

WILDFIRE

QUARTER 3, 2021
UNITING THE GLOBAL WILDLAND FIRE COMMUNITY

An official publication of the INTERNATIONAL ASSOCIATION *of* WILDLAND FIRE



JULIET CREW

ALL-WOMAN TEAM TESTS METTLE

IAWF AWARDS

SIXTH-GENERATION FIRES

EMBRACING PODS

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South African firefighter Kylie Paul watches the sun rise on the last deployment to see any active flames on the Jonkershoek fire in March, at the top of a kloof. Crew members had mopped up the previous day. Paul was resting on this peak reflecting on an incredibly challenging and rewarding week of firefighting: 13,000 hectares burned; five chopper rides; about 90 hours on the line in three deployments no loss of structure or life.

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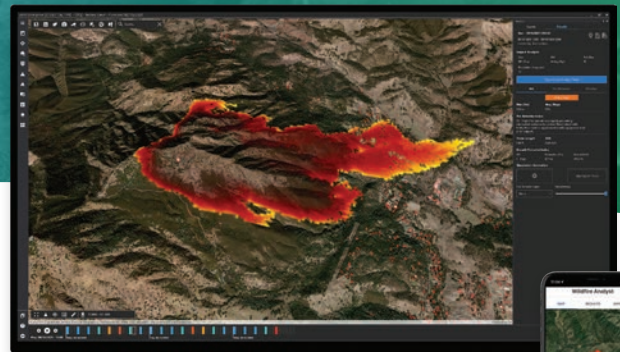
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INCLUDING DIVERSITY

You'll see, in this issue, that we're "flagging" each story with a word or phrase – Research, Policy, or Training, for example. These flags represent topics or issues of interest identified by IAWF members in our survey a few months back.

It's important to us that we produce stories and opinion pieces that represent the membership and the issues that are relevant around the globe.

Fortunately, we have a wealth of such stories from which to choose, following the 16th Wildland Fire Safety Summit | 6th Human Dimensions of Wildland Fire Conference in May, and we'll do our best to produce articles based on keynotes and other sessions over the next year.

If you missed the conference address by former Spanish prime minister Felipe Gonzalez, we've produced an edited (for length and clarity) version on page 16. Gonzalez's passion for policy change to prevention from suppression is clear, but it's not yet clear how to achieve the change – or if it will be achieved.

The membership survey indicated that diversity, equity, and inclusion are important, and that readers want coverage of DEI within the wildland fire sector.

When I interviewed Jane Park, a fire and vegetation management specialist with Parks Canada for our Fired up feature (page 28), I expected to talk about prescribed burns and Canada's worsening wildfire situation, but the conversation meandered, and we got into the weeds about diversity – or lack thereof.

Park is well known in Canadian wildland circles; her Master's of science in forest ecology led her to Parks Canada 20 years ago as a warden in Banff. Park spent time in northern Canada and the west coast from 2006 to 2011 before returning to Alberta and the mountains. Now, she's a familiar face and voice in the science and social-media worlds as an advocate for women and people of colour in fire management, yet on the ground, it's a different story.

"I'll attend meetings as the incident commander with my operations section chief, who's male," Park says, "and everything will be directed at him and not me . . .

"As an incident commander and on incident management teams, I don't see people who look like me as my peers, or in many of the operational settings. And it's a deterrent."

A deterrent to recruitment, primarily, and with already stretched resources and a challenging couple of years as agencies navigated hiring and training during COVID-19, diversity may have dropped a few notches on the scale of initiatives, despite support from agency management.

Which leads me to our cover story, about Juliet Crew, the first and only all-female firefighting team in South Africa. The first-person narrative on page 18, by crew leader Kylie Paul, is a testament to the grit of the crew and the available training.

The majority of the crew members are the breadwinners for their families and two are single mothers.

Juliet Crew deployed over three separate operational periods in March 2021, each a minimum of 24 hours. Paul details each deployment in her story, and the difficult conditions under which the crew worked.

We'd like to hear what you think about these stories, and the others, in this issue, and what's going on in your regions in regard to diversity, equity and inclusion.

Our Member Voices section, on page 10, provides a space for members to share feedback and ideas. Please do!

LAURA KING
Managing editor
Wildfire





WILDFIRE SMOKE AFFECTS AIR QUALITY

A study has found a connection between wildfire smoke and the number of extremely poor air quality events. The University of Utah research ties the decline in air quality incidents in the western United States to wildfire activity. The study also found that the increase in the tendency of smoke impacting air quality persists into September. The study results were published in *Environmental Research Letters*. "We're going to see more fire area burned in the western U.S. between now and 2050," Kai Wilmut, lead author of the study and doctoral student in the Department of Atmospheric Sciences, said in a news release. "If we extrapolate our trends forward, it seems to indicate that a lot of urban centres are going to have trouble in meeting air quality standards in as little time as 15 years."



FREQUENT FIRES HINDER LICHEN REGROWTH

Lichen communities may take decades – and in some cases up to a century – to fully return to chaparral ecosystems after wildfire, according to a study from the University of California, Davis, and Stanford University. The study, published in the journal *Diversity and Distributions*, is

the most comprehensive to date of long-term lichen recolonization after fire. Chaparral systems in California are adapted to high-intensity fires. But the study indicates that lichen communities may not have the window needed to return to chaparral shrublands after wildfire because of the increasing frequency of fires predicted under a drier, warming climate, and more ignitions because of population growth in these areas. Lichens are complex organisms that provide food for wildlife and help retain moisture in their environments.



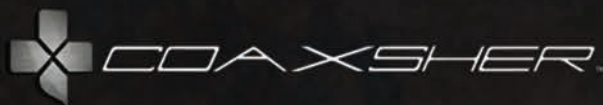
BISON COULD HELP LIMIT WILDFIRES

The reintroduction of the long-extinct European bison to Spain might reduce the impact of wildfires. A decline in sheep herding has left Spain without a large herbivore to clear the undergrowth that fuels the fires. But a program to reintroduce bison might help. But Fernando Morán, a veterinarian and director of the European Bison Conservation Center of Spain, says bison might help. Bison eat about 30 kilograms of vegetation a day comprising wood fibre and shoots and leaves. "The European bison delivers immediate biodiversity," Morán told *The Guardian*. "It opens up dense parts of the forest which lets in the light and allows grass to grow instead of scrub, which lowers fire risk and, in turn, benefits numerous species through food and freedom of movement."



U.S. SENATOR PROPOSES WILDFIRE COMMISSION

U.S. Senator Mitt Romney is calling for the creation of a wildfire commission to review wildfire policy and make recommendations to Congress. Romney introduced the Wildfire Mitigation and Management Commission Act of 2021 in June. Lives have been lost; structures have been lost; businesses have gone out of business because of fire," Romney said. "And we keep doing things the way we've done them in the past without recognizing that the world has changed. It's getting drier in the American west . . . The fires are becoming bigger, the loss of life is more significant and continuing to do the things the way we've done them in the past doesn't make a lot of sense." The bill would establish a commission "to study and recommend fire prevention, mitigation, management, and rehabilitation policies for forests and grasslands." Romney criticized the wildland fire policy as a "patchwork of legislation and agency guidance across departments and jurisdictions, further complicated by mixed land ownership." Jamie Barnes, acting director of the Utah Division of Forestry, Fire and State Lands, said 85 per cent of the 380 wildfires in Romney's home state of Utah in 2021 as of mid-June were human-caused.



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VIRTUAL REACH VERSUS IN-PERSON CONNECTION

TODDI STEELMAN
IAWF PRESIDENT

We closed out the 16th International Wildland Fire Safety Summit | 6th Human Dimensions of Wildland Fire Conference in late May; by every measure imaginable, it was a success.

We had more than 300 attendees from 24 countries who presented or participated in 111 sessions across three continents. With five concurrent tracks, there was a veritable feast of content spanning everything from human performance to collaborative fire planning, international co-operation, COVID impacts, firefighting futures, Indigenous approaches to fire, evacuation alternatives, tools and techniques to enhance safety, and technological advances for better planning and response. Recordings of all conference presentations remain available online to those who registered.

As we begin to transition into what will be a more open posture as the COVID pandemic subsides, we need to think about the lessons we will continue to learn. What do we want to hold onto, including intentionally considering the tradeoffs inherent in the choices we make? All professional societies will wrestle with these questions in the forthcoming years. In the meantime, our fire circumstances will likely only accelerate given current trends.

So, what are we learning?

Never have our interdependencies been more central to all we do. We find ourselves in the current pandemic because we are linked globally. We also know these mutual linkages will be key to working our way out of it. A notable lesson from the plenaries and panels on

COVID on the fireline was the relatively small amount of transmission of the disease, especially when we apply best available science and adhere to common sense protocols. Our interdependencies are our greatest strengths and our greatest weaknesses.

How do we strengthen, rather than simply overwhelm, our membership in a virtual or hybrid environment?

Connecting virtually allows us a lower carbon footprint and the opportunity to reach a greater portion of our international membership at a more accessible price. It is simply harder, more expensive and perhaps riskier to bring people together in person. But our virtual option comes at a price, and that is human connection. IAWF prides itself on our convening function, building networks, facilitating partnerships, enhancing knowledge and creating community. All these are possible in a virtual environment. Yet, when we don't see each other in person we miss something: the spontaneity of contact; the depth of connection; the body language and emotion; and the humanness of being together.

Virtual presentations are more easily recorded and preserved for future learning and accessibility. But the limitations of time remain. If one IAWF's goals is to ensure knowledge is transmitted, what are the strategic choices we make in the kinds of conferences and workshops we decide upon, and what are the tactical choices we make in highlighting the best of what comes out of these convenings? How do we strengthen, rather than simply overwhelm, our membership in a virtual or hybrid environment?

These lessons, questions and more will be under debate in the coming years as we find a new equilibrium and learn from all of these experiences. What is not up for debate is the importance of the IAWF mission, which is more vital now than ever in this complex, interdependent world.

If you were able to attend our conference, I encourage you to maintain your connection to us through our regular webinars, newsletter, social media, and *Wildfire* magazine. These are the ways we keep in touch and we encourage active engagement. *Wildfire* magazine now has a page for member comments; please let us know what you are thinking!



TODDI STEELMAN is president of the International Association of Wildland Fire and Stanback Dean of the Nicholas School of the Environment at Duke University, North Carolina, USA



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COVER STORY FEEDBACK

**RE: COVER STORY, Q2
OUTTHINKING WILDFIRE,**

BY MICHELE STEINBERG

I was very disappointed in the 2nd quarter Outthinking Wildfire article. Surely Steinberg must know that fire is inevitable in fire adapted ecosystems and that appropriate fire is mandatory for the ecosystem/plant community in question to be fully functional. RX fire should be the 1st tenet to Outthink Wildfire. What a lost opportunity that she does not even mention it in her article.

Dale Wade**WRITER'S RESPONSE**

One of the five tenets of Outthink Wildfire™ is the need for landscape-scale fuel treatment. There are many ways to treat hazardous fuels, and in the broad statements under each tenet, there is plenty of room for specifics, including the promotion of more prescribed fire. NFPA is not a land management agency – it would not be appropriate for us to specify a technique for fuel treatment as a singular solution. Land managers know what treatments will work (and are acceptable and permissible) on what landscapes. The same goes for our tenets to promote policies to drive safer new construction and to retrofit and mitigate existing structures. NFPA is not going to specify the building materials or design techniques in our policy tenets – that will be driven by performance-based codes and the market.

Outthink Wildfire is calling on policymakers to do things differently. There is ample space in the broad policy promoting hazardous fuel treatment to enable prescribed fire proponents to promote the reintroduction of fire to our landscapes. Of course, any such proposals must take into account the reality of the enormous growth of homes and communities in areas that will be impacted by fire and smoke whether the fire is planned or wild.

Michele Steinberg

Wildfire Division director

National Fire Protection Association

**CONFERENCE
MEETS THE MARK**

Some questions and responses to our participant survey following the 16th Wildland Fire Safety Summit | 6th Human Dimensions of Wildland Fire Conference, May 24-27

**Q: What is your one takeaway
from today's session?**

- Volunteerism, and watching for "active exclusion" by reinforced cultural promotion and cliques within brigade culture that inhibit diversity.
- Great to see the global perspective with contributions from all over the world. Great content. Dekker's keynote was excellent.
- The research into trust between subordinates and supervisors was excellent.
- How we deal with error is more meaningful than trying to stop it.
- Integrating First Nations practice into fire management practice needs leaders willing to try to shift the paradigm and give First Nations power in fire decision making.
- Covid could result in some positive benefits for fire fighting: smaller, closer camps; minimizing travel; and increasing sleep/rest.
- Safety is more about what went right than what went wrong.
- I learned to respect what people valued and to be mindful of making sure that mitigation measures completed in different communities are equitable. I loved the atmosphere of mutual respect in this wonderful conference.

**Q: What can we do to make your experience
better tomorrow?**

- Make the days longer so I can watch all the sessions you all have done such a fantastic job!
- I really appreciate all the effort that must have gone on in the background to organise this and keep it running.
- Any way to do a digital icebreaker in the networking breaks? I'd like to meet new people but don't know where to start a conversation (other than about their work).
- Perhaps have a few moderators chatting in the scheduled networking break sessions to start folks off – the breaks are great for bathroom runs, but there is less networking interaction than I thought we might get, except the chats in sessions, which is great!!



