"Uniting the Global Wildland Fire Community"

WILDFIRE®

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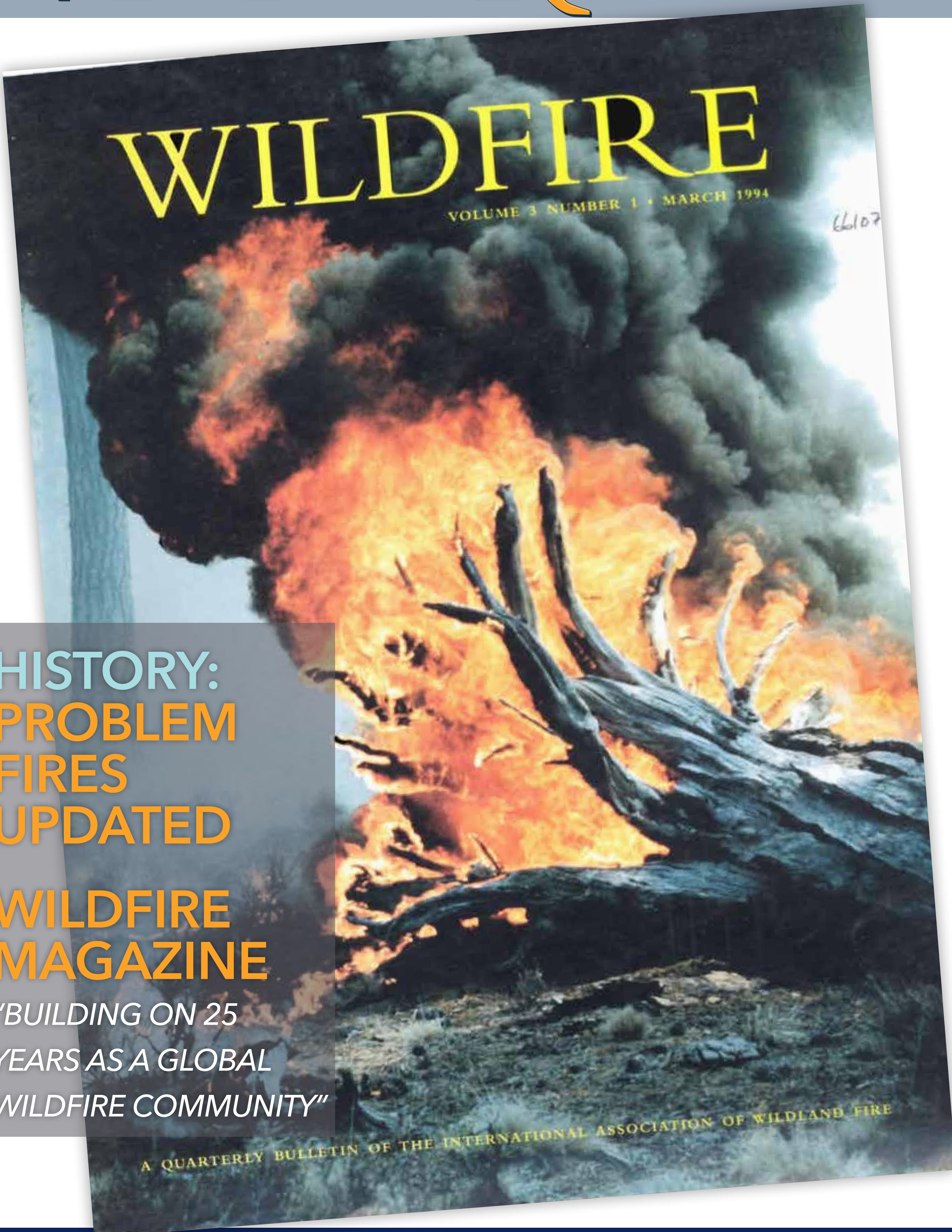

HISTORY: PROBLEM FIRES UPDATED

WILDFIRE MAGAZINE

"BUILDING ON 25 YEARS AS A GLOBAL WILDFIRE COMMUNITY"

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

March-April 2017 *Volume 26 Number 2*

Wangaratta, Victoria -- an experimental grassland fire tests the flame-front impact on an ultra-light gel protected tanker vehicle. More on page 28 -- "Developing a Tanker Crew Protection System."

On the Cover:
The cover of *Wildfire Magazine from* March, 1994. For more on our history and continuing impact of *Wildfire,* see page 16, where we share additional covers and an initial review of our early years. This launches a new regular section for 2017, "25 years of Wildfire Magazine."

COLUMNS & NEWS

FEATURES

Wildland Fire *and the* Importance *of* Continued Learning

TOM
Zimmerman
PRESIDENT,
IAWF

By Tom Zimmerman.

In the environment of today as well as that of the future, wildland fire is a very real and dominant force that warrants considerable attention and response. Since the inception of organized wildland fire management, wildland fire has dramatically evolved in scope, magnitude, and complexity -- with an impact that reaches far beyond our profession and that shapes social, economic, political, and ecological processes globally.

Wildland fire management involves planning, implementation, monitoring, and evaluation activities that facilitate the protection of people, property, communities, societal infrastructure, and natural resources from detrimental effects of unwanted fires. It includes the use fire, where appropriate, to make landscapes and human populations resilient to fire-related disturbances; and to accomplish stated objectives. It involves the application of ecologic, social, and physical science, risk management, human performance, and community engagement for discovery of new knowledge and capabilities; strategic planning for prevention, suppression, prescribed fire, use of wildland fire; and tactical application of all appropriate ground and aerial implementation practices. Long-term strategic planning accompanied by a spectrum of tactical operations now frame what once were actions driven by only short-range planning and unchanging response actions.

A long-term outlook

The National Cohesive Wildland Fire Management Strategy of the United States represents a detailed example of a comprehensive strategic plan that frames issues and challenges, and identifies long-term opportunities and direction. This Strategy (http://www.forestsandrangelands.gov/strategy/) establishes a national vision for wildland fire management, defines three national goals, describes wildland fire challenges, identifies opportunities to reduce wildfire risks, and establishes national priorities focused on achieving national goals.

By considering the role of fire in the landscape, the ability of humans to plan for and adapt to living with fire, and the need to be prepared to respond to fire when it occurs, this Strategy takes an all-inclusive approach to the future of wildland fire management.

The vision it identifies for the next century is:

To safely and effectively extinguish fire, when needed; use fire where allowable; manage our natural resources; and as a Nation, live with wildland fire.

Three goals are identified as necessary to achieve this vision:

- Restore and maintain landscapes
- Fire-adapted communities
- Wildfire response

This National Strategy defines challenges associated with wildland fire including managing vegetation and fuels; protecting homes, communities, and other values at risk; managing human-caused ignitions; and response to wildfire. Challenges are escalating but our science, knowledge, and experience are progressing and continue to reach new levels.

The importance of learning

The importance of learning cannot be overstated. Learning contributes to continuous program development and increased capability. Learning recognizes the importance of program examination; collection of new information; review of best procedures; application of knowledge, proven practices, and technology; and documentation of overall processes and results to improve program effectiveness.

To succeed in organizational learning, it helps to identify the key tasks, activities, and outcomes you require, as illustrated in this table.

Task	Specific Activity	Outcome
Collection of new information	• Acquire information and develop shared vision.	• Define what is known, what needs to be learned, and what lies ahead.
Review of best procedures	• Analyze program development, past performance, and interdependency of all program elements to address problem solving.	• Define how to advance knowledge, how to use this knowledge, and identify practices that will lead to superior performance and accomplishment.
Application of knowledge, processes, and technology.	• Transfer knowledge, principles, guidelines, procedures, practices, etc. through all available methods. • Incorporate new and best knowledge, new technological applications into business practices.	• Establish a continual flow of new ideas, knowledge, and technology into application. • Improve management capability and performance.
Documentation of processes and results	• Document program development, practices, and organizational growth. • Ensure the retention of critical information.	• Improved information transfer processes. • Retention of information for future reference and application.

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A continued commitment to learning opportunities

Conferences provide a stage where a definition of needs, accelerated information exchange and technology transfer, knowledge building, consensus building on best practices, and dedicated (and focused) learning can be offered on a large scale. At one location over a short period of time, participants can experience formal training; special sessions dedicated to important topics; practical application and skill building workshops; oral and poster paper presentations on scientific knowledge, new processes and practices, and technology; on-the-ground field trips of case studies and completed actions; and informative presentations by leading experts in the field. This structured format can dramatically quicken and focus learning.

Conferences are innovative, revolutionary, and enlightening. They provide a neutral forum that can successfully fulfill all elements of organizational learning. They bring together wildland fire experts and practitioners and enable them to define what is known, what needs to be learned, and what lies ahead. They facilitate the presentation of new knowledge and tools, successful management examples, and interpretations of actions. They establish a setting where ideas, knowledge, and technology can be transformed into application and lead to increased performance and accomplishment. Conference proceedings and participant information also provide useful documentation for future reference and permanent retention.

The wildland fire environment we face today and in the future necessitates that we continue to pursue learning and growth. There are many areas needing better definition, activities needing improvement, and areas where much remains to be discovered and learned. Some key areas facing fire managers include fire intensity, spread, and severity; altered fuel complexes; fuel management and treatment; community expansion, and wildland-urban interface sprawl; firefighter and public safety; air quality and smoke management concerns; and prescribed burning planning and implementation.

There have been several conferences presented recently that focused on important wildland fire topics. They created environments where information sharing and learning about fire behavior and fuels; smoke management and air quality; fire safety; and prescribed fire were optimized. The importance of these areas is great enough that these conferences recur on a scheduled basis.

Fire Behavior and Fuels. The 5th International Fire Behavior and Fuels Conference was a large-scale effort aimed at showcasing the latest information regarding the many issues associated with fuels, fire behavior, large wildfires, and the future of wildland fire management. Significant issues in these areas were identified and new solutions called for. Management of fuel complexes; accelerated fuel treatments; preparation of communities to withstand wildfire; incorporation of learning, experience, emerging science and technology; as well as sustainable funding for wildfire suppression and fuel treatments were identified as vital for success.

Smoke Management and Air Quality. The 2nd International Smoke Symposium focused on a specific and growing area of concern and need. It brought together researchers and practitioners from atmospheric sciences, ecological sciences, mathematics, computer sciences, climatology, social science, health professions, smoke response and management, regulators, policy-makers, interested and affected publics, and others to discuss the complex issues of wildland fire smoke. Conference attendees identified knowledge gaps and opportunities for innovation and development.

Fire Safety Summit. A key area in need of greater attention is fire safety. Safety has long been an important concern and since 1997, 13 International Wildland Fire Safety Summits have focused on safety, significant events and trends, safe practices, training, ways to advance operations, new research results and technology, and improved wildland fire safety.

The recent 14th International Wildland Fire Safety Summit provided detailed attention to decision making in high risk and high consequence environments. Participants included all individuals involved in decision-making – from front line firefighters to incident managers and fire executives. Topical areas addressed at the included:

- Understanding leadership decision-making responsibilities,
- Use of technology to improve situational awareness,
- Consideration of human factors in decision-making,
- Equipping incident management teams to make wise decisions,
- Continued relevance and importance of wildland fire safety doctrines in today's technical world,
- Learning from other (non-fire) disciplines where high consequence decisions are made,
- Lesson learned from past fire events.

International Congress on Prescribed Fire (ICOPFIRES). ICOPFIRES was the first international congress about prescribed fires in Europe. Prescribed fire is still not accepted and applied as a common practice in all countries around the world. Some are well versed in planning and implementing while others are engaged in the early stages of developing processes, procedures, guidelines, qualifications, and experience. But nearly all countries where forest and land management practices take place agree that altered fuel complexes and urban expansion are creating greater needs for fuel treatment and prescribed fire.

Slow adoption and movement into prescribed fire use can be related to social pressure, consequences of negative impacts, smoke impacts, lack of understanding of benefits, and potential loss of goods and lives. These are key areas where additional information, science, understanding, and experience are needed.

Prescribed fire has a necessary role in forest and land management. This conference provided a stage to address research, needs, facilitate intra-disciplinary and interdisciplinary communication, create synergies between science and stakeholders, transfer knowledge, create bridges among all participants to establish the first international network about prescribed fires, and increase awareness, understanding, and perceptions about prescribed fire.

The importance of prescribed fire and the need for learning will ensure that this will not be the last international congress on this topic.

National Cohesive Wildland Fire Management Strategy – National Workshop

The Cohesive Strategy affords the most comprehensive and detailed long-term strategic plan ever produced for wildland fire management. Along this line, we may consider ourselves well positioned for future challenges. At no time in history have wildland fire management agencies; organizations, and stakeholders had more science, technology, knowledge, and experience available. However, many aspects of implementation are still heavily weighted toward past experience, repeated practices, and historic templates that do not maximize capability, and implementation is not always based on the incorporation of the best available science.

At the beginning and throughout all stages of planning and development of the national strategy, science was at its center. Continued advancement and accomplishment of goals hinge on reinforcing the importance of science in implementation activities and improving mechanisms to facilitate science integration with implementation.

