel vision – seeking shelter in nationalism or climate-crisis denialism. We may be leery of social and political influences yet these too are in our risk-pool as we build fire-service and fire-science organizations that may thrive amid transitions.

Which may explain an evolving focus in *Wildfire* on organizational resilience. For instance, the current **issue-dialogue** paper frames questions and shares responses about our changing approaches to **fire suppression**, plus we share your responses to IAWF's first issue-paper dialogue on **extreme fire** – all of which are shaped by our search for resilience amid climate and political transitions. Similarly, Eric Kennedy seeks **new paths forward for fire science**, and our **Fire Globe** series continues as an international team explores what the melding of science-and-practice looks like in **Turkey**.

And we see what is gained when we successfully transition into increased complexity in the stories here (and in future issues) inspired by the recent **Fire Behavior and Fuels Conference**, simultaneously hosted in three counties. In a few intense days (after so many spent planning), our profession came together across the globe, adapting to a world in flux. Twenty-five years after the lives lost on Storm King, our staunchest memorial may be represented, in part, in a conference where we time-shared our recognition that fire is truly a global issue. Our global issue, and our transitions will be safer if we meet, even virtually, and build our team's resilience, regardless of our particular role or physical address. – RS

STICK WITH THE TRIED AND TRUE

For emerging leaders, those still building their leadership foundation, and for those of us who being a student of leadership is a part-time job, I encourage the proven and enduring fundamentals of leadership that have survived the tests of time and experience.

by Michael DeGrosky

Wildfire readers, have you checked-out the Harvard Business Review Leader's Handbook? Recently, I've begun giving this excellent reference to developing leaders who I want to see succeed.

What I like about this essential reference is that authors Ron Ashkenas and Brook Manville gather proven leadership ideas that have appeared in the pages of the Harvard Business Review over several decades and use interviews they conducted with more than 40 senior leaders, as well as their own experiences as consultants and advisors, to strengthen and reinforce the original thinking that appeared in the HBR. In the end, Ashkenas and Manville present the reader with six core leadership practices that have stood the test of time: building a unifying vision, developing a strategy, getting great people on board, focusing on results, innovating for the future, and leading yourself. I am, admittedly, an HBR junkie; so I'm biased, but I place great stock in the Harvard Business Review's evidence-based and really well-written content. I frequently start my morning reading a short HBR article as I eat my breakfast. Most often, I find my articles by following @HarvardBiz on Twitter. A protégé and I found that reading these short articles together provided a good basis for worthwhile mentoring conversations.

Wildfire readers, who have read this column for any time, know that I have an uneasy relationship with the pervasive leadership industry and popular leadership press. You know, the people who produce thousands of training workshops and are responsible for the hundreds of books that appear on bookstore shelves each year, adding to the many thousands already available — all purporting to offer the latest, greatest leadership thinking.

Don't get me wrong, I love learning about new thinking in leadership but, when it comes to leadership practice, particularly for emerging leaders developing their leadership foundation, there is a lot to be said for sticking to tried and true, evidence based frameworks and practices. The HBR Leader's Handbook puts a nice collection of that tried and true approach in one handy reference.

I really like where some of the emerging thinking in leadership is going, including the growing awareness of, and focus on, emotional and social intelligence, the acknowledgement that neuroscience has much to offer the study of leadership, and emphasis on

women and leadership. However, we students of leadership can allow ourselves to be carpet-bombed with ideas purveyed in any number of books by CEOs or Navy SEALs turned author and people who crank out a leadership book or two a year like they were romance novels. What I always want to know: Is this more than your personal opinion, has anyone tried this besides you, and does it work outside the context of your band of brothers?

It seems people are always searching for a new leadership framework, the game-changer. However, for emerging leaders, those still building their leadership foundation, and for those of us for whom being a student of leadership is a part-time job, I encourage the proven and enduring fundamentals of leadership that have survived the tests of time and experience. I know we recently modified our approach to L-480, stripping out a lot of fluff and focusing on giving our participants tools to better know and lead themselves — so that they in turn can mobilize the efforts of others around a common purpose. In doing so, while incorporating some cutting-edge stuff, we focused on time honored, evidence-based and proven leadership frameworks and approaches. I am glad we did, and I was proud of our cadre for providing our people not with leadership infotainment, but with practical tools that we, as experienced leaders, know work.

> **"I love learning about new thinking in leadership but, when it comes to leadership practice, particularly for emerging leaders developing their leadership foundation, there is a lot to be said for sticking to tried and true, evidence based frameworks. and practices."**

Similarly what I like about the HBR Leader's Handbook and why I've started giving it as a gift both to aspiring leaders and to experienced leaders trying to grow, is that this text provides a single source of advice grounded in both evidence-based research and experience. I recently read an article in which Ashkenas and Manville describes their work as reviewing decades of articles from the Harvard Business Review to "understand the recurring messages from academics and practitioners about what leaders should do." When they stacked that literature review up against their own experience as leadership advisors and consultants, they concluded that "the best leaders with the most outsize impact" nearly always employ the same six classic and fundamental practices.

Such successful leaders …

1. Unite people around an aspirational vision
2. Build a strategy for achieving the vision by making choices about what to do and what not to do
3. Attract and develop the best possible talent to implement the strategy
4. Relentlessly focus on results in the context of the strategy
5. Create ongoing innovation that will reinvent the vision and strategy
6. Lead themselves; knowing and growing oneself so that the leader can most effectively lead others and carry out the practices above.

We all know that leadership is both situational and contextual and that both the situation and the context matter. So, depending on the circumstances, the would-be leader may put more emphasis on one area than another, prioritize one practice over another, or sequence them differently than described above. But according to Ashkenas and Manville, regardless of context or situation, effective leadership always involves the employment of these same practices, and I cannot argue otherwise.

Having been a student of leadership for much of my life and a very formal student of leadership for 10 years, the more I have realized that, in the trenches of real organizations, leaders prove effective when they avoid chasing the latest pop theory or the heroic leader du jour, and organize their personal leadership philosophy around a core of proven leadership practices.

I, of course, strongly encourage all leaders to stay informed on the state-of-the-art; innovate continuously as they gain new knowledge; and treat their leadership philosophy as a work of continuous improvement. As I've written in these pages many times before, with new and turbulent organizational challenges comes the need for adaptive, enabling leadership. And that means adaptive, not only in real time, but willing to adapt our leadership approach in order to remain effective in a rapidly changing society and working environments. However, no one's going to go wrong innovating and adapting around the core leadership practices suggested by Ashkenas's and Manville's research.

I encourage Wildfire readers interested in leadership to check-out the HBR Leader's Handbook, which can serve as an excellent leadership primer and foundation made up of six core leadership practices that have stood the test of time.

The Harvard Business Review Leader's Handbook:
Make an Impact, Inspire Your Organization, and Get to the Next Level.

Available at https://hbr.org/product/the-harvard-business-review-leader-s-handbook-make-an-impact-inspire-your-organization-and-get-to-the-next-level/10158H-HBK-ENG.

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

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

A SEAT AT THE TABLE WITH VISION 20/20

Stakeholders in the World of Prevention. IAWF offers wildland fire insights to national US fire leaders developing national strategies for fire loss prevention.

A report by IAWF representative Kathy Clay.

Vision 20/20
National Strategies for Fire Loss Prevention

The Vision 20/20 Project - National Strategies for Fire Loss Prevention is guided by a coalition of national organizations who collectively exemplify how collaboration, communication, and the commitment to data-based solutions can save lives and property. The International Association of Wildland Fire brings a global and local focus to prevention with their seat on the Vision 20/20 Steering Committee table.

Steering Committee members from across the nation assembled in Baltimore Maryland April 16 and 17, 2019 for their most recent meeting, and IAWF was represented by IAWF board member Kathy Clay. Under the guidance and leadership of Project Manager Jim Crawford, retired Deputy Chief/Fire Marshal Vancouver, WA, stakeholder partners were given update reports on the mission and work of the Vision 20/20 effort in reducing community risk.

Five strategies guide the group working to fill the gaps in fire prevention:

- Advocacy
- Outreach and Education
- Culture
- Technology
- Codes and Standards

Sharing what others are doing across the nation sprouted the first Models in Fire Prevention Symposium in 2010, which has continued every other year since. The reports provided from prevention-focused presenters from across the nation in many lines of work can be found on the Vision 20/20 website https://strategicfire.org at the Home/History of Vision 20/20 tab.

This website is an abundant resource for prevention advocates, offering a plethora of tools for the prevention advocate including:

- The Fire Safety Materials Generator for creating customized community flyers can be found under the Education tab
- Podcasts, training, and networking under the Community Risk Reduction (CRR) tab
- Symposium materials, case studies, toolkits, logos, videos, success stories and more

CRR
COMMUNITY RISK REDUCTION

After the Steering Committee meetings were concluded at noon on the 17th, Jim Crawford was presented the Community Hero Award for his tireless work on community risk reduction by Johns Hopkins University - a very hard-earned, deserved award, indeed.

Next up and held in Feinstone Hall at Johns Hopkins Bloomberg School of Public Health, was the annual Daniel J. Raskin Memorial Symposium. "2018 California Wildfires: Lessons learned for public health from coast to coast" was presented in honor of fallen firefighter Daniel J. Raskin. The panel discussion was facilitated by former California Fire Marshal and current National Fire Academy Superintendent, Tonya Hoover. Joining her were retired CAL Fire Chief Ken Pimlott, Michael Gollner, Associate Professor Department of Fire Protection Engineering at the University of Maryland, College Park; and Michele Steinberg, Wildland Fire Manager, National Fire Protection Association.

Chief Pimlott provided comments on the difficulty of fighting wildland fire with extreme wind conditions, the inability to put aircraft in the air under these conditions, and the inability to build accurate situational awareness during high-wind, fast-

moving events. Michael Gollner (IAWF Board member) discussed the 2018 fires, evacuation challenges, the role of (community?) design, and research being conducted on long-term exposure to wildland smoke. Michelle Steinberg (IAWF Board member) spoke on the human dimensions of wildland fire, including planning at local levels, managing the existing homes and construction, and changing behaviors into positive action. A question and answer period followed when audience members inquired about current smoke research and the risk of wildland fire to property east of the Mississippi.