- Wow, I am finding this conference better than any I have attended in recent years. The topics are relevant and it is well paced. I can't think of any way of improving my experience. Well done team.
- Remind me that the sessions I am unable to attend are being recorded so I can watch them later. While I watch one, I stress about what I am missing
- I was a presenter today and remembering how to moderate/join was the most stressful thing, but my moderators were fantastic and made it super easy!
- This digital platform is working AMAZINGLY. Definitely not the same as being in person, but it is SO NICE to be able to connect with peers
- I really appreciate the "on demand" feature so that I can catch sessions that I missed.
- I thought the introductions to the opening session on Indigenous burning where the speaker walked around their landscape and narrated what they saw was FANTASTIC. That ability may make virtual better than live.
- I can't wait to see all these people in person at the next HD conference!
- Technologies: Networking groups, schedule conflicts.
- Modelling presentations were mainly at European night time, so difficult to participate.
- I am not sure how to remedy this, but many of the concurrent talks that I attended were poorly attended. The numbers of "live" attendees were between six and 15 (sometimes 20), which was disappointing. I understand that my time zone is very difficult for the U.S. and that a virtual conference is challenging in this way, but speakers worked really hard to put together good presentations and when only a few people show up, it's a bit of a let down.
- Exhibit Hall was poorly attended, despite the regular promotion. I think people may have been a bit confused about how to actually engage in this space. Whereas, in the networking area, engagement was great and easy to do.

Q: It is our intention to continue to provide a hybrid option for our future conferences when possible. If you had a choice, which would you select?

- I will always attend in person if possible.
- I will always attend virtually if this option is available.
- A combination of both.

Q: What else you would like to tell us?

- Great job on making a virtual conference the best it could be. One suggestion: I attended a virtual conference before that had "tables" instead of networking rooms on their conferencing platform. So everyone who entered the conference platform had an avatar that was seated at a table. You could then sit and chat with folks (with webcams on) during breaks or after the conference, and move around to other tables to visit. I found that helped a lot with being able to "interact" with other participants.
- Thanks, great work, I really enjoyed the conference. I also love that I've got six months to catch up on all the sessions I couldn't get to live
- Thank you for making this work amongst all the constraints that COVID brings. It was a super valuable endeavor and I am grateful. I have so much information to sort through now!!
- The Pyrosketchology workshop was wonderful and a real learning experience
- The Pheedloop platform really worked well. The Continental IC conversation . . . was FABULOUS.
- The presentations are quite rich in data and while I find it interesting, I also am left with the "What now?" thought, or how does this translate to the field in being useful? While I like the academics, I would also like to see some more experiential sharing. As a firefighter and research lover, I am often thinking that my research side is definitely getting met, but the firefighter/fire manager side is left wanting something that really provides food for thought for on the ground usage. Your keynotes like Sydney Dekker and Dan Cable I really resonated with, and would love to see some more human factors. Overall, great conference and so glad I get to sit in on the presentation using your awesome on demand feature, for the ones I missed. Thanks sooooo much!
- I really liked that closed captioning allowed for support of multiple languages.
- This was a great conference under difficult circumstances; thanks so much to all the organizers!
- I had fun! It was a great conference. Being in a department where I am the only one studying wildfire, it is great to be able to see and take inspiration from works that others are doing.



SIXTH-GENERATION FIRES

Public-policy change toward prevention required to address large-scale events

Felipe Gonzalez, former prime minister of Spain, delivered a keynote address during the 16th Wildland Fire Safety Summit | 6th Human Dimensions of Fire Conference in May. The transcript has been edited for clarity and length.



Between 2000 and 2017, 611 firefighters and civilians died in wildfires in European Union countries, with economic damage of more than U.S. \$60.5 billion. Portugal has recorded more than 18,000 wildfires a year since 2007. Fires in 2017 killed more than 100 people. And fire seasons are extending into June and October. A 2020 EU report noted that authorities still use traditional suppression methods instead of investing in long-term prevention. In Western Europe, people are moving to cities from the countryside. Untended fields, pastures and forests provide fuel for wildfires. Experts say there needs to be a change to prevention from suppression, and that policies need to consider climate adaptation, education and preparedness. If authorities fail to change the countryside, the European Forest Institute said in a report, emergency services will be unable to stop sixth-generation wildfires.

I was in charge of the government of Spain between 1982 and 1996, coinciding in the United States with Reagan, Bush, and Clinton, and from the first moment we committed ourselves to improve the technical means and human resources to fight forest fires.

At the time, there was a depopulation in Spain of the rural population from the countryside to the cities. This phenomenon produced an increase of the forest mass, especially fuel – the abandonment of rural areas allowed there to be a large area without the presence of human beings, and without intervention in nature. Our concern was to provide all the services of struggles against forest fires, and have sufficient means to detect them quickly and arrive on time, in such a way that they would not become serious fires; this was the objective, and that objective soon had a contradictory effect.

We were successful for two or three or four years; taking into account the climatic variations of dry years and wet years, more fuel remained naturally on the land because we had been effective at extinguishing the fire.

Remember that I am the same age as [U.S.] President [Joe] Biden, and remember what our ancestors said: the fires go out in winter, which did not mean that they had to act in winter in a special way. This was vital experience accumulated over centuries that translated into [the fact that they] lived in rural areas and took advantage of energy produced by the forest mass for everything – to heat, to cook, for everything.

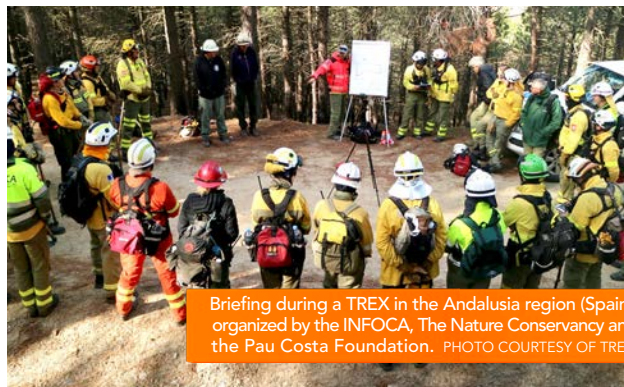
These people took precautions to avoid fires that would devastate their houses, their small or large properties, their livestock; they were already in the habit of preventing fires before the fires arrived, and therefore there was a direct action of preventive human beings on nature, and there was intensive use of the forest mass that people tried to keep clean to use as energy.

Nature was responding to climate change at least 20 years before we became aware of climate change.

We studied the socio-economic conditions of the spread and increase of forest fires including the abandonment of the rural environment, but later we were surprised by facts such as that in areas where there was no abandonment of the rural environment, fires were also produced.

Therefore, the socio-economic conditions were a factor to take into account and were diverse in the different parts of the planet where fires were occurring, each more and more voracious. We reached one conclusion – the link of this growth in the power of forest fires, the sixth generation of fires, of which the specialists spoke back in 2017 – was climate change.

Nature perceived much earlier than humans the effect of one degree more in temperature. Now, this evolution has reached what is called the sixth generation of fires, or mega forest fires. These are appearing in all the continents in different areas of the planet. But the great surprise, the concern, belatedly



Briefing during a TREX in the Andalusia region (Spain), organized by the INFOCA, The Nature Conservancy and the Pau Costa Foundation. PHOTO COURTESY OF TREX.

Olmi di Tuda Fire in Corsica, 2016.

PHOTO BY JORDI VENDRELL



perceived by humans, and much earlier noticed by nature, is that as of 2017, mega fires began to occur – the sixth generation of fires – in Chile, in Bolivia, in California, in Canada, in many areas of America, and in Europe in 2017 the mega fires in Portugal occurred.

Curiously, these mega fires also occurred outside of what we consider the high-risk period, at the end of the period and before the high-risk period arrives.

We share the Iberian Peninsula with Portugal; with a number of fatalities and destruction, the mega fire surprised us by the capacity to generate its own air currents, its own wind direction, and the columns of fire that they produce that rise through the atmosphere 13, 14 kilometers, and when they reach the cold zone of the atmosphere they explode like a bomb spreading, for 50 or 60 kilometers around the source of the fire, in such a way that the citizens who fled, terrified of the fire, found themselves surrounded by new fires.

The problem I want to reflect on is public policy. It is time to change the paradigm of public policy, so that it is not just about maintaining services of fight against fires of high quality and efficiency, that it is about changing the policies, remembering the old peasants of my land, preparing the forest mass so that the production of mega fires is avoided.

Therefore we have to act with preventive public policies. Citizens look at fire in terror and ask for more planes, more helicopters, more firefighters, and the action protocols themselves – the first thing they have to do, the first effort, is to save human lives.

The second effort is to save non-forest properties; this is how Paradise disappeared in 2017. We all remember because it was one of the first big surprises of this new wave of fires of this sixth generation of fire.

And the third thing, but not because they do not try to address it, is to try to put out the fire.

We have to change the paradigm and say how to preserve an orderly forest mass that avoids the dramatic spread that becomes mega fire? How we avoid it, and how we incorporate it into public policies that are respectful and preserve nature and also serve us, give us, for example, renewable energy through biomass that would allow the orderly and clean maintenance of the forest mass? Therefore, the public, preventive effort matches the objectives of a green economy, a circular economy of renewable energy, that it is replacing the fossil fuels that climate change produces, or contributes to climate change and global warming.

This is my appeal to the governor that you have in California, or to the president of the United States. These mega fires have occurred in Europe, in Portugal, in addition to fires where we would have never imagined them – in the Arctic Circle – and in Sweden, in Siberia; in Latin America they occur in Chile, in Bolivia, at an incredible speed of propagation and destruction capacity; in Argentina; in North America, accompanied by long droughts, or wet springs that increase fuel, therefore, they occur as a common effect of climate change.

And if the paradigm of behavior of nature has changed, we have to change public policies to fight against mega fires and take advantage of the forest mass, and commit to explaining that we are going to maintain technical and human resources in the fight against fires, but that we are also going to prevent fires, with intelligent policies, to take advantage of renewable energies and keep our forest mass alive, but be able to manage it.

We have to remember the old people of my land. We have to make public policies, being respectful of nature and with the warnings that nature and the forest mass have given us for decades, and that jibe with the objective of avoiding fires and taking advantage of the forest mass for renewable energies.

IAWF AWARDS

**EARLY CAREER AWARD IN FIRE SCIENCE | CATHELIJNE STOOFF**

Cathelijne Stoof is a highly versatile interdisciplinary researcher, already a leader in wildland fire science, and a role model for scientific communications and women in science. Stoof was initially well known for her outstanding PhD work on fire impact on soils; her research has now extended to environmental impacts, including greenhouse gas emissions, bioenergy, soil-water-plant ecology, and agronomy interactions. Based on Stoof's wide-ranging accomplishments, she received a prestigious Marie Curie Fellowship for her research and was shortlisted as one of 22 inspiring women at Wageningen University. Stoof is well regarded and highly cited by the scientific community. Her publication record includes 117 journal and conference papers that, according to Google Scholar, have attracted already more than 1,400 citations (at a current rate of 320 citations per year). Stoof has been instrumental in leading the scientific community, policy, and practitioners to recognize that climate change is impacting the fire regimes of countries that were previously considered safe from wildfires. As part of this work, Stoof founded and leads the Wageningen Fire Centre to bring together researchers and stakeholders from various disciplines to tackle the diverse issues of fire within non-traditional fire prone countries. Most recently, Stoof brought together and led a diverse group of academics and practitioners from across Europe to create a research proposal about her vision for living with fire. The project, called PyroLife, wants to tackle the increasing challenges of wildfire in temperate and Mediterranean regions by bringing together a diverse set of disciplines, from engineers to ecologists to social scientists, all engaged in risk quantification, governance and risk communications, and the many disciplines in between. As a result of this exceptional leadership and vision, PyroLife was awarded a € million grant in 2019 to train 15 PhD students from the Marie Curie International Training Network.

EARLY CAREER AWARD IN FIRE SCIENCE | SAYAKA SUZUKI

Sayaka Suzuki, PhD, of the National Research Institute of Fire and Disaster (NRIFD), Japan, is well known for crucial research on wildfire spread into and through communities. Suzuki is a leader in linking the traditional building and wildland fire science fields, and is a role model for women in combustion and fire -science research. Regarded as a leading expert in firebrands, Suzuki has written more than 30 journal papers focusing on understanding outdoor fire spread by firebrands. As a board member of the Japanese Combustion Society, Suzuki is making headway into recruiting more women researchers in fire research in Japan. Suzuki has led the development of young researcher workshops at the society's annual meetings, and hosts luncheons at which young women can join and discuss how a career in fire research can be rewarding. Further evidence of Suzuki's leadership is her role as the main liaison for the workshop series known as Operation Tomodachi – Fire Research. Tomodachi means friendship in Japanese. In Suzuki's role in this workshop series, she served to bridge the vast cultural differences as well as communication difficulties between American and Japanese fire researchers.

