OCTOBER – DECEMBER 2020 / VOL 29.4 UNITING THE GLOBAL WILDLAND FIRE COMMUNITY

An official publication of the International Association of Wildland Fire

PASSING THE TORCH AND SHARING THE FLAME

WHEN THE WORLD DEMANDS MORE,

AIR TRACTOR DELIVERS.

N TO CAT

AIR TRACTOR DELIVERS THE PERFORMANCE, EFFICIENCY, AND PRECISION THIS JOB DEMANDS. IT'S TIME YOU DEMAND MORE.



Several wildfires in the Sakha Republic, Russia, near the Arctic Circle. (Lat: 66.88913, Lng:150.72075), July 20, 2020. Infrared view. Contains modified Copernicus Sentinel data; processed by Pierre Markuse. Image about 77 km wide.

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Several wildfires in the Sakha Republic, Russia, near the Arctic Circle. (Lat: 66.88913, Lng:150.72075), July 20, 2020. Infrared view. Contains modified Copernicus Sentinel data; processed by Pierre Markuse. Image about 77 km wide.

ON THE COVER

Johnny Stowe Passing the Torch to firelighter McKenna Hammons, who led the Pyropointer Burning, Beaches & Bar-B-Q spring break trip to South Carolina in 2019. For more, see "Passing the Torch to Tomorrow's Wildland Fire Professionals," page 34. Photo: University of Wisconsin Fire Lighter Crew Oct. - Dec. 2020 Volume 29.4 Anotical publication of the International Association of Vielland Fire

EDITORIAL TEAM Mikel Robinson David Bruce Johnny Stowe Marjie Brown - Dispatch Editor wildfirewriter@gmail.com BUSINESS

Mikel Robinson - Administration

Kim Skufca - Advertising Associate kim@iawfonline.org

Century Publishing Post Falls, Idaho (Printing)

WILDFIRE/COMMUNICATIONS COMMITTEE (IAWF)

David Bruce - Chair Mariona Borràs Celia Conde Lucian Deaton Jennifer Fawcett Richard McCrea Mikel Robinson Johnny Stowe Ron Steffens Gavriil Xanthopoulos

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Gavriil Xanthopoulos (Greece)

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Address: :International Association of Wildland Fire. 1418 Washburn, Missoula, MT, 59801 USA. (406) 625:7059 | execdir@iawfonline.org. Editorial Email: **editor@wildfiremagazine.org.**

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PRESIDENT'S DESK



TODDI STEELMAN IAWF PRESIDENT

During this current generational crisis of historical proportions all of us are being called upon in ways unfamiliar to us. We are off the map, into areas where there are no reliable guides.

We have a public health crisis that requires us to be conversant in the physics of aerosols, virology, materials science and human psychology. COVID-19 has begotten a financial crisis that will have all of us feeling the pinch in our budgets, maybe facing layoffs, and certainly making difficult tradeoffs among our priorities. And the health and financial crises have sparked a global reckoning about racial inequities. The health and economic well-being disparities lay bare our collective failures to remedy the injustices of slavery, colonial pasts and structural forms of inequity that continue to haunt us.

And we are also seeing historically challenging fire seasons—if it is even appropriate to continue calling them

"IN MY EXPERIENCE, LEADERSHIP IS MOST EFFECTIVE WHEN IT LEVERAGES THE AUTHORITY OF THE POSITION WITH NEEDS OF THE PEOPLE UNDER OUR MANAGEMENT, ADMINISTRATION OR COMMAND." seasons. Australia saw devastating bushfires in December and January. The American West is being challenged as never before.

This is a heavy load to carry. The temptation is to shut it out and shut ourselves down. But now is the time to lean into situations and be there for whomever needs us now.

The IAWF community is comprised of leaders of all sorts—within your communities, at your workplace, in your volunteer activities. I suspect that most of us got into our current positions because of our love for fire or natural resources or being outdoors—something likely unconnected to the current health, financial and racial crises that have commanded so much of our attention. And yet, it is essential that each one of us be conversant to some degree in these cumulative crises if we want to be effective in our day to day jobs.

In my experience, leadership is most effective when it leverages the authority of the position with needs of the people under our management, administration or command. These two elements are brought together most effectively through listening, dialogue, collaboration and mutual understanding. Usually, this in the context of wild or prescribed fire, preparedness, response, or recovery. But these days our attention needs to cast a much wider net to be effective. In short, we need to move beyond the professional into the personal and allow ourselves to be a bit more fully human.

These current crises require a kind of leadership borne of listening to the heartfelt pain of others, absorbing the stories and messages bestowed upon us, learning about our own ignorance, humbling ourselves to our own inadequacies given the greatness of need, and transforming these experiences into commitment and action to do better and serve where we can.

Embracing this posture, I am learning a lot from those around me. Everyone is very stressed given current conditions. Mental health is more fragile. People are wrestling with educating children at home. They are caring for elderly parents or other relatives. Many are worried about family and friends who have compromised immune systems or other underlying medical disorders. So many more are struggling with fear, anxiety, and depression related to the cumulative uncertainties we face. Our employees want us to be a workplace they can be proud of when it comes to responding to the current racial equity crisis. People are feeling lonely and isolated. They are stressed about money

PRESIDENT'S DESK



and wondering if they will continue to have a job given financial uncertainties.

None of this is usual. None of this is typical. So, it means we cannot operate as if it were a normal or typical year. And that means adapting to our current conditions and not pretending we can operate as business as usual. In my day to day life, that has meant asking everyone to do a little less so they have the bandwidth to manage the inevitable uncertainties that will continue to arise. Importantly, while I am asking people to do less, I am asking them to do whatever they are doing to do it well.

The only way out of these cumulative crises is through

them. Wherever you are and whatever you are managing, I want to send out a message of solidarity. We are all off the map together.



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



ANOTHER YEAR OF RECORD WILDFIRES IN THE WESTERN U.S.

As we go to press for this issue of *Wildfire*, we extend our thoughts to all of those in our wildland fire community who are enduring yet another historic fire season in the American West, especially during these exceptional circumstances, as we all learn how to persevere during a pandemic. In California alone, more than 8,200 wildfires have burned over 4 million acres causing 31 fatalities and destroying nearly 8,500 structures. At this time, more than 30 Type 1 & 2 Incident Management, National Incident Management Organization and Area Command Teams are committed to wildland fires across California, Colorado, Wyoming, Oregon, Utah and Idaho. 7.7 million acres in total have burned so far this year, outstripping the 10 year average of 6.1 million acres. While we are not with you in body, we are with you in spirit.

IAWF Board of Directors

A HUGE HEARTFELT THANK YOU TO RON STEFFENS

On behalf of the International Association of Wildland Fire Board of Directors, Executive Director Mikel Robinson, the IAWF *Wildfire* and Communications Committee, the IAWF membership, *Wildfire* magazine readers around the world and the entire wildland fire community, we thank Ron Steffens for his many years of outstanding service as the Managing Editor of our *Wildfire* magazine!

Ron Steffens' name is synonymous with *Wildfire* magazine and always will be.

Ron joined the IAWF Board of Directors in 2010 and shortly after that became the Chair of the Advisory Board for *Wildfire*. In the early years IAWF worked with Penton Media to publish the magazine as a supplemental to *Fire Chief*. In 2014 when *Fire Chief* was no longer published, we had to decide whether to continue publishing *Wildfire* magazine. It was a situation where a big commitment was needed, and Ron stepped up and took over as Managing Editor, allowing us to transition to self-publishing the magazine. Most likely, had Ron not

been willing to take on this task, the magazine would have folded – thank goodness he did! For the past 6 years Ron has led the charge in publishing *Wildfire*; seeking out articles, working with authors, editing, working with the designer on layout, dealing with the publishing company on printing, working with ad sales staff, strategizing new ideas, and much, much more. He did this all while working full time as a professor at Green Mountain College, a seasonal Fire Analyst and Incident Commander in Teton National Park, and sitting on several boards. And during all of this, he traveled to Africa several times to conduct training and trekked across Australia, all the while continuing to manage the magazine despite limited connectivity and different time zones. Ron wears many hats and wears them well, and he does all these things while remaining gracious and kind.

In addition to being on the IAWF Board of Directors and managing the magazine, Ron sat on several planning committees for many IAWF Conferences and was the Keynote Speaker at the 2016 Fire Behavior and Fuels

> Conference in Portland, Oregon, with his talk being shown real-time at the joint location in Melbourne.

> Everywhere Ron travels he looks for potential articles and authors. His creativity and diligence are endless, and he has never ceased to amaze us with the quality of each issue of *Wildfire*.

But all things change with the passage of time, and Ron has stepped down as the Managing Editor. The change will allow Ron to spend more time with his family and on other projects and pursuits. It is a big change for Ron and a big change

for all of us, as well. For the past decade Ron has been dedicated to *Wildfire* magazine and all of us who have worked with him, all the members of IAWF, and all the myriad of people who have enjoyed and benefited from reading the many issues of *Wildfire* that he shepherded along to us -- we could not be more grateful. Thank you, Ron, for a job well done.

Ron will continue to be active in many facets of IAWF. He will especially be engaged with the IAWF Communications Committee, and he has generously agreed to help us transition to a new Managing Editor.





A Virtual Conference for Real World Problems May 24 - 27, 2021

Join us on a trip around the world through the lens of wildland fire. Across four days in May 2021, the IAWF will present real world risks and opportunities in an online environment. We will connect a truly international audience, with global topics and speakers from around the world, on different continents and time zones. The IAWF 16th Wildland Fire Safety Summit and the 6th Human Dimensions of Wildland Fire Conference will address the issues that make the global wildland fire community safe, smart and supported.

Show us your world

Submit a video around the 5 themes of the conference.

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SENIOR EADERS Senior leaders wishing to remain free of the boss

Senior leaders, wishing to remain free of the boss bubble, will lead adaptively and inclusively.

MIKE DEGROSKY

Senior leaders, those assigned to lead other leaders and managers while overseeing organizational functions, regions, units or the entire organization, exercise enormous influence with the people they are charged to lead. People look to their leaders for signals and cues; paying attention to the leader's actions; observing them, scrutinizing That makes senior leadership a big responsibility. However, the pressures of senior leadership can lead senior leaders into a trap, a self-defeating pattern that makes redeeming this enormous responsibility tougher than it already is. We all know that either an effective leader or a less than fully effective leader at the top of an organization or organizational unit can have far reaching consequences for the productivity, job satisfaction and commitment of people as well as both the efficiency and effectiveness of the organization.

Feeling the pressure of enormous expectations, if not careful, senior leaders can trap themselves in what I call the boss bubble. In the boss bubble, senior leaders feel smarter, wiser, cleverer than people they lead; surround themselves with people who reflect their own thinking and reinforce them; and cut themselves off from the people close to the work. Soon, you're breathing your own exhaust; acting on erroneous beliefs, assumptions and outdated information; and failing to make use of the talent in your organization.

So, what's a senior leader, who wants to stay out of the boss bubble, to do? First, an effective leader in today's complex and turbulent environment must practice adaptive leadership. An adaptive leader builds collective understanding and shared action throughout the organization. They engage the organization in continuous learning and adjust the organization's operations based on shared knowledge. Adaptive leadership requires enabling the organization to constantly assess its actions and acknowledging that the organization will have to continuously adjust and adapt their operations as they examine the outcomes of decisions and learn from them. That requires nimbleness that centralized decision-making does not allow.

Effective, adaptive leaders also maximize transparency in their decision-making and accept both challenges and feedback from the people they lead. In today's world, a major challenge faced by senior leaders is that their operating environment changes all the time and the leader can be quite isolated from the contradictions and realities of critical operations. The best senior leaders I know can acknowledge and accept that they are often not the most knowledgeable person in the room, defer to the expertise residing in their organization, and streamline their decision-making, trusting, and relying on, experienced and knowledgeable staff.

Conversely, when senior leaders feel the need to be the smartest person in the room or the centralized decisionmaker, they often revert to risk-averse and isolated decisions that feel safe but often prove inadequate and leave their most knowledgeable personnel feeling less than empowered or even excluded. When leaders acknowledge their humanness, their imperfection, and their fallibility, they create an environment of openness, psychological safety, and mutual trust essential in the truly adaptive organization.

The most effective senior leaders I have known have been inclusive leaders, those who make people feel as if they are treated fairly and respectfully and that they are valued and belong. Recent research indicates that when people feel included, they boost organizational performance because they engage, work with commitment, and collaborate. So how does one lead inclusively? I recently read a thought provoking Harvard Business Review article by Juliet Bourke and Andrea Espedido, in which the authors suggest that people feel included when they see their leaders are aware of, and acknowledge, not only their own biases but those of the organization. Most often, that looks like a leader consistently challenging their own assumptions, inviting others to stress test their thought processes for them, and encouraging others to also be aware of their own assumptions and pre-conceptions. According to Bourke and Espedido, people also want to see their leaders address their biases with humility and empathy; a combination that causes people to see their leaders as approachable, trustworthy and supportive.

For me, inclusive leadership is all about connection and creating a trusting environment in which people feel they belong. Doing so requires the leader to connect with people; communicate openly, honestly and often; instill confidence that the rules of engagement apply equally;

THE MOST EFFECTIVE SENIOR LEADERS I HAVE KNOWN HAVE BEEN INCLUSIVE LEADERS, THOSE WHO MAKE PEOPLE FEEL AS IF THEY ARE TREATED FAIRLY AND RESPECTFULLY AND THAT THEY ARE VALUED AND BELONG.

clearly communicate their expectations; and to ensure that everyone is on the same page. When these conditions are in place, people can relax, think, engage with one another, innovate, and create.

