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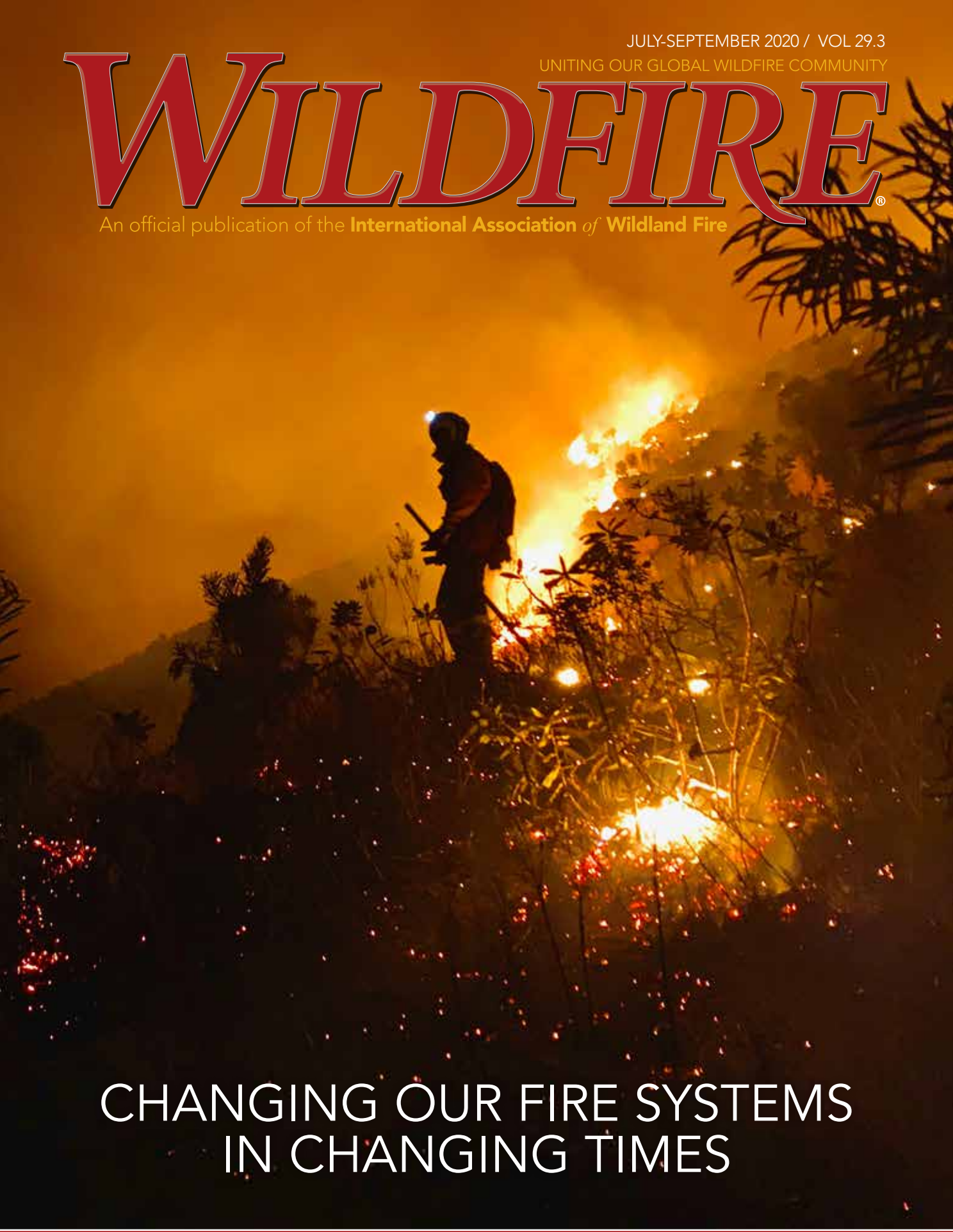
UNITING OUR GLOBAL WILDFIRE COMMUNITY

WILDFIRE®

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



CHANGING OUR FIRE SYSTEMS IN CHANGING TIMES

FIRE & COVID | **LEADERSHIP: "GOOD TROUBLE"** | **RX FIRE IN AUSTRALIA** | **MODERNIZING** | **GLOBAL FIRE GOVERNANCE**

WHEN THE WORLD DEMANDS MORE,

AIR TRACTOR DELIVERS.

AIR TRACTOR DELIVERS THE PERFORMANCE, EFFICIENCY, AND PRECISION THIS JOB DEMANDS.