**WILDLAND FIRE SAFETY AWARD | BRET BUTLER**

Bret Butler, a research mechanical engineer with the USDA Forest Service based at the Rocky Mountain Research Station's Missoula Fire Sciences Laboratory, has been working in the field of wildland fire science for 30 years, since the completion of his PhD. Butler's primary research and technology transfer efforts have focused on improving wildland firefighter safety. Among some of Butler's accomplishments are the preparation of a seminal case study of a major fatality wildfire; serving as a serious accident investigation team member; the development of a model for simulating wind speed and direction in mountainous terrain for use in predicting fire behavior; involvement in co-ordinating several IAWF Wildland Fire Safety Summits and international fire safety short courses; authorship of numerous peer-review journal articles and conference papers; and research and development of guidelines for specifying the desired characteristics of firefighter safety zones.



EMBER AWARD FOR EXCELLENCE IN FIRE RESEARCH PENNY MORGAN

The IAWF Ember Award recognizes and acknowledges sustained achievement in wildland fire science.

Penny Morgan, PhD, has achieved excellence in wildland fire research, teaching, education, outreach, and technology transfer, and has consistently demonstrated creative thinking innovation, exploration, and information dissemination throughout her more than 35-year career. Morgan's focus and specialization in fire ecology and management, landscape ecology, and natural resources ecology and conservation biology have yielded groundbreaking accomplishments, established new programs, increased collective knowledge, and set the groundwork for dramatically improved awareness of the importance, role, and application of knowledge of these disciplines. Morgan's contributions include scholarly advancements, education/teaching achievements, outreach inputs, and support to professional organizations and community service. Some of her most notable achievements include: a highly praiseworthy publication record including more than 85 peer-reviewed journal articles mentoring more than 40 PhD and master's students, 10 senior thesis students, and more than 150 undergraduates leadership in the development of the BSc and master's degree programs in fire ecology and management in the United States. While Morgan has had a profound effect on the wildland fire science community, it is also important to emphasize that she began her career as one of a handful of women pursuing careers in fire science. Since then, Morgan has promoted and led the advancement of women as well as all others in fire science; she was the first woman to receive the AFE Biswell Lifetime Achievement Award.

FIREBREAK AWARD FOR EXCELLENCE IN FIRE MANAGEMENT ARTHUR (BUTCH) BLAZER

The IAWF Firebreak award recognizes and acknowledges sustained achievement in wildland fire management.

Arthur (Butch) Blazer's many achievements have influenced wildland fire program management at numerous organizational levels. Blazer's primary interests focused on natural resources, forest management, watershed protection, and wildland fire management. Blazer's innovative and creative achievements are many. Blazer is a lifelong tribal member of the Mescalero Apache Tribe in New Mexico, involved with wildland fire management, either directly in positions affecting fire management, or indirectly while serving in consulting and program and policy making positions. Blazer was appointed by former New Mexico Governor Bill Richardson as the first Native American state forester. Butler led change within the agency as well as the New Mexico Department of Energy and Natural Resources, directed at greater focus on the use of wildland fire and landscape restoration. Blazer initiated and completed a reorganization of the State Forestry Division into a model management structure that managed the State Forestry Program and concentrated on increased program production and accountability resulting in improved statewide forest and watershed health with reduced threats from catastrophic wildfire. Blazer led the creation and implementation of the first truly comprehensive effort in New Mexico to bring together all affected stakeholders in wildland fire management for the purposes of community protection, ecosystem maintenance, and improved and sustained landscape resilience – the New Mexico Healthy Forest and Watershed Plan. Blazer was appointed in 2011 by President Barack Obama as deputy under-secretary of agriculture for Natural Resources and the Environment within the U.S. Department of Agriculture. In 2016, Blazer received one of the highest federal service honors and was presented the President's Lifetime Achievement Award for Volunteerism, signed by President Obama. Blazer served as the president of the Mescalero Apache Tribe, providing executive leadership to the Mescalero Apache People. He served as chair of the Mescalero Apache Tribal Council, CEO of the Mescalero Apache Tribe, and provided oversight to the wildland fire management program for the tribe. While Blazer's service has had substantial impacts on the wildland fire management community, throughout his career he promoted and led the advancement of Native Americans as well as all others in fire management and natural resources.



DISTINGUISHED SERVICE AWARD | SUSAN CONARD

The Distinguished Service Award recognizes individuals, groups or organizations for their outstanding contributions to furthering the goals of the IAWF.

Susan Conard, PhD, has had a productive career in wildland fire science, as a research scientist and as a research manager dealing with, and strongly influencing the direction, recognition, and funding of wildland fire science both within the United States and internationally. Conard is editor in chief of the International Journal of Wildland Fire, and emeritus ecologist, USDA Forest Service, Rocky Mountain Research Station and Faculty Affiliate, George Mason University, in Fairfax, Virginia. Conard was on the IAWF board of directors in the early 1990s. Conard began as an associate editor for the IJWF in 1992, and joined the editorial advisory board in 1998. After Conard retired in 2008 from the USDA Forest Service she became the co-editor in chief of the IJWF, with Stefan Doerr, and remains in the position. Conard began her 25-year USDA Forest Service career in wildland fire research in the western United States, conducting fire ecology and effects research as a research scientist and project leader at the Pacific Southwest Research Station in Riverside, California, serving from 1983 to 1996. Conard served as the National Research Program manager for fire ecology research with USDA Forest Service in Washington from 1996 until her retirement in 2008. During Conard's tenure she served in a long-term assignment to the White House Office of Science and Technology Policy, where she was instrumental in influencing national and international science policy. Conard played a key leadership role to increase USDA Forest Service wildland fire research and development funding from \$15 million in 1997 to \$50 million in 2002 through two new programs – the Interagency Joint Fire Sciences Program and the National Fire Plan. Conard also led the development of program priorities and strategies and oversaw allocation of funding as the first chair of the governing board for the Joint Fire Sciences Program. Conard has been a leader in establishing new collaborative research initiatives with Russia after the former Soviet Union opened to western fire scientists in the early 1990s; she remains active in supporting Russian scientists for research and publications. Conard is the author of more than 80 scientific publications on fire ecology and effects, vegetation structure and dynamics, vegetation management, and climate change impact studies in the United States and Siberia.

**IAWF SCHOLARSHIPS****EMMA SHERWOOD | MCMASTER UNIVERSITY | HAMILTON, ONTARIO | MSC SCHOLARSHIP RECIPIENT**

Emma Sherwood received her BSc in geographical sciences from the University of British Columbia in 2020.

Through her undergraduate degree, she worked on various GIS and fieldwork projects including looking at the impacts of climate change on bird diversity in northern Saskatchewan, caribou habitat disturbance in British Columbia, and Horned Lark ecology in southern Alberta. Fire impacts on the landscape were present on all these projects, and Sherwood is excited to be able to focus her master's thesis on wildfire in Northern Ontario. Sherwood's research involves mapping peat vulnerability to smouldering using remote sensing and machine learning. The project leverages known relationships between smouldering vulnerability and peat properties, and the mapping methodology will be verified against the 2018 Parry Sound 33 fire at the study site. In addition to the new methodology, Sherwood's project will investigate spatial patterns in peat properties and peat smouldering vulnerability from an ecohydrological perspective.

**JOSEPH NOVAK | UNIVERSITY OF CALIFORNIA, SANTA CRUZ | PHD SCHOLARSHIP RECIPIENT**

Joseph Novak, 23, from Raleigh, North Carolina, entered college skeptical of climate change. An introductory biology course convinced Novak that climate change is a serious threat to the planet and society. After a change of heart and major, Novak graduated Brown University with a B.S. in geology biology in May 2020. Now, Novak is pursuing a PhD in ocean sciences from the University of California, Santa Cruz, where he studies molecular fossils in lake and ocean sediments to understand relationships among fire regimes, climate, and vegetation in Earth's distant past. The IAWF PhD Fellowship will support Novak's study of fire proxies in sediments from Lake Baikal, Russia, where he seeks to understand the relationship between combustion products preserved on the lake bottom and historical wildfire records. This study is the first step in a larger project that will integrate 8.4 million years of climate, fire, and vegetation data preserved in Lake Baikal's sediments, which Novak hopes will prove to be foundational datasets for understanding the relationship between fire and climate state in boreal forests.





BOARD NOMINATIONS OPEN AUG. 1

The nomination period for new members of the International Association of Wildland Fire (IAWF) board of directors opens Aug. 1. Nominations will be accepted through Sept. 30 and successful candidates will begin their three-year terms on Jan. 1. Members who meet the requirements may self-nominate.

- Must be an "individual" member of the IAWF in good standing; student, corporate and agency members are not eligible.
- The IAWF board of directors is a working board; we expect individuals serving the membership in these positions will contribute the time, energy and expertise to serve on committees, participate in 11 conference calls per year and generally assist in furthering the mission of the association. (Calls are scheduled the last Tuesday of each month except December and generally last 60 minutes.)
- Applicants with skills/expertise in financial management, board governance, and communication/journalism/media (writing and editing) are highly encouraged to apply.

There are five board positions open for the three-year term from 2022 through 2024.



WORKSHOP TO PROCEED

The 4th National Cohesive Wildland Fire Management Strategy Workshop is proceeding, with in-person and virtual options.

The program schedule and registration will be available in July on the IAWF website.

The workshop theme is "Hard truths of risk inherent in cross-boundary, large landscape, and community-wide implementation."

Participants will work to develop a strategy to understand, co-manage, transfer, and accept risk at federal, state, tribal and local stakeholder levels, to prioritize and invest in decisions, projects and other efforts that result in widespread reduction in risk across landscapes, and communities, and make the public and firefighters collectively.



CANADIAN CONFERENCE POSTPONED

After careful consideration, the Wildland Fire Canada steering committee has decided to postpone the conference; the new dates are Oct. 31 to Nov. 4, 2022.

The committee considered vaccinations, international travel restrictions, and budget, and determined that the 2021 conference would not be viable.

Collaboration and networking are extremely important to Wildland Fire Canada conference organizers, and it was therefore agreed that a virtual offering would not be appropriate.

Thank you for your understanding. Conference organizers look forward to seeing everyone next year in Edmonton.



TALKS PLANNED THROUGH DECEMBER

Each month, IAWF offers an ignite talk on important topics around workforce resilience. Here is a sneak peek at some upcoming topics:

JULY:

Fitness and wellness for high performance in high-risk/high-consequence wildland fire fighting

AUGUST:

Current events and emerging best practices on diversity and inclusion

SEPTEMBER:

Dan Cable, The power of purpose

OCTOBER:

Cultural use of fire and traditional ecological knowledge

NOVEMBER:

Trans Awareness Month

DECEMBER:

The 2021 fire season – Transitioning from fire life/fire family to everyday life (partners, kids, self-care)

Check the site for updates and dates and times of upcoming talks. Recordings of previous talk can be found at www.iawfonline.org/events/webinars.

JULIET CREW

ALL-WOMAN TEAM
TESTS METTLE



Buhle Tebekwana, a professional model, has been a firefighter for three years, and is safety officer and first aider for Juliet Crew. Some crew members were lighting up while Tebekwana was mopping up and helping to hold the line once the big Jonkershoek fire in Theewaterskloof in March had burned through. Juliet Crew members were doing a burn of the young pine plantation; it was interspersed with spot fires and a very dirty burn site.

PHOTO BY KYLIE PAUL

BY KYLIE PAUL

My name is Kylie Paul, and I am the superintendent of Juliet Crew, the first and only all-women wildland firefighting crew in South Africa.

Juliet Crew was built on the dreams of Dean Ferrier, managing director of NCC Environmental Services, who recognizes that in greater South Africa, women are not well represented in private-sector wildland fire fighting.

NCC is working to bring more women into wildland fire fighting while also providing opportunities and training to vulnerable youth and previously disadvantaged women.

“Over time,” Ferreira says, “they will stand shoulder to shoulder – not male or female firefighters, just firefighters in green and yellow.”

Ferreira approached me, a volunteer firefighter, in 2019 and asked me to help him achieve this dream.

While NCC is supporting the crew by providing salaries, management support, training and a temporary fire base, the crew is not currently contracted and needs to raise funds from public and private entities to keep this project and dream sustainable. The majority of the crew members are the breadwinners for their families and two are single mothers. Juliet Crew has had incredible support so far and are feeling optimistic about our future. The name Juliet was selected by the crew as it is the only female moniker in the phonetic alphabet.

Between Feb. 21 and March 3, the Western Cape of South Africa experienced a large wildfire in the Overberg and Cape Winelands District Municipalities. Firefighting conditions were very difficult and took place in inaccessible areas. Extreme temperatures, tough and steep terrain coupled with strong winds further hampered our efforts. The blaze, which started in Grabouw, burned approximately 14,000 hectares (34,600 acres) of mountainous areas. Fortunately, no improved properties were damaged, and no lives were lost,

however in areas, young vegetation was burned at too high a temperature, and that may have severe ecological impacts.

Juliet Crew was deployed over three separate operational periods, each a minimum of 24 hours. The crew was trooped into the fire by both the South African National Defense Force (SANDF) Oryx and Leading Edge Aviation – South Africa’s Huey provider. For most of the crew this was their first time flying. Most had never even been in an airplane.


The Western Cape fire season had been fairly quiet before this fire, so Juliet crew members were chomping at the bit to get their boots dirty and do the job we love. Our deployments ranged from direct attack and strategically using the terrain to our advantage to suppress long and large fire lines, to mopping up and observing. No matter what assignment was handed to us, the crew was up for the task.

“Over time, they will stand shoulder to shoulder – not male or female firefighters, just firefighters in green and yellow.”