As wildland fire becomes a risk to more and more communities, the voice of the International Association for Wildland Fire will help guide policy-setters and decision-makers in the quest to save lives and lower property losses to wildland fires across the nation.

Partners in the Conversation

Partners in this important national conversation include:

- American Red Cross
- Center for Public Safety Excellence
- Institute of Fire Engineers
- Insurance Service Office
- International Association of Black Professional Fire Fighters
- International Association of Fire Chiefs
- International Association of Fire Fighters
- International Association of Women in Fire and Emergency Services (iWomen)
- International Code Council
- International Fire Marshals Association
- International Fire Service Training Association
- Johns Hopkins University Center for Injury Control and Policy Prevention
- National Association of Hispanic Fire Fighters
- National Association of State Fire Marshals
- National Fallen Fire Fighters Foundation
- National Fire Protection Association Education Section
- National Institute of Standards and Technology
- National Volunteer Fire Council, Society of Fire Protection Engineers
- Underwriters Laboratories

2019 Ember Award Recipients announced

AT FIRE BEHAVIOR AND FUELS CONFERENCES

The IAWF Ember Award is given to recognize and acknowledge sustained achievement in wildland fire science. All nominees for the 2019 Award represent individuals who have and continue to make significant contributions in this area.

Annually, IAWF receives nominations for many highly regarded, deserving, and accomplished individuals that have demonstrated sustained achievement clearly worthy of recognition. However, historically, only one recipient has been honored each year.

For 2019, once again many deserving individuals have been nominated. Because there are so many nominees that have extensive achievements for the betterment of wildland fire management are extensive, we are extremely proud to announce that for 2019, IAWF has elected to award the Ember Award to three individuals who have a marked record of achievement, have made significant long-standing contributions, are highly respected in wildland fire management, and are deserving of the Ember Award.

The Ember Awards were presented at the Fire Behavior and Fuels conference locationss in Australia and the United States.

Wendy Anderson with her daughters at the Sydney, AU award ceremony.

DR. WENDY ANDERSON

Throughout her career, Anderson has made highly significant contributions to wildland fire science, notably in the areas of fuel assessment and fire behavior. Her work with the analysis of experimental laboratory and field fires has aided in the development of models to support fire management decision making.

She has published a substantial number of research articles, book chapters and technical reports that have significantly contributed to the advances of wildland fire science across a broad range of fuel types (forest, grass, shrubland) and topic areas including fire propagation, fuel consumption, fuel moisture dynamics and fire danger.

Since completing her PhD at the University of New South Wales in 1987 Anderson has played a pivotal role in the development of an effective international fire behavior research community. Her mentoring role in supporting aspiring scientists through the complex physical attributes of wildland fire research while maintaining a patient considerate approach is second to none. Both in Europe, Australia and New Zealand a generation of current leaders in fire science can be identified as being her direct students and/or having closely worked with her in their early careers. Her Short-courses on fire behavior delivered in the early 90's to late 2000's in Coimbra, Portugal provided early career fire behavior researchers with a clear view of a cluttered, and sometimes chaotic field with multiple and sometimes competing research approaches.

In addition to Anderson's unparalleled academic work, she also devoted substantial energy to support and advise fire and land management agencies in Australia and New Zealand. Anderson established a bridge between complex scientific results and the needs of end users, providing advice on the most appropriate science to support fire management organization's processes and decision making.

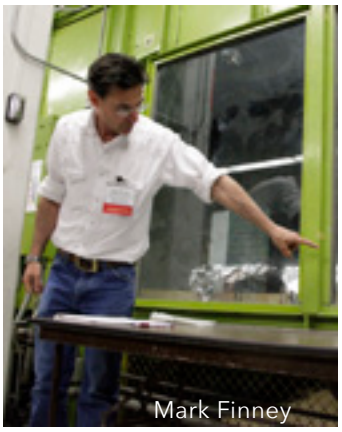
Anderson has retired from the School of Physical Environment and Mathematical Sciences, Australian Defence Force Academy, University of New South Wales, Canberra but she has continued to actively contribute to advancing wildland fire science through publication of scientific papers, mentoring early career scientists, and advising and training fire and land managers.

It can be easily stated that without Anderson's contribution to fire science the current capability to predict fire propagation in Australia and elsewhere in the world would be greatly diminished, with inherent negative repercussions to the safety of fire fighters and the public alike.

Anderson's award was presented at the Sydney, Australia conference.

DR. MARK FINNEY

Research Scientist, U.S. Forest Service. Missoula Fire Sciences Laboratory. Missoula, MT.



Mark Finney

Dr. Mark Finney has made highly significant contributions to wildland fire science through research in fire behavior. This research has involved fire behavior fundamentals and how key they are to understanding the opportunities for improving fire behavior modeling, especially for crown fires. He has led efforts to develop quantitative risk assessment that is essential to evaluating cost-effective operations in fire management.

He is best known as the father of FARSITE, the world's most successful wildfire behavior model, which is now an essential component of Forestry Agencies, Firefighting Command Centers and Fire Ecology Departments across the world.

FARSITE has been used since 1995 to model spatial fire behavior throughout the world. The model allows both suppression and prescribed fire managers to estimate more accurately where fires might burn, their potential intensity, spotting potential, use

of different fire management tactics, and how to better deploy human resources. Before its development all fire simulations were one-dimensional, had no spatial component, and could not take landscape considerations into account. Also before FARSITE, fire behavior analysis work was done by a long and tedious manual process, often too slow to inform Command Centers. Finney's work has paved the way for the development of similar computer models, and multiple fire behavior models in the US, Canada and Australia.

Not only are Finney's fire modelling contributions a standalone tool for foresters, ecologists and firefighters across the world, but FARSITE is now available as part of the U.S. Wildland Fire Decision Support System (WFDSS) that is used in planning on every large and long duration federal wildland fire.

But his contributions do not stop there, Finney has supported wildland fire science in other areas, including, but not limited to:

- Co-creating FlamMap, the software for fire mapping and analysis system used to study potential fire behavior across the landscape);
- Serving as team leader for the development of national Wildland Fire Investment Planning System (WFIPS) software designed for spatial modeling of initial attack, fuel treatment effects, and large fire costs to inform five federal land management agencies;
- Developing the Fire Spread Probability Model (FSPro) to aid managers in determining the probability of where and how a fire may spread to; and
- Led development of tools available in the Wildland Fire Decision Support System (WFDSS) in the U.S., which has received numerous awards and recognition, including the Forest Service Chief's Science and Technology Award twice and the Federal Laboratory Consortium Award for Technology Transfer.

His current research focuses on the study of fire spread in deep and discontinuous fuel beds, which will improve understanding of the fire behaviors that are not understood and able to be predicted today, such as crown fire. He is also investigating fire simulation for the purposes of risk assessment, to support the development of two major fire management systems, WFDSS and the Fire Planning Analysis (FPA). The Fire Spread Probability model (FSPro) is used in WFDSS to estimate the probability of impact of an ongoing large fire. A similar model, FSIM, is used to estimate burn probability and variability in fire behavior across large landscapes.

There is no doubt that through his scientific contributions, Finney has greatly improved our understanding of fire behavior and advanced wildland fire science worldwide.

Finney is out of the country and his award will be presented at a later date.

ROGER OTTMAR

Roger Ottmar has delivered actionable wildland fire science for over 35 years that has enormous benefits for the wildland fire system. He has led national programs that have resulted in 1) 19 volumes of the wildland fuels photo series (digital and hardcopy); 2) operational fuel consumption and emission production models; 3) the Fuel Characteristic Classification System (FCCS), and 4) assessing firefighter exposure to smoke. Ottmar is the original designer and project lead for the Fuel Characteristic Classification System and the CONSUME application currently in use by land managers across the country for building fuel beds and modeling fuel consumption and emissions from wildland fire.

Ottmar has authored and co-authored over 300 research publications and final reports and has served as principal investigator and Federal Cooperator on more than 100 grants, agreements, and co-ops between other Forest Service Research Stations, governmental agencies, private corporations, and Universities. He stands-out as one of the most prolific scientists to have worked with the Joint Fire Science Program (JFSP) since its inception in 1998. He regularly presents research at major scientific conferences. Ottmar has led over 35 classes on smoke management and leads several fuels workshops each year, including NWCG training. Ottmar led over 100 scientists

Roger Ottmar (center) receives an Ember Award from Tom Zimmerman (left) and Morgan Varner (right).

and technicians during the Joint Fire Science Program funded Prescribed Fire and Combustion Dynamics Research Experiment (RxCADRE) that was completed in September 2014. Ottmar now leads the much larger national level Fire and Smoke Model Evaluation (FASMEE) Project (www.fasmee.net). Although these accomplishments are vast, Ottmar stands out even farther because of his professionalism and ability to build and lead coalitions within the wildland fire system. In the field of wildland fuels and modeling Ottmar's name rings amongst the loudest. Some specifics include:

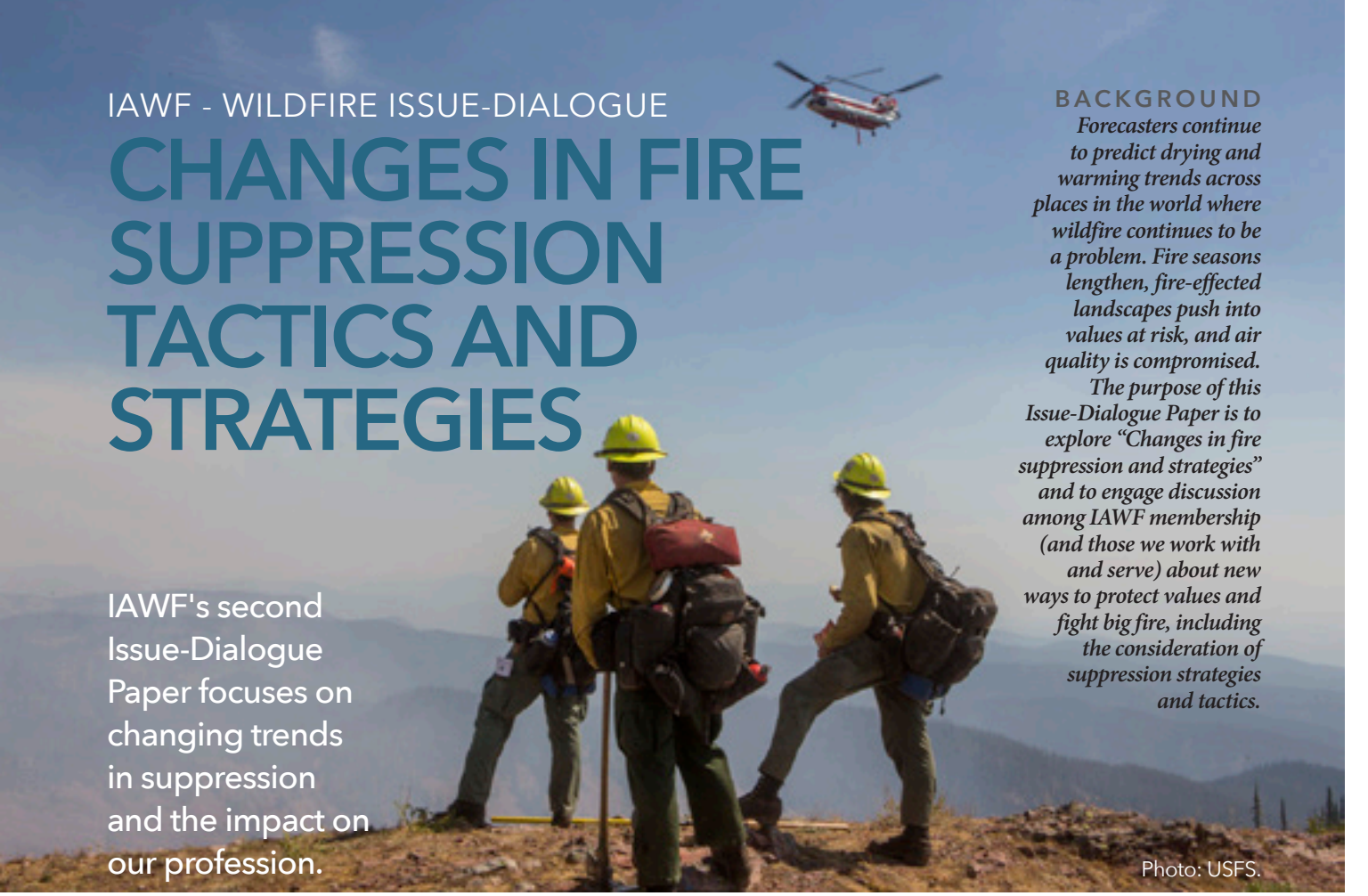
- Leads the Fuel Characteristic Classification System (FCCS) which calculates and classifies fuel bed characteristics (surface through canopy) and their potential fire behavior. Standard FCCS fuel beds exist throughout much of North America and are and important data product of LANDFIRE and are a main foundational data layer in IFT-DSS (https://iftdss.firenet.gov).
- Leads the Natural Fuels Photo Series which comprises 15 volumes of registered photographs along with accompanying fuel data which are used to make quick, easy, and inexpensive determinations of fuel quantities and stand conditions for both planning and response operations. (see: https://www.fs.fed.us/pnw/fera/publications/factsheets/factsheet_ps.pdf).
- Has served as an expert on fuel characterization and consumption in numerous workshops involving a large, diverse set of federal and non-federal scientists and practitioners. Important collaborators include EPA, DoD, the Forest Service, NOAA, NASA, and state organizations. Further, he serves as a prominent national consultant and technical expert on assessing top priorities for fire effects modeling and air quality-related research questions. Many of these collaborations do not involve funding, rather it has been Ottmar's professionalism and dedication to the importance of wildland fire science that governed his participation.
- For the last five years, led the development and implementation of the Fire and Smoke Model Evaluation Experiment (FASMEE), a multi-agency, national effort to provide advanced measurements necessary to improve operational fire and smoke modeling applications and their foundational scientific models. By its very nature FASMEE involves a complex network of stakeholders, coalitions, collaborators, and partners.. Most recently, Ottmar has led a coalition of researchers that have successfully competed for over $5m in new research funding from DoD that compliments the FASMEE program.

Although he is a great and diligent scientist, of equal importance is his ability to interact and work with other people. Many can attest to the unsurpassed role he has played in communicating fuels-related information in various training courses and other settings. He makes incredibly complex biophysical fire science topics easily understandable, which contributes to his research being implemented on the ground for real-world positive outcomes. He is a consummate professional and always ready to commend versus criticize.

Ottmar's award was presented by Tom Zimmerman (left, in photo above) and Morgan Varner (right) at the Fire Behavior and Fuels Conference in Albuquerque, NM.

IAWF - WILDFIRE ISSUE-DIALOGUE

CHANGES IN FIRE SUPPRESSION TACTICS AND STRATEGIES



IAWF's second Issue-Dialogue Paper focuses on changing trends in suppression and the impact on our profession.

Photo: USFS.

BACKGROUND

Forecasters continue to predict drying and warming trends across places in the world where wildfire continues to be a problem. Fire seasons lengthen, fire-effected landscapes push into values at risk, and air quality is compromised. The purpose of this Issue-Dialogue Paper is to explore "Changes in fire suppression and strategies" and to engage discussion among IAWF membership (and those we work with and serve) about new ways to protect values and fight big fire, including the consideration of suppression strategies and tactics.

KEY QUESTIONS FOR IAWF MEMBERSHIP

We propose a number of key questions related to suppression tactics and strategies. We invite additional responses, and hope to engage your ideas and insights as part of a broader discussion. In some cases, we have gathered initial responses to the questions posed below, based on input from IAWF review of this issue and related topics, but we recognize that there are varying viewpoints and perspectives. In other cases, the slate is blank. In every case, we hope to provoke ideas and insights as part of a broader discussion among the international wildfire community.

Tactics of Fighting Wildland Fire

1) **What are the tactical options that are under-utilized when we think about getting more fire on the landscape?**

Response: Rapid detection and initial attack with sufficient weight of attack are increasingly important. Are we making the best use of satellites to tell us where fires are and how best to access them?

2) **In many organizations (such as US federally managed lands), suppression is successful nearly 98% of time. Yet the tactics, strategies and tools that make us successful 98% of the time are not useful the other 2% of the time. More resources are not going to help in this 2%. What strategies and tactics are needed for this 2% and are we doing a good job training the current and next generation to recognize when it is happening and how to respond to it?**

Response: Not withstanding this, the Standard Fire Order # 10 says "Fight fire aggressively, having provided for safety first." Maybe there needs to be a new Standard Fire Order that says something like: In extreme fire behaviour, you best efforts may be ineffective; stepping back and telling people to get out of harm's way might be the most effective strategy.

Response: Large and Very Large Air Tankers are now common on large fires. In many jurisdictions, the need is driven by media and public demand, where you are seen as "unprepared" unless you have a VLAT on call. Do we really understand how effective they are? What is their return on investment and do we truly evaluate their effectiveness? What are their limits? What does this mean to crews who are on the ground? Are the crews supporting aircraft? Or is it the other way around?

3) **Because of more extreme events and more structures in areas, you can't do direct perimeter control. What are our other options?**

Response: The idea that we need to do perimeter control on every fire is incorrect. We actually have a wide tactical response spectrum and only deal with a small portion of that spectrum. These aren't alternatives, because they have always been there. We tend to first think about perimeter control, but increasingly we won't have enough resources to do that now. We need to look at other tactical responses—partial control, area management, herding/turning the fire, checking it, evacuations etc....

Managing Fire across the Landscape

4) **If we want to manage fire across the landscape, how do we**

What our current state of affairs in fire management looks like, circa 2016. From the "President's Desk" column by Tom Zimmerman, "Improving wildland fire management strategies," in Wildfire Magazine, February 2016. https://www.iawfonline.org/article/improving-wildland-fire-management-strategies/.

reconcile competing land use management missions between different jurisdictions and management priorities – such as provincial/regional and local? Public and private? County/state/federal (in the US)? Town and village, agricultural and conservation?

Response: In the United States, land use priorities at the state level may conflict with federal land use priorities, and federal agencies are also in conflict. For instance, a federal land management agency may want to increase prescribed burning, however this conflicts with federal air quality mandates. We need to reconcile or acknowledge these differences if we want to manage fire across the landscape.

Response: In the US the emphasis is on risk management. There is an increased focus by federal agencies to put more fire on the landscape and this increases the tension between agencies with different missions (federal, state and local each with a different emphasis on fighting fire more aggressively, directly than other agencies).

Response: Australia also sees tensions among agencies, especially when it comes to health and the environment. When conflict in management objectives occurs, control priorities become an important framework to resolve those issues. The primacy of life is always the first priority.

5) **With severe drought, we are seeing boreal forests succumb to fire. This results in large peat fires (Germany, United Kingdom, Sweden, Canada, Russia). Are our peat firefighting techniques proven? Do we need more research there?**

6) **If resources are more limited given current directions, what does that mean for strategy and tactics? Should we be thinking about what we can accomplish differently in a more resource constrained world?**

Response: When the US is at Preparedness Level 5, resources are scarce. This means we engage in more point protection of values at risk and area protection, which limits where all-out suppression activity can take place. This creates a vicious cycle of an ever-escalating fire situation that puts responders back on their heels and at risk. Decision space is limited based on resource availability, which means strategy and tactics are therefore limited. Is the public aware of the decreased funding to fire science and research?