This national workshop is structured to provide improved understanding of the importance and critical role of science in wildland fire planning and implementation. It will also reinforce that successful implementation is predicated on an "all hands, all lands" approach with seamless access to the best available and correct science vital to success at every level and every action. It will be a workshop that promotes maximum information sharing, identifies processes to ensure full integration of science in all planning and implementation activities, and ensure continued wildland fire management research.

The Takeaway: Excellence is a global goal

Excellence in wildland fire management is a global goal. The influence of continued learning has been accountable for a steady progression of definitive positive program changes. But, its influence cannot and must not be considered complete. The importance of continued learning; information sharing, information and technology transfer, and research cannot be overstated. It must continue. Conferences offer an important mechanism to promote learning and strongly support the advancement of knowledge and education and expansion of science and management.

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BRIEFING

Reality TV? Solve the Fire Problem.

Here's the pitch. *The Apprentice* is tanking. We might imagine that the executive producer, moving on to bigger challenges, is desperate for another vehicle, desperate for a win. A *huge* win.

Sir, we say, *all we need to do is just try to solve the fire problem. Even if we don't win, we've got guaranteed audience attention. Picture this: fire on the horizon, our forests and habitats and recreation grounds (not to mention our houses) just hours from becoming a bag of charcoal for the worst picnic you can imagine. Plus, solving the fire problem is the safest way to sneak the phrase climate change back into circulation by calling it what in reality it is. And to prepare not just for the future but for now — because now, with fires burning outside of our experiences and our capabilities to manage, climate change is a climate emergency.*

To translate the fire problem into a reality TV show is not so far from the reality on the ground today. From Chile to Kansas, wildfires are breaking records (and in the NY Times, an extension agent in Kansas says, of the wildfires and lackluster response, "This is our Hurricane Katrina.") As in any drama, scripted or not, we have heroes — those in Nomex, the fire fighters and fire responders, plus a supporting cast of white-coated fire scientists, fire thinkers, and fire managers and land managers (also usually in Nomex). And we have super-hero tools — backpack pumps, chainsaws, an armada of flame-extinguishing hardware in the air, from jumbo jets to single-engine tankers, from helicopters to drones (someday), not to mention satellites that offer near-real-time tracking of lightning, wildfire heat signatures, weather and climate.

And villains? Might it be so wrong to prop a black hat on developers and short-sighted leaders who allow unprotected (and sometimes unprotectable) housing in a fire-prone landscape. And on those who've manipulated key fire-management procedures and processes — by threatening budget cuts to satellite technology, and delaying the hiring of key firefighting positions in the US? As in any comedy, there are leaders advised by fools and clowns, plus the risk that one or all will make mistakes that are, in reality, far more hazardous than the mere trips and pratfalls of comedy.

On *"Wildfire: Our US Reality"* (and a global franchise might offer *"Bushfire: AU Burning"*), we might begin with Scene 1: Invite a team of fire experts each week to solve the Fire Problem and to Prevent the Worst "Not-on-my-Watch" Outcome, by identifying the Values at Risk and trying to resolve them.

Scene 2: organize Team Alpha to implement a strategy. You have 24 hours. Though in many cases, the fire (Scene 3) is only two hours from reaching at least one of the Values at Risk. So which do your protect. We close with Scene 4: Do you solve for X (ensure crew safety), or Y (evacuate citizens), or Z (save houses). Oh, and don't forget our key mission — to solve for long-term landscape resilience amid a climate chaos that most species (including *Homo sapiens*) have too little experience much less the *sapiens* to face.

Life's challenges, we're reminded by reality TV and reality alike, are shared and share-able, solvable if we can accept the physical nature of fire

(fire, after all, is simply a physics problem) and move beyond the perplexing and the frustrating social conflicts. The solution will come if we learn to honor the story as much or more than the story-teller. Solutions are thwarted by the selfishness and self-centeredness of those who focus only on being the winner; solutions are expedited by those whose foresight and goodwill and humor seek a global and communal win.

The winner in the show we're pitching would be the team and the community and the landscape, demonstrating together that our most resilient solution to the fire problem is solving not for *I* but for *Us*.

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We have the tools to solve for X, but perhaps not the shared wisdom. As this issue of *Wildfire* comes together, we've sought to add a few new tools, many thousands of words of real wisdom and some key images to inform the reality-TV script that we're living each fire season.

We begin with an update of the "Problem Fire" concept, originally defined by Stephen Pyne in 1982 and updated here by Pyne and Brad Washa for the 21st century.

We share a vision by a global cast of fire researchers on how fire modeling might help us work with a wider forecast cushion and thus more safely, and offer a research update on surviving a tender/ engine burnover from Australia, an After Action review on Australia's fire season, plus a variety of news updates, a weather meter review. And we feature a few cover images from the early issues of *Wildfire Magazine* -- to intro our regular updates on *Wildfire*'s history, impact and future. And all of these images and stories combine to tell the very real story — the days of real work by real firefighters who remind us that it's our decision when to burn and how to burn, and how to respond safely when the ignition is unplanned.

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A few years back I was cold-called by a producer's assistant who was conducting research for a potential reality show. She wanted to know about wildfire and firefighters. They were thinking of a show, the true story of firefighters, fighting fire. I shared a few stories about the fire problem and firefighting. She asked about my colleagues, our community, with a particular focus on our conflicts.

And I shared how much we learned from each other, how much each of us relied on the other's support. How the shared mission allowed us to work through our peeves and peccadilloes, and when it was time to respond we acted thoughtfully, calmly, as a team united by good, hard work and a shared mission.

I never got a call back. Perhaps I described the end result, the order that we make from chaos, with more clarity than the narrative, the very dramatic solutions we craft on the fly. But the show — our reality, which is both a great show and real — must go on, and does go on, regardless of where the camera is pointing.

And so we work to solve for Problem X — the Fire Problem, and the camera may be framed on us the way Camus re-framed our focus on Sisyphus pushing the rock uphill, again and again, since this ever-repeating task is our reality, part reality-TV and part dark comedy — Sisyphus meets *Groundhog Day* — with the fields and hills and mountains on fire, one day into the next.

Now that's a reality show we could watch, if it wasn't so much like our day (and night) jobs.

Local Leadership National Cohesive

How a small group of senior leaders brought life to the National Cohesive Wildland Fire Management Strategy in Nevada. Lessons that can be applied as we move ahead locally, regionally and nationally to apply the Cohesive Strategy, which is the focus of the upcoming IAWF National Cohesive Strategy Workshop in April.

by Mike DeGrosky

In 2009, the United States Congress mandated development of a strategy to comprehensively address wildland fire management across the country. What is now known as the National Cohesive Wildland Fire Management Strategy (Cohesive Strategy) rests on the premise that because wildland fires do not respect jurisdictional boundaries, our management of fire must involve collaborative effort and simultaneously address resilient landscapes, fire adapted communities, as well as safe and effective fire response.

In 2015, IAWF Executive Director, Mikel Robinson and I partnered to manage and facilitate the Nevada Wildland Fire Cohesive Strategy Summit. This was an effort designed to convene an inclusive stakeholder group to build familiarity with the Cohesive Strategy, create a stakeholder network, and identify tangible strategic actions for implementing the Cohesive Strategy in Nevada, both in the short and long term.

The effort, sponsored by a consortium of federal, state and local agencies in Nevada brought stakeholders who, over a period of a few days, developed a strategy and established an oversight group to both act as an advisory body to guide the Summit's action plan, ensure that the participants achieve their goals, and to monitor emerging topics through the Nevada Fire Board.

Working on the Nevada Cohesive Strategy Summit taught, or reminded me of, a number of leadership lessons for people hoping to lead collaborative change.

1. Efforts like the Nevada Cohesive Strategy Summit are best organized by relatively small groups of people with "horsepower." Not too small of course; too few people and the tasks of organizing become onerous. However, get too many people involved and the group gets unwieldy and the effort unfocused. An eight-person organizing committee made up of, among others, the State Forester, a Forest Supervisor, and the State Fire Management Officer for the Bureau of Land Management guided the Nevada effort.

2. Successful collaborative efforts require a sparkplug. With funding from a federal grant, then State Forester Bob Roper led the Organizing Committee; providing the continuous push that was needed to get things done.

3. Getting people to commit to a new idea or tool requires that they have opportunities to engage, to get involved, to discuss, to contribute. Organizers of events, like this summit, need to build into their process, both those opportunities as well as flexibility to allow people to put their stamp on the effort.

4. For government agencies to be cohesive with one another, they must first be cohesive internally. If your agency's vegetation management personnel do not first collaborate with your own fire people to achieve common goals, you will struggle mightily to collaborate with other agencies; at least in any meaningful way.

5. Gatherings can help develop stakeholder networks and create opportunities for relationship building and networking that actually go well beyond the designed purpose or desired outcomes for an event. There's no substitute for getting people together to collaborate.

6. People are cynical about plans and initiatives and we are getting worse all the time. Consequently, organizers of events like the Nevada Cohesive Strategy Summit need to deliver the goods; producing sustained attention, effort, action, and progress. People have really high expectations these days; and producing results that will satisfy people takes much more than good intentions and a meeting.

7. Leadership engagement throughout the Summit meant a lot to the participants. The Organizing Committee, made up of

Lessons *and the* Strategy

senior leaders, established themselves as a work group to address specific, overarching issues and to provide real-time, responsive decision-making. Key personnel from the Forest Service Regional Office, the State Forester's Office, the BLM State Office as well as senior staff from non-governmental organizations and fire department Chief Officers stayed engaged, as participants, throughout the effort and the State Forester, the BLM State Director, the Regional Forester, and a member of the Governor's cabinet addressed the group near the end of the event.

8. People want to see all the right people there, and people will be less than satisfied should they perceive the absence of other stakeholders, particularly if important stakeholders are either unrepresented or underrepresented. Act quickly and decisively to engage stakeholders who were either absent or underrepresented.

9. People are impatient and want to see results immediately. Start producing tangible action quickly. Take advantage of the engagement, energy, and commitment developed at a gathering. Engagement, energy, and commitment all recede with time and evaporate quickly if participants perceive delay. Communicate with participants to provide status checks in order to maintain a sense of both momentum and transparency.

10. Treat work products from a collaborative effort as the foundation of strategic goals (specific, measurable accomplishments you intend to accomplish over time) for which assigned personnel will establish objectives (a plan or methodology for achieving the goal), to which agencies can assign resources, and against which progress can be measured.

11. Treat the action items of collaborative efforts as evolving works-in-progress, and favor both quick action and immediate, tangible evidence of success over perfecting the recommended actions. Participants come out of well-conducted collaborative efforts with positive energy and momentum but that energy and momentum will recede with time; particularly if people are already skeptical about whether the effort will bring about real results. Favor "70% solutions" that people can see and get engaged in quickly over perfected solutions initiated after a drop-off in enthusiasm and an increase in cynicism.

I am a big fan of collaborative efforts and I believe that collaborative efforts can produce durable results to which people stay committed. However, collaborative efforts can also prove to be little more than feel good wastes of time without effective leadership that results in a well-focused effort with a single-minded dedication to producing results.

Mike DeGrosky is Chief of the Fire and Aviation Management Bureau for the Montana Department of Natural Resources and Conservation, Division of Forestry, and 2016 Adjunct Instructor of the Year for the College of Arts, Humanities, and Social Sciences at Fort Hays State University, where he taught for the Department of Leadership Studies for 10 years. Follow Mike on Twitter @guidegroup or via LinkedIn.

IAWF News | Wildland Fire Safety Award, Student Scholarships

Professor Domingos Viegas (left) receives the 2016 IAWF Wildland Fire Safety Award with Marc Castellnou, a prior award recipient and a conference host.

Domingos Viegas Recipient of 2016 IAWF Wildland Fire Safety Award

The International Association of Wildland Fire (IAWF) inaugurated the IAWF Wildland Fire Safety Award at the association's first International Wildland Fire Safety Summit held in 1997 in Rossland, British Columbia, Canada. The award has been bestowed on eleven individuals since that time.

The IAWF Wildland Fire Safety Award is presented to a deserving individual within the international wildland fire community who has made a significant contribution to wildland firefighter safety, either directly on the fireline; or indirectly through management, cultural changes, or through wildland fire research. Their contribution is frequently beyond their normal everyday job expectations -- sometimes at the potential risk to their own career, and their example can encourage others to act in a similar manner.

Selection of the recipient is presently based on nominations reviewed by a committee comprised of previous award recipients and typically but not always a member of the IAWF Board of Directors. A number of individuals were again nominated this past year for the IAWF Wildland Fire Safety Award. The final selection is always difficult as the nominees are all very well deserving of the award.

Professor Domingos Viegas of the University of Coimbra, Portugal received the 2016 IAWF Wildland Fire Safety Award at a dinner held during the 14th International Wildland Fire Safety Summit on January 31, 2017 in Barcelona, Spain.