Our second deployment was tricky as the conditions in the mountain were very different from the information we had received on the ground. The fire was burning in multiple areas, with different agencies spread across the Jonkershoek and Banhoek valleys. The crew was dropped in the middle of an active line and immediately started digging a fuel break to anchor the crew, followed by quick action to start beating out the line; this is done by having our fire beaters (flappers/swatters) up front working in unison to

hit the flames down, followed by crew members with McLeod rake hoes to scratch a line and mop up any active flames or hot spots, ensuring no flames sneak up behind us, or should there be a wind shift, that we don’t lose all of our hard work.

Once anchored, the entire crew beat out the steepish fire line for about 700 metres (766 yards) before being met with a blind valley that twisted in the direction of two peaks and Lourensford Wine Farm. The vegetation, a mix of restios – a reed-like grass – young pine and proteas, was very tall, and the ground disappeared into a marshy wetland/stream. If we lost this section, we would lose our entire line and have to contend



Crew leader **Kylie Paul** during a six-hour hike out after a rough night on the mountain; the crew had been in relentless smoke for more than 18 hours and was then met with more flames.

with three new ones. As we were the only crew deployed to this division, we had to call for aerial assistance. We simply could not cut a break with the tools within the timeframe we had. Enter the Oryx. We received 10 drops of around two tons (2,000 liters / 530 gallons) of water per drop on this section and were able to engage and catch it just in time.

We proceeded to contain the entire line, which extended to about one kilometre. Our objective was to continue into the next valley to work a new line, but the weather conditions had deteriorated so badly that we were met with an inferno. The crew sought refuge in our safety zone, while myself and our division supervisor analyzed the situation. Crew members made their way down to the valley behind us to attempt to engage with an active line funneling through the valley, but after reassessing the conditions, and with an approaching wind shift, it was deemed too dangerous. We had no way of escaping if the wind turned, as predicted.

We returned to our safety zone and were met with the anticipated wind shift. The shift was more pronounced than expected due to local conditions created by the terrain and fire itself. The fire moved up the steep unburned valley toward us in seconds. We moved deeper into our safety zone (the

black) and lay low down to try to weather the choking smoke, embers and ferocious wind. This was the moment when I realized that these women around me are warriors, that even though I believed in them, and was incredibly proud of all they had achieved up and until that point, this was it. These types of moments define whether this is the job for you. Crew members started chanting “only the brave,” in deference to the 2019 movie based on the true story of the 19 members of the Granite Mountain Hotshots who died in the Yarnell Hill fire in Arizona in 2013, and the lessons learned from it. The chant was to honor those who had fallen, but also to celebrate those who have risen in a moment when the human instinct is to panic and run away from uncomfortable and dangerous situations.

Crew members didn’t move until instructed to do so, and when they stood up, they seemed taller. They seemed more unified. They suddenly took up more room on the top of that mountain. Similar to the proverbial phoenix rising from the ashes, crew members stood up not as female firefighters, but as firefighters.

Once the conditions allowed, we sought a place of refuge for the remainder of the night, as the conditions were too dangerous to continue working. Winds raged at 80 to 100 kilometers an hour (50 to 62 mph), and thick mist started to

move in. It was impossible to differentiate between the mist and smoke. We huddled together in between some boulders, and faced a long, cold night. As soon as the wind died down to about 40 km/h (25 mph) we were able to make a small fire to get through the last cold hours of the morning. At first light we began the five-hour hike out. We were met with another active line on our way out, which we were able to push into some rocks on a cliff; it was later contained and mopped up by our replacement crew.

Sore and tired, I watched my crew walk off the line with smiles on their exhausted-looking faces. For two members this had been their fourth deployment ever. It felt like we had all changed in some way, for the better. We were most certainly closer than ever before as crew, but there was something else – I could not place it in that moment. During our crew

debrief it hit me like an Oryx water drop: the women beside me believed in themselves as firefighters – they were beyond the self-doubt that society has placed on them. The question initially was, can women do this job? The answer: yes, hell yes we can!

ABOUT THE AUTHOR

Kylie Paul is a former teacher who also has an environmental management degree. She moved to Cape Town from Pretoria to work with fynbos, South Africa's unique vegetation that makes up 80 per cent of the Cape Floral Kingdom. Paul was headhunted from Volunteer Wildfire Services by NCC Environmental Services to establish the all-female crew in 2019.



On its second deployment in 2021, Juliet Crew was dropped in the middle of an active line and immediately started digging a fuel break, then beating out the line with fire beaters (flappers/swatters), working in unison to hit the flames down.

EMBRACING PODS

ADVANCING WILDFIRE RESPONSE PLANNING

BY ALEXIS NEUKIRCH, DAVID CALKIN, CHRISTOPHER O'CONNOR,
MATTHEW THOMPSON, CHRISTOPHER DUNN AND MICHAEL CAGGIANO



A team of fire managers developing PODs, potential wildfire operational delineations, on the Arapaho Roosevelt National Forest in February 2018. Photo by Matt Thompson

PODs, potential wildfire operational delineations, give land managers, fire managers, partnering agencies, and at-risk communities a structured framework for developing landscape-scale wildfire response options before wildfires ignite.

"PODs are a great example of Forest Service research meeting the on-the-ground needs of the agency and the nation," said Vicki Christiansen, USDA Forest Service chief, as she kicked off the virtual PODs Collaborative Fire Planning Workshop on Feb. 24.

"As a science-based agency and a learning organization, we are using PODs to integrate our best knowledge about fire management and the ability to collaboratively plan," Christiansen said.

More than 450 land managers, planners, fire responders, scientists, and consultants participated in the two-day workshop hosted by the USDA Forest Service Rocky Mountain Research Station's Wildfire Risk Management Science team and its partners at Oregon State University and Colorado Forest Restoration Institute. The workshop featured case studies presented by a diverse panel of speakers, presentations of challenges facing PODs implementation and use, and five breakout sessions for closer engagement.

Following the 2021 workshop, efforts were begun to establish a PODs community of practice, a group of federal and non-federal managers, consultants, and scientists interested in expanding the application of PODs in wildfire response planning consistent with the goals of cohesive strategy and shared stewardship.

Responding to wildland fire requires partnerships. As of the spring of 2021, 43 national forests across the United States have used the PODs framework together with their fire manager counterparts at other federal, state, county, and local agencies. PODs are “containers” drawn on a map that are defined by potential fire-control features, such as roads and ridge tops, and can be used to summarize risk to landscape values in a way that is useful for communicating and coordinating response to wildfires before they occur. PODs also provide a strategic framework for restoration and fuel-reduction activities that can improve suppression effectiveness when needed and help get more of the right kind of fire in the right place where appropriate.

A BRIEF HISTORY OF PODS

PODs is one of the new goal-oriented and forward-looking approaches that deemphasize fire exclusion, expand application of prescribed and managed natural fire, and foster resilience of ecosystems and communities and adaptation to fire. The National Cohesive Wildland Fire Management Strategy in the United States focuses on making meaningful progress towards attainment of resilient landscapes, fire adapted communities, and safe and effective response to fire. How fires are managed – not just how landscapes are managed or how communities respond before and after fires occur – is a key determinant of long-term socioecological resiliency and the ability to “live with fire.”

The PODs framework is the product of researchers collaborating with local land managers to put robust data behind a good idea. The framework blends local expertise with advanced analytical tools to quantify and visualize wildfire risk to highly valued resources and assets, potential control locations (PCL), and the level of effort required to engage a fire at any point on a landscape, or the Suppression Difficulty Index (SDI).

Leading with the assessment of wildfire risk allows managers to map out the most likely positive and negative outcomes from wildfire and then leverage the PCL and SDI tools, with local knowledge, to break up landscape-level risk into operational containers that can be classified by their primary risk profile. Taking this one step further, the risk summary can be used to define risk-informed wildfire response objectives at the POD-level and to further map out defensible strategic response zones across a landscape. Grounding fire planning in spatial risk assessment methods directly links risk management principles to fire management decision making and increases the likelihood of attaining the goals outlined in the cohesive strategy.

The initial application of this work was led by the efforts of Phil Bowden, retired regional fuels planner in the Pacific Southwest Regional Office, and his team on several national forests in the Southern Sierra Nevada area of California. This pilot application served as the springboard for POD-based strategic fire planning throughout the western United States.

Further cementing the connection between data analytics and on-the-ground decision making, the PCL atlas and SDI were introduced to the PODs framework in 2016 and wildfire response decision shortly thereafter. These tools provide a common operating picture for fire management opportunities and challenges that can be used to rapidly assess planning and response options (see *The Path to Strategic Wildland Fire Management Planning*). PCL and SDI have also gained popularity as tactical decision support tools on more than 140 large wildfire incidents from 2017 to 2020. Through feedback from land managers and incident management teams, these products have undergone a series of improvements and updates and are now available annually at west-wide (PCL) or national (SDI) scales.

This risk-based spatial fire planning framework was first applied to a wildfire incident during the summer of 2017 on the Pinal Fire, located on the Globe Ranger District of the Tonto National Forest (see: *Engaging the Fire Before it Starts: A Case Study from the 2017 Pinal Fire (Arizona)*). Since this experience, numerous Forests, partnerships, NGOs and state agencies have engaged the POD framework to structure their shared risk around wildfire management (Figure 1). PODs supports the full range of wildfire responses from aggressive suppression in high risk areas, and conditional based response in areas where the balance between beneficial and negative consequences is largely determined by current and forecasted fire weather, to maintenance or reintroduction of fire to low risk areas where fire can assume its natural role in ecosystem processes reducing future risk potential.

THEMES

The PODs framework is illustrative of how shared stewardship is playing out on the ground – it is proactive, fosters co-management of risk, and creates the opportunity for cross-boundary planning implementation and fire response before the smoke is in the air. PODs facilitate risk informed response and strategic management of wildland fire, aligning activities to address the most current threat to ecosystems and communities alike. High octane, sophisticated science paired with land and fire managers’ on-the-ground-knowledge

is working in partnership to improve the safety and effectiveness of fire management. Communication during the PODs framework is structured around fire objectives and opportunities, and managers have successfully used PODs to respond to high complexity full suppression events, manage natural ignitions in remote areas with low risk strategies, and plan prescribed fire strategies to reduce an area's current wildfire risk. This type of community pre-fire planning expands implementation of the National Cohesive Wildland Fire Management Strategy, integrates fire into landscapes in a way that minimizes risks to lives and property, and builds long-term forest and grassland resilience.

FUELS MANAGEMENT AND ACTIVE FIRE INCIDENTS

In northern California, Jason Kuiken, forest supervisor, USDA Forest Service, Stanislaus National Forest, is using PODs for strategic fuels management on the Stanislaus landscape. By using PODs in combination with the Social and Ecological Resilience Across the Landscape (SERAL project), Kuiken is creating strategic fire management features where unplanned fire can be successfully halted before reaching the many communities near the forest. In northern Colorado, fire and land managers are using PODs to strategically manage fuels before fires start. Managers selected a north to south continuous line of PODs to undergo fuels management projects to stop future fires as they move from west to east.

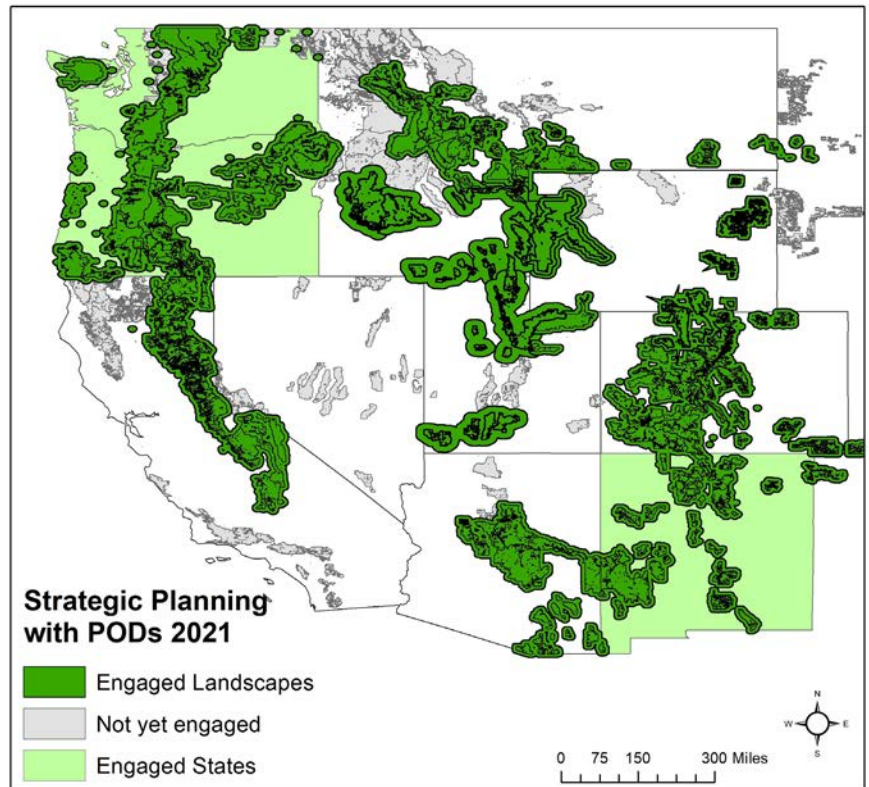
"To plan for fire on large landscapes, you have to think about your fireshed, build a strategic plan for that landscape and complete specific, local treatments to support that plan," said Monte Williams, Forest supervisor on the Arapaho and Roosevelt National Forests and Pawnee National Grassland, during the PODs workshop. "Using the PODs approach helps you carve the landscape into smaller pieces.