Politics and Fire

7) **How do you establish management objective that meet the multiple expectations we have for a fire (ecosystems, local populations, air quality, future fire risk)?**

Response: Suppression is very reactive tactically without thinking about the strategic implications at a larger scale. We may need to sacrifice some houses for other values at risk (VAR) that are actually more valuable. We need to think about the problem in a different way. Should we ignore the 10 houses to protect the other 1000? We race to protect the house rather than find the head of the fire. The instinct of first responders is to protect homes from risk of burning. But we can't prove the counter-factual of letting 10 houses go in order to protect larger number of VAR. This is very challenging politically.

8) **What metrics could we use to reflect changing fire goals in management? How do you measure success? How do you measure the positive impact of suppression? # of houses saved vs. lost, # acres restored vs. lost, # of people who went home safe vs. injured, etc….**

Response: Fire success metrics are focusing on the wrong thing. Response time to fire is a measurement in parts of Australia rather than looking at the longer-term risk and how it should be managed.

Response: Percent containment is not a good metric. Percent of fire contained before 5 hectares. Wildfire use would actually mean that number would go down and it would be positive. We need to change the metrics to reflect new goals and attention. We measure number of acres burned rather than severity of the acres burned. We need an impact measure that looks at severity, water yield and quality, carbon storage, ecosystem functions disrupted or not acres burned.

Response: What are the expectations of governments, the community and industry (including the insurance industry) for success? How are we able to influence these expectations? In Australia (and elsewhere) there is a lot of buzz around the term "resilience." But what does a resilient person/household, community and business look like? What do we need to do to strengthen community resilience?

Response: Globally over the last half a century we have seen that successful suppression also perpetuates the fuel problem and therefore makes future fires more severe and harder to control. Possibly a better measure would be around what has been saved and how overall risk has decreased as a result of fire management including suppression activities.

Suppression Efforts in the WUI

9) **How should we be thinking of fire-fighting in and outside the WUI?**

Response: In Australia (and perhaps in US and Canada) there needs to be greater recognition of land management agencies. As we witnessed in Greece, the National Forest Service lost control of forest firefighting to the Hellenic (Urban) fire service. In some cases, urbanized fire services do not have the appropriate skills, techniques, supervision or equipment to

tackle large fast-moving wildfires. Evidence of this can be seen in many parts of the globe, including in recent fires in Australia, Russia, Spain, Greece and Portugal.

Bringing up The Next Generation of Leaders

10) How do we get smarter, faster in the training of the next generation of leaders?

Response: We are experiencing a skills deficit. There is a loss of skills through retirements and monetary losses. We have rigid systems to train Type 1 commanders (takes 30 years). Experience is not necessarily a good indicator of ability. We need more capable people coupled with systems and cultures that encourage and support people to take on more leadership roles. We have a very linear system. If government freezes hiring then it creates a gap in your personnel curve in the future.

Response: We need to acknowledge that 98% of wildfires are dealt with very well using true, tried and tested means. So it is important to recognize long-accepted methods and keep teaching and practicing them. We need to promote excellence in trail construction; dry firefighting; back-burning and burning out; use of engines/equipment and hoselay drills. We also need to recognize fire weather and fire regimes are changing in many parts of the world, largely due to changes in land cover and climate.

Response: With so much technology and robotics, why haven't we seen "robo-firefighters." We need to step up our efforts to take human firefighters out of harm's way. Robotics should help.

Response: Are we dealing with Lessons and Lessons Learned adequately? How do we ensure that a lesson identified in northern Spain is picked up and learned by the fire manager in Scotland, Canada, Indonesia, China and New Zealand? Is there scope for a global knowledge hub?

Response: Should we consider creating more opportunities for people to be fast-tracked trough providing opportunities in alternative northern-southern hemisphere seasons? As there is always a busy season somewhere on the Globe that would potentially allow us to provide a "30-year experience" in 10 to 15 years.

11) What are the workforce implications of having a fire year instead of a fire season?

Response: As the "wildfire problem" increases across the globe, we need to get better and faster at responding firefighters and incident management (command) resources from one hemisphere to another. The down side is that, with increasing length of fire seasons, there may develop an overlap where there is competition for resources (boots on the ground, incident personnel and scarce resources such as aircraft). This might present an increasing problem of firefighter fatigue and burn-out (pardon the pun) and longer-term issues in the recruitment of volunteer and community-based resources where the ongoing demands are seen as excessive.

More Information

Headwaters Economics. "Summary: Wildfire Costs, New Development, and Rising Temperatures." April 2016. https://headwaterseconomics.org/wildfire/fire-research-summary/

National Interagency Fire Center. "Federal Firefighting Costs (Suppression Only)." https://www.nifc.gov/fireInfo/fireInfo_documents/SuppCosts.pdf .

Karin L. Riley, Matthew P. Thompson, Joe H. Scott and Julie W. Gilbertson-Day. "A Model-Based Framework to Evaluate Alternative Wildfire Suppression Strategies."Resources/2018, /7, 4; doi:10.3390/resources7010004 www.mdpi.com/journal/resources.

RESPONSES TO THE IAWF "ISSUE-DIALOGUE PAPER: EXTREME FIRES" (published in the April 2019 issue of Wildfire).

What are your thoughts on the Issue Paper topics and questions. Here are some responses we received and share regarding the first topic on "Extreme Fires."

What's missing? The human factor

***Frank Carroll** (Managing Partner, Wildfire Pros. Custer, SD, US) explores the missing human factor.*

Your recent issue outlining three major factors in the transition to extreme wildfires is missing a key element: The human factor and, specifically, the behavior of fire teams and the effects of fire management objectives.

Indirect fire suppression strategies: Big boxing wildfires has become the new normal, with incident commanders commonly burning out from indirect fire lines often many miles away from the fire, which is now responsible for an increase in fire size of 30-60% (Ingalsbee – Big Bar Fire 1999, Carroll – Flat Fire 2012, Kolb – Lolo Peak Fire 2018). Big boxing is memorialized in Federal land management policy as expressed by the 2019 Forest Service Wildfire Key Messages. This strategy adds an astonishing number of burned acres to many large fires and results in wildly skewed costs of suppression and fire damages, costs that are being passed on to taxpayers and defendants, without any oversight or input from affected parties.

Agency fire management objectives: From the 2019 US Forest Service Key Messages – "Tools include mechanical treatments, prescribed fire, and unplanned fire in the right place at the right time." Unplanned fire use is now the central theme and the most widely used tool of Forest Service and some state land management and is used with greater frequency than ever before, often to the detriment of all other considerations and natural resources and with no recourse or restitution for private landowners who lose years of investment in well managed

forests (Dr. Peter Kolb – Montana State Extension Forester). Unplanned fire is responsible for more management acres of accomplishment than any other land management activity.

And this from the same source: "To diminish the "fire deficit" and thereby mitigate fire risk, the FS and partners will need to step up the use of prescribed fires and managed wildfires in concert with mechanical treatments. Working with partners and stakeholders, the FS can find opportunities in fire-adapted forests to reintroduce the right kind of fire at the right time in the right places to achieve desired ecological conditions." "Reintroducing the right kind of fire at the right time in the right places" is the new default firefighting, fuels management, and land management strategy. The resulting running head fires, every bit as severe as the main fire, are doing unacceptable damage to ecosystems, often resetting the ecological clock for seral species and creating site conversions to brush fields and other much less fire-worthy vegetative structures (Kolb, Carroll 2019). The 2017 Legion Lake Fire in Custer State Park was 4,000 acres turned into 54,000 acres by managers in response to agency direction to reintroduce fire to the Park.

Management's new fire-centric natural resource objectives and blank check approach to firefighting mean that incident commanders are using wildfire to manage land without having to prepare environmental documentation (EISs) or go through public comment and input phases of project planning. There is no oversight, no public input, and no way for private landowners and others to have any say in fire management tactics or strategies. This practice is particularly detrimental to the forest products industry and to landowners of tree farms and to those who manage their lands to reduce fire effects.

Predictably, agency administrators are using fire to meet resource management objectives with no way to measure qualitative or quantitative effects. The environmental impacts of this new order of natural resource management by wildfire are unknown, undocumented, and not subject to the influence of public comment and public review, nor are they governed by environmental laws and regulations.

Large fires are becoming extreme for many reasons, not the least of which is our new firefighting regime. It's a new Wild West and anything goes.

An error of definition – and a need to make valid science key to our best practices

Rick McRae, an Australian-based wildfire scientist and fire behavior analyst, also offers insights on what was missing – in this case, perhaps even misleading – which is an authoritative definition. Equally important, he builds a claim that we need to support field crews and incident managers so that "valid science is applied as best practice."

I am writing as someone with a long-term involvement in IAWF, a wildfire scientist who has published a large number of papers on "extreme wildfires" (as per a published, carefully analyzed definition, not IAWF's - see footnote, below) and their drivers, and as a uniformed emergency manager who has deployed interstate and internationally as a Fire Behaviour Analyst.

So -- the "Extreme Fires" Issue paper is fatally flawed, as it conflates too many issues. Megafires are an issue that arises from long-term changes to the state of vegetation across key landscapes, as well as changes in fire management and suppression doctrine. Extreme wildfires are a very carefully defined type of fire that couples with the atmosphere and exhibits dynamic fire spread on one or more occasions.

They are not related beyond the fact that some megafires happen to be extreme wildfires. Many recent studies of wildfire issues have suffered from lumping together multiple types of fire and analyzing them as one. The outcomes are spurious and help with the future management of neither type of fire.

Response to "Why the Transition to Extreme Fires," Question 1 [climate change]. When a fire develops a blow-up event, and couples with the atmosphere, it cannot be stopped, nor can its impacts be mitigated. The only realistic incident objective is to save lives, until the blow-up event abates. The only explicit role for fuel is in the early, pre-escalation phase of a fire's growth. Having said that two of the most intense fires recorded Australia escalated catastrophically in less than half an hour, well before any response could arrive (Bendora Fire, 18 Jan 2003, and Kilmore East Fire 7 Feb 2009). We now have an operational ability to predict blow-up fire events.