If you want to stay out of the boss bubble, you must trust and empower people to do their jobs. This means, among other things, providing clear intent and then allowing employees to organize their own time and work; something researchers have identified as a very important leadership competency. Distribute power and responsibility throughout the organization, rely on the people who are closest to the work, and do not feel the need to make every decision, or even be involved in every decision. Research has repeatedly shown the positive effects empowerment and autonomy have on productivity, job satisfaction and commitment. According to Bourke and Espedido, inclusive leaders show openness to new ideas and foster organizational learning, and that squares with my personal experience of effective senior leadership. Senior leaders who encourage people to learn from their experiences and who openly support thinking that arises from that learning, are some of the most effective senior leaders I have encountered. It has been by observing those leaders that I've realized that, if leaders are to encourage learning, they first must be open to learning themselves and be prepared to change, without embarrassment, their course as necessary. That requires an approach to problem-solving and decision-making that allows others to generate knowledge and solutions without the senior leader over-steering.

Senior leaders exercise immense influence with the people they lead; and people look to them for guidance, pay close attention to the leader's actions, find meaning in their every move, and follow their lead. Consequently, an effective senior leader can exert enormous positive impact on the organization and its people. Conversely, an ineffective leader at the top of an organization or organizational unit can have far reaching negative consequences for the productivity, job satisfaction and commitment of people as well as on both the efficiency and effectiveness of the organization. Senior leaders, wishing to remain free of the boss bubble, will lead adaptively and inclusively. They will recognize and make use of the intelligence, wisdom, and

> talent of those around them. They will seek out diversity of thought and defer to the expertise in their organization. They will question their own assumptions, encourage others to do likewise, maximize transparency in their decision-making, and accept both challenges and feedback from people. They will connect with people and create a trusting environment

in which people feel they belong. Finally, they will trust and empower people to do their jobs, show openness to new ideas and foster organizational learning. These are not simple or easy things to do, but things to strive for -- when an organization's leaders and rank-and-file witness the senior leader seriously working toward these goals, it can create a rippling, positive effect throughout an organization.



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



POSTPONED BUT NOT FORGOTTEN

The 4th Annual National Workshop National Cohesive Wildland Fire Management Strategy

The best things come to those who wait. And wait.

The theme for the now postponed October 2020 4th Annual National Workshop was "*Hard Truths, Fantastic Failures and Landscape Implementation*". It was to be held in Asheville, North Carolina, the first opportunity to offer the workshop in the Southeastern Region. But like nearly all of this year's face-to-face events, the hard truths of COVID-19 required rescheduling the workshop for 2021. So, we're still coming for you Asheville. We just have to be patient.

The Wildland Fire Leadership Council (WFLC), the three Cohesive Strategy Regional Strategy Committees (NE, SE and West), and the International Association of Wildland Fire (IAWF) will co-sponsor the event.

During this delay we're taking the opportunity to present a review of the Strategy itself, its ongoing relevance and success, and the unique value that the annual workshops provide in hopes that you'll take advantage of the gathering and join us in Asheville in 2021.

The Strategy: A Review

The National Cohesive Wildfire Management Strategy was created to comprehensively address wildland fire management across all lands in the United States. It's by far the most wide-reaching, timely, and applicable strategy ever developed for wildland fire management. It sets broad, strategic, and national-level direction as the foundation for implementing actions and activities nationwide. It provides an all-inclusive and pertinent vision for wildland fire and society for the next century:

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

The primary, national goals identified as necessary to achieving the vision are:

- Restore and maintain resilient landscapes
- Create Fire Adapted Communities
- Facilitate safe and effective wildfire response

These goals effectively cover the major issues we face in wildland fire management now and into the future, addressing significant challenges that cannot be left unaddressed.

Keeping Up the Momentum

Now five years old, the National Cohesive Wildland Fire Management Strategy has seen many examples of the themes to be addressed when we gather at next year's workshop:

- *Hard Truths* What are they and where are the commonalities? What are the lessons learned about what's happened with wildland fire events and what must happen in the future to achieve change?
- *Fantastic Failures* where alignment of ideas and resources (both financial and people) did not produce the desired outcomes. What have we learned?
- *Large-Scale Landscape Implementation* We have the perception that there are many examples of large landscape resilience implementation. Are those areas large enough? How much is enough to create landscape resiliency? How will we validate that?
- Shared Responsibility how much is actually shared? How do we avoid the "blame game" when responsibilities are not redeemed as agreed?
- **Futuring** how do we plan for an unknown future and how do we act in it? What are we doing about it?

In the meantime?

Join us October 28, 2020 for an Interim, Interactive, Online Cohesive Strategy Event



The focus will be on how the Cohesive Strategy has continued to provide a vital, adaptable, and supportive framework even under the unique constraints and unprecedented challenges of 2020. We invite everyone who has a stake in wildland fire processes and outcomes now and for the future to register for the webinar and share this opportunity with others. https://www.iawfonline.org/events/

IAWF MENTORING PROGRAM

We are accepting applications for the winter cycle mentoring program through December 1. After the applications are received and reviewed, we will match the mentors and mentees based on interests and geographic location. Both parties will mutually agree to at least a six-month commitment. We will provide you with resources, i.e. checklists, agreements, suggestions, etc., if needed.

What makes a good mentor?

- Commitment to the mentee's learning and project goals.
- Ability to provide positive feedback, encouragement, and advice when requested.
- Interest in seeing and supporting the mentee's growth and success in their professional or personal goals.
- Ability to ask key questions to support the mentee to develop their problem-solving and creative thinking skills, and to be resilient and independent.
- Ability to establish clear expectations and commitments, to express these to the mentee, and to ask for the same.
- Generosity with tools and approaches that support others to learn
- Willingness to share key contacts and networks with the mentee, and to source other areas of expertise when required.

Timeline:

Application period open: October – December 2020

Review applications and introduce matches: December 2020

Mentoring Period: January – June 2021

Submit your application: iawfonline.org/mentoring-program

International Journal of Wildland Fire (IJWF) #IntlJWildlandFire

IJWF is published online and in print twelve times per year on behalf of the International Association of Wildland Fire by CSIRO Publishing.

One of many IAWF member benefits include access to

the online version of the Journal! IAWF members are also eligible for discounted Individual or Student print subscriptions.

View the Most Read papers on our webpage, the Most Read ranking is based on the number of downloads in the last 60 days from papers published on the CSIRO Publishing website within the last 12 months. Usage statistics are updated daily.

This months Open Access Papers are:

Forest fires in Mexico: an approach to estimate fire probabilities by Luis Galván and Víctor Magaña

Abstract: The probabilities of forest fires in Mexico are estimated using information on precipitation and temperature, along with data on type of vegetation, human activities near forests and fire prevention policies. The proposed model addresses the factors that account for extreme wildfire hazard, and may provide a basis for fire prevention actions, reducing vulnerability factors.

Additional keywords: climate, drought, natural hazard, vulnerability.

Climate change projected to reduce prescribed burning opportunities in the south-eastern United States

by John A. Kupfer, Adam J. Terando, Peng Gao, Casey Teske and J. Kevin Hiers

Abstract: Prescribed burning is a critical tool for managing wildfire risks and meeting ecological objectives, but its safe and effective application requires that specific meteorological criteria (a 'burn window') are met. Here, we evaluate the potential impacts of projected climatic change on prescribed burning in the south-eastern United States by applying a set of burn window criteria that capture temperature, relative humidity and wind speed to projections from an ensemble of Global Climate Models under two greenhouse gas emission scenarios. Regionally, the percentage of suitable days for burning changes little during winter but decreases substantially in summer owing to rising temperatures by the end of the 21st century compared with historical conditions. Management implications of such changes for six representative land management units include seasonal shifts in burning opportunities from summer to cool-season months, but with considerable regional variation. We contend that the practical constraints of rising temperatures on prescribed fire activities represent a significant future challenge and show that even meeting basic burn criteria (as defined today) will become increasingly difficult over time, which speaks to the need for adaptive management strategies to prepare for such changes.

Additional keywords: coastal plain, piedmont, managed fire regimes, statistical downscaling, wildfire



MEDIC ON THE FIRE INE

BY DYLAN BRUCE

A Gatorade bottle, a belt, a parachute cord, and a combi tool. These may not sound like your usual medical supplies, but in a pinch they can create a traction splint.

On the frontline of a wildfire, being able to improvise like this can be a lifesaver, and it's Molly Barker Bessey's job to teach these techniques to firefighters.

As an Emergency Medical Technician Firefighter, or Fire Line EMT, she provides medical support and emergency services to personnel on the frontlines from her home base in Phoenix, Arizona.

"Our role as wildland medical providers is extremely important on the frontline. Countless hours are spent training for the worst case scenarios because we need to be at our absolute best."

Working for emergency services provider Wilderness Medics, Molly, is a 32-year-old team leader who has worked on the frontlines of wildfires across the United States.

She got started with Wilderness Medics in 2018 when a co-worker at a local ambulance company in Phoenix, Arizona, told her about it. International Association of WILDLAND FIRE

UP INITIATIVE TO HONOR AND FEATURE STORIES OF SUCCESS

The "Fired Up" initiative features those who have made strides in advancing and contributing to wildfire/bushfire operations, mitigation/prevention, training and research. We invite members of the IAWF and the Wildland fire community at large to submit recommendations for individuals and groups that deserve to have their stories shared for publication.

"He was telling me about this incredible experience he had where he worked as a seasonal medic on forest fires.

"To be honest I had never heard of any professions relating to forest fires, nor did I believe everything he was telling me. He was describing my dream job!"

Before long, Molly had met the owners of Wilderness Medics, been interviewed, and passed the tests to be accepted.

Her first of now many wildland fires was the Buzzard Fire in the Gila National Forest in New Mexico, and the coworker who brought her on board is now her husband.

From treating blisters and bug bites to marking out spots for helicopter landings, Molly works to get her patients the care they need in the incredibly unpredictable environment that is the frontline of a wildfire.

In most situations a paramedic and an EMT are paired and sent out as a team to the frontlines, however circumstances sometimes demand they split up to cover more ground.

She and her team train fire personnel in basic first aid and teach them how to call in emergency traffic over the radio.

"Collectively we ensure the safety of life, the preservation of land, and the protection of values at risk."

She proudly calls the firefighters and others she works alongside on the frontlines her comrades.

"I have the utmost respect for every single man and woman that I have met in my relatively short career."

An important part of Molly's work is providing fire information to communities, as well as helping them prepare for post-fire disasters like flooding and mudslides.

"These are always difficult conversations to have; some are eager to put the preparation into action and some are quite the opposite."

She says that even though most people are receptive to the help, she understands how the stress of the situation can make people unwilling to listen.

"Not many people can relate to losing absolutely everything. I think it's important to keep an open dialogue."

The COVID-19 pandemic has added an extra layer of difficulty to Molly's work, and necessitated extra steps when handling patients.

"The quality of patient care has not changed, however some protocols and treatments have been modified to limit potential exposure.

"Masks are a must and temperatures are taken on every patient. We immediately inquire about symptoms and potential exposures."

With plans to complete her Registered Nurse qualifications in December and her Bachelors Degree of Science and Nursing in 2021, Molly says she is determined to keep working in the field.

"I knew when I was three years old I needed to be outside, and I am very thankful to Wilderness Medics for giving me this once in a lifetime opportunity."





Dauntless Air is an aerial firefighting company that exists to protect people, land and property. We fly to win the war against wildfires.

To learn more, visit our website at dauntlessair.com and download our vision paper, Transforming Aerial Firefighting for a Changing Environment, or reach out to us at **320-297-9088** to find out how you can strengthen your rapid initial attack capabilities.





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SCHOLARSHIP RECIPIENTS Where are they now?

We reached out to our past recipients to see what they are up to now; as you will see from the following, they are doing great, with successful careers, families, and many exciting adventures! We are so proud of them and wish them all continued success.

Each year the International Association of Wildland Fire (IAWF) awards two graduate-level scholarships typically valued at \$3,000 USD to Master of Science or Ph.D. students studying wildland fire or wildland fire-related topics. Student submitted essays are evaluated by an international panel of fire science experts and one award recipient is chosen for the Masters level and one for the Doctoral level. The IAWF has been presenting this award annually to members of the fire science community since 2007.

2011 RECIPIENT

ALEXIS WALDRON Oregon State University, Corvallis, OR, USA

I am currently a human performance specialist with the U.S. Forest Service. I have been very fortunate that I have been able to use much of the research I did while I was earning my degree – which IAWF helped support – to conduct leadership, resiliency and other personal development trainings with wildland firefighters and larger units within the Forest Service and other outdoor based organizations. This research has served as a foundation for other work that has been influential in how the wildland fire community thinks about leadership and its development. It has been so rewarding and exciting to receive feedback over the years on the difference it has made for people in the way they are able to show up for their work and lives to do what matters most. These days I don't find myself out on the fireline, but love hanging out with my husband, three-year-old and nine-month-old by bodies of water near the ocean, lakes, ponds, rivers, and puddles. Thanks IAWF!!