"The old adage is 'How do you eat an elephant? One bite at a time.' In our case, maybe one PODs at a time. The PODs framework also gives you the ability to communicate easily with your partners and the public about what you are doing to manage future fires and why you are doing it."

Washington State Department of Natural Resources (DNR) is integrating PODs into its 20-year forest health strategic plan for eastern Washington, which includes the evaluation of 39 high priority, multi-ownership watersheds. Land managers and owners will be able to use the information from the evaluation in future decision making.

At the 2021 PODs workshop, Ana Barros, Washington DNR fire scientist, described how during the evaluation, the DNR is analyzing the landscape with the goal of both improving forest health and benefiting fire operations. The DNR integrated PODs into the assessment to evaluate both of these factors, generate buy-in from the community, and create a map that can be used in future decision making for forest health and fire operations. By combining PODs with a wildfire response benefit assessments and landscape treatment prioritization, the team created a cohesive map with three classes of ranked PODs based on landscape treatment prioritization and forest health needs that can inform decision makers on each landscape.

Brad Pietruska, fuels program manager on the San Juan National Forest, demonstrated how PODs can be used to quantify potential suppression opportunities during active high



All landscapes and states engaged with PODs in the western United States as of spring 2021. The wildfire risk management science team, with partners from Oregon State University and Colorado Forest Restoration Institute, have worked with leaders from each of these landscapes to initiate the PODs framework.

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United States Department of Agriculture Secretary Tom Vilsack, Colorado District 2 Congressman Joe Neguse, Colorado Governor Jared Polis, and Colorado Senator Michael Bennet learned about cross-boundary work on the landscape, including PODs, on site on the Arapaho-Roosevelt National Forest in May 2021.

Photo courtesy Petra Popiel, USDA Natural Resource Conservation Service



complexity incident management. During the 2020 Pine Gulch Fire on the San Juan National Forest and Mullen Fire on the Medicine Bow-Routt National Forest, Pietruska used the PODs framework to generate data about the potential for controlling fire at different locations. He combined the likelihood of fire holding at different locations using PCL, amount of suppression work needed to prepare containment lines, and estimated fire arrival time at these locations. This process helped the incident management team recognize that a larger, more comprehensive strategy was necessary. In fire lingo, the team was able to identify that the next ridge was not the best ridge (however in this example it was roads instead of ridges).

CHALLENGES

Although PODs have been developed on 43 USDA forests and used in many active fire incidents, fire managers still face challenges developing and utilizing PODs. The PODs framework simultaneously depends on and facilitates cross-boundary communication and co-production of knowledge. Both the PODs framework and working together on land and fire management problems requires communities to break down silos among organizations and disciplines. PODs can help address these existing sociopolitical tensions and challenges to collaborative landscape management, but its successful adoption still hinges on these same factors. Following successful collaboration and development of PODs, the information needs to be effectively conveyed to and used by incident management teams, which can present additional challenges. Finally, PODs require maintenance, reassessment, and continued collaboration over time, which can be impeded by low staff capacity and capability. Addressing these challenges will require continued and additional effort to support working across boundaries and dedicating time and capacity to pre-fire planning.

WHAT'S NEXT?

The PODs approach is still growing and evolving as managers and scientists develop new applications. For example, PODs practitioners are beginning to extend PODs beyond forests to address fire in the wildland urban interface such as in Ashland, Oregon. PODs are designed to be adaptable, and the scientists developing PODs support on-the-ground innovation that land and fire managers bring to the process. Through continued conversation across physical and jurisdictional boundaries, the PODs framework has the potential to continue to facilitate co-production of knowledge. PODs connect scientists and managers and will continue to serve as a platform for two-way knowledge exchange and the development of actionable science.

Following the 2021 workshop, efforts were begun to establish a PODs community of practice, a group of federal and non-federal managers, consultants, and scientists interested in expanding the application of PODs in wildfire response planning consistent with the goals of cohesive strategy and shared stewardship. The CoP will provide a platform for connections among PODs users across organizations, geographies, and disciplines, providing new opportunities for the growth of PODs and the evolution of improved strategic wildfire response planning. The Rocky Mountain Research Station WRMS scientists will continue to advance PODs science while PODs users across agencies and communities prepare for each upcoming fire season – one POD at a time.

LEARN MORE ABOUT PODS AT

fs.usda.gov/rmrs/groups/wildfire-risk-management-science-team/potential-operational-delineations-pods

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CULTURE CHANGE

CANADIAN WORKS TO ALTER BIASES

BY LAURA KING

At first, Jane Park is reluctant to get personal. Then she opens up, about diversity and inclusion in wildland fire.

"Definitely, the wildland fire community is similar to other very hierarchical organizations that are typically male dominated and not very diverse," Park says.

Park is a fire/vegetation specialist with Parks Canada in Banff, a massive and picturesque national park near the Alberta border with British Columbia.

"I think it's a function of the stereotype of the rough, tough firefighter over the years that has kind of promoted that male-dominated, not diverse, kind of culture," Park says. "And, and it's been fairly slow to change."

Canadians know Park on Twitter as Burning Ideas (@fireminded), a prescribed fire expert and advocate for diversity.

Park's Korean-Canadian parents instilled in her the strength to stand up for her values and beliefs.

"I'm a Korean Canadian woman who is a child of immigrants, working in fire," Park says.

"A lot of focus has been on women and fire, and I'm a huge advocate for that, but there's really not very much diversity in the fire management profession.

"And so, understanding the challenges of Black and Indigenous and people of color within these types of professions is something that people need to

think about. I think sometimes that gets lost because obviously more people can relate to just the gender issues, because that affects everybody, regardless of their background."

Recently, the Canadian Interagency Forest Fire Centre (CIFFC) surveyed wildland firefighters and found that two of every five women and one of every four men have experienced disrespectful workplace behaviors; 57 per cent of LGBTQ+ members experienced incidents; and 10 per cent of men and four per cent of women experienced violence on a deployment.

CIFFC and its member agencies in Canada are developing an equity, diversity, and inclusion framework, which Park says is overdue.

"We've learned more about how representation matters," Park says, "and when you don't see yourself, you don't go for it."

Within Parks Canada, Park says, there are several initiatives that are targeted toward diversity inclusion and culture change. And there are concerted efforts across wildland fire agencies.

"I started working on some of the diversity stuff in 2011 or 2012, so it's been almost 10 years," Park says. "And I wouldn't say that there's been a massive change, but it is slowly picking up, and I've seen a change within my own program [recently] where I have more women and diversity than I have had in the whole time I've worked, but it comes with a lot of work."

For example, Park says, there are still microaggressions, and basic ignorance in the field.

"I'll attend meetings as the incident commander with my operations section chief, who's male," Park says, "and everything will be directed at him and not me.

"He has noticed that, and obviously I've noticed that as well – people meeting me and not expecting that I'm the incident commander or thinking I'm a summer student, or just making assumptions that I don't have experience because maybe don't look like I've been working in the field for the last 20 years. I think there are inherent biases . . . that play a role in how I feel as an incident commander, how I'm treated or are respected."

Park's path to a top position in Canadian wildland fire was lengthier than most of her counterparts, or, as she puts it, less direct.

Jane Park gives a briefing during COVID at the Flints/Stoney Meadows prescribed fire in Banff National Park on June 1. PHOTO COUTRESY JANE PARK.



"I obviously have no evidence that it's directly related to being a woman of color," Park says. "But at the same time, I do know that there are other people in similar positions or who have made it to similar positions that have not had to do what I've done to get there."

"There have been experiences I've had that are not positive. I've experienced discrimination and harassment on fires, and even my deployment to Australia, I was the only woman out of about 28 of us, and that's noticeable. It was a great experience. I met amazing women over there. But it wasn't all rosy."

What's frustrating, Park says, is that recruitment depends on people seeing themselves in an organization before they apply or put effort into getting hired.

"As an incident commander and on incident management teams, I don't see people who look like me as my peers, or in many of the operational settings. And it is a deterrent."

Park started with Parks Canada in 2002 as a warden but quickly transitioned to the fire and vegetation management section. She gained experience with prescribed fire, spent time in Yukon, worked in Haida Gwaii, then made her way back to the mountains.

Essentially, Park runs the fire and the vegetation management programs – wildfire, suppression and response.

"[That's] dealing with any wildfires that occur in our park. We have two initial attack crews, as well as a number of other fire technicians. Our program here is really focused on fire restoration and implementation of landscape-level prescribed fire. That program was started in the early eighties by my predecessor, [renowned fire and vegetation biologist] Ian Pengelly. We do a lot of prescribed fire and that's based on the fire regime here in Banff, which is heavily dominated by lightning in July and August, but also Indigenous cultural burning."

The role includes fuel management, teaching FireSmart™ principles, and study.

"On the vegetation side of things, we're looking at the restoration of native vegetation communities," Park says "which intersects with the fire side of things, and also controlling of invasive and noxious weeds and non-native plants and providing restoration and reclamation advice for any development that goes on in the park."

In Banff, Parks Canada is both the land manager and the fire-management agency. The target is to return 50 per cent of the of the historic fire cycle to the landscape, or about 1,400 hectares annually burned either through prescribed fire or managed wildfire.

"We have specific fire management zoning within the park," Park says. "So it's not just full suppression everywhere. We concentrate our suppression-management strategies around our infrastructure, the communities like the Town of Banff, transportation quarters, and other critical infrastructure."

Still, Park notes, the suppression mindset is prevalent.

"There's a fire-suppression culture all over the world, and not just in Canada," Park says "The history of our fire program within Parks Canada stems from fire suppression. When the Parks were established, a lot of the Indigenous Peoples in these areas were extirpated from this area and along with it, their cultural-burning practices."

"There is anecdotal and traditional knowledge all over the country that shows that Indigenous Peoples were using cultural burning for a variety of reasons, whether that was to promote a habitat for prey species, or travel routes, or medicinal plants, and a general ecosystem health."

"And I think a lot of that knowledge still does exist in some places and in some places it's been lost largely due to that colonization of the landscape. But I think there is more of a push now to work together with Indigenous nations on cultural burning and restoring that back to the ecosystem and knowledge exchange between fire agencies and fire keepers within Indigenous nations."

Essentially, Park says, there's an effort to "reset" the forest after 100 years of suppression.

"I think more agencies look at the whole suite of fire management tools, especially in the context of climate change. This isn't the time to double down on suppression. In a lot of places the fire agency is not the land manager, so we need to start thinking about things like prescribed fire and cultural burning."

That's not the only thing Park is working to modify.

"More personally, I've worked a lot on diversity and discrimination and harassment and those types of issues within the fire service, trying to change the culture so that it's easier for people like me – women or people of color, or Indigenous people – to be in the upper leadership positions in fire agencies."



The Flint's/Stoney Meadows prescribed fire on June 2, against a backdrop of Canada's Rocky Mountains, June 2.
PHOTO BY JANE PARK.

THE BEST TRAINING POSSIBLE BUT NOT THE BEST TRAINING

BY KELSY GIBOS

The 2020 wildland fire training season in Alberta involved some successes, suggested some improvements and provided a list of lessons learned that may be useful for others in the wildfire community.

This quote, from our after-action review on the 2020 training season summarizes the overall sentiment of that spring: "We gave the best training possible, but it was not the best training."

The Hinton Training Centre, north of Edmonton, is responsible for delivering provincial, national and external courses; this includes both wildfire and forestry topics ranging from basic wildfire crew member to wildland fire behaviour specialist and helicopter co-ordinator to timber scaling.

In a normal pre-COVID-19 year, a handful of staff lead, develop and co-ordinate delivery of almost 70 different courses in a mix of in-class (70 per cent), blended (20 per cent) and online (10 per cent) delivery.

COVID-19 arrived in Alberta in early spring of 2020. Averaging more than 1,500 new cases a day at its peak, the Alberta government imposed several social-distancing protocols across timing for the highest density of training courses. Meetings of groups of first responders were constrained in size and many provincial facilities closed to the public, including the Hinton Training Center. Courses deemed non-essential were cancelled and training specialists realized that the traditional, intensive, in-person training format of recruits and crew leaders would not be possible in 2020. With no back-up plan, we set out to find a way to train 300-plus seasonal employees.

The immediate training needs focussed on training our seasonal staff; all spring training for permanent staff was postponed.

Five training specialists designed and delivered two wildfire crew leader courses and three wildfire crew member courses in a real-time – instructor-led virtual classrooms, or in a synchronous fashion. These courses are more than one week in duration, and, historically, are a combination of live lecture, group exercises and a number of field labs.

The simplest compromise was to lean on the local forest area staff to help with training delivery instead of centralizing it at the Hinton Training Centre. This eliminated the need for firefighters to travel and removed responsibility to feed and house them away from their home unit within COVID guidelines.

There are 10 forest areas in Alberta, each with a hierarchy of permanent staff made up of operations officers, wildfire technicians and forest rangers.