Dr. Viegas' career has focused on wildland fire as both a researcher and educator for more than 30 years now. His primary interest has been in the understanding of fire behaviour in order to improve firefighter safety. Among his many accomplishments have been:

1. Development of an organizational structure to investigate the factors influencing fire behavior (i.e., Association for the Development of Industrial Aerodynamics).
2. Realization of an indoor research facility at Lousã, Portugal that also serves in the training of Portuguese firefighters in regards to fire behaviour and their safety.
3. Creation of a scientific research area at Gestosa, Portugal to study fire behaviour in an outdoor setting,
4. Investigation into the fire behaviour associated with several fatal wildfire incidents in Portugal and elsewhere.
5. Dissemination of his and the findings of his team in the form of peer-reviewed journal articles, books, and oral presentations at conferences and short courses.

Professor Viegas is without doubt one of the major actors in improving firefighter safety both regionally and globally. He is a most deserving recipient of the IAWF Wildland Fire Safety Award.

2017 IAWF Student Scholarships

In an effort to continue to promote the scholarly pursuits and graduate level training within the global wildland fire community, in 2017 the International Association of Wildland Fire (IAWF) will again be awarding two graduate-level scholarships, each valued at $3,000USD to IAWF members who are Master of Science/Arts (MSc/MA) or Doctoral (PhD) students studying wildland fire or wildland fire related topics.

We encourage applications from students studying any aspect of wildland fire be it from the perspective of physical, ecological or social science to less traditional subject areas as well: we are looking through this scholarship to recognize and support any type of research relevant to the global wildland fire community.

The application period will be open between 6 March 2017 and 24 April 2017. Award winners will be announced in June. Scholarships will be awarded to the top MSc and top PhD applicants based the student's submitted essay. Please see the guidelines and application information for details.

https://iawf.submittable.com/submit/80422/iawf-2017-student-scholarship-applications

International Association of WILDLAND FIRE
FIRED UP honoree

Adam Leavesley

After witnessing bushfires as a journalist and neighbor, Adam Leavesley joins the cadre of firefighters and fire managers in Australian Capital Territory (ACT).

"I feel very lucky to have a foot in both the research and development camp and in on-ground fire management. I've got a great job and I love it."

"The sky turned black and there was an eerie red glow on the horizon; embers were falling out of the sky right across the city; we drove across town to my cousin's house and saw fires burning in city bushland, but nobody was fighting them. "

That was the scene from the devastating Canberra bushfires of 2003 which inspired Australian Capital Territory (ACT) Parks and Conservation Service Fire Management Officer, Adam Leavesley to pursue a career in the industry.

The former journalist was looking for a change when the fire storm hit Canberra causing four fatalities and burning down 488 homes.

"I had become disenchanted with journalism - it was all telephone calls and typing on the computer – so I gave it up and went back to university to study biology.," said Adam.

"In one of the classes at the Australian National University I met the father of the fire regime concept, Dr Malcolm Gill, and became interested in bushfires."

One thing led to another and in 2008 Adam graduated from ANU with a PhD in fire ecology.

"I'd never wanted to be an academic and I always thought when I graduated I'd probably end up back in journalism or perhaps some sort of land management communications job.

"But before I graduated a bushfire job opened up in a remote part of central Australia and I grabbed the opportunity."

"For 12 months I worked for Bushfires NT in Alice Springs, driving the desert in my Toyota Landcruiser, meeting and working with pastoralists, park rangers and Aboriginal people across a 330,0002 km block.

"It was a sensational job and when I think back on it I remember the smell of burnt Spinifex which has a sort of fresher kind of smell than the Sorghum grass that you burn in the Top End of Australia.

"The best part of the day was the early evening, the temperature drops, the flies go to bed and you cook your lamb chops on the ashes of the burn you've just finished. And as you chew the bones, you sit in your camp chair and watch the stars as the moon comes up."

In 2010 Adam moved back to Canberra and got a job with ACT Parks and Conservation Service. "In hindsight," Adam reflected, "the desert job was really good because when I got back to Canberra I could demonstrate lots of experience and a high level of responsibility that is very hard to get in such a short time in south-eastern Australia.

"At ACT Parks my main job is assessing development applications for compliance with bushfire regulations and I'm also linked in with the national bushfire research agenda through the Bushfire and Natural Hazards Cooperative Research Centre and the Australasian Fire and Emergency Service Authorities Council.

"I'm in the position to write papers about the work that we're doing to improve bushfire management, I'm helping to bring new research and technology into our agency, and helping to shape the future of bushfire management."

Adam's job still gives him a connection to the bush and burning.

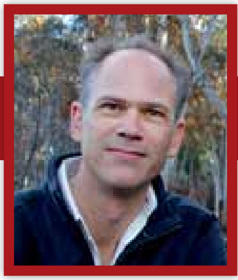
"When we've got bushfire operations, I'm a crew leader and a member of the Remote Area Fire Team which is deployed to fires by helicopter. I feel very lucky to have a foot in both the research and development camp and in on-ground fire management. I've got a great job and I love it," said Adam.

Beginning this issue, Adam is also joining our roster of Contributing Editors for Wildfire Magazine.

International Journal *of* Wildland Fire

Outstanding Editor

and Current Issue Highlights



GEOFF CARY OUTSTANDING ASSOCIATE EDITOR AWARD 2016

Dr. Geoff Cary is the receipient of the Outstanding Editor Award of the International Journal of Wildland Fire for 2016. Please join us in congratulating Geoff for his many years of excellent service to the journal, both as an Associate Editor (since 2002) and as a member of the Editorial Advisory Committee (since 2009).

Geoff is Associate Professor in wildland fire (bushfire) science in the Fenner School of Environment and Society at the Australian National University (ANU). He has held this position since 1996, previously as Lecturer and Senior Lecturer. Geoff was awarded a Bachelor of Applied Science (Environmental Biology) (Honours) from the University of Technology, Sydney, and a PhD in the topic of landscape fire modelling from ANU.

Geoff's research interests include: evaluating fire management and climate change impacts on fire regimes using landscape-scale simulation; ecological investigation of interactions between fire and biota from genes to communities; empirical analysis of house loss in wildland fire; and laboratory experimentation of fire behaviour. Geoff co-leads, with Dr Bob Keane (US Forest Service) and Professor Mike Flannigan (University of Alberta), an international group of landscape-scale wildland fire simulation modellers. He gave a keynote address on the effect of fuel treatment on house loss in wildfires at the Wildland Fire Canada Conference (Kananaskis, Canada) in 2012, and has given invited conference and lecture presentations in China, Japan, the Netherlands, Spain, UK, USA and Australia. He has been awarded research funding from the Australian Research Council, the Bushfire Cooperative Research Centre, and the Bushfire and Natural Hazards Cooperative Research Centre.

Geoff specialises in teaching bushfire dynamics and management at ANU, including convening 'Fire in the Environment', co-convening 'Weather, Climate and Fire', and contributing to a range of other courses. Geoff supervises honours and graduate scholars investigating diverse wildland fire topics including post-fire dynamics of plant and bird communities, political and cultural history of Indigenous burning in Australia, and a wide range of bushfire simulation topics. He has received an ANU 'Top Supervisor' award and an ANU College Supervision Award.

As mentioned, Geoff has been a member of the Editorial Advisory Committee since 2009, and an Associate Editor since 2002, of the International Journal of Wildland Fire, and a member of the International Association of Wildland Fire since 2002. He has served on the NSW Parks and Wildlife Advisory Council and the Federal Science Minister's Bushfire Research Advisory Group. He managed the PhD and MPhil program in the Fenner School, ANU, as Associate Director for Higher Degree Research in 2010 and 2011.

We are pleased to add the 2016 IJWF Outstanding Editor Award to his impressive list of achievements, and we thank him most sincerely for his exceptional service to the International Journal of Wildland Fire.

IAWF members have free online access to all research articles and back issues, a great member benefit. The IAWF member page directs you to the Journal, where you can search for your paper, author or fire subject of interest. All papers that have been accepted, even those not yet published in hard copy, can be found on the site.

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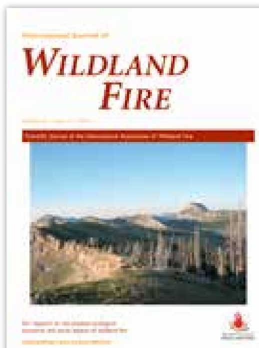


The third issue of the International Journal of Wildland Fire in 2017 contains the following papers:

Variability and drivers of extreme fire weather in fire-prone areas of south-eastern Australia. Sarah Harris, Graham Mills and Timothy Brown.

We identify the most extreme fire weather days based on McArthur's Forest Fire Danger Index (FFDI) for 24 sites across south-eastern Australia for potential use in fire risk planning. The extent and variability of these highest FFDI days are analysed by the contributions of temperature, relative humidity, wind speed, wind direction and drought indices

Hillslope-scale prediction of terrain and forest canopy effects on temperature and near-surface soil moisture deficit. Sean F. Walsh, Petter Nyman, Gary J. Sheridan, Craig C. Baillie, Kevin G. Tolhurst and Thomas J. Duff.

Fire managers often use a drought index at coarse spatial resolution to determine soil moisture status in flammable forests. In complex terrain, there is a fine-scale mosaic of near-surface soil moisture deficit that may create important constraints on prescribed burning operations. A simple method is proposed for predicting this pattern

Spatial distribution of grassland fires at the regional scale based on the MODIS active fire products. Zhengxiang Zhang, Zhiqiang Feng, Hongyan Zhang, Jianjun Zhao, Shan Yu and Wala Du.

This study used kernel density estimation to analyse the spatial pattern of grassland fires based on the MODIS active fire product and to define grassland fire risk zones. The results show that the kernel density estimation method can be applied to analyse the spatial distribution of grassland fires.

Spatially varying constraints of human-caused fire occurrence in British Columbia, Canada. Philip E. Camp and Meg A. Krawchuk. *(Editor-choice open access paper.)*

The relative importance of different drivers of human-caused fire can vary based on levels of human footprint and biophysical characteristics of a study region. We show that human-caused fire occurrence in areas with substantial human footprint are controlled by a different set of variables than in remote areas.

Evaluation of the spectral characteristics of five hyperspectral and multispectral sensors for soil organic carbon estimation in burned areas. Juanjo Peón, Susana Fernández, Carmen Recondo and Javier F. Calleja.

The spectral characteristics of five hyperspectral and multispectral sensors were evaluated for topsoil organic carbon prediction in burned areas. The spectral resolution of both sensors was suitable for prediction. The most relevant spectral regions for topsoil carbon estimation were the visible and short-wave infrared.

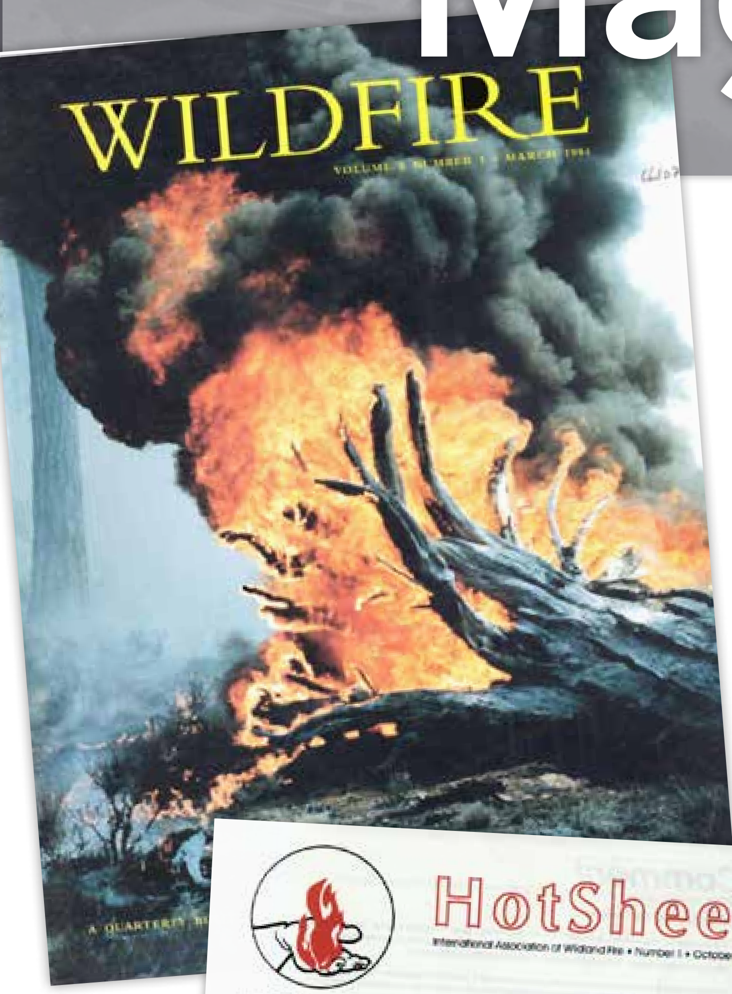
Forest fire danger, life satisfaction and feelings of safety: evidence from Australia. Christopher L. Ambrey, Christopher M. Fleming and Matthew Manning.