Response to Question 2 [fuel and vegetation]. Basically, the same as for Question 1. Most of the damage comes from very few fires, and there is nothing to be done about that. Building codes have never demonstrated any ability to change the impact of blow-up fire events. Even VLATs can be ineffective.

Response to Question 3 [rising trend of destructive fires]. The rapidly expanding global scope of extreme wildfires is the biggest challenge facing the world's fire services. It is no longer just a matter of counting extreme fires (although in Australia they are growing exponentially) it is matter of counting the countries starting to experience their impacts. This global growth is astonishing. New countries face new challenges and should not be left to develop their own solutions. IAWF is instead offering them ineffective mis-targeted advice. This has to change.

What IAWF needs to prioritize is what the published science has already made clear – that there are a number of types of wildfires, each posing different threats and requiring different responses. For example:

These are various species of fire:

- Steady-state fires - the normal ones, where fire behavior reflects weather, terrain and fine fuel load
- Megafires, which defy suppression due to total fuels
- Extreme wildfires which undergo coupling with the atmosphere due to deep flaming and exhibit violent pyro-convection.
- Extreme wildfires driven by isentropic drawdown

The triggers of deep flaming, the cause of extreme wildfires, are known to include:

- strong winds, as seen in Western Australia last November
- wind changes, as seen in Victoria on Black Saturday
- vorticity-driven lateral spread (VLS), as seen in Canberra in 2003
- eruptive spread, as seen in the Elephant Hill Fire in BC in 2017
- dense spotting, as seen in the Grose Valley (NSW) in 2006, visited in the 8th IFBFC this month.
- "interior ignition," as seen in the Plateau Complex (BC) in 2017
- excessive use of incendiaries, as seen in… - best left unnamed.
- isentropic drawdown, often seen in California but increasingly seen in NSW.

Looking narrowly at pyrocumulonimbus (pyroCbs) as an unambiguous tracer for the spread of the problem (since the start of the earth observation satellite era in 1978), we see a startling picture:

- the northern boreal forests have always produced pyroCbs.
- Australia started getting lots of them in

Pyrocumulonimbus ice capping at +-25k feet over the Mazatzal Wilderness during the Willow Fire (July 2004) near Payson, AZ. Shot from Mt Ord. PHOTO: Eric Neitzel - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=31292202.

2001, We now have had 80.

- Western Russia got its first in 2010.
- Europe got its first in Portugal in 2017
- South America and Africa get their first in 2018
- the first ever (globally) tropical pyroCb was recorded in Western Australia in 2018.

Where next? Many expect Scandinavia.

I could go on, but I think that the list is long enough already. The goal is to get this diversity clearly across to all IAWF members. Tools are needed to ensure that all field crews are able to apply these concepts to safely and effectively implement their incident action plans.

To conclude, it is possible that the Yarnell Hill Fire burn-over event was due to vorticity-driven lateral fire spread (VLS). The discussions of the satellite and other data, and numerical modelling, by a group of international scientists strongly supported this. The lessons learned from that fire would be very different if VLS was accepted to have played a role. Lookouts would be trained to look over their shoulders for a tell-tale column of dark smoke over certain parts of the terrain. Perhaps even both sets of lessons could have been produced. The point is that where we are today, if it was VLS, then the unfortunate events could recur. Is it IAWF that needs to take the lead on ensuring that all of the valid science is applied as best practice?

Share your ideas at: twitter.com/IAWF
facebook.com/IAWFire
email: **issuepapers@iawfonline.org**

Footnote: We have been plagued for decades by the re-use of terminology. "Extreme Fire" has recently been established as technical term, that needs to go into the Glossaries. It should be used in the sense of the recent Issue Paper. We struggled to find terms that avoided colored words such as catastrophic. It is indeed a difficult task.

EDITOR'S NOTES

For a recent concept paper on the definition challenge, see "Defining Extreme Wildfire Events: Difficulties, Challenges, and Impacts," Fantina Tedim et al. Fire 2018, 1(1), 9; https://doi.org/10.3390/fire1010009.

For more on pyrocumulonimbus, see Michael Fromm et al, "The Untold Story of Pyrocumulonimbus." Bulletin of the American Meteorological Society. September 2010. https://www.researchgate.net/publication/47374030_The_Untold_Story_of_Pyrocumulonimbus.

Wildfire ANALYST

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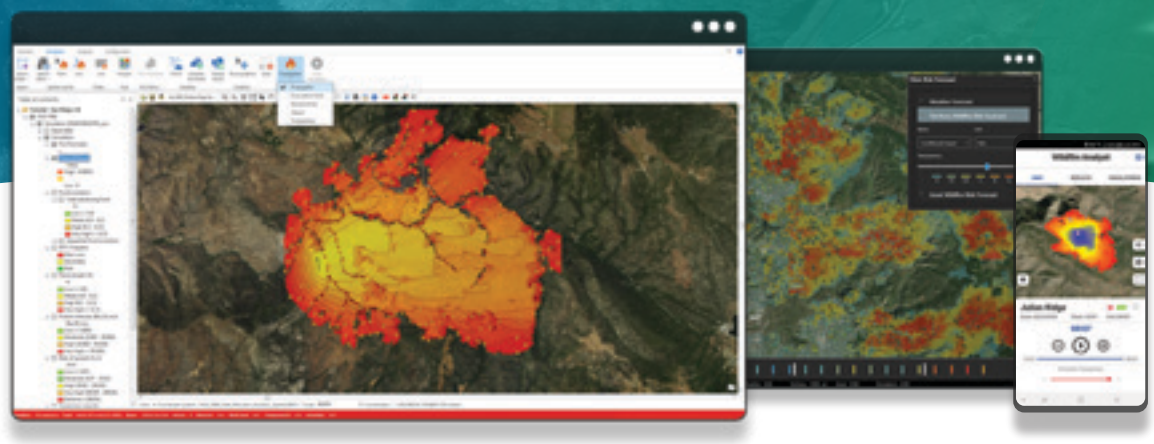

Wildfire Analyst is software that provides real-time analysis of wildfire behavior and simulates the spread of wildfires. Wildfire Analyst is available as a standalone Desktop software program and an Enterprise wide subscription service. Both offerings utilize the same Wildfire Analyst modeling engine that provides **advanced fire behavior analysis in seconds**. Enhanced modeling capabilities support deterministic, probabilistic, real-time adjustments based on field observations, and values-at-risk exposure analysis.

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TACTICAL ANALYST technosylva fiRESPONSE

WILDFIRE IN TURKEY

Fire management challenges at an ancient crossroads of nature & culture

Fire threatening greenhouses in a landscape of forests, agriculture and villages.

By Coşkun Okan Güney, Kevin C Ryan, Aylin Güney, and Sharon M. Hood

Millennia of extensive grazing, agriculture, and timber harvesting have altered Turkey's native vegetation and modified fire regimes. The degree to which this is so is a topic for debate among policy-makers, managers, and scientists – with implications for understanding the potential impacts of land use and climate change on future forest management.

While rapid urbanization, modern agribusiness, intensive forest management, and fire suppression continue to dominate the Turkish landscape, the dynamics of land use and climate change raise questions about the sustainability of future landscapes. How should and how will policy and management evolve to deal with expected increases in wildfires and insect and disease problems? How will these disturbances affect the land's ability to provide adequate supplies of food, productive soil, clean air, and water as well as increasing demand for outdoor recreation? And what is the role of research and development in informing policy and management changes?

These are the questions – particularly the role of research – that engaged our team's exchange between scientists from Turkey and the United States, held in Turkey in the fall of 2018. And this is the history and the issues we explored.

The crossroads of nature, culture, and agriculture

Turkey is an ancient crossroads. Surrounded on three sides by water, it forms the bridge between Asia and southern Europe. It is where East meets West and people, their cultures and vegetation merge and mingle. It is a country of great beauty steeped in human history. For a sense of scale, Turkey is nearly the size of California, Oregon and Idaho combined (303,000 square miles vs. 345,000 square miles), with nearly twice the population (80 million vs. 45 million. Located between 36- and 42-degrees north latitude, defined by 4,474 miles (7,200 km) of coastlines, dominated by rugged mountains and the Anatolian Plateau, Turkey has diverse climates and vegetation morphologically quite similar to those found in the three states. Unlike those states, whose mountains tend north and south, Turkey's mountain ranges tend east and west with increasingly high mountains to the east. It is literally the land bridge formed by tectonic forces. Eighty percent of the land is considered rugged. The average and median elevations are 4,400 feet (1,332 m) and 3700 feet (1,128 m), respectively. In the Asiatic portion flat land is largely limited to the river deltas.

Western Turkey is bordered by the Aegean Sea and the Sea of Marmara. The region has a distinctly Mediterranean climate with mild, wet winters and warm, dry summers. The terrain is generally

COASTAL FORESTS.
The Taurus Mountains rise abruptly from the Mediterranean Sea. This results in rapid urban-wildland transitions, steep vegetation and fuel type gradients with elevation, and forests dominated by Turkish red pine (Pinus brutia) from 0 to 5,000 ft (0 to1,500 m); European black pine (P. nigra) from 1,300 to 6,900 ft (400 to 2,100 m); and Cedars of Lebanon (Cedrus libani) from 2,600 to 7,500 ft (800-2300 m).

FLAMMABLE SHRUB.
The foreground "maquis" shrub vegetation is similar to California chaparral and indicates past fire. The water impoundment is a yangın havuzu ("fire pool") at 2,382 ft elevation, on the slopes of the 7,762-foot (2 366 m) Mount Tahtali. Such fire pools are strategically placed throughout the Mediterranean region and are a critical resource for initial attack.

rolling, a matrix of productive farms and intensively managed forests. The Black Sea region along Turkey's northern coast is cool and humid throughout most years. The landscape is extensively fragmented by agriculture including orchards and tea plantations. Intensively managed hardwood and conifer forests dominate the higher slopes of the Northern Anatolian Mountains which rise steeply and block moisture from the Black Sea from reaching the interior of the Anatolian Plateau.