The local area became responsible for dealing with logistics – this included finding a training space that met physical distance requirements of two metres of space between students. This challenge was compounded by widespread facility closures. The forest areas also had to set up computers, screens and projectors, microphones and video cameras to accommodate the live lecture component of the training. Many areas did not have the bare minimums to meet this requirement, and corralling all the technology was a steep learning curve!

To accommodate limitations related to the pandemic, training specialists quickly reworked the practical skills evaluation templates, quizzes and exams to a format that could be delivered by staff in their home areas. This material, along with reference binders, was organized, printed and shipped out to the 10 forest areas across the province to chosen local training contacts. In order to deliver the field labs, moderators and mentors were identified in each of the areas, and instructions were prepared on how to deliver the hands-on field lab components.

Courses deemed non-essential were cancelled and training specialists realized that the traditional, intensive, in-person training format of recruits and crew leaders would not be possible in 2020. With no back-up plan, we set out to find away to train 300-plus seasonal employees.

The training specialists had to find a platform that was best to support the live lecture series. Many used PowerPoint supplemented by live demonstrations such as fuel characterisation, practical use of the fire behaviour field guide – the Red Book, pump troubleshooting, and radio operations. Different platforms were explored, including Webex, Skype, Zoom and a document-viewing camera like the Ladybug were all trialed. The final delivery used Skype and the Ladybug camera together to show slides, videos and live hands-on activities.

In many instances, video shared with students to demonstrate important principles, such as fire behaviour, was choppy and the quality was lacking.

The standard final exam for the WFCM course has both a nationally recognized written test and a practical field evaluation, during which skills such as map reading, compass use, radio competency, melon rolling and pump knowledge are tested at hands-on stations. The forest areas administered the tests at their leisure and reported performance and grades back to the Hinton Training Centre.

So how did we do? Here's a look first at the feedback from the students who participated in the wildfire crew leader and wildfire crew member courses that we delivered in spring of 2020.

THE GOOD

The mentors who were selected to assist with the course were critical for the students to be able to ask questions, seek clarification and so forth. Most of these people were chosen based on their background skills and knowledge, but none had any form of instructor training; some were experienced seasonal employees and some were permanent full-time staff. The mix was great to help build relationships between the seasons' new firefighters and the local area staff. If a mentor was not available in the local area, it was noted as detrimental to the training success.

THE NOT SO GOOD

Students missed the interaction with other crew leaders and members from around the province, which happens on site at the Hinton Training Centre. Participants bring diverse perspectives, experiences and ideas, and the networking component is super critical for when they all bump into each other while working together on larger fires later in the season. Questions and discussion about things like strategy and tactics, aircraft operations and fire assessments were missing. The silence was notable.

Asking questions via the video conferencing software was virtually impossible; it was difficult to get instructors' attention, and challenging to communicate. We all know what it is like to try to chime in during a web meeting!



Unlike in previous years when in-person training was a given, the 2020 wildland fire training season in Alberta challenged managers to find new ways to work. These 2018 recruits are being taught on melon hose, something better done face to face.



In a normal, pre-COVID-19 year, a handful of staff at the Hinton Training Centre in Alberta lead, develop and co-ordinate delivery of almost 70 different courses in a mix of in-class (70 per cent), blended (20 per cent) and online (10 per cent) delivery. This 2018 photo of a wildfire training specialist teaching techniques for using a hose strangler demonstrates the effectiveness of in-person training.

Technology was frustrating; not all the areas managed to get appropriate technology set up in time. There were issues in permitting video audio and an annoying delay in video transmission

The forest areas needed more time to complete the on-site training and field labs. Many students felt like the delivery was rushed and that the absent hands-on component would have reinforced the lecture material.

There were definitely a few more not-so-goods than goods. At the end of last season and the beginning of this season, the training specialists got together to share their thoughts on

how this first fling at synchronous online training went.

Admittedly, we got the training done as best we could, but it wasn't the best training we had ever delivered. Most of the training specialists felt that the quality and consistency of the training was adversely affected and our provincial standard of training was not fully achieved. If live virtual training is to continue with support from local resources, there are a number of items that are immediate areas of opportunity for improvement.

Because each forest area was left to its own devices to deliver the training, it was often done out of order and in a rushed manner compared to the standard in-person delivery. This was very apparent in the skills-based, hands-on objectives, which were poorly rated by the students. If additional training requirements are going to continue to be necessary from staff at the area level, the field exercises need to be better documented with stronger lesson plans and clearer learning objectives communicated to area staff. The training specialists deliver this stuff year after year and know it inside out, but there were gaps in the written descriptions that forest areas had to fill, which led to some provincial discrepancies.

Mentors and local support were mostly chosen based on their availability, rather than their abilities as instructors. This meant

that many people delivering training weren't actually trained to be trainers; not to say they didn't make it work, but perhaps in the future we should look at creating a list of local resources who have been formally tagged for training. They could attend adult instructor training or spend time with Hinton training specialists to learn the ins and outs of adult learning.

Pushing this last-minute training onto the forest area placed huge pressure on local staff. It is estimated that both courses together required about 500 full-time equivalent days to deliver (compared to 100 with our standard central delivery that normally happens at the Hinton Training Center). Spring time is generally really busy – we experience a lot of our large destructive fires by the middle of May, and this spring training really impacted local rosters for duty officers, response officers and standby. To add to that, there was a ton of escalating workload at this time of year, and area staff worked to open lookout towers, onboard new hires and get seasonal work programs up and running. This is the Hinton Training Centre's time to shine and instead we had to pile it on to folks who already had a pretty busy spring lineup. Fortunately, we had an unseasonably wet start, with no major fires that spring.

A quote from the evaluations filled out after the course from a permanent area staff member: "The week before the May long weekend, which is often one of the busiest weeks of the

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year, we had no staff available to respond to wildfires. Nearly every permanent (along with many seasonal) staff member in the area was involved in training/commencement of staff . . . Had it even been an average May where it wasn't as wet, [we] would have been in trouble."

Another big issue highlighted by the students was this lost nuance of sharing experiences, exploring questions and relating relevant situations. Things like leadership, safety, fire behaviour and fire assessments are so difficult to teach one-sided, so someone spewing a lecture from a PowerPoint slide simply cannot connect that human dimension required to make the topics real.

There are exercises embedded in a number of the presentations that are meant to break up the lecture and engage discussion in the classroom. Even just getting students to read things off of slides brings them back into the discussion – this was super difficult to recreate in that Skype platform. The conversation was very one-sided and participation in discussion especially with the instructors was very limited

I don't think it is possible to fully recreate the comradery that is present in a live classroom, but there are so many new online tools and tricks to keep virtual audiences engaged. The training specialists had such a short amount of time to pull together a digital platform that they did their best with what they had. It has



Many students felt the delivery of training in 2020 was rushed. A common comment was that the hands-on training was lacking to reinforce lecture material. Recruits (shown) heading out for a pump lab in 2018 had a better experience.

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definitely highlighted the need to learn more about digital delivery and how best to cater to adult digital learners. The combination of the virtual delivery and a slow fire season probably means that there was an overall lower retention of knowledge.

The glitchiness of the technology really took away from the course delivery. There was inconsistent equipment and technical expertise at each forest area that can remedied fairly easily. Some of the internet at the base camps where training was being delivered was not adequate – a lot of the embedded videos were lagged and terrible, so much so that they had to be skipped during the presentation. This meant that videos showing fires of different intensities, flights of different assessments and tours of various hose lays were not able to be shown. I guess this highlighted our dependency on in-person training with no foresight into preparing ourselves to have to do it all remotely. Did anyone really see the seriousness of this pandemic in the beginning? How could we have planned better to be prepared to be isolated to our own home areas? Technology now seems like the obvious fix: there have definitely already been improvements in our digital accessibility, even at our more remote camps.

That assessment was a bit harsh on us; let's have a look at some of the successes from last year.

First off, the few folks we have here doing all this training are phenomenal; what they managed to pull together and deliver in such a short period of time is outstanding. Operating in the pandemic has really highlighted the resilience and resolve of our staff. I'd pat myself on the back here but I actually missed out on all of this while I took a year of maternity leave. I commend my coworkers for the effort they put into this, especially with all the barriers and uncertainty they faced and big kudos to the area staff for stepping up and getting it done for their home forest area.

The exposure to the new world of virtual learning environments has really caused us to take a new, refreshed outlook on our suite of training and we're working toward modernizing our delivery model. In the last year, we have converted nearly a dozen courses into a fresh shiny online learning platform. These courses are self-paced and stand alone or asynchronous training and are available to do from the home area (or home office!)

With the development of all of these new asynchronous online courses, we have improved access; there are more and more people signing up than ever before as we reach into this wider web. A number of permanent staff often find it difficult to travel to Hinton for training due to family commitments, rosters, workloads and the like; being able to work through a




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course online makes it so much more accessible to our staff. Increasing training deliver options allows us to target a larger audience as well as reduce costs and travel.

Finally, here are a few lessons learned. I asked the training specialists to summarize lessons that they would like to share with the rest of wildfire fighting community and here is what they came up with. If you are looking to move forward with your virtual training arsenal, consider the following:


It is very different teaching to a computer screen. People don't laugh at your jokes or engage in your anecdotes. You will need to put in effort and enthusiasm to engage learners. Channel your inner DJ and imagine the audience enjoying what you are saying! Do some research on ways to make your presentations exciting with add-ins like interactive polls and whiteboards.

Because of the lack of banter, synchronous virtual training goes faster than in-person. Schedule more material to fill in the gaps, or consider giving more breaks to your learners. You cannot take classroom, in-person training material and deliver it live online. Moving to a virtual delivery requires a reassessment and overhaul of materials, methods and course sequencing. All forms of online learning put a lot of the onus on the student to read the material, follow along and participate in group chats. You need to motivate them too.

Support your local area; give them what they need to make sure the students are successful in-house. Technology is key: make sure it works! Build strong lesson plans with gear lists, step-by-step instructions and clear learning objectives. Also, try to find the best local folks to provide support and that missing comradery piece.

Lastly, find a technology that works for you. There are so many different platforms, all with varying abilities to improve engagement, host evaluations and deliver exams. Take the time to review your online training needs and choose a technology that enhances what you already have and encourages you to make it better. Decide what would suit your course best – live instructor-led learning or a synchronous delivery, or let students work through the material themselves in an asynchronous delivery style.

In April, we did a trail delivery of a crew leader course with 16 students. Our classrooms were large enough that all students could be seated and spaced two metres apart. Masks were mandatory when moving around the classroom and common touch surfaces were regularly disinfected, with heaps of hand sanitizer and surface wipes available. There was even a piece of tape on the floor of the classroom so that instructors wouldn't cross the line when speaking (I'm a pacer myself). Fitness activities were cancelled. Washroom and kitchen usage



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were offset and accommodation was set to single occupancy. The course ran smoothly, and was even prepared to respond when one of the students received news that they were a close contact and had to isolate. We had accommodation put aside ready for them to use and passed them training material to bide their time. Eventually the individual was sent to a quarantine facility.

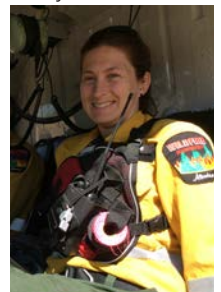
All of our instructor staff had had their first dose of vaccinations and many of the students had as well. Running concurrent courses posed some additional forethought into keeping cadres separate, but we have a strong COVID response plan in place if anyone (instructors included!) were to come down with symptoms. We were also trialling the introduction of a wellness dog in our evening mentoring sessions, in the hopes that belly scratches would help ease some of the anxiety of the pandemic.

Once the craziness of the courses subsided, the plan was for Hinton Training Centre staff to continue to review and upgrade our training materials. Some courses are great candidates for asynchronous delivery, and work is already underway to convert more of these for a larger training audience. Self-paced learning helps us get better at self-motivation and improves technical online skills.

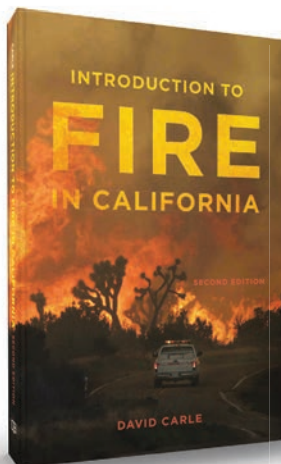
Other courses like the wildfire crew member and crew leader still really need a live instruction component, based on the feedback from our students from 2020. This winter, our training specialists will be looking at combinations of synchronous and asynchronous delivery for a number of our longer courses. The suite of new virtual training tools out there is enormous and exciting; we're going to be busy upgrading regardless of the pandemic and striving to embracing some of this new technology to train the next generation of firefighters.

ABOUT THE AUTHOR

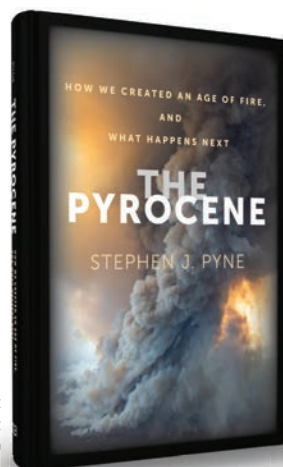
Kelsy Gibos has been a wildfire training specialist with Alberta Wildfire for two years. Gibos previously worked as a wildfire management specialist, calculating wildfire risk at the landscape level. Most of Gibos's career has been science-based; she has worked as a fire researcher in Canada, Australia and New Zealand and completed a MSc in forestry while studying topographical effects on fire behavior.