2016 RECIPIENT HÉCTOR LEONARDO MARTÍNEZ TORRES (LEO) National Autonomous University of Mexico, Mexico City, Mexico

I write from a small town in west-central Mexico where I have lived since I finished my PhD in October 2018. For now, I am very fortunate to participate in a project that seeks to bring university education to places and people that have long been excluded from this type of education in my country. I have seen, as never before, the enormous effort that many people must make in order to get study. Literally every peso (dollar, euro, rupee, etc.) can make a difference. That is why I think that the scholarship program of our beloved IAWF is perhaps the noblest, the most necessary ... and yes, I think it should be expanded! The acknowledgments at the end of the academic papers are usually very cold and short, so I take this space to thank the entire IAWF community. As I already said, financial aid is important, but IAWF goes much further than that: The friends that you make, the meetings, congresses, the academic opportunities, and more. For me, it is an honor to be part of this community, which I hope will continue to grow and grow, in number and diversity (more academic disciplines, more countries, more worldviews, more voices are necessary). Really, thank you so much.

2010 RECIPIENT

BROOKE CASSELL University of Washington, Seattle, Washington

I finished up my PhD in landscape and fire ecology at Portland State University in 2018. Since then I started my career in scientific publishing as a technical editor for Freshwater Science and as a writing coach and consultant for academic and science writers. I am absolutely thrilled to be working with writers from across the globe and all stages of their academic and research careers to tell compelling stories about why their work is so important (and I get to put on my grammar-nerd hat, which also makes me very happy). IAWF made a big difference in this path. My first ever poster presentation was at the IAWF 3rd Fire Behavior and Fuels Conference in 2010, and my IAWF scholarship that year helped cement my path firmly in fire research through helping fund my master's work in fire history reconstruction in Mexican pines. I went on to incorporate landscape modeling and social science to paint a picture of potential futures, and how local communities perceive them, in fire-prone forests in eastern Oregon. My favorite Covid-era activities have been snuggling with my baby girl and getting out for hikes (smoke permitting), and I am extra excited that chanterelle-hunting season is on the horizon.

2012 RECIPIENT RACHEL ANNE CARTER LaTrobe University, Victoria, Australia

I am the Director of The Geneva Association's Cyber programme. The Geneva Association is the leading international think tank of the insurance industry. Under my leadership, this research programme aims to help stakeholders understand cyber risks, and in particular, to assist the insurance industry in devising ways to respond effectively to cyber risks as they evolve. I co-founded the Journal of Terrorism and Cyber Insurance. I also worked in the international policy environment in the OECD and the corporate sector with a number of global insurers in their London headquarters. I also experienced the public private environment through my experience working for a government backed terrorism insurance pool. My roles were predominantly in research, development, innovation and strategy. I have a variety of research, strategy, underwriting, policy, consulting, regulatory and corporate experience, with specialties in catastrophe risk (re)insurance

solutions and disaster-risk financing options. I am a regular speaker at international conferences and have even spoken at the World Economic Forum (during a special focus cyber event). In addition to working in the areas of natural catastrophe, I expanded my research and practical experience into other potential disaster risk areas including terrorism and cyber and cyber terrorism. I have a desire to use leadership, innovation and education to help promote economic protection of lives, businesses and communities through sustainable insurance solutions. The focus is on elucidating the risk and encouraging society, through cross sectorial collaboration and efforts to educate the public, to become more resilient. The scholarship received through the International Association of Wildland Fire enabled me to complete my PhD in Law (Insurance). My PhD research was presented as evidence in Australian Parliament (Senate Economic References Committee) on promoting insurability for flood prone areas within Australia. I co-authored a book and was a contributing author to a multitude of academic research papers and reports. I am hoping that in due course, I can work with a number of practitioners to transform my PhD research into an operative multi-peril natural disaster insurance scheme to help Australians ensure they have adequate levels of insurance cover.

2015 RECIPIENT

WILL OLSEN Michigan Technological University's School of Forest Resources and Environmental Science

I graduated from Michigan Technological University in 2016 with my MS in Applied Ecology, with a research focus on post-fire erosion and the effects of salvage logging on water resources, supported in part by the IAWF scholarship. I started in April 2017 as the Forest Practice Monitoring Specialist in the Watershed Protection Program of the California Department of Forestry and Fire Protection, and I am currently a Senior Environmental Scientist in this position with the Department. I serve as lead technical analyst on monitoring projects related to timber harvesting on non-Federal lands in the state of California. I have led development of monitoring projects and served as lead author on reports related to post-fire salvage logging operations, and forestry operations related to increasing wildfire resilience. I also serve as a GIS specialist for technical analysis on post-fire state Watershed Emergency Response Teams following large wildfire events, including for the 2017 Thomas Fire, 2018 Carr Fire, and several of the 2020 summer wildfires in California. I have continued to focus on the same research studies that IAWF supported during my graduate studies, while enjoying some of the best mountainous wilderness found in far northern California in my free time.

2017 RECIPIENT MARSHALL STAGEBERG Michigan State University

I currently am a GIS/Data analyst for the environmental consulting firm, Antea Group. I am working on publishing the work I was able to accomplish due to the help of the IAWF Scholarship and hope to continue the work moving forward!



2014 RECIPIENT

MILTIADIS ATHANASIOU National and Kapodistrian University of Athens, Greece

I am working as a Research Affiliate with the Institute of Mediterranean Forest Ecosystems in Athens, Greece. My work includes documentation of wildfire behaviour and firefighting in the field, followed by behaviour analysis in the office using GIS, and analysis of safety considerations, especially for extreme fires. Among the fires I have studied is the tragic wildfire of July 23rd, 2018 in Northeastern Attica, Greece, which caused 102 fatalities. I am currently working on a book that will include all the information I have collected, the analyses I have carried out with other colleagues and the conclusions that will help avoid similar accidents in the future. Fuel measurement and modelling, fire risk assessment and prediction and firefighting effectiveness and safety are additional fields I work on. Regarding safety I have reconstructed and analyzed many past firefighting accidents that have taken place in Greece and published the lessons learned. In parallel with my research activities, I train professional and volunteer firefighters on wildfire behaviour, hazards, human factors, safety and health on the fire line, and forest firefighting tactics, I develop and conduct fullscale wildfire drills with first responders and teach citizens how to prepare their houses and protect themselves. One example is my participation in a team of international and Greek fire experts who, in April 2019, delivered a week-long high level course on extreme fire behavior, Wildland Urban Interface fire dynamics and impact, as well as firefighter safety at the Hellenic Fire Academy in Kifissia, Athens, Greece. The trainees were 25 selected officers of the Hellenic Fire Corps. On top of the above, I try to promote the use of fire in fire prevention and suppression in Greece, which for the time is not legally recognized.

2016 RECIPIENT

MONIQUE WYNECOOP

Fire Science Program, College of Natural Resources, University of Idaho

I am working in the ancestral homelands of my husband and children on the Colville National Forest as the Fire Ecologist for NE WA Region 6 and also am working part-time with the Northern Rockies Fire Science Network as Fire Ecologist/ Tribal Liaison. The scholarship has opened doors that have helped connect me with many groups and professionals with a similar passion for helping tribal communities, and has led to me working on projects with the Northern Rockies Fire Science Network and with groups, such as the Northwest Climate Science Adaptation Center, NW Scientific Association, Journal of Native Sciences, and others that have helped me pursue my passion of working to promote improved collaboration and communication between communities and tribal and non-tribal agencies.



2019 RECIPIENT

SAMUEL HILLMAN

RMIT University, Australia

The IAWF scholarship has provided the catalyst for collaboration with world leading remote sensing experts in Australia and the University of British Columbia in Canada (UBC), and fire experts at the US Forest Service's Rocky Mountain Research Lab in Missoula, Montana. The scholarship contributed to my travel expenses which enabled me to spend time at UBC and in Missoula in 2019. My project investigates the utility of 3D point clouds captured from drones to measure fuel hazard and vertical connectivity in fire prone landscapes around the world. The IAWF scholarship allowed me to collect new data in multiple locations: three forests in central British Columbia and conifer forests in the Lubrecht Experimental Forest in Missoula. This will complement data already obtained in the savannah grass lands of the Northern Territory and Eucalypt forests of South East Australia. The scholarship provided me with an opportunity to work with world-leading scientists and experienced operational practitioners. The results of this project will form a chapter of my PhD, and more broadly enhance the way we measure and interpret fuel hazard information. I also work part-time with Forest Fire Management Victoria, in developing fuel monitoring applications to capture hazard and moisture information across the state. The importance of linking research with operations to improve fire management was further reinforced during the 2019-20 fire season, which resulted in severe environmental, social and economic impacts. I look forward to continuing my involvement with the IAWF and being involved in connecting research with operations.

IAWF SCHOLARSHIP

2009 RECIPIENT

KELSY GIBOS University of Toronto, Toronto, Ontario, Canada

I'm officially 15 years in the wildfire business now! After completing my MSc at the University of Toronto, I landed a great gig analyzing fire behaviour following the Black Saturday Fires in Victoria, Australia. My experiences in the sun-burnt country have changed my perspectives on fire, and I'm positive I would not have had this opportunity without the scholarship funding support that I received. I learned so much about fire behaviour in a land where trees explode, weather systems spin in a reverse direction, and fire burns at night. The friendships and professional connections I made over there will last a lifetime! In 2014, I returned to Canada and worked 5 years as a Wildfire Management Specialist in the Edson Wildfire Management Area where I analyzed landscape scale fire risk and supported wildfire operations as a Fire Behaviour Analyst. Recently I accepted a new

adventure as a Wildfire Training Specialist and have moved my family to Hinton, Alberta where we are loving living in the Rockies. I am the chair of the national Fire Behaviour Specialist Course, and I get to share my passion and teach fire behaviour to new recruits all the way up to the advanced level. I recently added the cutest little dude to my family, so it's the first fire season I've taken off in a while. Sullivan is now 9 months old and we're having a blast playing outside with our 2 dogs Twigs and Huckleberry. Thank you IAWF for your support in my professional development... I think I have absolutely the best job ever!



IAWF 2020 ANAARD RECIPIENTS

The International Association of Wildland Fire is pleased to share the 2020 Award Recipients. These prestigious awards are generally presented at one of our conferences, however, due to Covid-19, this year we have planned virtual award ceremonies to honor the recipients. The Call for Nominations for the 2021 Awards is now open through December 2nd. Learn more and nominate on our webpage. https://www.iawfonline.org/awards/

Congratulations to all of the 2020 Award Recipients.

EMBER AWARD FOR EXCELLENCE IN WILDLAND FIRE SCIENCE DR. DAVID L. MARTELL

For 45 years Dr. David Martell has been a passionate and dedicated member of the wildland fire science and management community. Dr. Martell is recognized as a synergistic force for his work in operations research, renewable resource management and forest fire science, and for his contributions to the development of innovative fire occurrence prediction modelling. One of Dr. Martell's seminal research projects involved the development of an initial attack simulation model which strongly influenced the Province of Ontario's decision to expand their air tanker fleet. This decision led to the development of the Level of Protection Analysis System, which allows the structured assessment of the outcomes and costs associated with alternative fire management policies, budgets, and suppression resource mixes, and has been adapted for use by several Canadian fire management agencies. Dr. Martell has had a strong influence on the development of fire leaders and managers across Canada because

he dedicated time to understanding their operational point of view, integrating academic and operational perspectives, and absorbing the real application of fire management. In addition to his research and modelling accomplishments, Dr. Martell is an outstanding collaborator, professor, and student mentor. Dr. Martell established the Fire Management Systems Laboratory in the Faculty of Forestry (now the Institute of Forestry and Conservation in the John H. Daniels Faculty of Architecture, Landscape and Design) at the University of Toronto where he developed approaches to solving regional, national, and international management problems. Under Dr. Martell's guidance dozens of students have received graduate degrees through this laboratory and many now have leadership roles in fire management agencies. Dr. Martell has authored or co-authored more than 75 peer-reviewed papers and dedicates time as an Editor and Member to a number of prestigious national and international organizations.

FIREBREAK AWARD FOR EXCELLENCE IN WILDLAND FIRE MANAGEMENT TIM SEXTON

Tim started his career as a seasonal firefighter on the Shasta-Trinity NF. Early in his career Tim held positions on various National Forests, the Bureau of Land Management, and National Park System, a few of which are highlighted below. Tim was also the first Superintendent of the Redmond Hotshot Crew, where he positively influenced numerous individuals who later went on to esteemed careers in resource and fire management. Tim then became a District FMO on the Winema NF, while obtaining a master's degree in Fire Ecology from Oregon State University. As the Deputy Regional FMO for the Intermountain Region of the National Park Service Tim's attitude and perspective of "fire use" began to evolve. With the support of mentors and leaders he began to understand the need for beneficial wildfire on the land and quickly became an advocate himself. After a year as Deputy Regional FMO Tim took on a new position

as a Fire Ecologist for the National Park System. In this position, Tim showcased his deep compassion and empathy for folks in the fire community by unpopularly advocating for the crewmembers who were implementing the prescribed burn that escaped and became the Cerro Grande Fire. Many of those individuals have said that Tim's unwavering support was critical in the days after the fire when they felt vilified. Tim returned to the USFS as the national Fire Use Program Manager where he became a vocal proponent of the use of wildland and prescribed fire. Due to Tim's leadership in this area he was selected as the lead in an interagency effort to update the federal wildfire management policy. This update was a major change in how federal land management agencies managed natural occurring wildland fires and removed many barriers to the flexibility needed in developing objectives and strategies to manage these fires. Currently, Tim is the Program Manager for the Interagency Fire Program Management RD&A program. He has been instrumental in improving the Wildfire Decision Support System by being responsive to users on needed updates for the next generation of the database. He and his staff provide critical tools to support Agency Administrators, fire managers, and incident command teams in managing wildland fires.