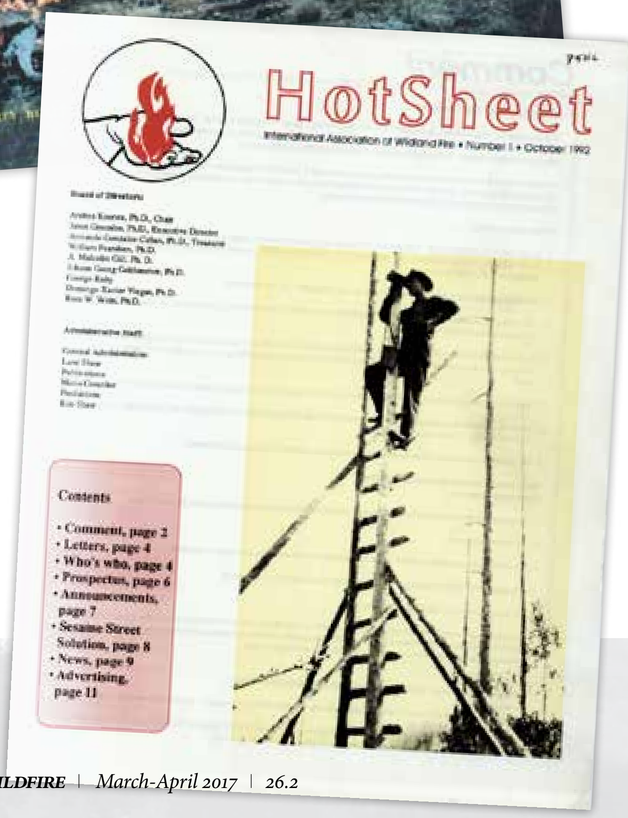
Forest fire danger is negatively associated with an individual's life satisfaction and with an individual's feelings of safety. Feelings of safety largely explain the association between forest fire danger and life satisfaction. We find that individuals are willing-to-pay $10 to avoid a one unit increase in forest fire danger.

Homage to L. M. Coutinho: fire adaptations in cerrado plants. Juli G. Pausas.

Professor Coutinho (1934–2016; Sao Paulo, Brazil) studied fire adaptations in Brazilian savannas during the 1970s, when few researchers recognised fire as an evolutionary force. He focused on fire-stimulated flowering, serotiny and nutrient cycling.

HISTORY: Wildfire Magazine -





Wildifre Magazine started out as the no-fuss newsletter Hotsheet in October 1992 (lower left) with a proposal to become a forest fire magazine that would complement the growing list of publications published by the International Association of Wildland Fire. These included the scientific journal, an international directory, an international bibliography, a monthly bibliography newsletter and an association newsletter.

The magazine proposal stated an aim:

This will be a monthly magazine directed at field level personnel involved in wildland fire. It will be an international magazine.

Its purpose is twofold:

Educate. Inform and educate entry level firefighters in technique, issues and technology. Keep readers of all levels informed of developments, new technology, and other news.

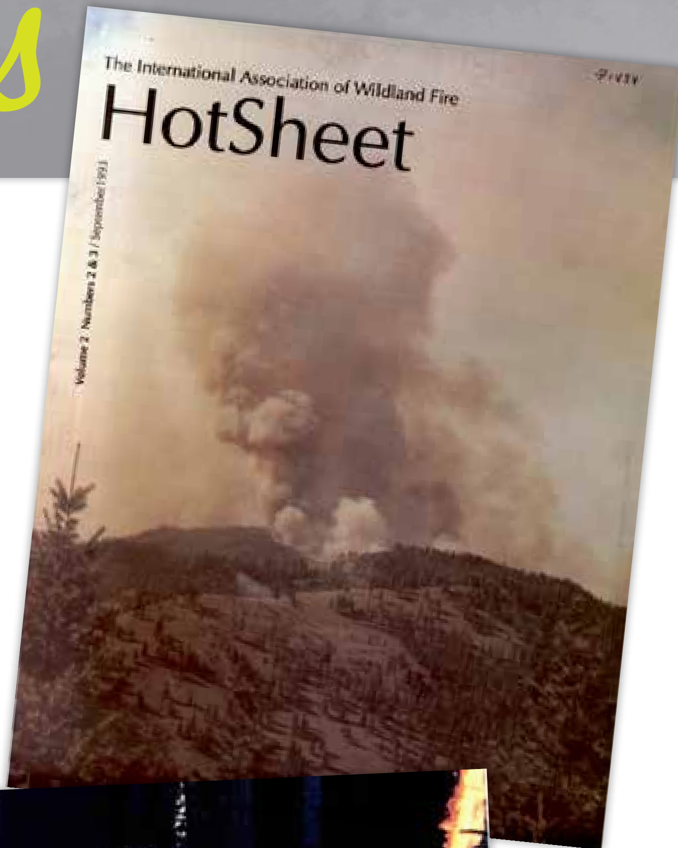
Network. Bridge communications between fire managers in various parts of the world. Provide a forum for regional, national and international issues.

Hotsheet very soon became the color magazine Wildfire.

Research projects were a priority with many longer articles – with abstracts and long lists of references - often taking up much of the publication. These were gradually replaced by more operationally focussed articles on recent large fires, new training methods or opinions on fire management policy and funding.

A REGULAR SERIES IN 2017

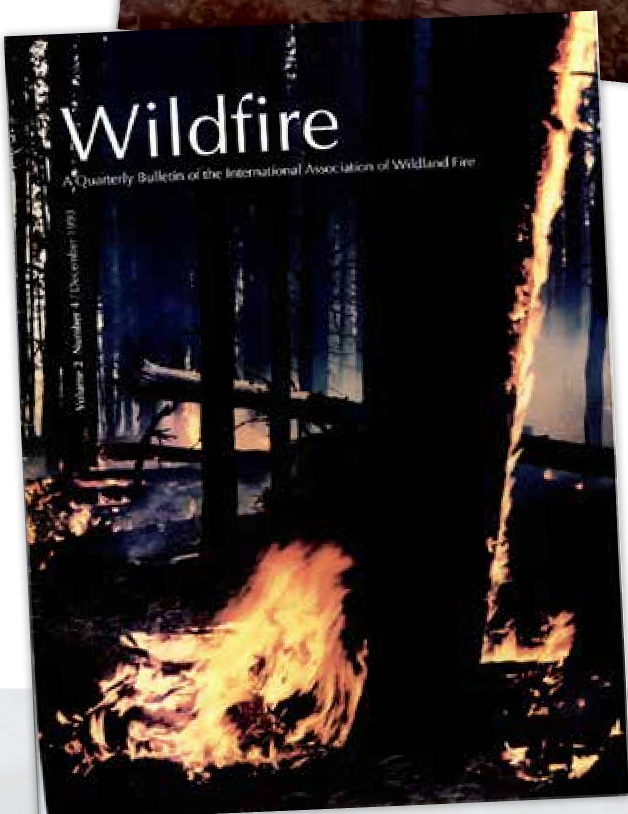
GLANCES AT 25 Years



The magazine featured profiles of inspirational fire researchers and operational managers and staff. The inaugural editions were quick to grasp the need to share content from around the globe, with feature articles and news snippets on fire operations and research in Russia, Brazil, Indonesia, Greece, Australia, Canada, Bosnia, Lebanon, New Zealand, Italy, Spain, Germany, and from all corners of the United States.

Early feature articles included

- The launch of FireNet - an international information exchange network on a world wide electronic network
- An analysis of news media coverage of wildfires
- The economic impact of fire on forest resources
- Smokejumping – how it began
- IAWF becoming active in Russia
- The truth about Smokey Bear
- Rethinking how fuels are heated and dried
- The water-scooping aircraft option for California.



Future editions of Wildfire in 2017 will draw on content from early editions and see how we have gone about the task of "uniting the global wildland fire community."

From all these voices, we'll explore how we've changed: Are we still talking about the same issues? How far has technology advanced? What have we learnt and where are we heading?

— David Bruce,
Chair, WIldfire Magazine Editorial Board

HISTORY

RHYTHM OF THE REIGNS

AN UPDATE OF THE **"PROBLEM FIRES"** ANALYSIS FOR THE PYROCENE.

by Stephen J. Pyne and J. Bradley Washa

History, thought Mark Twain, didn't repeat itself but it did sometimes rhyme. And one of the ways American wildland fire history seems to rhyme is with rhythms in how it defines problems, specifically those fires that seem to inform, or reign over, the imagination of a generation, if not an era. The first historical survey of American landscape fire, *Fire in America* (1982), identified four such rhymed eras, beginning in 1910, and organized into a chart. Moving the subject from wordy paragraphs to periodized boxes found a welcome audience since they distill a complex historical record into a visual form that allows for comparisons.

But the history recorded in that book ended in the mid-1970s, or approximately half-way through the era it identified as "wilderness fire." Further reflection, announced at a 1983 conference, noted it was possible to project the 20-year cadence back to the 1891 Forest Reserve Act, and pointed out that, if the cadence continued, a new informing fire should emerge around 1990. The best guess was that the new period would grapple with the question of exurban developments, what we have come to know as the wildland-urban interface fire. Pushing further, if the old patterning held, we could expect that era to yield to yet another around 2010. Would it? And if it did, what might it be called?

Or to pose an obvious question, why should history - that "seamless web," as Frederic Maitland famously described it - parse so cleanly at all? Might this all be so much historical numerology, or scholarly astrology?

Let's begin with the concept. At any time wildland fire management has to cope with everything that matters to fire. But the fire community also has to establish priorities, some of which can last for many years. A problem fire is a kind of generational priority - a fire, or fire problem, that seems to distill the character of an issue for an extended time. It's a type of fire that announces itself dramatically, the type of fire that expresses what most distinguishes the issues of the day, the type of fire that claims the most attention, the most funding, the best minds. More than anything else, it informs - gives internal structure and significance to - the fire management of its time. When it fades as a problem fire, when its reign ends, it does not vanish from the scene. It simply becomes part of the administrative background while another problem comes into favored status.

Each problem fire period might be parameterized according to several traits. Each aligns with a strategic vision. Each brings forward tactical emphases. Each has a characteristic research agenda. Each seems to rely on some kind of abundance, which is to say, some surplus beyond basic needs that does not merely respond to the day's challenges but helps define them.

In thumbnail summary, the original eras went as follows:

Frontier fire (1910-1929) described the efforts of the early U.S. Forest Service (USFS) to bring systematic fire protection (that's a technical term) to bear on the forest reserve system, trying to match the abundance of lands, particularly after 1907, with the abundance of funding made possible through the Forest Fires Emergency Act of 1908. Policy sought to bring an economic sense to protection, which in

"Elk bath" may be the most emblematic fire photo of our era -- but is this wilderness fire or megafire? The updated "Problem Fire" table can help us come to terms with our evolving fire eras. The photo, a TIme Magazine Photo of the Year, is credited to John McColgan, photographed during an August 2000 forest fire in Montana's Bitterroot National Forest.

practical terms was limited to accessible frontcountry lands.

Backcountry fire (1930-1949) begins with the big burns of the early 1930s and the response by the Franklin D. Roosevelt administration, which invested immense resources into conservation and economic recovery. The Civilian Conservation Corps (CCC) made it possible to project fire protection into the backcountry, and unsurprisingly marks the beginning of organized crews. It was amid this largesse that the Forest Service announced the 10 am policy which stipulated that a fire was to be controlled by 10 a.m. the day following its discovery.

Mass fire (1950-1969) continues many of the themes of the preceding era but with a military and civil defense alliance typical of the Cold War replacing the New Deal. The feared big fires were those that came from or echoed a possible war; military funding moved fire research out of its forestry ghetto, particularly into fire physics; war surplus equipment - mechanization, especially aviation - replaced the muscle of the CCC.

Wilderness fire (1970-1989) embraces the attempt to replace fire control with fire management, to restore good fire, and to bond fire management with land management. A policy of fire by prescription supplanted the 10 am policy. Fire in wilderness was the most organic and dramatic expression of the era, but prescribed fire was the agencies' treatment of choice. The wealth of knowledge gleaned from fire science would, it was hoped, substitute for machines and manpower. This era would come to a close following the Yellowstone Fires of 1988.

If we wish to revise the original table and add an era for 1891-1909, it has the effect of splitting and redefining some properties of the 1910-1929 era. Rename the 1910-1929 period as the era of frontcountry fire since it was the accessible portion of the public domain that claimed attention. Call the earlier period the era of frontier fire since it was the specter of untrammeled fire and ax along the edge of settlement that provoked state-sponsored conservation, which served as an inchoate policy. The strategic concept was to create forest reserves. Its tactical emphasis was a simple notion of guarding those lands against trespass (including fire); its most effective expression was the U.S. Cavalry, which oversaw the major national parks. There was no systematic research, just mapping reconnaissances, mostly done by the U.S. Geological Survey. The abundance was land - a vast estate; in fact so large it overwhelmed efforts to protect it. Just before he left office, President Theodore Roosevelt effectively doubled the reserved forest lands. In 1909 the Forest Service had one fire guard for every 670 square miles.

This early time attracted little attention from readers (no surprise). What did interest them was the period contemporaneous to the 1982 publication of *Fire in America*, what has come to be known as the era of the WUI fire. In truth, nearly a third of the modern history of American fire has occurred since that book was published.

A new narrative, *Between Two Fires: A Fire History of Contemporary America*, has brought the chronicle to 2013. It did not, however, update the table of problem fires. In 2016, an updated revision was proposed by Brad Washa that broke the recent history into 10-year lumps and sketched how we might fill the chart's parameters (Table 1 - 1990 and beyond).