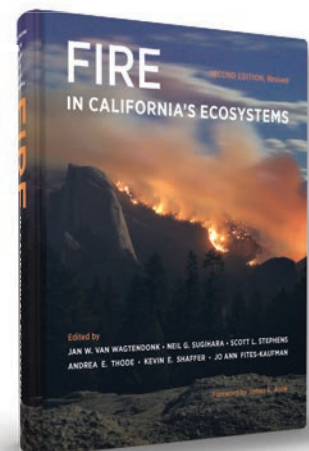
FIRE AND THE FUTURE



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FIRE-GENERATED STORMS

TECHNOLOGY IMPROVES WARNING SYSTEMS

BY BETHANY PATCH



The frequency of fire-generated thunderstorms has increased in the last 20 years, with Australia entering an era of violent pyro-convection. This research helps predict the formation of fire-generated thunderstorms, such as the one that formed over Lake King in Western Australia, February 2020. Photo by Christine Harper, DBCA, Western Australia

Fire-generated thunderstorms, sometimes called pyroconvulonimbus clouds or pyroCbs, are ferocious weather systems that can exacerbate the damage already caused by the bushfires that create them. While pyroCbs are only just beginning to be understood, research by Australia's Bushfire and Natural Hazards Cooperative Research Centre is helping measure and predict fire-generated thunderstorms more effectively. This research aims to improve warning systems and assist agencies with analysis and forecasting.

Kevin Tory, senior research scientist at Australia's Bureau of Meteorology, is part of a team exploring fire-generated thunderstorm prediction. The team's research has developed a tool that is helping fire agencies and weather forecasters predict when these dangerous storms might occur, so that fire agencies can warn communities and firefighters.

Tory explains that fire-generated thunderstorms have much in common with conventional thunderstorms – both require warm, humid air to be lifted into an unstable layer above. However, far less is known about fire-generated thunderstorms, including why they have become so much more common recently.

"We are getting better at identifying these storms with improved satellite coverage, but this can't explain the dramatic increase in numbers of events we've seen globally in the last few years," Tory said.

According to Rick McRae, who has been studying fire-generated thunderstorms for almost 40 years, Australia has entered an era of violent pyro-convection since the first closely studied storm in Berringa, Victoria, in 1995.

"PyroCbs are a very strong signal of how badly climate change is impacting the globe," McRae said. "With normal fires, if you know the fuel, the weather and the terrain, then you know what the fire will be doing, with a few exceptions. A blow-up fire event displays dynamic fire behaviour – they are basically a different species of fire. They develop feedback processes."

McRae began searching for previous instances of fire-generated thunderstorms in 2003. Prior to 2001, there were two known and two suspected events in Australia. There are now 118 on the list, including 37 during last season's Black Summer bushfires, which raged through south-eastern New South Wales and eastern Victoria; this made the Black Summer bushfires the most intense series of pyro-convective events ever recorded.

The smoke from fires near Mallacoota, Victoria, eventually reached a height of 35 kilometres, and is now being studied worldwide. Sergey Khaykin at the Laboratory of Atmospheric Research and Satellite Observations at Sorbonne University in France recently reported that the smoke was so thick that it acted like a planetary shade, blocking the sun and briefly creating a cooling effect similar to a moderate volcanic eruption. Of course, not all extreme fires go on to produce intense new weather events, but conditions can become ferocious and significantly destructive when they do, often resulting in far-carried embers or the creation of entirely new fires from lightning strikes.

This kind of firestorm occurs when the hot gases in the smoke plume rise high enough to begin interacting with the atmosphere, causing clouds to form and inducing a powerful local thunderstorm. With the increase in these firestorms, it is becoming easier to identify and predict them with the help of new technologies.

Tory explains that, in some ways, the formation of these storms is very simple to understand. The analysis of fire and plumes is more complicated.

"All you need is an enormously hot fire in an unstable atmosphere and a fire-generated thunderstorm will develop," Tory said. "The real complexity is in understanding how large and intense a fire would need to become for a specific atmospheric environment, and whether or not you have the right mix of fuels, terrain, local winds and complex fire behaviours that would allow the fire to become large and intense enough."

According to Tory, a basic understanding of three things is needed in order to grasp how large and intense a fire needs to be to create a fire-generated thunderstorm:

The height to which smoke plumes rise for any given fire intensity and wind speed. The greater the fire intensity, the taller and more vigorous the smoke plume, whereas the

stronger the wind, the more the plume is blown over and spreads out downwind.

The height to which the smoke plume must rise before it cools enough for cloud to start forming. This requires an understanding of how the temperature and humidity changes with height in the smoke plume.

The instability of the atmosphere. This determines how buoyant and strong the updrafts in the cloudy plume need to be for a thunderstorm to develop.

A series of Cooperative Research Centre studies has helped analyse plume behaviour more accurately. Building on this research, Tory's team has focused specifically on the first



point, in order to understand how large and intense a fire would need to be to produce one of these fierce storms.

"We focus on the atmosphere, which is much more predictable than fire," Tory said. "If we know how large and intense a fire will become, and how large and intense a fire needs to be for a fire-generated thunderstorm to form, we can, in

theory, predict them. However, predicting the future fire size and intensity remains an enormous challenge."

Tory's work has culminated in the development of a diagnostic tool that can determine when the atmosphere is conducive to both deep plume development and large, hot fires. This research is assisting fire agencies and the Bureau of Meteorology with accurate and quick predictions that inform subsequent warnings.

The Pyrocumulonimbus Firepower Threshold (PFT) is new technology that measures the threshold or minimum firepower required for fire-generated thunderstorms to form, essentially assessing the atmospheric potential to support the development of a fire sufficiently large and intense for one of these storms to develop. The technology is proving to be highly predictive.

"We were surprised how well the tool seems to work," Tory said. "We seem to have identified a handful of key ingredients,

The Pyrocumulonimbus Firepower Threshold (PFT) is new technology that measures the threshold or minimum firepower required for fire-generated thunderstorms to form . . .

A moist pyro-convective plume on the Lake King fire in Western Australia in February 2020.
Photo by Christine Harper, Department of Biodiversity, Conservation and Attractions, Western Australia

and the way they fit together largely determines how favourable the atmosphere is for fire-generated thunderstorm formation.”

The research team began by using a computer-generated weather forecast to create contour maps of the PFT, then handed them out to a selection of fire weather forecasters and fire behaviour analysts.

“We know that a fire-generated thunderstorm can be very hazardous, but we also know that many are quite benign,” said Tory. “The PFT is great because it helps to pinpoint the threat timing and location.”

Within weeks, these maps were being used to predict the Black Summer firestorms. This allowed the researchers to practise using and refining the tool, identifying its strengths and weaknesses and making improvements. Partnerships with fire and emergency services and other government partners, co-ordinated through the Cooperative Research Centre, have been essential in building and developing the tool. The tool is now used by fire behaviour analysts within fire agencies and land management departments, as well as by Bureau of Meteorology forecasters, who work closely with fire agencies advising on severe weather.

Jamie Molloy, a fire behaviour analyst and program manager of the Forest Protection Survey Program at the Victorian

Department of Environment, Land, Water and Planning, explains just how helpful the PFT has been for his team when analysing fires.

“The Pyrocumulonimbus Firepower Threshold is a significant improvement in identifying fire-generated thunderstorm risk, including helping to flag other factors that should be looked at, such as mixed-layer windspeed,” Molloy said.

“I review it every day that I am deployed as a fire behaviour analyst. It gives me a very quick heads-up on the potential, broad timing and location of fire-generated thunderstorms – if the chance of a storm is identified, it prompts further investigation of ignition potential, atmospheric instability and thus the likelihood of firestorms and community risk in those areas.”

In Western Australia, the tool has been used by the Department of Biodiversity, Conservation and Attractions during the past two southern fire seasons. Brett Beecham, having worked in intelligence and predictions for the department for the past 10 years, reiterated how helpful the PFT was when assessing pyro-convection and the risk of extreme fires.

“The Pyrocumulonimbus Firepower Threshold provides one more piece of information about the potential for a fire to interact with the atmosphere around it, and I now use it in

conjunction with other tools to gain a better insight into the risks of extreme fire behaviour," Beecham said.

"It provides vital information about the likelihood of extreme fire behaviour due to strong pyro-convection, and this ultimately leads to improved firefighter and community safety during a bushfire."

The PFT is also being regularly used by New South Wales Rural Fire Service fire analysts such as David Philp.

"From the perspective of a fire behaviour analyst for an incident management team, knowing the possible potential storm risk triggers the need for closer monitoring of the broader weather conditions to ensure appropriate storm warnings are issued, rather than waiting for specific warnings being issued through the Rural Fire Service State Operations Centre," Philp said.

The tool will continue to be improved and expanded as more evidence comes to hand. Tory and other scientists are racing to learn as much about fire-generated thunderstorms and other extreme weather systems as possible, knowing that a better understanding is essential to reducing preventable

fire-related deaths.

"If we knew more about what makes fire-generated thunderstorms dangerous, we should be able to tailor some of the ingredients or adjust thresholds to better highlight dangerous events," Tory said. "More field studies, with every type of monitoring equipment we can think of, will help us better understand these events."

To learn more about this research, visit the Improved predictions of severe weather to reduce community impact project page at <https://www.bnhcrc.com.au/research/predictingsevereweather>



ABOUT THE AUTHOR

Bethany Patch is a writer in Melbourne, Australia, for the Bushfire and Natural Hazards CRC.

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RESEARCH AND MANAGEMENT

WORKING TOGETHER FOR THE COMMON GOOD

BY ROGER OTTMAR, MORGAN VARNER,
KEVIN HIERS, KELLY CORNWALL AND JASON KLING

Better understanding the physics of fire that will lead to improved operational tools for managing wildland fire often requires scientist and researchers to shift data gathering and instrumentation from the laboratory to an active wildland fire field environment. This provides the research community an opportunity to validate, fine tune and advance current operational fire and smoke tools to better support land managers and represent real world complexity.

Since scientists often do not have the resources, jurisdiction, or fire management qualifications to establish research fires in the field, they rely on land management agencies and private landowners to support wildland fire research opportunities on incidents.

Research objectives and the presence of numerous scientists can complicate burning operations, so it is imperative for

researchers to work closely with the fire managers to make sure their involvement does not negatively affect desired outcomes or accomplishments and cause unnecessary safety issues. A co-operative working relationship is critical if research is to be carried out and the results are to be useful to land management planning and execution.

The science community in the United States embarked on an effort that is of utmost importance and of great consequences to land managers called the Fire and Smoke Model Evaluation Experiment (FASMEE). Following the development of a detailed and peer reviewed study plan, the project initiated the collection of large data sets from wildland fires that covered fuels, fire behavior, energy release, plume dynamics, meteorology, smoke, and fire effects. These data sets will be used to evaluate and advance operational fire and smoke models providing substantial benefit to land managers



Aspen sprouting after a stand-replacement prescribed fire during the fall of 2018, which followed a stand-replacement prescribed fire in June 2016, on the Richfield Ranger District, Fishlake National Forest, Utah.

Photo by Roger Ottmar, USDA Forest Service

and improving their ability to manage wildland fire on the landscapes (**Figure 1**).

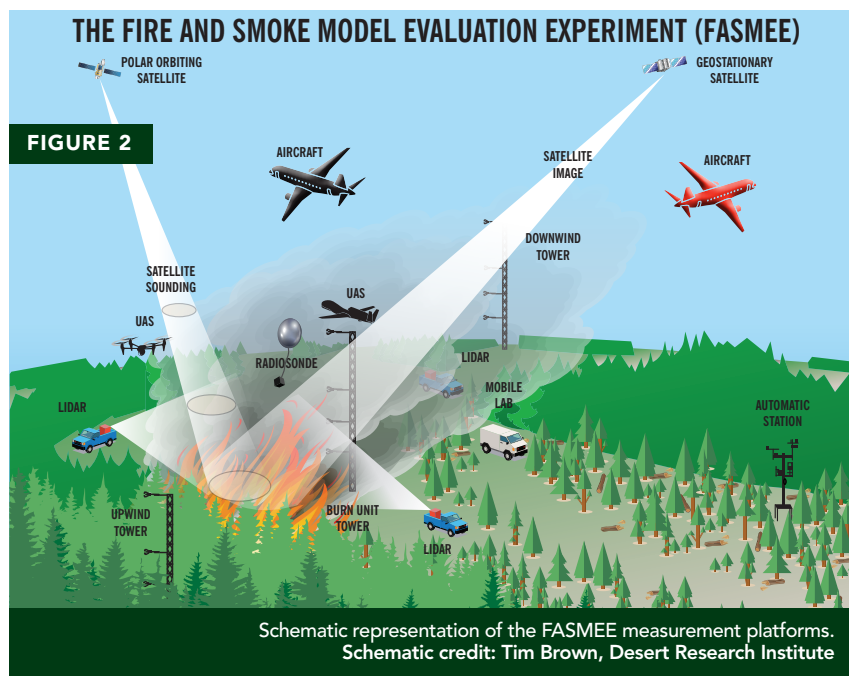
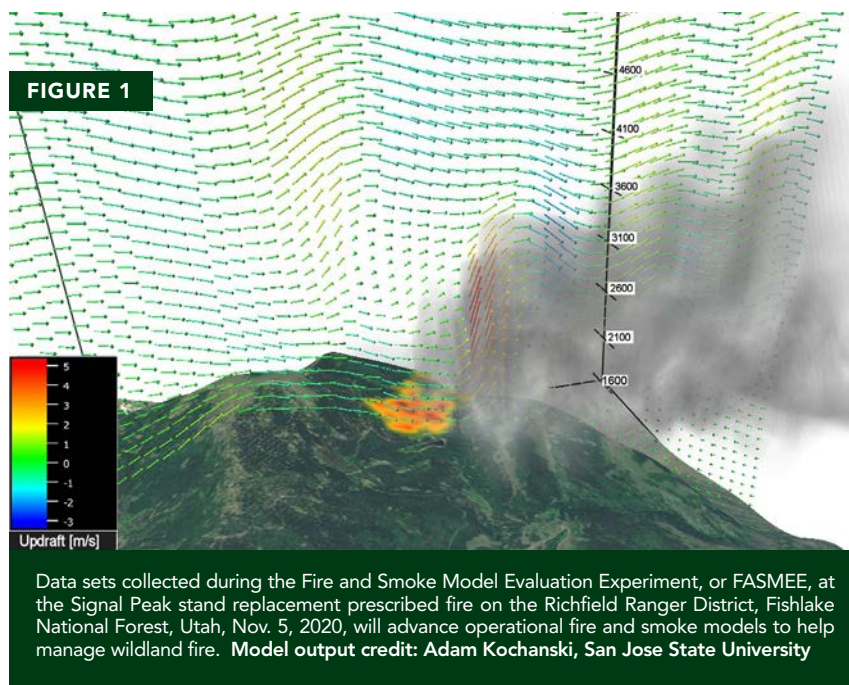
More than 100 scientists and 20 agencies and organizations are working together as part of the experiment to gather data on active wildland fires. This type of effort is extremely rare in the United States and very difficult to accomplish, and required a co-operative working relationship between research and management.