FIREBREAK AWARD FOR EXCELLENCE IN WILDLAND FIRE MANAGEMENT NEIL COOPER

Neil Cooper has made a defining contribution to modern fire management in the Australian Capital Territory (ACT) and his influence extends across the globe. Neil commenced firefighting in 1983 with the ACT Bushfire Service and has remained actively involved. Over the past 36 years, he has held every position from basic firefighter through Group Captain within the ACT Rural Fire Service. In 1999, Neil was appointed manager of all fire related activities within ACT Forests and in 2006 he was appointed Director of the newly formed ACT Fire Management Unit (FMU). The FMU was responsible for managing fire across 80% of the ACT including a large wildland-urban interface, fire-prone nature reserves within the urban area and steep, rugged alpine terrain of the Territory's water catchment. Neil developed a world class ACT fire program based on the latest science, technology, training and safety knowledge.

Neil is a member of the National Council of Australasian Fire and Emergency Service Authorities Council. As a member of the board of directors he represents the interests of all land management agencies from across Australia and New Zealand in their fire management functions within the Australasia's industry peak body. Neil is also Chair of the Forest Fire Management Group which reports to the Council of Australian Governments, the peak intergovernmental forum in Australia. Neil is a founding member of the National Burning Project Executive Committee – a multi-million dollar project that delivers operational outcomes that provide consistency for the fire industry across Australia. He is also the ACT representative on the Forest and Forest Products Committee. Neil has twice represented Australia at the United Nations Committee on Forestry, and currently represents Australia at the North American Forest Fire Working Group meetings. Neil has also contributed to international fire-fighting deployments to North America in 2006 as Branch Director, in 2008 as Liaison Officer, and in 2017 as International Liaison Officer.

2020 IAWF AWARDS

EARLY CAREER AWARD IN FIRE SCIENCE DR. ALEXANDER FILKOV

Dr. Alexander Filkov's research program and expertise in fire behavior is recognized at a national and international level. He has been conducting wildland fire research since 2002 and has published 35 refereed journal articles, authored 2 books, 1 book chapter, and 10 refereed conference papers. Dr. Filkov has also recorded 2 patents and 2 certificates, and his research achievements have been recognized in numerous national and regional awards. Dr. Filkov's work covers a broad range of topics in fire behavior research, from understanding dynamic effects and how they influence the ignition and combustion of fuels, to how fires transition into Wildland-Urban Interface (WUI) areas, and how structural materials perform in fires. Dr. Filkov's collaborations with the laboratory of the National Center of Scientific Research in France has resulted in

some major findings in understanding thermal properties and smoldering of peat, the results of which contributed to the existing models of peat fires. Dr. Filkov also collaborated with Worcester Polytechnic University (USA) and the University of Edinburg (UK) to conduct a series of experiments studying firebrand production using infrared cameras. From these experiments he developed a software to detect the location of flying particles generating an estimate of the number and flux of firebrands generated by a wildfire. He also studied the probability of fuel bed ignition by firebrands in laboratory experiments, the results of which allowed him to develop a mathematical model for the transport of firebrands from the combustion zone. This contributed to a better understanding of generation, transportation and ignition potential of firebrands during prescribed and wildland fires. Dr. Filkov has also mentored numerous graduate students, demonstrating his commitment to future generations of wildland fire researchers. He has been co- supervisor of one PhD student, 2 master students and 5 specialist students at Tomsk State University, Russia. He is currently co-supervising one PhD student and one master student at the University of Melbourne. Dr. Filkov has a strong growth potential and he will continue to contribute greatly to the wildland fire community and to wildland fire science.

EARLY CAREER AWARD IN FIRE OPERATIONS **NOLAN BUCKINGHAM**

Mr. Nolan Buckingham currently serves as crew superintendent of the first of its kind Kootenai National Forest OU3 Asbestos Wildland Fire Suppression Module. This 10-person module, established by Mr. Buckingham, is responsible for suppressing wildfires and mitigating wildfire hazards in the 30,000-acre Operable Unit 3 (OU3) of the Libby Superfund site. In addition to the typical challenges associated with wildland firefighting in the steep terrain of the Kootenai National Forest, a new level of complexity is added by the Superfund site. The tree bark, duff, and soil in this area has documented presence of Libby Amphibole Asbestos, a well-known toxic substance that requires the use of Positive Air Pressure Respirators (PAPRs) when suppressing wildfires in the area. Leading the nation's first ever Hazmat wildland firefighting module includes unique

challenges, such as ensuring safety of the crewmembers, which Nolan effectively managed. Nolan ensured his crew correctly wore PPE and were decontaminated following assignment in the Superfund area. During the 2018 and 2019 summer fire seasons Nolan's crew experienced zero injuries, a testament to his leadership and commitment to safety. Another testament to Nolan's leadership is his crew retention rate. Despite the challenging and frequently uncomfortable nature of fighting fire in a hazmat area, over half of Nolan's crew from 2018 returned in 2019. With the Kootenai hazmat module as a pilot, Nolan and his crewmembers have created a workable model for suppression of wildfires in Superfund and other hazardous locations across the country. Similar adherence to safety guidelines, training, and replicable procedures established and perfected by Nolan will allow other similarly situated Forest Service districts to safely suppress and mitigate wildfires in hazmat areas. When not serving as crew superintendent of the OU3 module Mr. Buckingham serves as a crew boss and prescribed burn boss for Chloeta during the fall and spring prescribed burn seasons in the southeastern and Midwestern United States, responsible for a portfolio of prescribed burn projects exceeding 15,000 acres annually. Nolan is also a wildland fire instructor for both Chloeta and Colorado Firecamp.

Wildfire in the Sakha Republic, within the Arctic Circle, Russia (Lat: 67.42687, Lng: 154.53369) - June 21st, 2020. Infrared view. Contains modified Copernicus Sentinel data, processed by Pierre Markuse. Image is about 37 kilometers wide.

Fire in the North THE 2020 SIBERIAN FIRE SEASON

BY SUSAN G. CONARD AND EVGENII PONOMAREV

INTRODUCTION

The year 2020 started out with record high temperatures across much of Siberia (Figure 1). Average spring temperatures were more than 8 degrees C over long-term means in many areas. Scientists from the World Weather Attribution Organization concluded that these extreme temperatures could almost certainly be attributed to long-term climate change (Ciavarella, et al., 2020). The result was early snowmelt and rapid drying of fuels in many areas. While temperatures in southeastern and western Siberia became cooler than average by late June due to changes in atmospheric circulation patterns (Figure 2), the stage was set for high fire hazard across much of the region. Whether you get your news from mainstream media, Twitter, or the Siberian Times, it would be hard to have missed the chatter about the severe fire season in northern parts of Siberia this past summer. In this article we provide some basic information about monthly and latitudinal distributions of fire in Siberia from March through September of 2020 and compare the annual relative importance of fire in northern Siberia to total burned areas in Siberia for 2000-2020. Russia has a large firefighting organization, comprised of the national Aerial Forest Protection Service (Avialesookhrana) and local fire brigades. In the northern areas of the country (mainly above 65N latitude in Central and Eastern Siberia) the primary mode of fire detection is through satellite monitoring. Fires in this region are typically not suppressed, except immediately around the sparsely-scattered towns, villages, and industrial sites. Suppression is more active below about 65 degrees N latitude, but many fires even in those areas are little affected by suppression. About 3–10% of the fires each year can get quite large, and these fires comprise a high percentage of the burned area. At northern latitudes, any fire under 2,000 ha (about 5,000 acres) is considered a "small" fire, and individual fires over 100,000 ha (250,000 acres) are quite common. However below approximately 65 N latitude, where fire detection is typically by on-ground monitoring and aerial fire observers, any fire over 200 ha (500 acres) is classified as a large fire. For residents in most of the US or any other northern country, with the possible exception of Canada, the scale of the landscape and therefore the amount of area burned every year in Siberia can be hard to imagine. Siberia extends from the Ural Mountains to the Russian Far East and from the Chinese and Mongolian borders (about 50 degrees N) to the Arctic Ocean (about 75 degrees N). It covers over 10 million square kilometers (nearly 4 million square miles), about 6.6 million square kilometers of which is forested.

The borders of Siberia are defined in several different ways; the area we are considering is outlined in Figure 3. A typical fire season in Russia starts in the south around March and gradually moves to the north as the weather warms and the snow melts. Early to mid-summer is the primary season for fires in the far north (above 65 degrees latitude), but the active fire season in middle latitudes can have a second peak in August, and occasionally into September (Valendik 1996; Soja et al. 2004). The earliest fires are in steppe regions along the Chinese-Mongolian border. Many of these are relatively short-lived agricultural fires; others may be quite extensive. (E. Ponomarev, data on file). There was intense media, scientific, and social media interest in northern Siberia fires generated by this summer's severe fire season in northern parts of Siberia (e.g. Berwyn 2020; McCarty et al. 2020; plus many Twitter

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Figure 1. March 19-June 20, 2020 Land surface temperature anomalies compared with average temperatures for Spring 2003-2018. Source: https://earthobservatory.nasa.gov/images/146879/heat-and-fire-scorches-siberia

posts on satellite data by Mark Parrington, Thomas Smith, Pierre Markuse and others). This article attempts to put these fires in perspective with both the 2020 fire activity throughout Siberia and the extreme interannual variability of fire activity across the region. Our analysis is based on burned area. We do not discuss fuel consumption or emissions, although we recognize that these are important considerations for understanding the interactions of fire with carbon cycles and greenhouse gases. For the current article we have compiled information on the seasonal and latitudinal patterns of fire across Siberia for the 2020 fire season, and on the relative importance of far northern fires (above 65 degrees north) over the past two decades. While much of the press and other online information has talked about Arctic fires, we have chosen to use latitudinal bands. This is because the Arctic circle (about 66.5 degrees N) has little specific relevance to vegetation and fuels distribution in Siberia, where the forest/tundra boundary ranges from below 65 to over 70 degrees N latitude.

BURNED AREA ESTIMATION

We used satellite data from NOAA/AVHRR (2000 – 2003), NOAA and TERRA/MODIS (2003 – 2006), and TERRA, AQUA/MODIS (2007 – 2020) which has been received daily by the Krasnoyarsk receiving station since 1996 (Sukhinin et al., 2004). Active wildfires were detected by analyzing reflectance and temperature values in near-infrared (0.8-0.9 μ m), medium-infrared (3.5-4.0 μ m) and long-wave infrared (11 – 12 μ m) spectral ranges.

Generating the wildfire data base was a multistep process, including: (1) active fire detection; (2) the creation of fire polygons from adjacent fire pixels; and (3) the correction of resulting polygons. The processing chain for MODIS data was adapted from Giglio et al. (2003) by incorporating several

Veg. cover type	Number of wildfires ×10 ³	Burned area (Million ha)	% of wildfires	% of burned
Deciduous	1043	1.35	6.94	5.07
Dark coniferous	287	0.39	1.91	1.46
Light coniferous	4343	12.54	28.88	47.10
Tundra (65+N zone)	672	3.52	4.47	13.22
Steppe (<57N zone)	7994	8.36	53.16	31.40
Other	699	0.466	4.65	1.75
Total for 2020	15038	26.626	100	100

Table 1. Distribution of 2020 fires in Siberia by vegetation cover types. The "other" category includes various mixed vegetation types. Peat bog is not shown here as a separate category since some of it is included in the forest types and some is under "other". Dark coniferous forest includes spruce, fir, and Siberian pine; Light coniferous forest includes Scots pine and larch forests. These are standard categories in Russian forest classification.

FIRE GLOBE - BOREAL FIRES

Surface air temperature anomaly - June 2020 [Data: ERA5. Reference period: 1981-2010]

500 hPa geopotential height anomaly - 18-30 June 2020 IData: ERAS. Reference period: 1981-2010

Figure 2. Surface air temperature and geopotential height anomalies for June, relative to the 1981-2010 June average. The geopotential height anomaly highlights areas of unusually high (H) and low (L) pressure over Siberia and the associated direction of the large-scale wind patterns (black arrow). Data source: ERA5. Credit: Copernicus Climate Change Service, ECMWF.

adjustments in background characterization and detection probability estimation (Shvetsov, 2012).

Active fire pixels detected in a series of successive satellite images were combined into individual fires (polygons for GIS). For each fire we determined the location, the first and last date of registration of the fire, and the polygon area. Especially for small fires, active fire data overestimates fire size because the heat signature is reflected over a larger area than the fire. After aggregating fire detections into fire polygons, the active fire database records were calibrated to burned area using 112 scenes of Landsat post-fire imagery over three fire seasons (2011-2013). The sample included about 5% of the fires in the study area for those years. We developed linear regression equations for four fire size classes to describe the relationship between initial burned area estimates from MODIS hotspots and burned area of fire scars observable on Landsat. These equations were used to adjust fire polygons for the rest of the active fire detection data (Ponomarev and Shvetsov, 2015). As expected, corrections were greatest for smallest size classes. For fires up to 200 ha the area of the thermal signature was three times the estimated burned area. This overestimate decreased rapidly with fire size, such that for fires over 2000 ha to 50,000 ha the burned area was 80 percent of the active fire area. No calibration was necessary for fires over 50,000 ha. In a typical year 75 percent (up to 90% in extreme seasons) of the burned area in Siberia is in fires over 2,000 ha. (Ponomarev et al. 2019)

VEGETATION CHARACTERIZATION

We used the USSR 1990 landscape map (see Soja et al. 2004) as well as a map of major Siberian forest types for 2018 (VEGA-PRO Service of the Russian Academy of Sciences' Space Research Institute – IKI, Moscow, http://pro-vega.ru/maps/) to determine the land cover type associated with each fire. Polygons were classified as forest or non-forest. Some of the non-forest fires, especially in the south, are visible for one day or less. Most of these are agricultural fires and are under 200 ha. In 2020, such short-lived springtime fires accounted for about 55% of total numbers, and 13% of the total area burned.