On its southern border, the Taurus Mountains also rise steeply from the Mediterranean Sea forming narrow band of Mediterranean climate.

Similarly, the Taurus Mountains block moisture from the Sea. As a result, the interior Anatolian Plateau is predominantly a semi-arid shrub-steppe similar to the high deserts of the Great Basin and Columbian Plateau east of the southern Cascade Range of California, Oregon. Summers are hot and dry and winter cold and harsh often with deep snows.

Wheat and barley farming are common on the productive sites while animal husbandry (primarily goats and sheep), alkali flats and terminal (endorheic), saline lakes dominate the less productive sites. And, like the semiarid lands east of the Cascades one might encounter a herd of wild horses (photos, page 22). The Northern Anatolian and Taurus Mountains converge in eastern Turkey with high, inhospitable mountains bosting peaks over 10,000-feet (>3,000m) with Mount Ararat 16,853 feet (5,137m) the highest point in Turkey. These ranges are the headwaters of the Tigris and Euphrates Rivers that defined ancient Mesopotamia.

HISTORY OF LAND USE.
Long-term human impacts on vegetation include the Anatolian mountain grassland degraded by grazing. Wild horses graze on the flanks of 9,898-foot (3,070 meters) Mount Kizlar Sivrisi in the Taurus Mountains.

ANCIENT FORESTS.
Elmali Cedar Research Forest. Centuries of intensive cutting have devastated Cedars of Lebanon forests in the Mediterranean region. Turkey is home to the largest remnant cedar forests. In addition to harvesting for its fine wood properties, cedar oil has been extracted for medicinal and industrial purposes for thousands of years. Co-author Sharon Hood poses beside an ancient cedar once used for oil extraction. Extensive ground disturbance from grazing by domestic animals, primarily goats, and wildlife limit development of fine fuels thereby reducing fire potential.

While the similarities of climate, terrain and natural vegetation bear striking resemblance to large areas of the western United States, the scale of intensive farming, forestry and grazing is quite different. As a result of several millennia of intensive land use vs. less than two centuries in the western US, few areas in Turkey could be characterized as "untrammeled by man."

The rugged topography and history of intensive land use have resulted in a highly fragmented landscape that limits the free spread of fires (photos below), but the land is in transition. Roughly 7 million people live in 22,000 villages located in or near the forests, a drop of 800,000 in the last decade. As is the case in many Mediterranean countries, the decline in traditional land use results in a build-up of fine fuels and an increase in fire potential. Migration of people from rural areas to urban centers stands is in contrast to the influx of urbanites moving into the wildland urban interface of the western US. In recent years, rapidly increasing population and urbanization have increased the pressure on forests for recreational use rather than agrarian subsistence. This is particularly true in the southern and western coastal areas which are preferred by both, domestic and foreign tourists. Around 40 million visitors come to Turkey each year. This change has implications for wildland fuel dynamics and Turkey's fire prevention program.

INTERFACE FIRE.
Greenhouses burned by wildfire.

FRAGMENTED LANDSCAPES.
Many villages are located within the pine forest resulting in a high risk of fire occurrence and damage, though fragmented landscape can disrupt fire spread.


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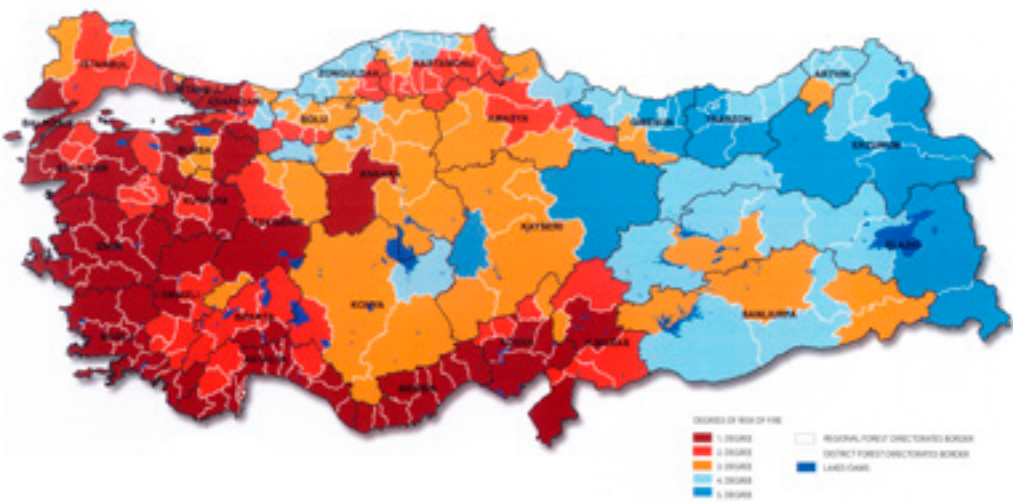
FIRE RISK.
Fire Risk Map illustrates regional variations in Turkey's fire environments, ignition risks and the resulting volume of fire business. Risk ranges from "1 Degree" = Highest to "5 Degree" = Lowest. Graphic: OGM.



Fire management in Turkey today

Prevention of forest fires, forest firefighting, and post-fire rehabilitation efforts are managed by the Turkish General Directorate of Forestry (Orman Genel Müdürlüğü, OGM). OGM has gained significant experience in forest fire suppression with relatively successful, trained staff and a management approach that incorporates technology. Approximately 28 percent of Turkey is forested and forest fires are common. In the last eight years, the average number of forest fires has averaged nearly 2,500 fires. These fires burned about 17,000 acres (~7,000 hectares), approximately 7 acres (2.8 hectares) per fire. Eleven percent of fires are caused by lightning. Of the remaining 89% of human-caused fires, the cause for 60% is unknown. In 2018 fire suppression cost $131 million (USD). The greatest risks of fire occur in the Mediterranean climate dominated areas in the south and west (see FIre Risk map). The average area burned per fire is much less compared to other Mediterranean countries, which reflects quite positively on Turkey's forest fire-fighting policies and management. The current policy is to initiate an initial attack on forest fires within 15 minutes of detection. The fire detection network, silvicultural practices, extensive road networks and fuel/fire breaks, water impoundments, and air resources render this goal realistic in much of the country. The average time from detection to initial attack has steadily declined from 40 minutes in 2003 to 14 minutes in 2018. Currently, 42 helicopters are available for initial attack.

REMEMBERING FIRE.
Roadside fire displays help to increase public awareness of fire behavior and effects and help build support for fire management goals. This "Fire Memory Point" display illustrates the life of the Kumluca fire in a series of photos documenting suppression and rehabilitation activities.

This close-up of a "FIRE MEMORY POINT" focuses on direct attack.

THE OGM TRAINING CENTER. The International Forestry Training Center directed by the Turkish General Directorate of Forestry (Orman Genel Müdürlüğü). Photo: OGM.

A firefighter in training navigates an obstacle course.

Turkey's largest fire occurred in Serik-Taşağıl (Serik-Tasagil, July 31, 2008) burned 38,865 acres (15 795 hectares). This fire lasted for six days and caused heavy damage to many sites, timber loss, and serious erosion. To commemorate large/significant fires and enhance public awareness, roadside museums are often built exhibiting pictures from the fire, from initiation through suppression and post-fire rehabilitation, including primers on fire ecology. (photos, page 25).

An International Forestry Training Center, developed and directed by OGM, is located in Antalya (photos above). The Center is a state-of-the-art training facility complete with living quarters where fire managers use computer-based training modules to teach job-based skills for personnel assigned different tasks in forest fire management. Trainees take formal coursework and use realistic fire simulators to develop their operational, tactical, strategic and leadership skills. Over 4,000 Turkish firefighters have trained at the center since it opened in 2013.

The Center provides a forest fire training program not only for Turkish fire management teams but also for participants from other countries. To date, a total of 169 trainees have been trained, representing Bosnia-Herzegovina, Ukraine, Kyrgyzstan, Azerbaijan, Tajikistan, Kazakhstan, Turkmenistan, Macedonia, Pakistan, Palestine, Mauritania, Senegal, Turkish Republic of Northern Cyprus, Niger, Tunisia, and Georgia. OGM also sends teams to help with large forest fires in neighboring countries, for example, Bosnia-Herzegovina, Georgia, Albania, Israel, Turkish Republic of Northern Cyprus, Libya, Macedonia, Russia, Syria, Greece.

After a fire, the current policy in OGM focuses on intensive efforts to recover timber values and restore burned sites. Burned areas are salvaged and reforested within the first year after a fire. However, concerns about the effects of intensive management on site productivity and future forest development under changing climate and land use are raising questions about the adequacy of current policies to meet the changing needs of the Turkish people.

Given that the need for natural resources is expected to increase in the future, it is increasingly important to know more about the ecological effects of forest fires and to design future management approaches accordingly. Expected climate change, unusual weather events and insect and disease outbreaks might increase the number, size, and severity of forest fires. Therefore, there is a need to understand the fire ecology of Turkey's ecosystems, both for successful suppression as well as for forest protection and conservation. OGM policy is to use research results to inform management decisions. The Southwest Anatolian Forest Research Institute, which is part of the OGM, has a special emphasis on forest fire research focused on preventing forest fires, reducing fire impacts, and determining the ecological effects of forest fires. Within this context, special attention is paid to the cooperation and science exchange with researchers and institutions that are

working in the field of forest fire research from all over the world.

International Collaboration

Within this scope, a forest fire science exchange meeting was held at the Southwest Anatolian Forest Research Institute located in Antalya, Turkey on the Mediterranean coast in October 2018. The meeting was led by Coşkun Okan Güney, forest engineer and forest fire researcher at the Southwest Anatolian Forest Research Institute. Special guests were Dr. Sharon M. Hood from the US Forest Service, Rocky Mountain Research Station, and Dr. Kevin C. Ryan, US Forest Service (retired). The exchange was funded by the Scientific and Technological Research Council of Turkey (TÜBİTAK) within the Fellowships for Visiting Scientists and Scientists on Sabbatical Leave Program, with additional support from OGM. The aim of the meeting was to exchange information on fire ecology and forest fire research activities in both countries, to gain knowledge from the American researchers, and to learn their ecological viewpoint which might give direction to future research and collaborations. A variety of researchers from different departments, as well as forest managers and trainers, attended the nine-day meeting.