IT'S TIME YOU DEMAND MORE.

COLUMNS & NEWS

CHANGING OUR FIRE SYSTEMS

MODERNIZING

" …it can be easily seen that the degree of difficulty in accomplishing wildland fire management objectives is becoming immeasurably more complicated."

RESILIENCE & THE COVID-19 PANDEMIC

" …the more we focus only on one risk, the riskier other risks become."

GOVERNING

"My time in South Africa showed me that environmental governance does not necessarily follow a linear path, that there is no one-size-fits-all approach in wildfire policy and management …. Governance cannot be imposed in the same way that management can sometimes be. Governance is more a system of relationships than a system of rules."

PHOTOS

ABOVE. The Soda Rock Winery in Sonoma County, Calif., is lost during the Kincade Fire, 2019. For more on how we must change our systems to find resilience in a fire landscape, see "**Creating a Fire System for our Future**," starting on page 16. **Photo: Kari Greer.**

ON THE COVER. Firefighters in South Africa practice and study burning and suppression techniques and bolster their capacity for wildland fire operations and management through the adoption of the Incident Command System (ICS) and international firefighter exchange. For more, see "**Governing Wildfire: A global inquiry**," starting on page 32. **Photo: Harrison Raine.**

July-September 2020 Volume

WILDFIRE

An official publication of the International Association of Wildland Fire

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WILDFIRES AND COVID-19

In this pandemic era everyone is impacted, including all those who work and live with wildfire. As IAWF President Toddi Steelman reflects on a pandemic that's changing every aspect of our lives, it's clear that the only certainty is uncertainty.

TODDI STEELMAN
PRESIDENT

The impacts of COVID-19 have been all pervasive across the globe. Every aspect of our lives has been affected, including wildfire. While COVID-19 is affecting the northern hemisphere right now, in only a month or two the southern hemisphere will also be affected.

There are multiple dimensions to how COVID-19 is impacting wildfire.

First, the health crisis has precipitated a financial crisis that will have immediate and long-lasting impacts on how we prepare for, manage and recover from wildfire. Budgets from the local to the national will be affected and this will have consequences for operating plans for not just this year, but next year and beyond.

Second, before the wildfire season started, preparedness work was disrupted. Many places lost a majority of their prescribed fire season and their ability to do mitigation work. Because large gatherings were discouraged, pre-wildfire planning and preparedness meetings did not take or had to take place in remote settings where it is harder to make connections that are leveraged during the heat of the fire. Pre-season fire training also suffered.

Third, during fire season there have been questions about how mutual aid agreements will be executed. Some jurisdictions are being prohibited from responding beyond their borders. We have seen and will likely continue to see more air resources for initial attack because they are safer under COVID-19 conditions, but they are also more costly—see the first point about budget pressure. More resources are being put on smaller fires to keep them from becoming bigger. Modularization is being practiced in fire camps this summer—basically 20-member "families" are sticking together and not interacting under usual camp practices. Camps are smaller or more remote and congregating around food and standing in the chow line is a thing of the past—there are lots of bags with food that are delivered. Briefings are occurring over the radio.

Fourth, we know there are cumulative and interactive effects from wildfire smoke and COVID-19 and this will have consequences for wildland fire fighters and the public alike. Wildfire smoke has high concentrations of particulate matter (PM2.5) as well as other air pollutants. Research has demonstrated that there are relationships between exposure to PM2.5 and

asthma, among other respiratory issues. According to Sarah Henderson, from the University of British Columbia Center for Disease Control, smoke exposure may make the pandemic worse because when your immune system is overwhelmed dealing with smoke particles it has less capacity to deal with the virus—thereby making people more susceptible to COVID-19. Evidence from Erin Landguth and Curtis Noonan out of the University of Montana found that smoky summers lead to more severe flu seasons the following winter.

Those most vulnerable to smoke impacts must pay extra attention. This includes children, older people, pregnant women, those with underlying cardio-pulmonary issues, and firefighters who carry a high smoke load already. Dr. Henderson suggests to avoid smoke, people should shelter at home, close doors and windows, use portable air cleaners, including installing an air filter with MERV rating of 13 or higher, use the recirculate option instead of fresh air option in your house and car. Importantly, cloth masks do not protect against PM2.5, but N95 respirator masks will—of course, these are in short supply because of the demand from health care workers.