RESULTS

Figure 3 shows all the 2020 fires observed for Siberia and adjacent areas, such as China and the Russian Far East. The data we present are only for Siberia (the area bordered in dark green). Forest areas are shown in light green. This map illustrates both the broad distribution of fires across northern Asia and the patchiness of where fires occurred. It is typical in Siberia to have fire outbreaks in different regions from year to year. Where large, persistent areas of fire occur in a given year is determined largely by atmospheric circulation patterns, including the occurrence of dry lightning storms. The position of loops or waves in the Jet Stream, and how fast these Jet Stream waves are moving from west to east can determine the location and duration of cool wet and hot dry periods, which have a strong effect on when and where large and severe fires occur (Valendik et al., 2014). Figure 2 illustrates how a loop in the Jet Stream can affect surface temperatures. This transition from higher than average spring temperatures across Siberia, to cooler temperatures (and rainfall) in areas of southeastern, central and western Siberia in late June is reflected in the spatial distribution of fires. There were few fires in the region where cool air and a low-pressure system disrupted the drought. The largest burned areas (Figure 3) are found where high temperatures and drought persisted into the summer. These prolonged dry periods in northern regions, especially in parts of north-eastern Siberia, led to an unusually severe fire season over a broad region.

The latitudinal distribution of Siberian fires in 2020 is illustrated in Figure 4. Our total estimated burned area, which includes forest and all types of non-forest fires in Siberia from the beginning of the fire season in March through the end of September, 2020, was about 26 million ha (64 million acres). Note that this is different from official data, which would cover fires only in forest zones. About 31 percent (8.4 million ha; 20.8 million acres) of the fires in 2020 occurred in the steppe regions in southern Siberia. Thirteen percent (3.5 million ha; 8.6 million acres) was in tundra to the north. About 37 percent (14.3 million ha; 35.3 million acres) was in various forest types, including pine, mixed conifer, and larch forests (Table 1). Over the course of the fire season, burned

areas were similar in all latitude bands (except north of 75 degrees; Figure 4). Total burned areas ranged from about 6.1 million ha (15.1 million acres) between 60 and 65 degrees N to 6.8 million ha (16.8 million acres) between 65 and 70 degrees N. The number of fires, however, varied markedly in the different zones, with many small fires in the south, and a lesser number, but larger, fires in the north. This is a function of both vegetation and differences in fire suppression and accessibility from south to north. Many of the large southern fires are either in steppe or in pine and larch vegetation with herbaceous or lichen surface fuels, where fire is generally lower intensity and easier to suppress. Farther north, forest understories are denser and moister, natural fire intervals are longer, fires occur only under conditions of severe fire danger, and fires that do burn are more likely to be high-intensity crown fires. Furthermore, the active detection and suppression of most fires below 65 degrees N differs from areas north of 65 degrees, where detection is mostly by satellite and suppression actions are focused primarily on protection of life and property. Lastly, in the 2020 season the severe, prolonged drought in the more northern areas led to higher than usual fire intensity and made fires more difficult to suppress, and less likely to be extinguished by rainfall events. These factors combined lead to the trend shown in Figure 4.

Burned Area and No. of Fires by Latitude in 2020

Figure 4. Burned area and number of fires in Siberia from March through September 2020, distributed by latitudinal bands. Total burned area for Siberia in 2020 was 25.5 million ha, in almost 15,000 individual fires.

Fires north of 65N Latitude

Year

Figure 5. Percent of burned area and percent of total number of fires for Siberia that occurred above 65 degrees North latitude from 2000-2020. In 2020 26.8 percent of the burned area was north of 65 degrees

Monthly Burned Area by Latitude

Figure 6. Monthly progression of burned areas by latitudinal band in Siberia during the 2020 fire season. Some individual fires burned in more than one month, so parts of them may be included in separate bars.

HOW UNUSUAL WAS THE **2020 FIRE SEASON IN** NORTHERN LATITUDES?

While the dominance of northern fires was unusually large in 2020, it was not unprecedented (Figure 5). Since 2000, there have been several years when a high percentage of the burned area in Siberia occurred north of 65 degrees. In almost 2/3 of years less than 5% of the burned area was in this region. There were only 7 years (33%) when more than 10% of the burned area was in this region. Nonetheless, burned areas in 3 of these years (2001, 2013, 2020) exceeded 25% of the total area burned in Siberia. While this past year has clearly been unusual in the area burned in northern Siberia, it is hard to see a trend over the 21 years of record. In fact, the year with the largest percent of burned area in these northern regions was 2001. Extensive high severity fires were observed only in 2001, 2005, 2013, 2019, and 2020. If you exclude these years of extreme fire activity, the average percent of total Siberian burned area that occurred north of 65 degrees was 1.9% from 2000-2009 and increased to 3.0% from 2010-2020. This provides at least preliminary evidence of a possible trend toward increased burned areas with warming climate. While these data align with what we might expect as climate warms, interannual variability is so high that more than two decades of observation is needed for conclusive evidence of a long-term northward shift in fire activity toward the Arctic and northern boreal zones. The data do not support a relationship between the number of fires and area burned. This is not surprising as correlations between the number of fires and burned areas are generally weak. Burned area is largely driven by a relatively small number of the largest fires. Although we do not show it here, other data indicate that the high fire years in the far north are not necessarily correlated with high fire years in the rest of Siberia. The seasonal trends in where fires occurred in 2020 are documented in Figure 6. Some fires burned for several weeks. In this case the burned area of an individual fire could be distributed across more than one month. There were large areas burned at southern latitudes starting as early as March and into April. By April large areas were burning between 50 and 60 degrees north. Much of the March and April burning was in steppe, some of which would have been agricultural burns. These early fires in southern regions are carried by dead herbaceous fuels, which dry out and become

Wildfire in the Sakha Republic, within the Arctic Circle, Russia (Lat: 69.21915, Lng: 149.95995) - June 23rd, 2020. Infrared view. Contains modified Copernicus Sentinel data, processed by Pierre Markuse. This fire in burning in a lowland area with a matrix of forest, bogs, and lakes. It had been burning since early June. Image is about 70 km wide.

flammable after snow melts in the early spring. While there are large areas of steppe fires, some of these southern fires also occur in conifer forests, especially in pine and southern larch forests. Larch is a deciduous conifer that can have a lush herbaceous understory, whereas the southern pine forests tend to be more open with grass and other low surface fuels. As the grasses and other herbaceous vegetation begin their spring growth in steppe and southern forests, the understory decreases greatly in flammability. While there was a lot of fire activity between 55 and 60 north in April, only 12 percent of this burned area and 18% of fires were in forest. The low burned area in May reflects a transition period between fire season in these southern areas, and increased fires in more northern forests as forest floor fuels, or fuels in normally-wet open peat areas, dried where summer drought occurred. June and July of 2020 were the most active months of the summer fire season north of 60 degrees. This is the period when large fire outbreaks were observed in the far north (65-75 degrees N). While much of the publicity speculated that large areas of peat were burning, as occurred in 2012 in western Siberia, we estimate that fires in peat bogs accounted for 0.82 million ha in 2020. In 2012 1.44 million ha of peat bogs burned, but these were primarily in western Siberian on a vast alluvial plain that contains extensive peat bogs in a peat-forest matrix. In 2020, most of the northern fires occurred in forested areas. Many of these were in northern larch forests on permafrost, where surface fuels are typically dominated by mosses, and organic layers may be quite deep.

SUMMARY

Unusually high spring temperatures in 2020 set the scene for a potentially severe fire season, especially in areas where these extreme temperatures persisted throughout the summer. Burned area data show that there was an unusual amount of fire activity in the 2020 fire season in northern Siberia (north of 65 degrees). This fire activity was associated with severe summer drought that led to extreme fire behavior and long-duration fires. In March fires started at lower latitudes (50-55 degrees N) and expanded to midlatitudes (55-60 degrees N) in April. After a lull in May, fire activity increased in June and July from 60-70 degrees N. The largest burned area during this period was north of 65 degrees, near or above the Arctic Circle. Most of this fire was in areas classified as forest, some of which, based on evidence not reported here, was almost certainly intermixed with peat bogs. While the fire season extended into August and September, actively burning area decreased and fires were focused on latitudes below 65 degrees N. Some fires continue to burn at this writing, but areas of active fire were decreasing rapidly in early October. Because of the extreme interannual and geographic variability of fire occurrence, severity, and burned area in Siberia, it is difficult to conclusively attribute this summer's fires to changing climate, although this type of severe fire season in northern Siberia certainly can be expected to become more common in the future.

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ABOUT THE AUTHORS

Susan G. Conard,

Affiliate Faculty, George Mason University, Fairfax, Virginia USA.

Susan holds a BA in environmental studies from Antioch College and MS and PhD degrees in ecology from the University of California,

Davis. She worked as a fire researcher and research project leader with the US Forest Service from 1983 to 1996. From 1996 through 2008 she was the Forest Service National Program Leader for Fire Ecology Research. She currently holds an Affiliate Faculty position at George Mason University. Dr. Conard is a past president of the International Boreal Forest Research Association, and a Fellow of the American Association for the Advancement of Science (AAAS). Her research has focused on wildland fire, with an emphasis on integration across scales and disciplines, including fire regimes and fire effects, fire behavior, remote sensing, and fire/climate interactions. She has conducted research in western North America and Siberia. Dr. Conard has been co Editor-in-Chief of International Journal of Wildland Fire since her retirement in late 2008. She has over 75 publications. (sqconard@aol.com)

Evgenii I. Ponomarev

Laboratory of Forest Monitoring, V.N. Sukachev Institute of Forests, Federal Research Center, Krasnoyarsk Science Center SB RAS, Krasnoyarsk, Russia.

Evgenii is a senior scientist at the V.N.

Sukachev Institute of Forests, Federal Research Center, Krasnoyarsk Science Center, Siberian Branch, Russian Academy of Sciences. He is also an Associate Professor at the Siberian Federal University in Krasnoyarsk, Russia. Research interests include wildfires, post-fire effects, remote sensing, and GIS technology. He has led the wildfire remote sensing program in Krasnoyarsk for the past 10 years and has over 60 peer-reviewed publications on fire in Siberia, both in Russian and in English. Dr. Ponomarev received his PhD in 2003 on "Operational Assessment of Fire Danger in Forests Based on Satellite Data". (evg@ksc.krasn.ru)

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PASSING THE TOROR OF A TO TOMORROW'S WILDLAND FIRE PROFESSIONALS: THROUGH MENTORING, TRAINING AND PYROTOURISM

Torch Miller gittin' it done in the Florida pineywoods

BY STEVE MILLER AND JOHNNY STOWE

Culture and heritage are not just the past, but they are, as well, what we do today ... and what we do today becomes the culture of tomorrow.

> We can and must carefully craft our cultures, keeping the best of the past as we adapt for the future.

When surveying a species you wish to see prosper, it is good to see plenty of mature adults, but just as or more important to see reproduction; without recruitment and also retention, when the older cohorts are gone, a population plummets. And restoring a population is a great deal harder than maintaining one.

In today's world of increasing socioecological complexity, the need to recruit wildland fire professionals (WFP) for the future is greater than ever. The current demand for WFP far exceeds supply, as is evidenced by regular intercontinental transfer of staff to manage large wildfires. As we venture into what Stephen Pyne has coined the Pyrocene Epoch, the increasing need for qualified, talented and productive professionals will continue.

In "Challenges to Educating the Next Generation of Wildland Fire Professionals in the United States," Kobziar *et al.* (2009) propose a career development paradigm. We use Kobziar's model and others to describe recent and current professional pyropathways, and we propose ways to develop the women and men who are the future of wildland fire. Breaking a concept down into three components as a way to describe physical, and especially social phenomena, is a widespread practice permeating society. Be it in physical or biological sciences or the humanities; advertising and marketing; songs and slogans; or pretty much anywhere you look, you see this tendency. Whether that is simply the way the world often happens to work or because it is a psychologicallycomfortable and mentally-manageable construct and a useful way of understanding and remembering things, groupings of threes are a valuable mnemonic tool.

Often, we use the figure of a triangle to represent these concepts. We have our basic fire triangle, easily understood by anyone, with the three legs of fuel, heat and oxygen all necessary to have the triangle, and all thus necessary to have any fire, wildland or otherwise. And there are many other triangular concepts within and without the realm of wildland fire.

The Wildland Fire Professional Development Triangle

Kobziar et al. introduced yet another fire triangle: the wildland fire professional development triangle, the three sides of

The Wildland Fire Professional Development Triangle. Kobziar et al. 2009

which they define as education, training and experience.

The education leg is typically supported by university and similar programs, while the training leg, as we use the term here, tends to be the more job specific National Wildfire Coordinating Group (NWCG) style training provided by agencies in the U.S. Other countries have similar training programs.