The relationship provided the means to meet the objectives of the scientists and clients in a process known as coproduction of knowledge. Working together, and following recommendations developed by the FASMEE team, science and land management communities can improve collaboration for future efforts.

RESEARCH

The availability of an integrated, quality-assured fuels, fire, fire effects, and atmospheric dataset for the evaluation and advancement of fuels, fire behavior, emissions, and fire effects models is limited. Since managers are so reliant on operational model output, integrated quality-assured data sets are needed to test and advance these models. With so much at stake, the Joint Fire Science Program and the US Forest Service generously supported FASMEE. This data set will be instrumental in moving fire models and ultimately the management of fire, years ahead, which will be indispensable in today's world as fire is playing an ever more important part on the landscape (**Figure 1**).

Although a small portion of the experiments were laboratory based, much of the data were collected during active prescribed fires in the western United States. The field data set is designed to improve our ability to identify how fuels, fire behavior, fire energy, and meteorology interact to determine the dynamics of fuel consumption and fire behavior, smoke generation and plumes, the long-range transport of smoke, and local fire effects. Effective measurements of feedbacks between wildland fire and the atmosphere will improve current operational models and will assist land managers to better predict fire behavior, smoke impacts, and the short- to long-term effects of fire. More than 100 scientists participated from



the US Forest Service, several universities, private ventures, and Tall Timbers Research Station.

THE HOST

The Richfield Ranger District is located on the Fishlake National Forest near Richfield, Utah. The district has embarked on an ambitious project to restore native aspen forests that are being encroached by mixed conifer stands at high elevation areas in the Monroe Mountain region. Large stand replacement fire is the tool of choice to invoke the resprouting of aspen clones to rejuvenate these native aspen

stands (**Figure 2**). As many as 75 wildland firefighters with two helicopters and firefighting equipment from across the surrounding area converged at the Richfield Ranger District to implement the prescribed burns.

INITIAL CONTACT

FASMEE was searching for high intensity, large-scale prescribed fires in the western United as outlined in the study plan for the southwestern campaign. During a question-and-answer exchange at an Rx410 smoke management course in Boise, Idaho, Brian Van Winkle, fire ecologist for the Fishlake National Forest, mentioned the stand replacement prescribed burn plans for the aspen restoration project on the Richfield Ranger District. Communication between FASMEE and the Richfield Ranger District fire personnel and Richfield Ranger District/Fishlake National Forest management commenced in the summer of 2016, followed by several site visits and meetings with the district ranger and fire management specialist. The Joint Fire Science Program, initial sponsor of FASMEE, had its annual meeting at the National Forest headquarters followed by a site visit to stand replacement fires that had been conducted in 2016 and sites proposed for FASMEE research.

APPREHENSION AND FIX

Although the district fire personnel and management agreed to support research and host FASMEE, there was initial uneasiness with the additional burden. Managers have a job to do and often feel that if research is part of the game plan,

it will take away from their flexibility and may impede their activities. To reduce this burden and apprehension, several specific actions were undertaken by FASMEE including: Scheduling several in-person meetings and site visits with the district ranger, forest supervisor and fire specialist, where the science team outlined research objectives and needs, and created consensus for what the expectations of management would be for hosting FASMEE.

Organizing a fire research planning and logistic team to provide for safety, ICS forms, housing, personnel accountability, transportation and communication coordination among individual scientists, research - and incident management teams; conducting science briefing and after-action reviews.

Conducting regular calls and in-person meetings among the FASMEE planning and logistical team, science leads, and management discussing plans, logistics, prescriptions, meteorology, and probable burn date.

Requiring all participating scientists to pre-visit each burn site, locate all data collection instrument location points, complete a dry run of deployment, have personal protective equipment, attend pre-fire briefings, and be escorted if not fire qualified.

Requiring all media personnel associated with FASMEE to be coordinated through the research PI, FASMEE liaison team and local public affairs officer.



Members of the research and fire team at a briefing prior to the Manning Creek stand replacement prescribed fire ignition, on the Richfield Ranger District, Fishlake National Forest, Utah, June 20, 2019.

Recruiting local incident meteorologist from the National Weather Service to provide daily forecasts and briefings to management and research staff.

Providing research instrumentation associated with the research that could assist management in fire operations including unmanned aircraft systems infrared surveillance and photography; instructing two classes on fuels and smoke modeling tools to Fishlake National Forest fire and fuel managers.

IMPROVEMENTS

All pre-fire planning and preparation effectively provided a comfortable environment and reduced the anxiety of the prescribed burn team and management. However, several improvements became evident that should be considered in future science-manager collaborations similar to FASMEE.

These include:

- The provision of funding to cover land managers' costs associated with hosting scientific projects.
- Increasing availability of fire qualified squad bosses to escort research teams.
- Improving radio communication between scientists and incident fire managers.
- Improving accountability for site access by individual scientists before and after burns.

OUTCOMES

This co-operative spirit led to the teams safely achieving several positive outcomes on complex prescribed fire

ignitions. Data collected will be available to all scientists to advance fire and smoke models in operation today, improving land managers' ability to use and fight fire. In addition to the publications that are generated by the scientific efforts, other tangible benefits resulted from the work. Scientists collected pre-fire fuel and fuel moisture data that were made available to the fire staff to evaluate pre-treatment effectiveness and prescription readiness. In addition, drone flights with photographic and infrared cameras were used to grid the area for hot spots inside and outside the fire line. Finally, recruiting a meteorologist for the project was a critical success to both scientists and managers and there is now a US Forest Service process for requesting an incident meteorologist for large prescribed fire projects.

Developing a clearly defined strategy that meets both science and management objectives is essential if actionable research projects are to be hosted by land managers. Scientists need to be aware that the hosting agency has specific accomplishments and objectives that need to be met and develop ways to limit or eliminate the impact on the fire staff and management personnel. FASMEE was able to provide this co-ordination and continuity, and has developed guidelines to follow for future co-operative ventures.

ABOUT THE AUTHORS



Roger Ottmar is a research forester with the Fire and Environmental Research Applications Team, Pacific Northwest Research Station at the Pacific Wildland Fire Sciences Laboratory located in Seattle, Washington. Ottmar has been involved with fuel-, fire- and smoke-related

research across the United States, Brazil, Portugal and Mexico. Ottmar led the Prescribed Fire Combustion Atmospheric Dynamics Research Experiment (RxCADRE) and currently leads the Fire and Smoke Model Evaluation Experiment (FASMEE) and the Department of Defense 3D Fuel Characterization project. Contact him at roger.ottmar@usda.gov

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BUILD THE BENCH

BY MICHAEL DEGROSKY

I very recently retired after more than 40 years in the fire service. Retirement, it turns out, is a big transition and one that provides opportunity to think a lot about a lot of things. Mostly, I've been thinking about whether I accomplished what I set out to do in my most recent position.

Early on in my tenure as chief, I established just a few personal goals, none more important than my intent to build the bench, grow leadership and provide opportunity. My goal reflected both an organizational need and my firm belief that tenaciously grooming future leaders and preparing the next generation of leaders is an obligation of leadership. That goal remained on my whiteboard, to serve as a constant reminder, for more than five years.

I recently read comments by Aaron Rodgers, quarterback of the Green Bay Packers, who said "I think sometimes people forget what really makes an organization." Rodgers went on to say "People make an organization; people make a business and sometimes that gets forgotten." As you can imagine, the Packers QB is not a go-to leadership reference for me, but he got this right. People make up our organizations and leaders watching out for the future of their organization must make it a priority to doggedly prepare future leaders.

Building your bench and growing leadership is not a casual task; there's a lot to think about. First and foremost, one must consider the organization's needs. Don't get me wrong; I want people to benefit from the opportunities that interest and excite them, and I don't mean to imply that the organization's priorities outweigh what the employee sees as their needs. But we need to remember that we are taking a role in a person's development; we are helping them prepare for their future in the organization. Carefully considering the organization's needs is not only good for the organization, but good for the individual. What does the agency need from its leaders and what will it need in the future? What competencies do the agency's leaders require, and what skills will those leaders need in the future? Too often, I see organizations providing seemingly random leadership development that does not position employees well for the organization's future.

After you have considered the organization's future, look around and ask, "Who has the potential to lead in this organization?" Be objective, and honestly assess leadership capacity. Do not hesitate to identify potential leaders as early as possible in their careers. Many agencies face a legitimate leadership crisis, and need to identify and invest in people with leadership potential as quickly as they can. And besides, while past performance can forecast future success, remember that once people transition into formal leadership roles, their job responsibilities change and their past performance may no longer predict their abilities anyway.

Honestly, I kept a list of people I was keeping my eye on, and recruited from that list. In a single year, I hired three people from that list into key positions, two of which had completed temporary assignments, with me.

Once you've identified leadership candidates, help them to plan their self-development and do what you can to provide them with education, training, and growth opportunities. I encourage you to think, and help your developing leaders think of leader development as a marathon, not a sprint. Guide people who you believe have potential to a variety of opportunities. A weeklong training session does not a leader make. Traditional leadership training programs are important but so are details, projects, special assignments and other developmental assignments that allow developing leaders to receive feedback as they learn by doing. These assignments should cause people to stretch, broaden their knowledge, work outside their normal circles, and potentially learn from both success and failure. Most importantly, when guiding the development of future leaders, constantly ask, "Are they getting the opportunity to lead?" Too often I see people on details and special assignments getting the opportunity to do, but not to lead.

Finally, please generously coach and mentor developing leaders. Get and stay actively involved, provide personal and individual attention, require budding leaders to identify and satisfy their development needs, help them focus their energy, and lend a hand as they come up against obstacles. Connect people who exhibit leadership potential with good leadership role models from whom they can learn. Provide honest, and supportive feedback that helps them grow, gain confidence, and mature as leaders. I don't think we can overestimate the value of a person taking an interest in another person and their personal growth, particularly when that happens early in someone's career.

Mentoring and coaching emerging leaders has been one of the most rewarding experiences of my career and one of the most important roles I have played.

Tenaciously grooming future leaders and preparing the next generation of leaders is an obligation of leadership. Build the bench, grow leadership and provide opportunity.



ABOUT THE AUTHOR

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

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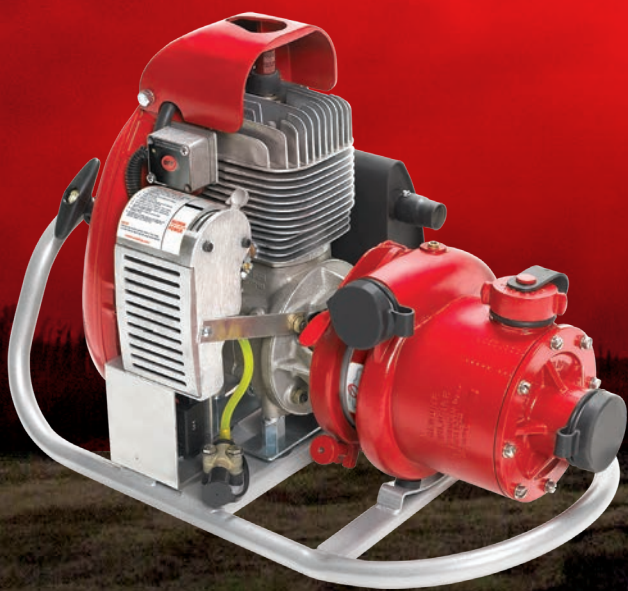
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