Table 1: 'Problem Fires' Proposed Revision (10-Year Blocks)

Era	Problem Fire	Policy	Fire Control		Research	Abundance
			Strategic Concept	Tactical Emphasis		
1910-1930	Frontier fire	Economic Policy	Systematic fire protection	Administration	Fire as forestry	Land (Transfer Act) Emergency fire funds
1930-1949	Backcountry fire	10 AM Policy	Hour control	Manpower		Emergency conservation programs
1950-1969	Mass fire		Conflagration control	Mechanization	Fire physics	War surplus equipment
1970-1989	Wilderness Fire	Fire by prescription	Prescribed fire	Fire behavior information	Fire effects (biology & economics	Information
1990-2000	Intermix fire	Fire by prescription	Integrated fire services	ICS	Global change	Rural & volunteer depts.
2001-2009	Mega Fire	National Fire Plan	Appropriate Management	Contracting	JFSP	Fuels Treatments
2010	WUI	Cohesive Strategy	Managed Fire	Point Protection	Collaboration	Loss of LAT

Table 2: 'Problem Fires' Revised (organized in 20-Year Blocks)

Era	Problem Fire	Policy	Fire Control		Research	Abundance
			Strategic Concept	Tactical Emphasis		
1891-1909	Frontier fire	State-sponsored conservation	Forest reserves	Fire guards	USGS mapping	Land
1910-1930	Frontcountry fire	Economic policy	Systematic fire protection	Administration	Fire as forestry	Emergency fire funds
1930-1949	Backcountry fire	10 AM policy	Hour control	Manpower		Emergency conservation programs (esp. CCC)
1950-1969	Mass fire		Conflagration control	Mechanization	Fire physics	War surplus equipment
1970-1989	Wilderness fire	Fire by prescription (coded into 1995 policy)	Prescribed fire	Fire behavior information	Fire effects (biology & economics)	Information
1990-2009	Intermix fire (WUI)		Fuels treatments	ICS	Fuels	National Fire Plan JFSP
2010-	Megafire	Appropriate management (2009 guidelines)	Cohesive strategy	Managed wildfire and point protection	Fire within global change	All hands-all lands (eg, VFDs, states, private)

This schema seemed plausible and interesting, and an update should have been included in *Between Two Fires*. It wasn't - a gap that this essay seeks to fill.

Table 2 shows the final outcome of that dialog and the effort to bring the problem fires table up-to-date, now broken down into the original 20-year increments. It reflects an understanding that another inflection seems underway. What to call this emerging era? Megafire was coined in the early 2000s, but it makes a nice shorthand for a time in which fires seem to have spilled over their old boundaries. As we use megafire, the term refers not just to very large fires but to the enhanced complexity of not just fire complexes but of fire management. It may be other terms (managed wildfire suggests itself) will seem more apt as the era unfolds, or as historians in decades hence look back on today. So let megafire serve as a placeholder until the contours of the era sharpen.

In this new era, the old policy continues but with guidelines that have invited a widening use of managed wildfire. The new abundance is the "all hands, all lands" breadth of what fire response, resilient landscapes, and fire-adapted communities require these days - all those states, all those local and county agencies, all those private contractors and collaborators. They not only magnify the resources available for collective use, but threaten to overwhelm the system, as a system, with competing interests, which argues for the National Cohesive Wildland Fire Management Strategy to serve as an organizing vision. Tactics developed after new guidelines in 2009 favor point protection and box-and-burn operations; these were first noticeable in the western U.S. but seem to be finding niches elsewhere. No less expansively, fire research has reached far beyond its old sciences to consider fire within the context of global change, with the upshot that fire-related publications have increased exponentially. (Some of us would like to see the Anthropocene renamed the Pyrocene.) The era is young, so it is hard to divine what the final contours will look like.

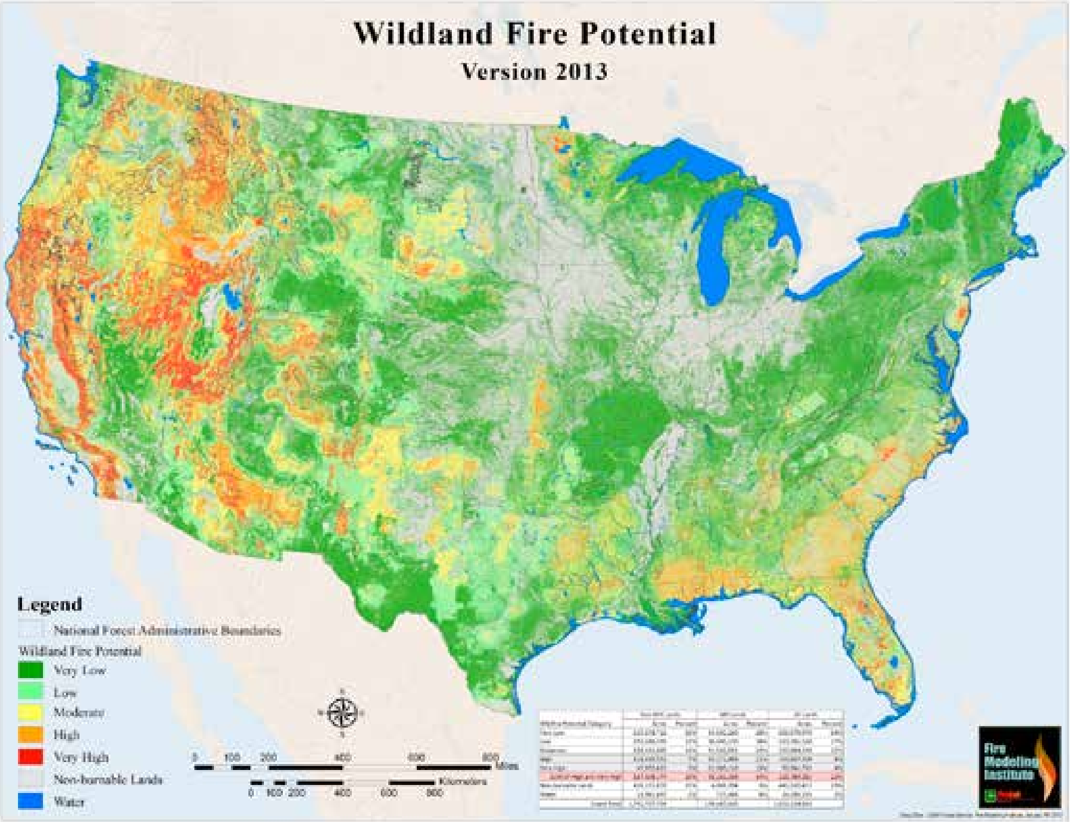
The deep significance is that the times are indeed a-changing, as our most recent Nobel laurate in literature once wrote.

The rhyme continues.

Why should it? While there is no definitive explanation, a first guess is that it is tied to the cycle of bureaucratic generations. Until the 1980s, the U.S. Forest Service so dominated fire that its story can stand for the national one. The agency began, almost overnight, with a cohort of young men, not a mixed or generational workforce, so it makes some sense to tie the shifts in problem fires to generational waves. But it's odd that it should hold for so long, and this explanation might be expected to have ended with the advent of interagency cooperation and new players at various levels. It didn't, because the workforce from other agencies effectively constituted a new generation, again suddenly acquired, and because the consent decree to accelerate affirmative action programs broke the continuity of USFS generations. Its own workforce began anew. So did the cycle of problem fires.

Or not. The reasons behind the rhythm remain opaque, so it is difficult to predict whether the cadence will persist. The cycles, though, do seem to hold value as a heuristic device.

Perhaps more curiously there is another rhythm buried in the chronicle, this one of 30 years, that describes a cycle of policy shifts. Begin in 1905 with the formation of the U.S. Forest Service and its first *Use Book* (1906) that stipulated fire protection as a fundamental duty. In 1935 the 10 a.m. policy hardened that precept. Thirty years later, in the mid-1960s, there was no explicit policy shift so much as a general ferment that led over the next decade to reforms to restore fire where possible. The National Park Service adopted such a policy in 1968, with the USFS following in 1978. Fast-forward to 1995 and the thickening interagency agenda argued for a common Federal Wildland Fire Manage-



The landscape of our US problem fires, circa 2013. USFS Fire Modeling Institute.

ment Policy. With updates along with the National Fire Plan and the Cohesive Strategy, the 1995 policy still survives. If this rhythm holds, however, we should see another fundamental shift around 2025, roughly eight years from now. A cause to pause.

Or to widen the field of vision still further, there appears to be a 50- to 60-year macro-rhythm at work. For 50 years, beginning in 1910, the U.S. sought to exclude free-burning fire and used the U.S. Forest Service as the institutional means to do it. The outcome was to remove good fire as well as bad and to create a national (if relatively benign) hegemon. Then, beginning in the 1960s, the country tried to restore good fire and diversify wildland fire's institutional matrix. Results have been mixed, but a sure outcome has been to confirm the value of landscape fire and to craft interagency institutions. Now this era, too, may have run its course. We seem to be undergoing a phase change that enlarges the institutions to all levels of government, and even to non-governmental actors, and that is creating fusions of ideas and practices. The old dichotomies may matter less. The managed wildfire, for example, is a hybrid - part suppression, part prescribed burn. Management can look, to outsiders, like a mashup.

How might these rhythms help us understand the scene today? It suggests that we are a third of the way through our current problem fire, about three-quarters of the way toward a fundamental policy shift, and at the cusp of a new long-wave cycle in national fire history. Interesting times.

Musings like these come with a hope and a disclaimer. The hope is that others might find the parsing of American fire history useful. History may indeed be a seamless web, but we need seams to sew experience into a usable past. The disclaimer is a warning not to put too much faith in the numbers. Numbers get reified in not always helpful ways. Times do change, and sometimes they rhyme. But not knowing how or why, other than the commonsensical observation that change is always happening, it's hard to invest too much confidence in forecasts based on perceived rhythms. Concepts are an act of mind, which has its own logic and longings. We typically see what we want to see. Correlation, or its literary equivalent, analogue, isn't cause. It may all be coincidence, given apparent coherence in retrospect.

In the long term, house odds (read: real history) beat any system we concoct. History has lots of pasts. We choose the ones that help us get through the present.

ABOUT THE AUTHORS

STEPHEN J. PYNE (left) is a Professor in the School of Life Sciences, Arizona State University, stephen.pyne@asu.edu. He will offer a historical perspective during an all-day webinar, "A Century of Wildland Fire Research: Contributions to long-term approaches for wildland fire," on March 27, sponsored by the National Academy of Science's Board on Earth Sciences and Resources.

BRADLEY WASHA (right) is the State Fuels Management Specialist at the Utah State Office, Bureau of Land Management, bwasha@blm.gov.

NEXT

DESIGNING the FUTURE of WILDFIRE MODELING

By Mélanie C. Rochoux[1], Cong Zhang[2], Michael Gollner[2] and Arnaud Trouvé[2]*

1 CECI (Climate, Environment, Coupling and Uncertainties), CERFACS-CNRS, Toulouse, France

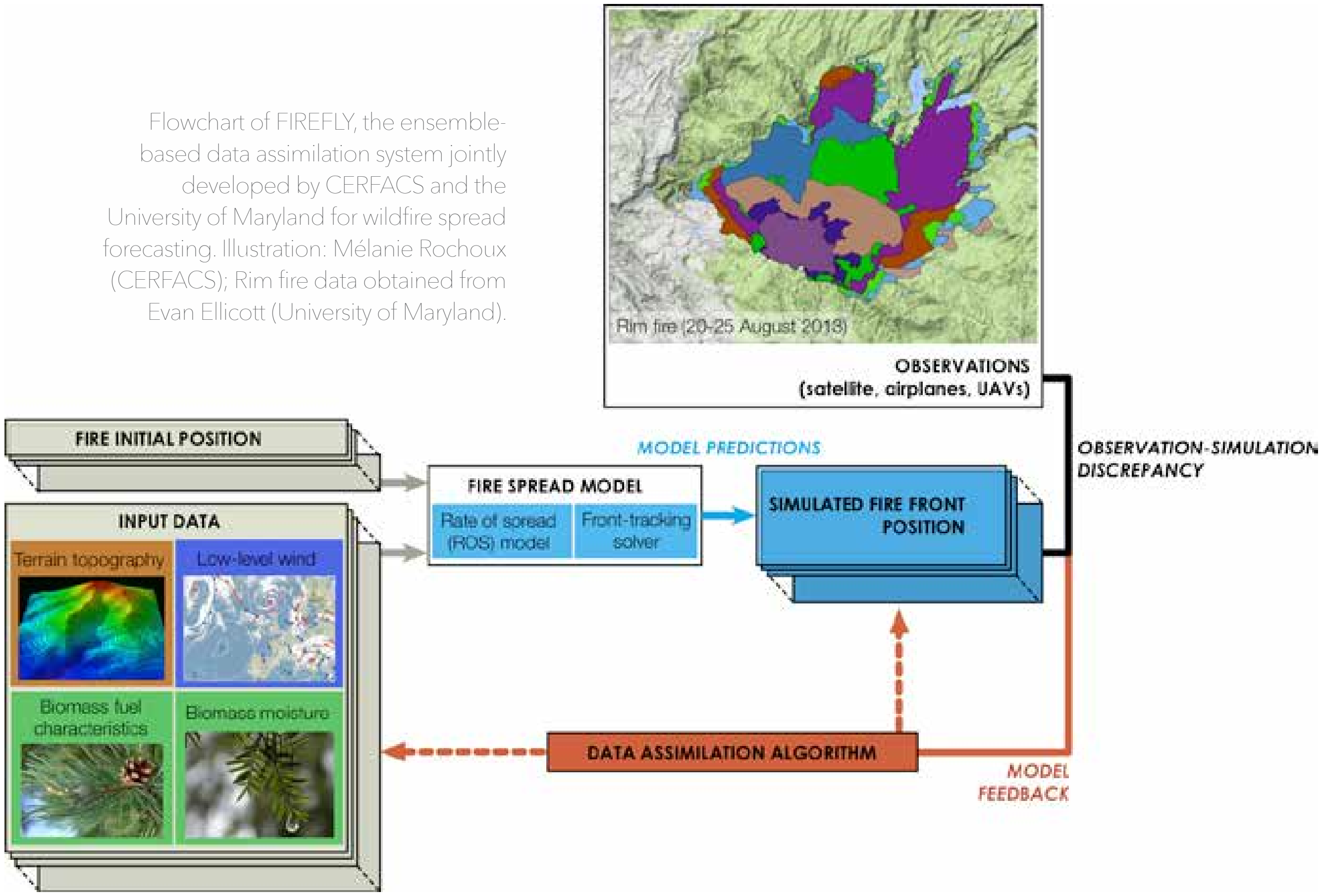
2 Dept. of Fire Protection Engineering, University of Maryland, College Park, MD, USA * Corresponding author