The experience leg is doing the work. The challenge for budding WFPs is finding the right balance of the three legs for their particular needs. Job responsibilities vary, and a given job may require much more or much less of one of the legs. But whereas in the fire triangle each leg is vital -- and when one is taken away there can be no fire--in our treatment here of the WFP development triangle, in certain jobs, one or more of the legs may be absent and not missed. Generally, though, for young folks preparing for a career in wildland fire, some of each leg is important. Well-rounded preparation provides a wider range of opportunities and advancement.

For countless scores of millenia back into deep-time, and up to the present day, certain people, mostly prescribed burners, have come into wildland fire simply by doing it, by working under the direct tutelage of experienced firelighters who put a torch in their hand and watched over them to keep them safe as they got the job done. Many of the most proficient prescribed burners have little or no education or training, but they safely, reliably and effectively burn woods and grasslands based on deep experience gained through traditional practices and knowledge. When people are indigenous this wisdom tends to be called Traditional Ecological Knowledge (TEK); for other rural folks who have been living in the same biome, managing the same landscapes, and especially the same ecosystems for many generations, these lifeways have no name of which we are aware. We will propose one.

Co-author Stowe began lighting fires over a half-acentury ago, burning ancestral lands with his Grandpa, who had learned from his Grandpa in a tradition reaching back through unlettered generations unbroken into the smoky mists of time. Many of his woods-burning ancestors and other elders had no education at all, much less any in wildland fire. It was twenty-five years after he lit his first fires before he found the education leg, learning about the ecology and history of fire in forestry school at the University of Georgia. And only after leaving university did he receive any fire training. His firelighting background might be called Traditional Rural Lifeways (TRL), being based on the lessons passed down by the rural AfroEuropean elders of his homeland.

Co-author Miller was first introduced to wildland fire, both prescribed burning as well as prevention and suppression, in the Texas Forest Service 36 years ago. His 31-year career in Florida included an emphasis on the ecological role of fire and demonstrating to the public the value of controlled burning to reduce destructive wildfires. Over his career, Steve's on-the-job training and experience led to qualification as Incident Commander. He has worked fire in 18 states and both the northern and southern Culture hemispheres, training many hundred WFPs along the way. Rxd Fire in the Southland

Ecology

Public Safety

Johnny's Why We Set the Woods on Fire Pyramid

Economics

The Times, They Are A-Changing

In contrast to both of us, many of today's cohort of WFPs are getting education and training before experience. For many agency burns in the U.S. today, increasing levels of training are required. These trends will likely be more pronounced in the future.

Wildland fire work is a broadly nuanced endeavor, for some people it is their entire job, for others it may be a smaller part of broader responsibilities in professions such as emergency response, wildlife management or forestry. For some it may be about fighting fires--prevention, mitigation and suppression; for others it may be about lighting fires. For many it is about both lighting and fighting fire. And for some it may be a matter of conducting prescribed burns on their own or neighbor's lands for cultural, economic, ecological or public safety purposes and not a vocation at all. Stowe's Why We Light Fires Pyramid depicts these goals for prescribed burning.

Catch-22 Conundrums

If someone starts with a fire job early in their career, she may be able to develop very strong experience or training legs but struggle to build a strong education leg. Conversely, those focusing on developing the education leg may have very limited opportunities for gaining experience. Here Catch-22 rears its exasperating head. If someone lacks adequate experience, she may have very limited access to the training leg, because NWCG courses often have task book and experience prerequisites. Sometimes there are significant financial disincentives for WFPs to make mid-career jumps from the experience pathway to the education pathway, and vice versa.

Challenges in finding balance in the three legs of the WFP development triangle are not limited to students and budding professionals. Potential teachers often struggle to provide opportunities for the next generation. And here again, Catch-22 looms large--faculty at universities who wish to offer NWCG training as a part of the curriculum may struggle to gain or maintain credentials necessary to teach the courses. Conversely, WFPs with decades of experience and a great depth of NWCG qualifications may lack the PhD that universities often require.

Progress has been made in the education leg. There are nine universities in the U.S. providing bachelor's degrees in wildland fire science that are certified by the Association for Fire Ecology (AFE: fireecology.org/afe-certified-academicprograms). Moreover, institutions around the world offer various levels of education and training, and opportunities for gaining experience in wildland fire research, operations, ecology and humanities as part of other programs. Budding firelighters and fighters at the nine institutions above have joined those at 11 other universities to form 20 Student Association for Fire Ecology (SAFE) chapters. (https:// fireecology.org/safe-chapters).

It is an egregious incongruity, it just ain't right, that only a single university in Southeastern North America--the birthplace of modern fire science--offers a degree in wildland

The PyroPointers experienced Cracker Culture firelighting in Florida with Steve Miller. The ranching culture of western North America has deep roots in the SE corner of the continent.

fire science, although many institutions in the region teach top-notch, wildland fire-related courses and provide wildland fire training and opportunities to gain experience.

John Kush and Kent Hanby taught over a thousand students how to conduct prescribed burns over the last quartercentury in their innovative Auburn University prescribed burning course, the budding burners "settin' the woods on fire" (https://www.youtube.com/watch?v=F3hzYRVAkUs) on many thousands of acres. Helen Mohr and Wes Bentley of the US Forest Service formed a student wildland fire crew known as the Clemson Fire Tigers to provide training and experience to students while achieving prescribed burning objectives on state and federal lands (https://youtu.be/Wav9ndiZigk). Students from the Warnell School of Forestry and Natural Resources at the University of Georgia gain valuable controlled burning skills during a spring break field course spent with prescribed firemaster Mark Melvin at the Jones Ecological Research Center, and Martin Cipollini immerses his students at Berry College in controlled burning as well as all other aspects of longleaf pine firelands restoration and management.

The PyroPointers: A Paragon Program and Paradigm for Developing the Triangle and Passing the Torch

Education

The University of Wisconsin at Stevens Point (UWSP) Wildland Fire Science Program is AFE-Certified and connects education to training and experience. We are fortunate to be connected to this paragon program. Students from the Stevens Point campus are called "Pointers."

Training

UWSP encourages its students to pursue NWCG and other training and certification to make themselves more competitive in the job market. Employers may provide training, but all-else-equal, a well-trained job applicant will have a leg up on her competitors. Students are connected to qualified and experienced fire practitioner-instructors, including co-author Miller.

Experience

The UWSP program recognizes the need to connect education with development of knowledge, skills and abilities, stating "In addition to our integrated curriculum, we strongly encourage and support experiential learning by our students through classroom and field trip experiences, computer simulation models, summer jobs, internships and involvement in student organizations." (fireecology.org). The Pointer Fire Crew, which includes students majoring in forestry, wildlife and other disciplines as well as wildland fire science, has established relationships in Florida, Oklahoma and South Carolina to provide students with opportunities for Rxd fire field trips (pyrotourism). Some of these connections have been structured from the top-down by the university, while others have grown through the initiative and energy of students.

Since 2012, teams of students have traveled annually to Florida, volunteering for the Florida Park Service, St Johns River Water Management District and Camp Blanding National Guard Training Base. The students spend a week assisting with prescribed fire unit and equipment preparation, ignition, holding and mop-up. They get experience, work on task books and make valuable contacts.

Since 2013, teams of students have also traveled to Oklahoma over spring break, working on a wide range of tasks on lands owned/managed by the Oklahoma Department of Wildlife Conservation and The Nature Conservancy, while interacting with Fire Science Faculty from Oklahoma State University.

Beaches, Burning and Bar-B-Q: How IAWF Yoga led the PyroPointers to the Southland

In 2017, the students added South Carolina to their spring break opportunities, traveling to burn with the South Carolina Department of Natural Resources (SCDNR) Heritage Trust Program, setting the woods on fire for both biodiversity and fuel reduction on heritage preserves, and for bobwhite quail management on private lands near the preserves. The fires they light are also part of rekindling a cultural landscape of woods-burning that was first assaulted by the government beginning a century ago and has never fully recovered (Stowe 2017). The SCDNR/UWSP nexus developed through connections made at the 2016 IAWF Conference held concurrently in Melbourne and Portland. Students Paul Priestley, Ethan Robers and Jacob Livingston gave a presentation that we attended in Portland, and then they came to a workshop we hosted, which led to a trip to Powell's Bookstore. Co-author Miller, a UWSP-trained forester who has maintained close ties to the university, already knew the students, and Stowe connected with them when they attended conference yoga classes he taught at the IAWF's first wellness program, initiated by the IAWF's Executive Director Mikel Robinson and her sweet Mom Linda Predmore. Co-author Stowe's graduate work in environmental philosophy centered on Aldo Leopold's land ethic, developed when Leopold was professor at the University of Wisconsin, and so when he found the lads were well-versed in Leopoldian reflection, they bonded quickly, becoming fast friends, buddies and colleagues. That led to the students accepting an invitation to come burn with Stowe in South Carolina and the next spring

Steve's Parade Theory of Life ... Marching in the *PyroProcession*

Steve Miller's Parade Theory applies to many aspects of life--not just fire and not just jobs. When we are born, we know nothing and have all our learning ahead of us; we follow behind our elders and teachers. When we begin our careers, we join the back of our profession's parade. The people in front of us have traveled in this procession before, having learned the routine from their elders. When they were toward the end of the parade, the current leaders learned valuable lessons; they learned what to do, and often as importantly, they learned what not to do. They now serve as the parade's teachers, mentors and guides. They share information and serve as role models for those who follow, enabling the parade to go farther and faster, to safely get more done. Then as the leaders of the parade retire or move on, we as tailenders find ourselves moving forward in the procession. We begin to assume a leadership role ourselves, serving as guides to the newcomers who are behind us, while continuing to learn from those still ahead. As we get closer to the front of the parade, it is crucial to devote energy to helping those behind us. This involves shifting a large part of the focus and energy we had been using to seek and absorb information, to sharing what we have learned with the next generation. Eventually, and this does not imply necessarily reaching any official, high-ranking leadership pinnacle--for parades come in all sizes and have leaders in various roles--we find ourselves near or at the front of the parade, and then, although it is important to keep learning, at that point it is vital to diligently serve as mentors, and aspire to be role models, giving back what we were lucky to be given.

Steve's pyroprocession paradigm can also be thought of as Passing of the Torch in a wildland fire management relay race--the closer we get to finishing our lap, the more we need to focus on successfully passing the torch to the fire manager taking the next lap. Part of that is a good hand-off and cheering the new runner on, while making them aware of their responsibility to prepare the next runner. Leaders who let the torch go out, or who fumble in passing it, miss the opportunity to see their life's work carried forward and their profession improved, and they are not repaying their mentors. they made the 16-hour drive and arrived "fire-booted and suited" with torches-in-hand, and rearing to go. Their inaugural spring break pyrotourism trip, themed as Beaches, Burning and Bar-B-Q (BB&B), was a huge success and was continued in 2018 and 2019, but C-19 nixed it in 2020. But once things settle down this new tradition will be renewed. We will not let this annual event die!

In South Carolina, students get experiences they are unlikely to get elsewhere. Co-author Stowe has been burning on public and private lands in Lee County for 26 years, and during that time, he has established close relationships with local farmers and landowners, including Jimmy Bland and Whit Player, who manage lands that have been in their families for several generations. The three have formed an informal, local prescribed fire management triangle of sorts themselves, each leg supporting the other, as they help each other with burning and other land management activities. This community connection has been strengthened by a shared love of hunting and local history and the land. Between them, the three partners have over a century and a half of on-the-ground prescribed burning experience, but relatively little training and formal education about wildland fire. Another key partner that the crew has connected with is Gee Atkinson, Editor of the local newspaper, the Lee County Observer.

While burning in Lee County, as well as with Jamie Dozier on the SCDNR's Tom Yawkey Wildlife Center on the Carolina coast (the beach leg of BB&B!), the students learn about participatory land management, experiencing a deeply-rooted, place-based, traditional way of controlled burning that is as much an art as a science, most of it being TRLs not set down in print, and very much different than the rigid, top-down, command-and-control NWCG system. They have invariably adapted quickly--working hard and safely and having fun, learning lots, performing well and getting land burned--while embracing the culture and getting along really well with preserve neighbors and landowners and other local folks. The Harry Hampton Wildlife Fund has provided groceries and Bar-B-Q for the crew, and Jimmy Bland gave the crew a generous donation, while Whit Player lets the crew stay at his family's cabin. On departing the Southland the crew had the distinction of being christened the PyroPointers and recognized as Honorary Southerners!

Mutualistic Symbiosis and the Cultural Quest for Synergy in *Sharing the Flame*

Biological symbiosis can be parasitic, commensal or mutual. When managers do nothing to propel the next generation, they play a zero-sum game bordering on parasitism, as if time spent with the next generation somehow takes away from what they perceive as more important work. Mentoring relationships, even relatively effective ones, can also be commensal, with one side benefitting and the other not being impacted significantly either positively or negatively.

Our partnerships with the *PyroPointers* have been both mutually symbiotic as well as synergistic, with the benefits flowing and growing with each interaction so that the total

In addition to the benefits to the students, we old-timers have gained, among other things: keen, spry, fireline-ready legs to drag a torch, and a rekindling of our fire careers through the crew's enthusiasm and vigor. We also have the profound joy of helping to shape young minds and lives as we provide them on-the-ground, torch-in-hand experience and training, and of knowing that some of the things we learned from those who passed the torch to us long ago--values and passion and obligation--as well as the things we learned from science and also our mistakes, that some of those things will live on after we are gone. As mentors it's big-time fulfilling to pass the torch of obligation to the students, instilling in them the responsibility to in their turn Share the Flame with those who are coming along to fill *their* boots.