The meeting started with presentations on the working areas and institutional structures of the US Forest Service, Rocky Mountain Research Station and the Southwest Anatolian Forest Research Institute. Thereafter, presentations followed on fire prevention, fire suppression and post-fire rehabilitation research, development and forest practices in Turkey. The meeting included tours of the fire lab and soils lab at the Southwest Anatolian Forest Research Institute and the fire training simulator at the International Forest Training Center. The meeting continued with mutual presentations, exchange of ideas, and discussions on several topics, including:

- Silvicultural applications for fire management planning, fuel, and ecosystem management
- Determination of fire intensity, fire severity, and fuel consumption
- Post-fire beetle attack and ecological effects
- Prescribed fire, current practices, challenges, and ecological effects
- Post-fire vegetation dynamics and post-fire restoration
- Post-fire tree mortality modeling

In addition to formal presentations, site visits to recently burned areas fostered discussions focused on measuring and monitoring the ecological effects of the fire. Forests reserved for research purposes within the Southwest Anatolian Forest Research Institute were also visited and information was exchanged about current and former studies carried out in these forests. Forest sites included examples of ongoing research on post-fire regeneration and growth and tree mortality for Pinus brutia.

FIELD STUDY. Coşkun Okan Güney and Ali Kavgaci discuss post-fire regeneration and soil erosion issues on the 2008 Serik-Taşağıl fire following salvage logging and replanting of Pinus brutia.

The meeting culminated with discussions of possible cooperation between the US Forest Service and OGM. The aim is to continue communication and establish opportunities for joint collaboration between the two countries. Potential vegetation/fuel and fire ecology research topics within the scope of the Southwest Anatolian Forest Research Institute's fire research group were identified:

- Determine the effects of climate change on fire regimes
- Explore the potential use of prescribed fires in fuel management and for fire silviculture
- Model the effects of forest fires using remote sensing techniques
- Map fire risk and determine its relationship with current forest practices
- Monitor and model post-fire vegetation dynamics
- Determine ecophysiological effects of management, climate, and fire on plants

The international exchange provided scientists and managers from Turkey and the United States the opportunity to learn from each other's experience, identify similarities and differences in approaches to common problems, and develop a bond of friendship.

ABOUT THE **AUTHORS**

The exchange participants and authors include Coşkun Okan Güney, Southwest Anatolian Forest Research Institute, and Aylin Güney, Department of Biology, Akdeniz University — both from Antalya, Turkey; and Kevin C Ryan, FireTree Wildland Fire Sciences, and Sharon M. Hood, US Department of Agriculture, Forest Service, Rocky Mountain Research Station — both from Missoula, Montana, United States.

Photos by the authors unless otherwise noted.

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The challenge for wildfire science (and those who apply it) is reinventing our contract with society.

WILDFIRE SCIENCE FOR SUCCESS
SCIENCE AT A CROSSROADS

PART 2
IN A SERIES

In the wake of questions about the future of the Joint Fire Science program and the release of Canada's new Blueprint on Wildland Fire Science, Eric Kennedy offers a set of conversation-starting ideas for the future of wildfire science. He suggests that wildland fire science is at a crossroads: rather than simply looking to preserve current funding, we need to reinvent our "social contract" with society.

*This series was inspired and inaugurated in part by panel from the **Human Dimensions** conference in December 2018. Part 1 was published in the April 2019 issue of Wildfire.*

By Eric B. Kennedy

It's hard to imagine a more tumultuous time for wildfire science than we've experienced in North America in the past few months. In the United States, March was marked by a significant slashing: news that the Joint Fire Science program, a major actor in wildland fire research since 1998, was being recommended for discontinuation in the 2020 budget. Meanwhile, Natural Resources Canada released their eagerly-awaited "Blueprint for Wildland Fire Science in Canada, 2019-2029." The contrast has been striking, even if much uncertainty remains about what the final outcome will be in each country.

Amid the whiplash of these developments, wildfire science remains as important as ever. Pressures from every side – a changing climate, increased settlement in urban interface areas, underfunded preparedness and mitigation programs, and excess fuel loads among others – multiply together to raise the stakes that firefighters and fire managers increasingly face year-round. Fire science offers many promises including fire detection and mapping, modeling smoke and fire spread to support finer-grain tactical responses, more fire-proof building materials, and more effective suppression technologies.

This brings us to a critical crossroads: a moment where wildland fire science is concurrently under existential threat, being reinvented, and is needed more desperately than ever before. In Part 2 of this series (Part 1 can be found in the April 2019 issue of Wildfire), I argue that we need to be more courageous in our response to these pressures. In an era of hyper-polarization and accelerating pressures, we as a fire community – from frontline firefighters to seasoned academic researchers – need to come together to reimagine what wildland fire science can and should be.

Why Research at All? Science and its Social Contract.

Before we can reimagine fire science, we need to revisit its promise and perils.

In the previous issue of Wildfire, I argued that there are two misleading and untrue myths that we tell ourselves about the scientific enterprise. The first myth is that more money leads to more science (it doesn't, or at least not in a predictable, linearly increasing way). The second myth is that science can provide answers to the biggest challenges in wildland fire management (it generally can't, because most of these issues are actually based on competing values, risk tolerances, and visions of ideal futures).

These myths, of course, aren't unique to wildfire science. They're also fables that we tell ourselves about science as a whole. In the field of Science and Technolkgy Studies, we'd refer to this as the 'social contract for science.' Just give us more money, scientists suggest, and we'll shower you with good outcomes like societal wealth, health, and technology. In the case of wildland fire, these 'good outcomes' are often related to safety: more powerful technology for fighting fires or better models that can inform our tactics, for instance.

A researcher shoots video of temperature variations in the flames during a research prescribed fire in Montana. PHOTO: Marjie Brown.

Yet, it's easy to see why members of the public – and perhaps politicians writing budget proposals – might question whether we have actually delivered on these goods. Despite the Joint Fire Science annual program budget increasing from $8 million in 1998 to $14 million in 2006 (before eventually falling to $3 million in 2018), the past decade of fire doesn't suggest that this scientific investment has meaningfully reduced the impact of wildfire on our communities. Nor has the growing number of publications on wildfire or amount of global fire research funding resulted in fewer fires or home losses. Fires have continued to burn, exacting a massive cost on infrastructure, public health, and firefighter and public safety.

To be clear, I don't think this perceived failure represents any lack of investment, commitment, or skill on the part of wildfire researchers. On its own, fire science itself cannot prevent homes from burning or protect community members. Rather, it's only when fire science is meaningfully integrated into mitigation, preparedness, and response activities that these goods can be achieved. In other words, our fundamental problem isn't a lack of funding for wildland fire science, it's the chasm between the silos of research, preparedness, and response.

An Incremental Approach - Better Coordination, Better Objectives?

There have been important efforts to try to close these gaps. The Canadian Blueprint for Wildland Fire Science, for instance, identifies all the right areas of attention for work going forward. A massive undertaking, the 31-member steering committee ought to be commended for working through such a broad mandate and producing such a comprehensive synthesis. It identifies six themes that require ongoing scientific work:

- Fundamental physical fire science, including fire behavior models and risk assessment
- Recognizing indigenous knowledge in meaningful and collaborative ways
- Building resilient communities, including codes, standards, and WUI fire spread modeling
- Ecology, including fire impacts past, present, and future, and integration of silviculture
- Fire management, including decision support, knowledge exchange, and occupational health
- Physical, mental, social, and economic impacts, with a holistic definition of community health

The document also lays out a wide variety of suggestions for how to deliver on research in these areas, including student training, thematic working groups, the establishment of a national coordinating committee for science, and the support of conferences and virtual knowledge exchange.

Yet, there's also potential risk. One of the exemplars identified as a "proven model … for coordination of national wildland fire science" is the Joint Fire Science Program, which currently faces an existential funding threat. In its Fiscal Year 2020 Budget Justification, the US Department of Agriculture proposes "permanently cancel[ing]" the Joint Fire Science program, arguing that the program is no longer necessary as …

"…the Forest Service will focus reducing wildland fire risk, contributing to the improvement of forest and grassland conditions across shared landscapes, and contributing to rural economic prosperity."

The other example cited as a model was the Bushfire and Natural Hazards Cooperative Research Centre (CRC) in

Australia. The CRC has done incredible work in fire science, especially in establishing meaningful and ongoing links between the research and practitioner communities. Yet during the panel on funding mechanisms for fire science at the *Human Dimensions of Wildland Fire* conference in Asheville, North Carolina in December 2018, some attendees highlighted challenges that remain even in such a progressive approach. Because the CRC is funded on a relatively short-term basis given its size and scope, for instance, it creates challenges for establishing long-term projects that exceed that time horizon and for funding responsive research during the latter half of a grant period.

In other words, I wholeheartedly agree with the priorities established by the Blueprint and think that the steering committee is absolutely correct in their recommendations. Yet, I worry that this kind of incremental approach – tweaking research topics towards priority areas, lobby for more funding, and adopt a similar coordinating body to the Joint Fire Science or CRC model – has a chance of exposing Canadian fire science to the same long-term limitations and risks these organizations are currently experiencing.

A More Radical Path Forward.

To review, there are at least three challenges that we face as a wildland fire science community. First, there is arguably a perception that we might not be delivering on the outcomes we promise. Second, there's massive volatility: one of the biggest players might be about to disappear, while even established ongoing models can be limited in their coordinating functions when hamstrung by short-term funding. And third, the wildfire challenge is poised to become worse – not better – in terms of both threat and impacts.

Given these considerations, I think we need to be more courageous and radical in our strategy going forward. In the spirit of spurring discussion – and certainly not having perfect answers – I'd offer five suggestions for how we might reinvent this enterprise from the ground up.