Providing accurate predictions of the spread of wildland fires has long been a goal of the fire research community. Whether used as a planning tool prior to prescribed burning or as an operational tool to predict the growth of uncontrolled wildfires, the accuracy of wildland fire spread models and their ability to provide useful information in a timely manner are of paramount importance. This is particularly true in the perspective of changing wildland management practices, the movement of populations to rural areas and climate change, where these coupled influences dramatically increase the risk of highly destructive fires known as "megafires", with strong implications for public safety and air pollution far away from wildfires.

Despite the development of a number of models, the use of wildland fire spread modeling has been relatively limited operationally. Some of this stems from the fact that all models are by nature approximate, simplified versions of reality (the problem of wildfires is particularly complex to model due to the wide range of relevant spatial scales and to the multiple physical processes involved, ranging from biomass pyrolysis, combustion and flow dynamics to atmospheric dynamics and chemistry). Available data to initialize and parametrize these models, such as fuels, topography, and weather, are also subject to large uncertainties and limited resolution, both spatially and temporally. This was emphasized in the March/April 2016 issue of Wildfire Magazine, where author Rachael Quill highlighted one of the most challenging issues in fire modeling today: uncertainty. A new approach to this problem is to couple existing models and real-time observations, with the objective of reducing the uncertainties in both model fidelity and input data by using real-time observations of the wildland fire dynamics. This approach is called "data-driven modeling" (or "data assimilation"). Data-driven modeling allows an optimal use of available information and leads to improved forecasts of the system evolution, which we believe holds great potential for the wildfire community. Data-driven modeling thereby offers to take full advantage of the recent advances in remote sensing technology for real-time wildfire detection and tracking. This is critical in the context of climate change, where accurate predictions of the resulting change in the fire regime and intensity cannot rely on past-observed wildfire events. Following a 2015 workshop, "Towards Data-Driven Operational Wildfire Spread Modeling," we will present here some of the challenges and opportunities this new approach offers.

While real-time data-driven modeling is at an early stage of development for wildfire applications, it is envisioned that this approach will eventually be similar to current weather forecast capabilities, providing real-time fire forecasts including a description of both wildfire dynamics and plume emissions. Currently, weather data such as wind speed, temperature, and cloud cover, from real-time sensors are compared with current model runs and used to improve predictions, compensating for uncertainties and errors in initial data. For fire modeling, the location of the fireline can be used as real-time observation data, where it is then used to adjust simulated fire location, fuels, and even changing weather conditions to improve future predictions of the fireline propagation. While there are challenges to this approach (observation of the fireline location is necessary), it represents a "leap" in capability, offering the ability to provide accurate predictions that, when coupled with the "holy grail of firefighting," knowledge of firefighter and fire locations at all times, could provide a new era in firefighting strategy.

Current approaches to real-time data-driven modeling are based on operational-type models, i.e. simplified semi-analytic models that predict the propagation of a fire as a function of time. Operational models are different from Computational Fluid Dynamics (CFD) models, which are three-dimensional numerical flow solvers based on the Navier-Stokes equations and the basic principles used in fluid mechanics and heat transfer of conservation of mass, momentum and energy. While CFD models invariably can provide more accurate predictions because they provide a description of the coupling between the atmosphere and the fire, current operational models can run much faster than real time, which is essential for future practical applications. Operational approaches such as those deployed in FARSITE [1], PROMETHEUS [2] and PHOENIX RapidFire [3], adopt a front-tracking perspective. They may be physical models based on a simplification of complex processes; empirical models that rely on correlations to observed data; or semi-empirical models combining the two approaches. Almost all operational models are empirical or semi-empirical in nature, requiring adjustments from real observations to calibrate the model unknowns. CFD approaches combining fire spread model and a meso-scale



Flowchart of FIREFLY, the ensemble-based data assimilation system jointly developed by CERFACS and the University of Maryland for wildfire spread forecasting. Illustration: Mélanie Rochoux (CERFACS); Rim fire data obtained from Evan Ellicott (University of Maryland).

atmospheric solver such as FOREFIRE/MesoNH [4] and WRF-SFIRE [5], allow simulations of wildfires that can make their own weather and are thus leading the state of the art in fire modeling.

Operationally-oriented fire spread models can be used to simulate fire growth using selected vegetation maps and wind-weather scenarios but offer no information on the probability of an area being impacted in the short term under multiple vegetation and weather scenarios. Ensemble-based modeling overcomes this limitation by generating hundreds of potential vegetation and weather scenarios, leading to the prediction of thousands of individual fires. The ensemble-based predictions result in probabilities for fire spread. Data-driven modeling then offers to take advantage of real-time data to reduce the scatter of the ensemble-based predictions around a small sample and to produce a more reliable forecast at future times. The FIREFLY system [5-6] jointly designed by CERFACS and the University of Maryland develops this idea using an Ensemble Kalman filter and is currently being evaluated against data from the Rim fire. The main quantity of interest – the rate of spread – is better assessed, providing a time-persistent correction in the simulated fire front and improving wildfire dynamics forecasting.

The challenge of real-time modeling, of course, is access to useful real-time data. Initial studies have all used the fireline location as observations; this necessitates remote sensing, particularly from airborne- or satellite-based sensors. These measurements detect fire location and may provide an estimate of the fire intensity for each pixel (fire radiative power, or FRP). While polar orbiting satellites such as Terra, Aqua, and S-NPP (with MODIS and VIIRS sensors, respectively), provide autonomous, synoptic observations of fire activity, both day and night, nominally twice a day from each sensor, this temporal resolution, and the corresponding spatial resolution, may not be adequate for real-time fire modeling. NOAA's Geostationary Operational Environmental Satellite system (GOES) offers greater temporal resolution, but suffers in terms of spatial resolution. This applies to both post hoc model evaluation of a fire event or real-time predictions of fire spread. Therefore data fusion with various sources of remotely sensed data, as well as downscaling techniques, could improve remotely sensed data resolution to fill gaps.

Firelines with spatial resolution of approximately 10 m and temporal resolution of approximately 10 minutes are ultimately desired to achieve a reliable forecasting tool with accurate-enough predictions for fire dynamics. These requirements can theoretically be met with current satellite technology; however, these requirements may also be cost-prohibitive at the moment. Some of these problems could be alleviated with the deployment of unmanned aerial vehicles (UAVs) over a fire. However, the use of UAVs has separate jurisdictional issues which to date have limited their use for prescribed fires. NIROPS (USDA Forest Service National Infrared Operations) have shown that it is possible to capture firelines at good spatial resolution using an airborne infrared sensor. However, the low frequency of the fireline mapping (maps are made only once per night) is a limitation. Part of the problem is that the process is not automated. The use of drones, for instance the use of an MQ-1 Predator Remotely Piloted Aircraft (RPA) on the Rim fire in California, was successful in observing particular fires, but no permanent program has been established, most likely because of the high cost and UAV safety concerns .

Several changes in the near future may change this picture. Smaller and cheaper sensors, new satellites funded by private industry and advancements in sparsely networked data may provide new means for data to be captured from multiple sources

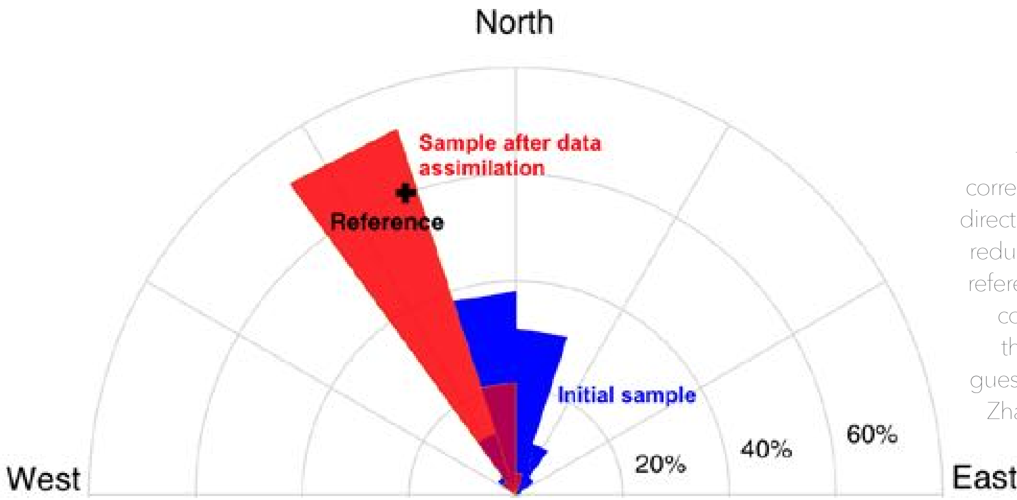


Illustration of fireline data assimilation for predicting near-surface wind direction: the updated sample (in red) corresponding to corrected wind direction features reduced scatter, reduced bias (with respect to the reference in black) and increased confidence level (indicated by the %) compared to the initial guess (in blue). Illustration: Cong Zhang (University of Maryland).

and automatically compiled together. This could come from public and commercial satellites, equipped firefighting aircraft that already span a fireline and UAVs that are advancing in popularity and decreasing in cost. Obviously, without procedures for UAVs to deploy during a fire and relay that information in a timely manner to modelers, data-driven operational fire spread modeling may not be feasible. However, advancements in technology and policy are coming so quickly that we foresee that real-time fireline data will be available within a decade.

The technology necessary to provide real-time wildfire simulations is rapidly emerging. The fire research community should be prepared to utilize this new technology along with high-performance computing to systemically quantify uncertainties and improve model predictions. Currently, there is little large-scale effort to put the pieces into place. Software development, notably at NCAR (National Center for Atmospheric Research, USA), CERFACS (Centre Européen de Recherche et Formation Avancée en Calcul Scientifique, France), UAB (Universitat Autònoma de Barcelona, Spain), UMD (University of Maryland, USA) and UCSD (University of California, San Diego, USA), have provided many of the pieces required to assimilate wildfires. Investments in remote sensing suitable to fireline scales and/or geographical scales (i.e., with approximately 10-m spatial resolution and 10-min temporal resolution) and in cyberinfrastructure allowing real-time integration of fire spread models and sensor data are necessary to connect the dots. With support from funding agencies and the fire response community, we strongly believe real-time data-driven wildfire modeling could provide a paradigm shift in the way we design and manage fire emergency response to future fires.

Further references

[1] Finney, M. A. (1998) FARSITE: Fire Area Simulator – model development and evaluation. Forest Service, US Dept. of Agriculture, Research Paper RMRS-RP-4.

[2] Tymstra, C., Bryce, R.W., Wotton, B.M., Taylor, S.W., and Armitage, O.B. (2010) Development and structure of Prometheus: the Canadian Wildland Fire Growth Simulation Model, Canadian Forest Service, Information Report NOR-X-417.

[3] Chong, D., Tolhurst, K.G., Duff, T.J., and Cirulis, B. (2013) Sensitivity Analysis of PHOENIX RapidFire. Bushfire CRC, University of Melbourne.

[4] Filippi, J.-B., Pialat, X., and Clements, C.B. (2013) Assessment of ForeFire/Meso-NH for wildland fire/atmosphere coupled simulation of the FireFlux experiment. Proc. Combust. Inst., 34, 2633–2640.