The Wildland PyroPathway Ahead

More universities and other educational institutions need to develop wildland fire science programs and student wildland fire crews. We must advocate and promote this growing trend. And as these and similar programs develop, we need to innovate more opportunities for mentoring, field trips and training, and other participatory workways.

Beyond the general need to connect generations of professionals, we need to branch out in other ways. Wildland fire impacts all the world's diverse cultures to some degree, either directly or indirectly, and as is attested to by the growing interest in and focus on human dimensions research and outreach, wildland fire is no longer largely a matter of suppression strategies, tactics and operations. We must embrace both traditional ecological knowledge as well as traditional rural lifeways; they have much in common that can mesh with modern science to serve our needs. Connecting intergenerationally while reaching across cultures and disciplines is not just a wise, enriching and fulfilling way to move forward, it is an inevitable, emerging, wildland fire lifeway for our irrupting Pyrocene Epoch.

Share the Flame!

Steve "Torch" Miller retired from the St. Johns Water Management District and now serves as Regional Director of Fire and Aviation Management for the US Forest Service.

Johnny Stowe lights and writes about controlled burning culture and human ecology in Southeastern North America, where he Shares the Flame every chance he gets.

Steve and Johnny serve on the IAWF Board of Directors and are disciples of Aldo Leopold. They met via their mentor, IAWF elder Dale Wade, who connected them in 2005. Mr. Wade continues to inspire, challenge and encourage them as they move closer to the front of the parade. This essay springs from a talk the authors gave at the IAWF/AFE conference in Missoula in 2018.

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creates intergenerational dyads and provides them with broad and flexible guidelines. This program is showing great promise for both teachers and learners, and it's not always easy to tell which side is learning the most! Check it out at www.iawfonline.org/mentoring-program/

NORTH AMERICAN BLUEPRINT FOR WILDLAND FIRE SCIENCE COLLABORATION

BY DIEGO PÉREZ SALICRUP, STACY SANKEY, MATT JOLLY, JONATHAN BOUCHER, ERIC TOMAN, CHRISTY ARSENEAU, AND MICHAEL NORTON

We need a comprehensive strategy to improve collaboration and capacity for wildland fire science in North America. Every year, wildfires burn across large areas of Continental North America. These fires recognize no political boundaries; some cross borders directly and require collaboration between countries for their suppression while resulting fire effects have social, economic and ecological consequences that are felt far from the location of individual wildfires. For example, smoke from California wildfires burning in September 2020 impacted air quality in Eastern Canada and Eastern United States. Despite the international distribution of biomes, sharing fire science across boundaries has proven difficult. (Figure 1).

The majority of land area in continental North America comprises three countries that offer contrasting fire management strategies and fire management histories. While Canada and the United States have comparable land areas, they have vastly different population densities: the United States has nearly 10 times more people per sq kilometer than Canada (Table 1). Population distribution is also different, with most Canadians living along their southern border, while the population in the US is more evenly distributed.

Not surprisingly, 50% of Canadian wildfires are ignited by lightning¹ while humans account for about 84% of all wildfire ignitions in the United States². While forest areas in both countries are also comparable, forest land tenure is contrasting, with more forest area in private hands in the US. Mexico is much smaller, with almost one fifth of the area of its northern neighbours, but with almost twice the population density than the US (Table 1). Similarly, ignitions in Mexico are 90% associated with human activity. Forested areas in Mexico are also roughly one fifth of that of Canada and the US, yet because of Mexico's proximity to the equator, it has a much higher diversity of species and ecosystems. Most forest land in Mexico is in the hands of rural communities who also exercise a communal (named ejidos) approach to forest management, which has a large influence on how forests and fires are managed.

COUNTRY	POPULATION	LAND AREA (sq.km)	POPULATION DENSITY (People per sq km)
Canada	37,971,020	9,984,670	4
US	328,239,523	9,833,520	33
Mexico	128,649,565	1,972,550	65

¹Canadian National Fire Database (CNFDB) https://cwfis.cfs.nrcan.gc.ca/ha/nfdb

²Human expansion of the fire niche. Jennifer K. Balch, Bethany A. Bradley, John T. Abatzoglou, R. Chelsea Nagy, Emily J. Fusco, Adam L. Mahood. Proceedings of the National Academy of Sciences Mar 2017, 114 (11) 2946-2951; DOI: 10.1073/pnas.1617394114

 Table 1 – Population, land area and population density of Continental North American countries.

With all these diverse conditions and with increasing occurrence of large, severe wildfires, it is time to reflect on the experiences gained from the three countries and to assess common knowledge gaps in order to apply lessons learned to address emerging needs of contemporary fire management. The number of publications on fire research coming from North American countries is significant (Figure 2), but it is not diverse. Nor is the traditional approach of pursuing theoretical research questions and publishing findings in scientific journals sufficient. There is an increasingly urgent need to adapt, or even transform, fire management in North America and scientific publication is not enough to get the knowledge into the hands of wildland fire practitioners. Ultimately, a different approach is needed, where research is aligned

with current and future needs and results are actively and deliberately shared in a manner that supports decisionmaking. We propose developing a Blueprint for collaboration across borders to accomplish this.

NAFC- FMWG

The North American Forest Commission (NAFC) provides a policy and technical forum to discuss and address regional forest issues. The Fire Management Working Group (FMWG) of the NAFC was established in 1962 and has recently incorporated more science into its deliberations. It does not, however, currently have a continental direction for wildland fire science. By providing a Blueprint for wildland fire science collaboration, we expect to catalyze collaborative research across the three nations, and help identify what scientists and forest managers perceive as the largest voids of knowledge to improve forest fire management. The proposal to develop a North American (NA) Blueprint for Wildland Fire Science Collaboration was initiated at the NAFC-FMWG meeting in 2018. In 2019, the FMWG fully endorsed the proposed initiative and added it as an ongoing item on its work plan. As a first step, an ad-hoc group of representatives from government agencies and academia across Canada, the United States and Mexico have outlined a path forward towards a North American Blueprint.

three clear goals. First, it should identify common research themes and priorities as a basis for enhanced collaboration. Second, it will identify and offer proposed solutions to barriers to international research collaboration on wildland fire. Finally, it should help expand international networks and knowledge exchange forums.

This initiative will deliberately build from the success of the US Fire Exchange Network supported by the Joint Fire Science Program to redraw the map on fire science collaboration in North America (Figure 3). It is expected that the existing networks will be reinvigorated and expanded beyond traditional partners into a trans-boundary network of networks, as well as beyond the US borders. The intention is to not simply produce a document, but a living collaboration where the Blueprint is the roadmap.

Wildland fire management involves planning activities that go well beyond fire. The development of the North American Blueprint for Wildland Fire Science Collaboration will be purpose driven, based on shared priorities, and will privilege the co-creation of solutions by scientists and fire management practitioners.

Inspired by the Canadian Blueprint for Wildland Fire Science (2019-2020) (Sankey et al. 2019), initial discussions regarding a North American Blueprint for Wildland Fire Science collaboration identified three overarching themes of common interest to Canada, Mexico and the United States:

The Blueprint

The development of a North American Blueprint for Wildland Fires Science Collaboration should foster at least

Recognizing Indigenous Knowledge

- Community Resiliency
- Understanding Fire and Fire Management in a Changing World

We expect these themes to be validated and potentially expanded through workshops and surveys to help identify existing needs, consider similarities and differences across locations, and provide insight into the presence of existing networks that may facilitate information exchange between fire practitioners and researchers.

The process of developing a blueprint amongst countries as different as Canada, Mexico and the United States could offer lessons and guidance to serve the global wildland fire community. The approach will be interdisciplinary, in which specialists from social sciences such as economics, anthropology and sociology collaborate with plant ecologists, smoke experts, and fire modellers, and other disciplines to collaborate and engage with fire managers and landowners. This co-production approach with a diverse group of scientists and managers should lead to a better shared understanding of wildfire problems as well as the development of novel solutions to those problems.

The topic will be discussed at upcoming meetings of the Commission for Environmental Cooperation (CEC), Canada-US Forest Health and Innovation Summit, International Association of Wildland Fire (IAWF), and the Association for Fire Ecology (AFE). Reach out to NAFireBlueprint@gmail.com to stay informed.

ABOUT THE AUTHORS:

Diego Pérez Salicrup

Institute for Ecosystem Research and Sustainability, Universidad Nacional Autónoma de México (UNAM)

Stacy Sankey

Regional Policy Analyst, Northern Forestry Centre, Canadian Forest Service

Matt Jolly

Ecologist, Fire, Fuel, and Smoke Science Program, United States Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory

Jonathan Boucher

Researcher, Forests Fire, Laurentian Forestry Centre, Canadian Forest Service

Eric Toman

Professor, School of Environment and Natural Resources, The University of Ohio, Columbus, Ohio, USA

Christy Arseneau

Science Director, Atlantic Forestry Centre, Canadian Forest Service

Michael Norton

Director General, North Forestry Centre, Canadian Forest Service

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FIRE GLOBE – SCIENCE CONNECTIONS

Pyrolife: TOWARDS AN INTEGRATED FIRE MANAGEMENT

REVIEW OF THE INTERNATIONAL SYMPOSIUM HELD IN JUNE AND JULY 2020

BY POOJA PANDEY EARLY STAGE RESEARCHER AT PYROLIFE

Intentional or unintentional, fire has always been either a good servant or a poor master, teaching people a way of living and adapting to its ashes and flames for centuries. But current adaptation strategies are changing with increasing fire incidents and with global climate change. Therefore, researchers and scientists are finding new ways to live with fire rather only than finding ways to escape it.

A blend of physical science and social science techniques seems to be a good recipe to serve planet earth. Increasing fire incidents and other natural disasters all over the world are affecting not just the land but people's livelihood and their existence.

So, what should be done in this regard? Suppress all such incidents, thereby increasing their future severity? No, rather we must find ways to live with fire, and this is why the Pyrolife Innovative Training Network came into existence. Pyrolife is not merely a project aimed at finding ways to deal with this issue but also to train the future generations of scientists and practitioners to create more fair and resilient societies and to carry the findings and philosophies of the project forward.

Pyrolife Innovative Training Network made its public debut in June, 2020 where all 15 PhD candidates and consortium partners took part in the first Pyrolife International Symposium focusing on creating new international links across scientific fields and disciplines in order to understand what integrated fire management could look like across Europe and internationally. The symposium held a total of 15 multidisciplinary webinars that were open to all: more than 400 participants registered every Wednesday from different parts of the world. Though the main focus of Pyrolife is sharing knowledge within Europe, the symposium successfully shed light on lessons learnt from different disciplines in many parts of the world.

Dr. Cathelijne Stoof, architect of Pyrolife Innovative Training Network and member of the board of directors at the International Association of Wildland Fire, kicked off the Pyrolife International Symposium 2020 by introducing the project and discussing the need for diversity within the greater wildland fire community and showing paths on how to deal with the challenges as we adopt living with fire. With her reallife experiences in dealing with fire issues, she understands the importance of local knowledge and expertise and how it can be beneficial for planning and in science communication. Dr. Stoof explained how everyone is dealing with the same issue of fire but in a different context, and she suggested: "If we want to move from suppression to integrated fire management, we need to hear all the voices."

HIGHLIGHTS FROM THE WEBINAR

Every Wednesday for an hour-and-a-half the experts and the Early Stage Researchers delivered their concerns and excitement on the topics and shared their experiences and opinions with the audience with the help of an interactive Q&A session at the end of every webinar. After an amazing introduction from Dr. Stoof, Marc Castellnou Ribau discussed the lessons learned from the Mediterranean and how they could be helpful for temperate Europe in the context of climate change. The webinar focused on how land management is an essential tool to decrease fuel loads and reduce vulnerability in extreme wildfires events in the Mediterranean region.

Does fire discriminate? No, fire sees no social boundaries, and yet different social groups experience fire events very differently. Danielle Antonellis, a senior fire safety engineer at

Arup, drew our attention to fire safety inequality, its societal consequences and the ability to deal with it. Adriàn Cardil from Tecnosylva explored how fire research can support the industry. In accordance with the operational tools used in fire risk planning, scientific research can enhance decision making in fire management in important ways.

"Almost without exception, highprofile fires are in the developed world" But where do fires burn? This simple question with deeper implications was raised by Peter Moore from the

Food and Agriculture Organisation. Fires during the crisis of Covid 19 were pushed to the limelight, an important issue which should never be forgotten as lessons learned from these events translate into constructive actions. Our speakers thoughtfully expressed investing in areas that will reduce fire risk rather than investing in techniques of suppressing the fire. Using appropriate technologies is a must to prepare cities and landscapes.

As such, Bertram L. De Rooij, a well-versed panelist in city planning said living with fire must be flexible and must engage different stakeholders who participate in integrated fire management. Fulco Ludwig from Wageningen University emphasized how proven approaches on "living with water" for flood management could also be integrated in "living with fire." The challenge is how such an approach could be implemented. Potentially, by making friends.

Alexander Held, a senior expert at the European Forest Institute agreed, saying that if we need change, we need to involve and increase our networks before we actually need them. Paulo Fernandes from the University of Trás-os-Montes & Alto Douro brought to our attention that non-fire prone countries are facing the increasing actuality of fire, and due to lack of fire histories people are keen to accept the fire suppression paradigm. This differs greatly from southern Europe which has an immense history of both controlled and extreme fires.