These consequences from the current pandemic are not going away any time soon. In the absence of a vaccine, colleagues in the southern hemisphere are also seeing these patterns emerge and expect them to continue through the fire season and into the new year. Regardless of the hemisphere in which we work, the key preparedness and prescribed fire activities will also be impacted. While timelines vary about when a vaccine might be ready, in all likelihood, fire season in the northern hemisphere in 2021 could be facing similar challenges.

The only thing certain is the pervasive uncertainties through which we are all managing at this time.


RON STEFFENS

Pandemic spreads, balloons fall, fires burn — and from chaos we build order.

CHANGE PERMEATES HUMAN EXISTENCE — in our world and in our profession, and in *Wildfire* magazine too. As the International Association of Wildland Fire explores its mission to unite our profession globally, it has become time to ask how a magazine like this can best serve our members, our profession and our communities in a global and online era. As board and committee members and so many others help to explore these new paths, I find it's time for me to explore all topics wildfire from another lookout. And so with this issue I'll be stepping aside as editor.

Over the years I've been honored to support hundreds of colleague-contributors as we've shared stories, ideas and images with our colleague-readers and the public beyond. As with any work of art, a magazine is a communal effort, and it's been grand to improvise a bit of wildfire-jazz these past years. My gratitude would take an entire issue. I simply offer my thanks — to all. I send my special thanks to all who've supported this issue, which explores the challenges of our pandemic times and the many ways we are beginning to adapt our work, our lives and our systems in response.

In rough order, the front part of this issue features IAWF president Toddi Steelman's reflection on our profession's response to the pandemic, followed by our always-awesome leadership column by Mike DeGrosky on how to lead by making "good trouble," a lesson learned from the late civil rights leader John Lewis. Plus we have updates from our profession and our science, and a review of a book on using fire to manage fire in Australia.

Moving into the main features, a range of writers offer three approaches for building order out of our chaos — local and global — while enjoining us to act, and to act together. How can we (and should we) modernize our wildland fire organizations? How can a social-science approach guide us in our response to the pandemic and fire? And how can a burgeoning wildland fire professional's travel fellowship guide us into a shared vision of how environmental governance may help us face our fire problems by building on our many fire solutions?

THERE'S ANOTHER STORY on my mind these days, a local one, of a strange morning when the terror falls to the ground, like a bird fledging a day too early, and it's our job to put it back on a safe branch.

This morning felt the warmest of the season, still air with dark clouds flanking north and south. I came early to work to complete the month's fire outlook and called in-service as Dispatch was reporting a balloon accident, County responding. Minutes later I was en route south to control highway traffic for a potential air evac. Not one balloon but three. A mass casualty incident. IC asking for triage — red, yellow, green? On scene the helicopter was already off with a Red patient, so I offered support as family members were escorted to a van. Leaning on each other, their eyes sharing a deep-stare of shock. Next, I co-led a crew of ski patrollers to sweep the wet willows and aspen thicket to make sure we'd left no one unfound. An ambulance was pulled from the meadow's mud, the final of five transports plus the air evac. More than 30 folks had just fallen to a field, 11 transported with injuries — and from the chaos, order had been crafted, admirably quick, by folks I'm proud to call my colleagues.

This was not my trained-for job, except anyone trained in incident management may be called to improvise their support for an all-hazard incident. So I supported, nodding and smiling from behind my mask to the families, and doing the same with the many county responders, many of whom I'd worked with before.

An all-risk response is not wildfire. Neither is a pandemic a wildfire — yet somehow the fires we manage can be compared to the spread of pandemic. Fire is physics with bio-fuel added; the novel coronavirus is a bio-agent with us as the fuel. Far different, yes, but both share the risk of contagion and rapid transmission, and the jeopardy of a good day turning bad. And the pandemic can be compared to fire spread because fire is a process we actually know and can see. We feel its heat — plus it's a terror we've shown we can manage, albeit not as well as we'd like. And most of us know campfires and wood stoves, or wildfires in our media or our backyards, or controlled burns on the back forty — while the spreading novel coronavirus is an infection that lives within and among us, invisibly transmitted, signaling its presence with a fever (which we should monitor for twice a day), or by no sign at all.

When we respond to an emergency there are common protocols, yet each vector of our many hazards requires a unique, technical and often urgent response. This response-adjusted-to-vector is worth noting. Even an emergency of some scale — a multi-balloon accident, a wildfire rising into pyrocumulus, a

flood, a hurricane — can be isolated as an "incident" and managed with specific actions adapted over time. But a pandemic or climate crisis can only be managed with community, state and global responses.