[5] Mandel, J., Beezley, J.D., and Kochanski, A.K. (2011) Coupled atmosphere-wildland fire modeling with WRF 3.3 and SFIRE 2011. Geosci. Model Dev., 4, 591–610, doi:10.5194/gmd-4-591- 2011.

[6] Rochoux M.C., Ricci S., Lucor D., Cuenot B. and Trouvé A. (2014) Towards predictive data-driven simulations of wildfire spread – Part I: Reduced-cost Ensemble Kalman Filter based on a Polynomial Chaos surrogate model for parameter estimation, Natural Hazards and Earth System Science 14:2951–2973. doi:10.5194/nhess-14-2951-2014.

[7] Rochoux M.C., Emery C., Ricci S., Cuenot B. and Trouvé A. (2015) Towards predictive data-driven simulations of wildfire spread – Part II: Ensemble Kalman Filter for the state estimation of a front-tracking simulator of wildfire spread, Natural Hazards and Earth System Science 15:1721–1739. doi:10.5194/nhess-15-1721-2015.

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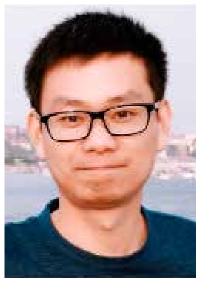


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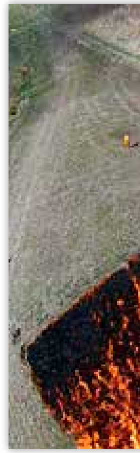
DEVELOPING and TESTING a TANKER/ENGINE CREW PROTECTION SYSTEM



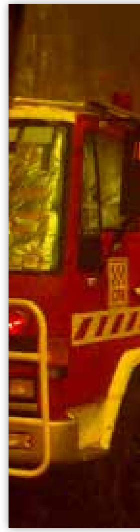


Figure 1. Flame immersion of ultra-light gel protected tanker test vehicle on the Bushfire Flame Front Simulator, Mogo, New South Wales.

Research by Country Fire Authority (CFA, Victoria, Australia) tests crew protection systems to ensure survival during wildfire burnovers

by David Nichols, CFA Manager of Research and Development

Bushfire firefighting, tanker vehicle entrapment, and fire burnover are life-threatening situations for fire fighters. The most dangerous Australian tanker/engine burnovers typically occur on a narrow track in a eucalyptus forest environment. The abundance of elevated and surface fuels between an entrapped tanker and the fire front can allow for a sudden escalation of fire intensity associated with changes in slope or following a wind change of direction and/or strength.

Burnovers are characterized by an initial period of strong radiant heat followed by peak flame contact from a fast moving flame front. This initial period is followed by a short intense short flame immersion of the tanker of less than two minutes. After the flame front passes the tanker crew may still be impacted by significant radiant heat from the fire as the flame front progresses away from the tanker. The fast moving fire flame front might only allow for an extremely short period of time for the tanker crew to become aware of the threat and to prepare for a burnover. Due to the fast moving nature of a bushfire in a burnover situation, any crew protection system needs to be easily and rapidly deployed by the crew.

Country Fire Authority (CFA) Victoria fire fighting tanker crew protection systems have been evolving since the 1977 Western District fires when standard tanker design and heat shielding were first deployed. After the 1983 Ash Wednesday fires where 12 CFA volunteers were lost in a burnover, the tanker fleet was upgraded with all diesel powered vehicles and pumps and research was completed into fire resistant materials on tankers. Significant crew protection component research commenced following the 1998 Linton fire where five CFA volunteers perished when their tanker was entrapped and burnt over.

The objective of the crew protection system research since 1998 has been to provide an evidence based system that will protect tanker based fire fighters in a burnover entrapment situation during a bushfire of high intensity of up to 10,000 kW per metre. The bushfire conditions that occurred during the Linton bushfire have been used as the benchmark for the research.

Since the Linton bushfire, the CFA has undertaken research and development into a variety of tanker crew protection methods.

Figure 2. Wangaratta, Victoria grassland fire experimental test flame front impact on ultra-light gel protected tanker test vehicle.

Figure 3. Brucknell, Victoria experimental bushfire pre-fire flame front impact on medium and ultra light fire fighting tankers.

The research has resulted in the installation of crew protection systems commencing in 2006 on new build medium tankers (2000 litre water carrying capacity) and heavy tankers (3000 litre water carrying capacity) in the CFA fleet. A retro-fit crew protection system for all CFA medium and heavy tankers was completed on 1200 tankers prior to the 2013-2014 fire season. Post-Linton crew protection systems installed on new tankers include personal protective radiant heat shield blankets, low-level water indicators, water spray deluge systems, internal cabin drop down radiant heat shielding, additional radiant heat shielding around water pump systems and vulnerable tanker components, a reduction of plastic materials on the external surfaces of the tankers, metal air cleaner filters, and flame resistant hoses and cabling. Crew training, with a requirement of minimum fire fighter skills and situational awareness, has also been emphasised since 2000.

Even with new crew protection and improved situational awareness training, multiple CFA tanker entrapment and burnovers have occurred. Fortunately there has been no serious injury or loss of life since the initial tanker crew protection system installations in 2006.

In addition to the validation of the medium and large tanker development, CFA is conducting research into crew protection systems for the ultra-light tanker vehicles. Given that the ultra-light vehicles do not carry large quantities of water, the research has been directed at water enhancing products including Class A foam and polymer gels. The water enhancing products have been tested on ultra-light vehicles at the Bushfire Flame Front Simulator, managed by New South Wales Rural Fire Service and CSIRO, located at Mogo, New South Wales (Figure 1). The delivery system of the polymer gel product underwent validation testing at a grassfire burnover scenario test at Wangaratta, Victoria (Figure 2) prior to the Brucknell forest fuel validation test (Figures 3-4).

Since the medium and heavy tankers in the CFA fleet have a large water carrying capacity, a water spray system that uses 500 litres of water over five minutes is a good protective agent for those tankers. CFA also has a large fleet, over 150 units, of ultra-light tankers with a much smaller water carrying capacity (less than 500 litres) that limits the use of water as a part of a crew protection system. Since 2014, CFA has been researching the use of water enhanced technology, including polymer gels and A Class Foam products as a part of crew protection for the ultra-light tankers.

The CFA Research and Innovation Unit, in collaboration with the Commonwealth Scientific and Industrial Research Organisation (CSIRO), recently completed an experimental bushfire burn test to determine the survivability of crews in three differently protected fire fighting tankers in an entrapment burnover situation.

CFA identified a suitable site for conducting a high intensity experimental fire in a forest environment to validate the crew protection system research and development process. Objectives of the experimental fire were (1) to conduct a high intensity experimental burn over scenario, with a wide fire front (approximately 100m) and target fire line intensity of at least 10,000kW/m (a benchmark from the Linton bushfire burnover), and (2) to field test the following CFA crew protection systems:

- A retrofit water spray deluge system installed on a medium tanker (2000 litre water capacity).
- A polymer gel delivery system fitted to an ultra-light tanker (400 litre water capacity).
- A Compressed Air Foam System (CAFS) installed on an ultra-light tanker (400 litre water capacity).

The field validation burnover tests were conducted at an area (Brucknell Scout Camp near Timboon, Victoria) with bushfire forest fuels, topographic influence, and weather conditions similar to conditions that have occurred in past Australian tanker entrapments and mpst fatal burnovers.

CFA crew protection systems have been researched and developed through a rigorous scientific process of structured, repeatable experiments on the CSIRO bushfire flame front simulator (Figure 1), followed by a field validation experimental test fire burns in grassland fuels (Figure 2).

The final system validation experiment was conducted in the forest bushfire fuels at the Brucknell test site (Figures 3-4). The forest fuel validation test is based on a fire of 10,000kW

Figure 4. Brucknell, Victoria experimental bushfire pre-fire flame front impact on all three fire fighting tankers.

per metre that would build its intensity over a period of time determined by the fire level of intensity, with a total flame immersion of the vehicle of less than two minutes. The burnover would require five minutes of water coverage on the tankers to protect the crew from the most intense radiant heat levels and the flame immersion phase of the fire burnover.

The delivery system for the Class A foam product was tested at the Brucknell forest fuel validation test. This experimental validation tested a medium tanker with current crew protection system, a polymer gel protected ultra-light tanker and a Class A foam protected ultra-light tanker (Figures 3-4).

The average fire intensity of the experimental fire was 19,000kW per metre, with a peak intensity impact on the tankers of 31,000kW per metre.

In addition to testing the radiant heat and flame contact on the tankers, internal cabin air toxicity was also measured. Air toxicity exposure criteria within the tanker cabin during the fire burnover experiments are based on two considerations:

- Tenability – the fire crew will be able to occupy the cabin for the bushfire burnover period without experiencing intolerable irritation, significant loss of alertness, or irreversible health effects.
- Survival – the fire crew will be able to occupy the cabin for the bushfire burnover period without loss of consciousness or loss of life.

All the tanker crew protection systems provided adequate crew air toxicity tenability and survivability objectives during the experimental burn test.

The crew protection system over-spray of one to two metres moistened the fuels around the tankers and thus decreased fuel combustion and the radiant heat load and direct flame front contact on the tankers.

The temperatures on the outside of the tankers ranged from over 300°C on the medium tanker to over 400°C on the gel protected ultra-light tanker. The inside cabin temperatures at medium seat height level were:

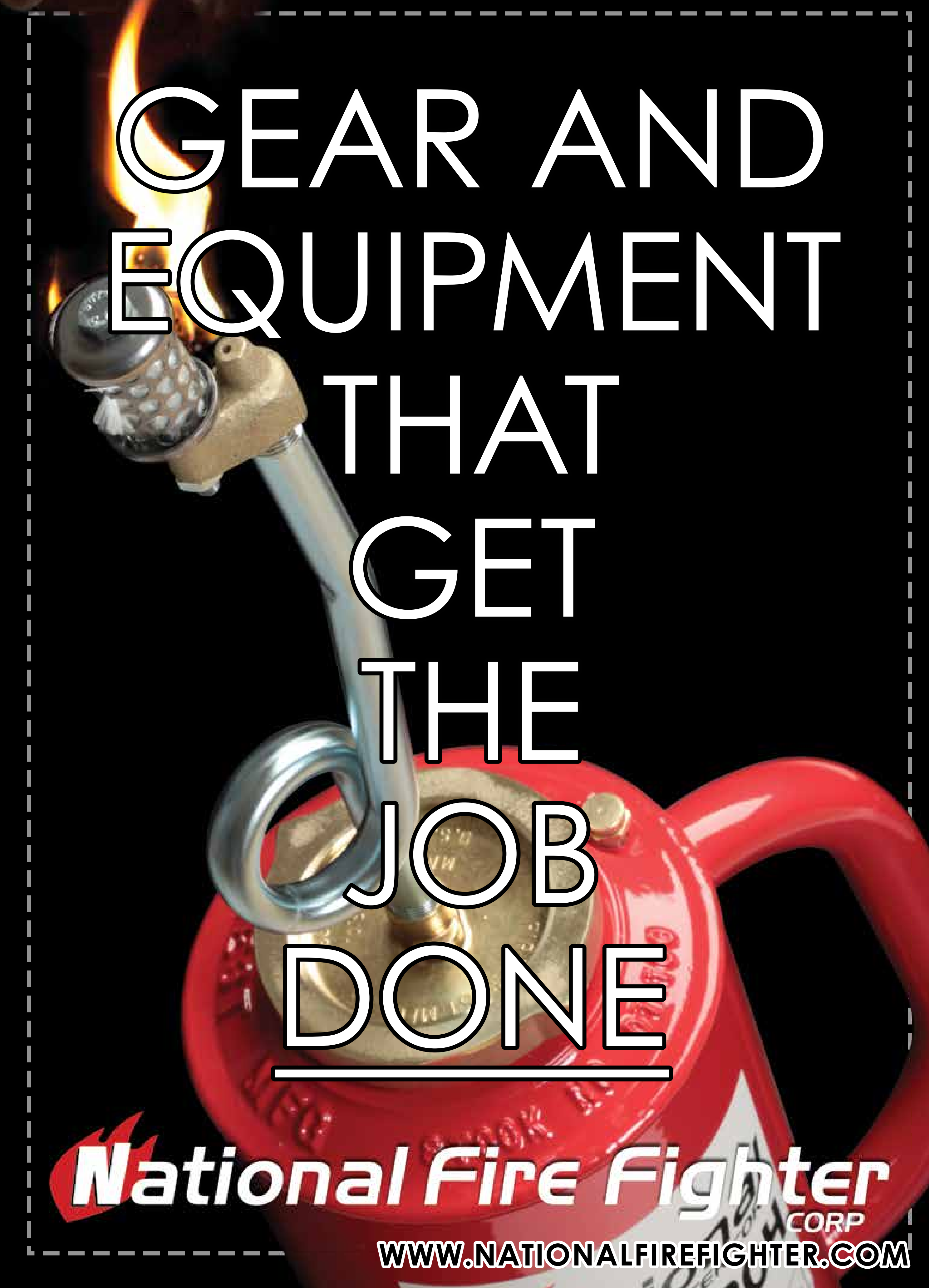
- Medium tanker: <50°C for seven minutes after the fire flame front passage
- Gel protected ultra-light tanker: <50°C for four minutes after the fire flame front passage
- Class A foam protected ultra-light tanker: <50°C for 5 minutes after the flame front passage.