Vanessa Cavanagh from the University of Wollongong and Lisa Langer from Scion opened our eyes to the importance of women's roles in cultural burning practices in Australia and New Zealand, as these cultural knowledge holders ensure the health of land and people through Indigenous fire knowledge. Lucian Deaton from the National Fire Protection Association in the U.S. and Nuria Prat-Guitart from the Pau

Costa Foundation in Catalonia highlighted how communities get empowered for fire management by receiving the right information and right tools, and they need the opportunity to create collaborative networks among all stakeholders in order to save their communities from these present day "fire monsters." Real change comes when the community itself

> has ownership over its achievements. Additionally, George Boustras from the European University in Cyprus explained how sustainably management of resources is required for strategic and skillful planning in order for policies to function effectively at local, national and international levels.

Finally, Míriam Arenas Conejo, researcher of CareNet group, IN3-Open University of Catalonia, illuminated the social aspect of fires and everyday life. Working with vulnerable populations lets us better understand different realities, and

further helps us discover missing gaps, questions and ideas through mutual learning in research and social action.

The Pyrolife webinars were helpful as they were accessible to audiences from all continents and gave easy reach to the panelists and the Early Stage Researchers for future collaborations. Most importantly, attendees and hosts got an opportunity to engage with each other at the end of every webinar.

Thanks to the webinars, I feel more connected to my fellow Early Stage Researchers and the consortium partners involved in this project and I truly appreciate being part of such a diverse project and consider myself lucky to be working with so many enthusiastic people.

Did you miss the Pyrolife webinar? No problem! All the webinars were recorded so you can access it by visiting the Pyrolife website https://pyrolife.lessonsonfire.eu/pyrolife-blog/ Also, you can join us in the Pyrolife's monthly webinar starting this fall. Stay tuned!

ABOUT THE AUTHOR

Pooja Pandey has a bachelor's in Geography and a master's in GIS, Pooja tries to explore ways to dive into techniques of disaster management. She believes mindfulness in the work you do is a key to success – a tenet she lives out through her interests in hiking, meditation and poem writing. She has gained experience while working in the field. She is always open for new challenges and constructive feedback.

ENGINEERING A SAFER CREW PROTECTION SYSTEM

By Andrew Webb and Andy Gooden

Burn-over crew protection systems have been installed into fleets of rural wildland Fire-Fighting Vehicles (FFVs) in parts of Australia, successfully providing protection for crews in recent large fires. Research out of the Country Fire Authority (CFA) in Victoria is leading the change in vehicles carrying more than 1000 litres of water.

These systems, and underlying engineering design principles, are robust and have remained largely unchanged since first introduced as standard fitment in Victoria in the mid 2000's. Where utilized there have been no recorded firefighter deaths, and only minor injury, from burn-overs. Most notably during the Victorian Black Saturday bushfires in February 2009 hundreds of FFVs were involved in firefighting operations with eight involved in significant burnover situations and a further 18 directly impacted by fire. In the recent 2019-20 bushfires in New South Wales and Victoria that burnt out of control for many months the same result occurred – multiple burn-overs without deaths or significant injuries.

Principal engineering features, described in detail online [https://www.iawfonline.org/wildfiremagazine], form part of the overall layered approach as described in *Wildfire* magazine, (March-April 2017, p 28-30 "Developing and Testing a Tanker/ Engine Crew Protection System", D Nichols, CFA Manager of Research and Development).

- 2) Water deluge system
- 3) Radiant heat shielding curtains
- 4) Fire blankets and Personal Protective Equipment (PPE)

CFA Engineering was tasked to design and implement a resilient and reliable system around this layered approach. Prior research in this field was limited so the system had to be largely designed from scratch.

The system needed to be

- Sufficiently robust to withstand day-to-day off-road operations in heavily forested environments and open grassland plains.
- Able to remain operable for a minimum of five minutes (the accepted benchmark burn-over duration) when subject to radiant heat loading of at least 5000 kW/m2 and full flame immersion with temperatures approaching 1000 0C.
- Passively operable following initial simple discretionary activation protocols.

The system was developed from much of the research and development that was detailed in the 2017 *Wildfire* article and supported by practical experimentation. Developmental work commenced in the early 2000s in collaboration with the Australian research organisation CSIRO (Commonwealth Scientific and Industrial Research Organisation).

Testing has included:

- Controlled laboratory experiments to understand flammability and heat transfer characteristics of various relevant protective material layers and proposed insulating coatings.
- A series of experimental burns at the NSW Rural Fire Service owned gas-fuelled flame front simulator located at the Hot Fire Training Facility at Mogo New South Wales.
- Field validation tests in forested and open grass land environments. Most notably:
 - February 2004 Maragle State Forest, Tumbarumba, NSW – two forest field trials
 - March 2014 Wangaratta, Victoria open grass fire field validation
 - March 2017 Brucknell Forest, Timboon, Victoria - forest field trial

The system has since been adapted to a range of vehicles in a major retrofit program undertaken by the CFA between 2010-14. More than 1000 vehicles were modified covering a wide variety of size, configuration and age. **CREW PROTECTION**

Several key engineering design principles have been developed.

Cabin and body skin/panelling heat shielding and critical lagging

Fire agencies throughout Australia use commercially available cab chassis as platforms for customised fire fighting vehicle bodies. Cab chassis are typically sourced from Japan or Europe. They undergo a range of local modifications to make them suitable for use in arduous environments and to maintain critical operational functionality and cabin integrity during a burn-over.

These include:

- Plastic brake and fuel lines are lagged/sleeved, shielded or replaced with high temperature flame resistant equivalents to ensure the vehicle remains mobile and critical firefighting functions operable.
- Radiant heat shield panelling is placed around body critical elements such as batteries, pump and plumbing systems.
- Vulnerable cabin exterior plastic panels are replaced with metal, or non-flammable equivalents, to minimise the possibility of radiant heat/flame intrusion into the cabin interior.

Water deluge system - pumps and plumbing

Traditional Australian tanker engines use a stand-alone onboard diesel engine driven fire-fighting pump with capacity in the range 100 – 1000 litres/min and a centrally mounted water tank varying in size from 500L – 4000 litres.

For CFA vehicles the last quarter is held as a discretionary reserve and is a trigger for fire-fighters to leave the fire ground. It is also sufficient for the minimum five minute water deluge system operation. Depending on the size of vehicle up to 750L of tank water is held in reserve.

After manual activation the system requires no further operator intervention. The pump and tank supply a selfreplenishing water curtain to protected surfaces via up to 30 small strategically positioned spray nozzles - on cabin windows, external body panelling and tyres. Water run-off provides a wetted fuel load immediately around and under the vehicle to mitigate flame progression and burn-under. The system operates at total flow rates of 75 – 150 l/min depending on the size of the vehicle.

Radiant heat shielding curtains

Cabin glassed areas are the major entry points for radiant heat and the greatest hazard to fire-fighters inside the cabin. Cabin windows are protected internally using Radiant Heat Shielding Curtains with a highly reflective outer layer and insulating inner layers.

CFA has successfully tested two curtains:

- Thermaguard Radiant Heat shields
- Storm King Mountain® Fire Curtains

These are typically multi-layered. Thermaguard's Supertherm Radiant Heat Shield curtains comprise:

- a highly reflective outer aluminium foil
- a kevlar layer imparting tensile strength and flame resistance
- a proprietary, glass free, insulating core mitigating potential carcinogenic risks
- an internal fabric liner.

Careful design consideration has been made to ensure rigid mounting, compact stowage and rapid deployment. The curtains are stowed in a rolled-up fashion, immediately above each window for rapid "drop down" deployment via quick release tabs. Upper edges are mechanically fastened to a metal surface. Curtains are deployable in any order to reduce cognitive stress. Compactness of the stowed curtain roll, particularly over the front windscreen, is critical to maintain the driver's forward field of vision.

Stand-alone ongoing fail-safe operation following initial activation

Fire fighting water pumps are driven by compression ignition diesel engines that are inherently safe. Burnover fail-safe operation has been enhanced by providing:

- An all metal air filter/pre-cleaner and fire retardant filter element to mitigate combustion air starvation
- A small fuel header tank fed from the main cab chassis engine fuel supply sufficient for stand-alone supply during a burn-over
- "Energise-to-stop" control functionality, meaning failure of electric control does not stop pump operation.
- Protection for the pump/engine assembly and critical plumbing behind radiant heat shield panelling.

Alternative deluge systems for small volume water tanker engines

The water deluge system described above is increasingly problematic for smaller fire-fighting vehicles, particularly those with less than 1000L on-board water storage. Too much water held in discretionary reserve is seen as operationally prohibitive for normal firefighting. Alternative water enhancing systems have been developed to increase water surface adhesion properties and minimise run-off effects. Two systems have been prototyped and successfully benchmark tested, both using around 50-60 L of water for the five minute burn-over window:

- Compressed Air Foam (CAF)
- Polymer GEL

The CAF system has been endorsed for further production development by CFA. The system inductively mixes 1% Class A foam (Phos-Check WD-881) with water (10 l/min) and compressed air (125 cfm at 180 kpa). The mixture is then distributed to strategically placed plenum expansion chambers resulting in a gravity fed, self-replenishing, CAF blanket that forms over critical surfaces.

Compressed air is sourced via a regulated 6.8L/300 bar firefighter Breathing Apparatus (BA) cylinder sufficient for 9 minutes of operation.

The Polymer GEL system uses 3% Barricade GEL premixed with water that is sprayed onto critical surfaces as a one-shot system. The delivery system includes a series of "pop-out" nozzles and common feeder plumbing. It can be deployed at any time prior to the approaching fire-front.

Both systems are part of a layered protection approach and use the radiant heat shielding curtains described above.

Further details on these design principles and additional references are available online www.iawfonline.org

ABOUT THE AUTHORS

Andy Gooden has 30 years experience in mechanical and chemical engineering, safety, international standards and testing, intellectual property law, and construction. He is a passionate proponent of crew protection innovation, weighing the science as well as the practicalities, and enjoys supporting likeminded organisations andrew@ thermaguard.com.au

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DROUGHT-DRIVEN WILDFIRES IN KENYA STRAIN RESPONSE SYSTEM

BY JOSÉ NGUNJIRI AND WAKO ABGUDO

The COVID-19 pandemic has combined with vast wildfires in Kenya to place a great strain on an already overburdened wildland fire response system.

Kenya typically experiences long rains from March to May, and then short rains from October to December. June through August is mainly cool and dry over most parts of the country.

But since last January, Kenya has experienced an extreme "dry spell" in the Northern regions, which includes Garissa, Turkana and neighbouring counties, and in the central part of Kenya, which includes Meru, Nyeri and Kirinyaga counties. Wildfires have burned across these areas as well as around Mount Kenya, which lies just north of the Equator.

The Kenya Red Cross Society (KRCS), and government agencies involved in the wildfire response, including the Kenya Wild Life Service (KWS) and Mount Kenya Conservation, report that about 80,000 hectares have burned thus far in 2020. (Source: European Commission's Directorate-General for European Civil Protection and Humanitarian aid Operations). Staff of both the Kenya Forest Service and the KWS are trained to manage forest and grassland fires. But they lack the capacity to control these fast-moving fires. Personal Protective Equipment (PPE), mechanized equipment, tools and manpower are all limited. Kenya Defense Forces as well as NGOs such as the Sheldrick Wildlife Trust, have at times provided assistance.

When PPE is available, and this is not often, it is usually structural firefighter gear, which is generally cumbersome, heavy and not designed for wildland fire suppression activities. In addition to limited mobility and visibility, fire suppression staff wearing structural gear are burdened by extreme heat, even when pausing to rest. Agencies and other entities involved in wildland fire management in Kenya are interested in partnering with people who can assist them in developing resources to protect the people who live in areas impacted by wildfires. The Africa Fire Mission (AFM) has been training, empowering, supporting and encouraging firefighters in Kenya since 2013. While the focus has been primarily on structural fire, there is a growing need to train and provide equipment and other resources for managing forest fires and bush fires. You can learn more about AFM and how you might get involved at: **www.africafiremission.org**

ABOUT THE AUTHORS

José Njuki-Imwe

Ngunjiri is a social change enthusiast, entrepreneur, mobilizer, and fire safety advocate with Africa Fire Mission. At 4 months old, José survived a fire that burnt 85% of his face. José went on with his life and trained as a

firefighter later on graduating with a Firefighter 1 Certification. José is a self-motivated individual with an objective of saving lives and preventing property damage by working together with community dwellers and leaders to achieve the desired goals. He has regularly responded to a wide range of emergency situations and provided community outreach services to improve public knowledge of fire safety in vulnerable areas in Kenya. José volunteers with the Kiambu Fire Brigade Service in Kenya. He resides in Nairobi Kenya with his son.

Wako Abgudo is Chief of Fire and Rescue Services for Isiolo County, Kenya. He earned his degree in mechanical engineering from Masinde Muliro University and has worked in that field, and also as a General

INTEGR-

Service Unit Police Officer. Chief Abgudo's years of experience in environmental monitoring and occupational health and safety auditing showed him the paucity of fire safety protocols in many workplaces and inspired him to find a way to meet this need by pursuing and gaining his current job, where he has developed a diverse background in structural and wildland firefighting.

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