(1) We need a wholesale changing of priorities, accelerating the shift from investigator-driven research to end user- and community-motivated investigations. The impact of wildfire is simply too significant and real – in terms of lives, health, communities, and infrastructure – to allow a business-as-usual approach to fire science. Academic curiosity is an insufficient justification for investing time and funds into research, nor is there reason to believe that important topics would go unfunded in a user-needs driven model (e.g., there will still be a critical need for historical work to establish past fire regimes and effective management strategies).

In short, we need a model where users and communities are the ones in the driver seat, initiating projects and identifying the questions that matter to them and where research could tangibly improve outcomes. The Joint Fire Science Program indeed represents a strong attempt at shifting this equation, although making this change lasting requires being much more critical of the incentives, norms, and reward structures within the academic community.

(2) We need more research coordination on an international scale. With end-users and communities identifying the questions, we then need a coordinating body that can help (a) formulate questions effectively, (b) identify existing answers, and, in the

case of new questions, (c) design together teams with the right expertise to answer these questions in a meaningful way.

Team formulation should bypass traditional shortcomings of research group formation (e.g., over-emphasizing privilege and established researchers or networks) and emphasize interdisciplinary and Indigenous expertise, as well as researchers from diverse backgrounds and different career stages. This coordination needs to be international in scope, as most questions have applicability across national boundaries – and would benefit from trans-national collaborations and overcoming national silos.

(3) We need to separate coordination from funding. The prospective loss of the Joint Fire Science program would be doubly devastating. Not only would it result in a gutting of money available for fire research, but it would also destroy the critical coordinating function Joint Fire Science plays in setting priorities. Likewise, the CRC and any such Canadian creation would be similarly vulnerable to being eliminated due to a lack of funding – a move which would gut coordination and collaboration precisely at the moment it was most needed to help steer research to new funding sources.

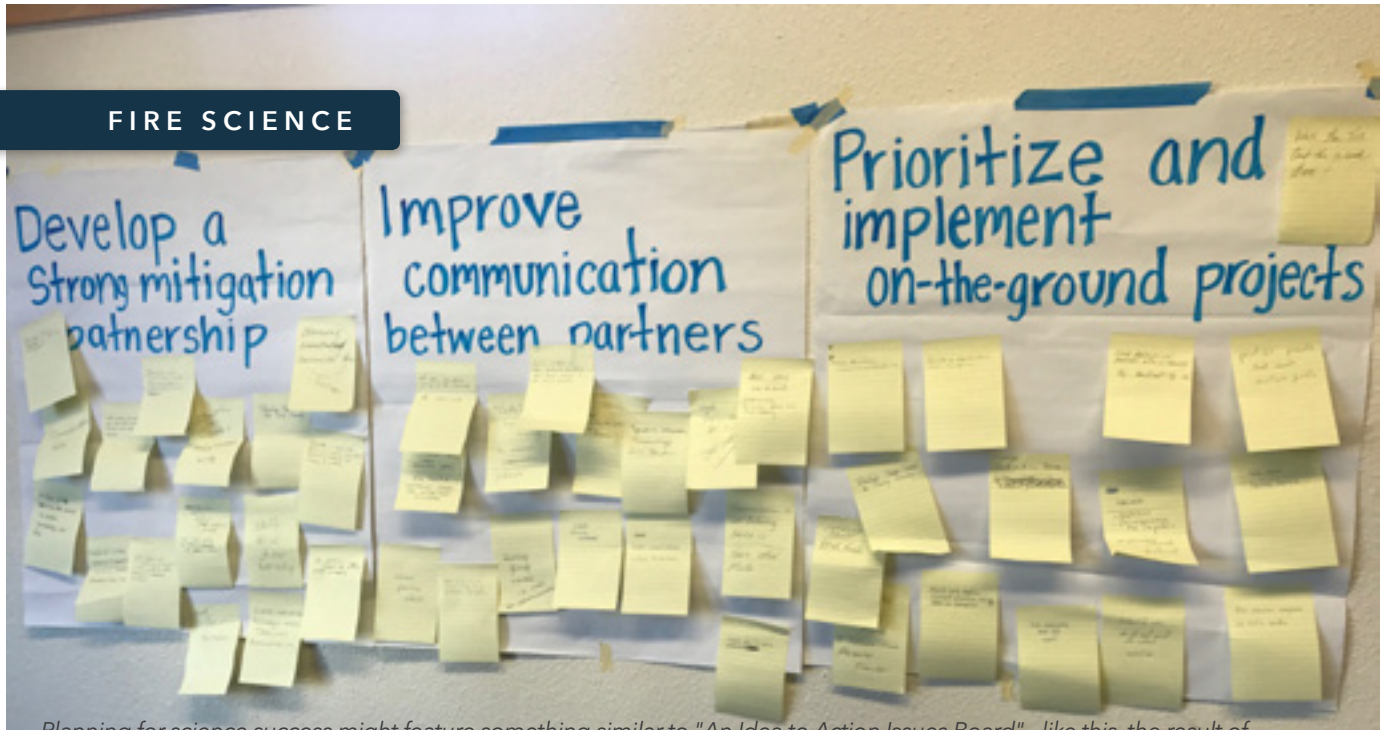
Navigating the role of this body relative to granting councils and prospective funders would obviously be complicated (e.g., there would be no way to force funders to support these projects as opposed to lone wolf, independently driven efforts), but the credibility of user-driven, thoughtfully scoped projects could help establish a track record of success in obtaining funds from national councils, fire-specific science appropriations, and private sector opportunities (such as insurance companies).

This would also free us to lobby more effectively as a community for increased investment in fire science from all levels of government and from multiple agencies and programs, rather than letting funding be consolidated into and 'owned' by a single, more vulnerable program.

ABOUT THE AUTHOR

Eric Kennedy is an Assistant Professor in the Disaster and Emergency Management program at York University in Toronto, Canada. With a Ph.D. in the Human and Social Dimensions of Science and Technology from the Consortium for Science, Policy & Outcomes at Arizona State University, his research focuses on how experts, agencies, and institutions manage wildfire – and deal with conflicting views on this contentious topic. He teaches courses in the ethics, sociology, and psychology of emergency management, working closely with practitioners in the field in Canada and beyond to train the next generation of emergency managers.

You can reach him at ebk@yorku.ca or on Twitter at @ericbkennedy.

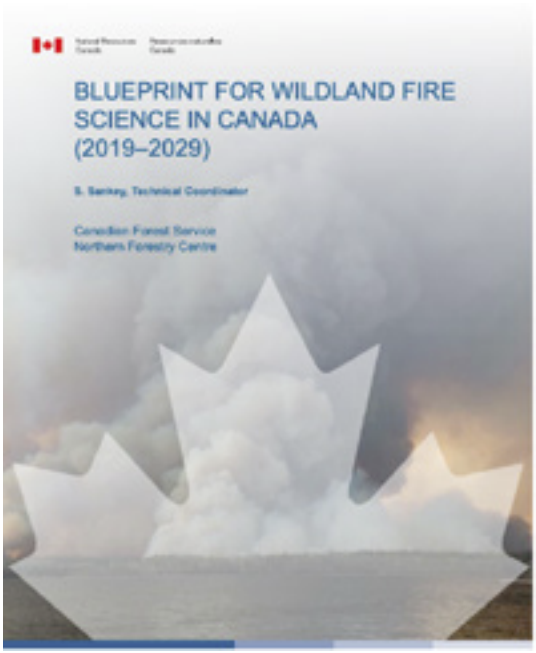


Planning for science success might feature something similar to "An Idea to Action Issues Board" - like this, the result of Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis on the 2017 Chetco Bar Fire, Oregon USA. Photo: USDA Forest Service Community Mitigation Assistance Team Program https://www.fs.fed.us/managing-land/fire/cmat

(4) We need to embrace "slow science." Counterintuitively, as the wildfire threat increases, we need to respond with slower science. Among other things, the slow science movement emphasizes the value in reducing the number of projects being undertaken concurrently by any one given researcher. It prioritizes quality over quantity, encouraging those in research to invest more time and focus on a smaller number of efforts.

The international coordinating body would have a key role to play in modeling this behavior, seeking to distribute funds throughout the research community rather than centralize it among 'superstars,' establish mentoring relationships that bring new researchers in and provide opportunities for support, and encourage teams to stay with projects through implementation, evaluation, and iterative improvement – rather than simply seeking to publish high volumes of papers. By modeling this behavior on an international scale, it would also create subject-wide support for this practice, helping to address tenure- and promotion-related concerns.

(5) We need to integrate science into preparedness and response. I imagine that most readers would agree that there is a need to reemphasize preparedness funding rather than responding to wildfire simply by a relentless increase in response spending. Likewise, we should push for research funds to be found from a new home: not from a separate line item for science, but as a component of preparedness and response. This means renegotiating that 'social contract,' moving from a model of "give us the money to get the goods" to "share your questions and we'll give our capacity in partnership to answer them." It will require engaging with federal and provincial/state governments alike, building credibility through examples of science having improved outcomes, and embracing a model where we are judged on outcomes (e.g., how our work supports fire managers) rather than outputs (e.g., the publications we write).



At the Crossroads -- a Call for Radical Re-imagination of Purpose.

We face a dramatic and challenging crossroads for fire research. On one hand, our core institutions are at risk, such as the potential loss of the incredibly valuable Joint Fire Science program. On the other, we face an ever-accelerating problem that will not be adequately addressed through a 'business-as-usual' approach to science. To respond, we need to do more than just work to preserve existing institutions. Rather, we need to radically reimagine our purpose as a research community by focusing on end-user driven questions, designing new institutions that span national boundaries and reduce political vulnerability, and creating a new generation of fire science that is reflective, focused, purposeful, and action-based.

For more background, see the *Blueprint for Wildland Fire Science in Canada.* https://www.nrcan.gc.ca/forests/fire-insects-disturbances/fire/21614.

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