Prior CFA research has shown that fire fighters, in normal wildfire protective clothing, can be exposed to 55°C temperatures for 20 to 25 minutes before any increase in body core temperature. The test of the temperatures inside the cabin demonstrate that, while fire fighters may be hot and uncomfortable during the flame front impact and burnover, they would certainly survive the burnover in the protected vehicles.

The bushfire flame front entrapment and burnover experimental test that impacted the medium tanker validates the crew protection system research and development of systems now installed on over 1200 medium and heavy CFA tankers.

The results are very encouraging from CFA testing of crew protection systems incorporating water enhancing products for ultra-light tankers. CFA will continue the research and development of water enhancing systems until it can confidently incorporate a validated system into the fleet.

Evidence based tanker crew protection system improvements and bushfire situational awareness training continue to help make tanker-based fire fighting crews safer on the fireground in the unexpected occurrence of a bushfire entrapment and burnover.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REVIEW: KESTREL 5500 FIRE PRO – A KEY UPDATE FOR THE CLASSIC WEATHER METER

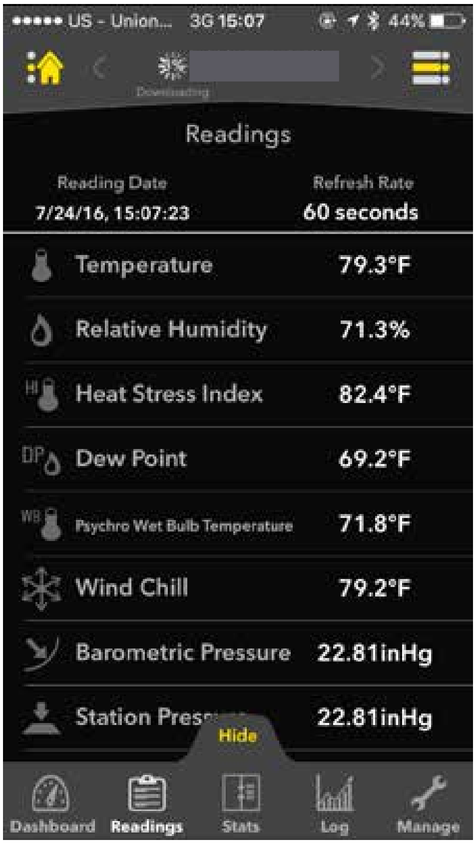
The Kestrel 5500 feels, looks, and operates like it was designed for the fireline. With a tough exterior, bulky feel, and the transition to AA batteries, it fits in with most fire operations and apparatuses. Where the 5500 sets itself apart from the rest of fires' un-user-friendly devices is the customization and nearly Sunnto-esque look. Over the last couple of years I have seen the rapid transition to user-friendly iPads for mapping and information transfer, evolving from the standard Garmin 60csx track, a couple of weathers taken and recorded in chicken scratch, coupled with a generic comment like "Division Zulu looks good." The 5500 is pushing that evolution within weather observation.

The tech-friendly and ultimately user friendly 5500 has a mostly reliable Bluetooth option for quick and easy transfer of info in the field. Like the new Garmins this has been good for ICs wanting info on the line. For the operations folks tracking trends this nifty device has a built-in barometer, PIG calculator, standard weather observations (wind, temp, RH, etc.), and the ability to save any observation you want.

This leads into the biggest strength/weakness of the 5500 – trends, not hard data. As with any device that requires calibration, the Kestrel is good for trends and one should be wary to take every number for hard fact. The RH will bounce quite a bit with micro climate, how sweaty you are, or if you are talking to a buddy too close to the sensor. If you give it some time it will settle and you can get pretty close and track trends pretty darn well. The thermometer was spot on during my trial with little to no variation from the sling psychrometer. This is one place where the 5500 really shines. Also accurate, but questionable for hard data, is the PIG (Probability of Ignition) calculator. How does it know aspect (always south?), elevation above, level, below, or shaded PIG? Great for trends, but the picky FEMO may want to go to the charts. One final element that will take some practice: ensuring thtat your Bluetooth data link stays connected with your smart device, as at times it seemed to drop out.

All said and done, the 5500 was a sweet piece of equipment on the fireline that proved itself well. As with most previous Kestrels, it did great with wind measurements. Combine that standard of excellence with an increased aptitude for temp, barometric pressure, and data manipulation -- and you have a good piece of fire tech. This is a good enough update to the standard weather meter to hold a little end of year cash out, or even prioritize for a pre-season purchase. Think of the money (and time) you'll save with easy-to-acquire AA batteries, as well as the innovative connection with smart phones and data export that will make data-sharing faster and more efficient. Sharing better and quicker weather data and interpretaion can increase our time to respond -- an argument for the value of this tool as one of many in our arsenal of weather tracking that supports a safer fireground.

- Review by Alex Spannuth – Fire Effects Monitor. Tested by Spannuth, Ron Steffens and others in Wyoming, Utah and Africa, Summer-Fall, 2016.



Screen shot from the Bluetooth real-time data link from the Kestrel 5500 to a asmart phone

AUSTRALIA'S SUMMER 2016-2017 FIRE SEASON: **EXTREME HEAT AND A FEW DESTRUCTIVE FIRES**

Sir Ivan Bushfire. A bushfire that started near Leadville east of Dunedoo in the NSW Central Tablelands and ripped through bush and grasslands in a day that NSW fire authorities classified as catastrophic. Sheep and cattle maneuver around a dam to avoid a fast running grass fire south of Uarbry as the fire front moved East. Photo: Dean Sewell / Oculi.com.au.

Responding to a lightning-caused fire burning in the Blue Mountains west of Sydney on February 18, 2017.

By Michael Scott Hill

The 2016-2017 fire season in Australia has been relatively quiet overall with a few periods of increased initial attack activity, like this weekend in mid-February 2017 (see aerial photo). Flying in the rear of a Bell 412 helicopter across New South Wales' rugged, rolling Blue Mountains with my small RART (Rapid Area Response Team), we are on our way to another fire. This is to be our big weekend chasing fires for this season.

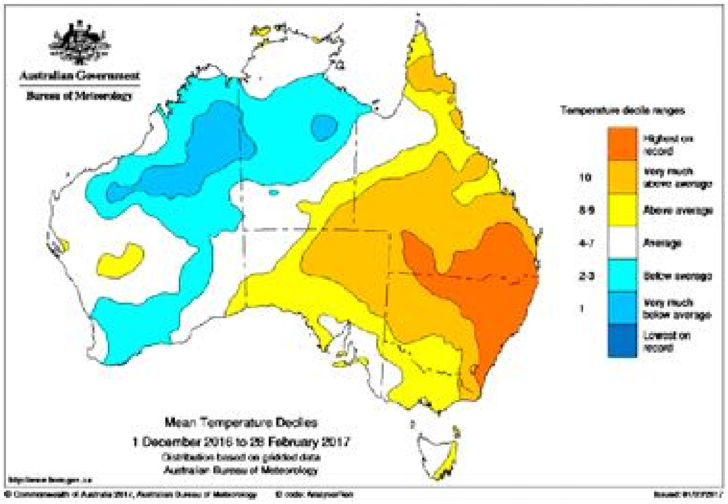
The weather pattern across Australia this summer was basically one of cyclic rainfall broken by several consecutive periods of uncharacteristic extreme heat, until the rains came to cool the land once again. Three heatwaves occurred over the summer, which saw the highest monthly average temperatures on record for Sydney, New South Wales (NSW) and Brisbane, Queensland (QL) and the highest daytime temperatures on record for Canberra, Australian Capital Territory (ACT).

The summer in coastal Sydney ended up with 10 days of above 36 degree Celsius (96 F) as measured from the Observatory Hill in downtown Sydney, breaking weather records that stretch back to the early 1800s. These abnormal high temperatures spikes were carried to the normally cooler eastern areas of New South Wales, across from the hotter desert areas, by a repeating series of weather cycles blowing in a circular motion across the whole southern region of the continent from the west to the east coasts.

Australia's Bureau of Meteorology stated that, "During these heatwaves, daily maximum temperatures across south-east Australia exceeded 40 degrees Celsius over very large areas and were typically 8 to 12 Celsius above the January and February averages. The highest temperatures recorded during this period were 48.2 Celsius at Tarcoola, SA (South Australia), followed by 47.9 Celsius at Walgett, NSW; these are new February high temperature records at both these sites. While the January 1939 south-east Australian heatwave remains one of the most significant in recorded history, the frequency of such intense large-scale heatwaves has increased across spring, summer and autumn, and especially over the last 20 years."

Australian Bureau of Meteorology data also shows a pattern in the interior that extended beyond the heatwaves. Behind the rugged Blue Mountains (which shield the cooler Sydney's coastal basin from its more arid western interior), roughly one third of the state of New South Wales experienced temperatures of 35 degrees

Celsius or above for 50 or more days. Such sustained extreme summer temperatures have not been experienced across this region since the summer of 1938 to 1939.



The 2016-2017 summer's cycle of returning heat spikes peaked during the weekend of the 11th and 12th of February when 120 bushfires took light across the state of New South Wales and over 2,500 firefighters responded to these fires. Two of these blazes were destined to become famous on the national scale -- the Kains Flat Fire and the Sir Ivan Fire. Both of these fires were located in the central eastern region of NSW on the backside of Australia's Great Dividing Range in an area of rolling hills and plains.

Of these two, the Sir Ivan Fire proved to be the most destructive. This fire covered 54,000 hectares with an active fire edge of around 200km which, by the time it was controlled, had destroyed 34 homes, a church, community hall and 120 outbuildings, and damaged six other homes and 30 outbuildings, plus led to huge livestock losses in cattle and sheep.

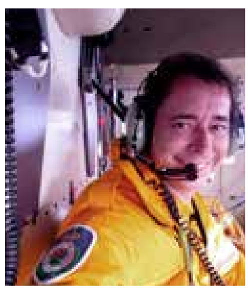
The small community of Uarbry was completely devastated by the Sir Ivan Fire, and its loses are included in the list above. Across the weekend, two serious injuries were sustained by firefighters; one firefighter was burned on hands and face and the other received a very serious laceration to the hand.

A week later, a series of thunderstorms moving south across the state of New South Wales ignited more than 100 bushfires, which were initial attacked by truck and aircraft based fire crews. This series of fires grew individually to various sizes across the predominantly eucalyptus forest, bushland and grasses, until either rain from the passing storms, or responding emergency personal like us were able to get them under control.

From our group of fires we responded to, the most high profile fire from this late summer storm event started after lightning hit an area of heat-cured grassland in the Australian Capital Territory (ACT).

The grass fire then moved swiftly across the landscape burning sparsely populated, mostly grazing country, 10km east of the community of Queanbeyan on the border of NSW & ACT. This grass fire was called the Carwoola Fire, and before its flames had gone out, it had covered 3500 hectares, led to more livestock loses, and had consumed 11 homes, 45 outbuildings, and damaged 40 others. Sustained firefighting efforts from ground and aerial resources however were credited with saving 56 homes. Sadly in the process, there was a serious injury on the fire, when a firefighter aged in his 40s, suffered pelvic injuries and burns.

Extreme weather events such as these abnormal temperature spikes experienced during the Australian summer could be a rarely reoccurring weather pattern, or it could be the sign of more extreme fire conditions in store for the rest of us who also reside in other fire prone locations across the globe.



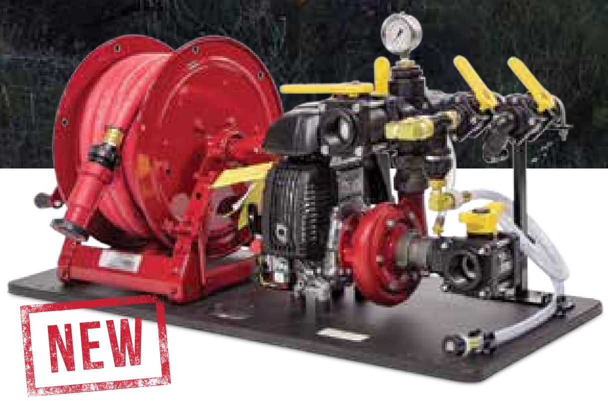
Michael Scott Hill, a contributing editor for Wildfire Magazine, manages fire and aviation with a global perspective from a home base in Virginia (USA).

Related IJWF Research *(IAWF membership log-in required)*

Variability and drivers of extreme fire weather in fire-prone areas of south-eastern Australia. *Sarah Harris, Graham Mills and Timothy Brown.*

We identify the most extreme fire weather days based on McArthur's Forest Fire Danger Index (FFDI) for 24 sites across south-eastern Australia for potential use in fire risk planning. The extent and variability of these highest FFDI days are analysed by the contributions of temperature, relative humidity, wind speed, wind direction and drought indices.

IJWF ARTICLE | http://www.publish.csiro.au/WF/WF16118?jid=WFv26n3&xhtml=F2985ECC-67C6-47C1-988B-3692C049CCF7



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