First responders, wildland fire managers and technical and scientific experts are committed to respond to incidents, but in 2020 we do our work amid a societal-scale triage, responding amid the pandemonium of global stressors from COVID-19 and climate change. While we're assigning a crew to build fireline or drag a drip-torch, we're also recruiting everyone to work the COVID fireline by, at a minimum, wearing our masks and urging others to join us.

Which is why it's so important, in this issue of *Wildfire*, that we ask — how can we change our systems? As Mike DeGrosky observes: "Damn, but I love [John] Lewis's idea of 'good trouble!' Leadership requires risk. Leadership requires courage. Sometimes leadership requires a willingness to get in good trouble."

SOME OF WHAT I EXPERIENCED in the balloon response echoed what I've learned about ourselves and our profession while editing a decade of *Wildfire*. Should the unplanned event occur — a balloon (or three) falling during our shift, or a seismic social deflation, the pandemic "spreading like wildfire" — we will respond, both in the field and as leaders in our profession and communities.

And on our shifts this year (and into the future) we must work to sustain the lands we're responsible for, and the colleagues and communities we work with. Yet we live in a world beyond firelines and controlled burns — so we also must bust our tails to limit viral infections amid the pandemic; we must support an urgent struggle for equity and justice for all; we must find a safe escape route and know our safety zones for our crew from our current economic and political turmoil — and we must find ways to face the epoch-defining climate crisis as we work our day (and night) shifts, managing wildland fire.

These are giant challenges, but I sense, I hope — and I've learned from a thousand and more pages of your ideas in *Wildfire* — that we will build from and share our profession's strengths to help make our days better, and safer.

We must do our best each day.

We will wake up, make our beds (or pack our sleeping bags, if we're on assignment), and put on our personal protective equipment — with some new PPE this year, a mask (or a thick bandana, already familiar fireline wear). And when we get close enough to the flames we can check our COVID safety zone — a fire swatter's length of social distance — and take off our masks, swing a tool or light a burn, and be home again in our good work, with a foot in the black as we share a smile with the sisterhood and brotherhood, our wildland fire family. - **RS**

The Passing of an Iconic Leader

Courage, perseverance and the need for 'good trouble' – the lessons of John Lewis

MIKE DEGROSKY

I cannot recall when I first became fully aware of Representative John Lewis. I am not particularly a student of the Civil Rights Movement, though I have a solid 8th grade Civics kind of understanding of its importance and have long admired the leadership of the Reverend Martin Luther King. More recently, I think around the release of the movie Selma, John Lewis came into my view. Lewis is an icon of the civil rights movement, one of the so-called "Big Six" leaders of that movement: a founding member and Chairman of the Student Nonviolent Coordinating Committee, one of the original Freedom Riders, an organizer of the 250,000-person March on Washington for Jobs and Freedom, and the leader of the march from Selma to Montgomery now immortalized as "Bloody Sunday."

Until his recent death, Lewis was serving his 17th consecutive term as the member of the U.S. House of Representatives representing Georgia's 5th District. The degree to which Lewis's constituents supported him is legendary. Lewis's influence in Congress was moral, with many considering him "the conscience of the Congress." I am aware that not all Wildfire readers may share Lewis's politics as he was staunchly liberal, but the purpose of this column is not to celebrate his politics, but his leadership. John Lewis embodied characteristics that I both admire in leaders and see as common among effective leaders, both those I have known personally and others that I have studied.

Humble Beginnings/ Humble Leadership

Many leaders enjoyed advantages early in life that facilitated their path to leadership. John Lewis was not one of those people. Born in rural Alabama, Lewis was the third of ten children whose parents were sharecroppers and grew up in an era of racial segregation. I have noticed in my life that people of humble origins often remain modest people throughout life. Humble people can become humble leaders, those who connect with others at a human level; create a climate of trust, equality and respect; and understand their own limitations. By all accounts, John Lewis was such a

person. Despite being honored many times in many ways, including both the Presidential Medal of Freedom and the only Profile in Courage Award for Lifetime Achievement, Lewis was known as a man largely unaffected by the praise he received.

Dedication and Commitment to Purpose

John Lewis dedicated his life to a driving purpose – racial equality and justice. I recently read in The Guardian that, in an interview just before his death, Lewis told Oprah Winfrey "I tried to do what was right, fair and just. When I was growing up in rural Alabama, my mother always said 'Boy, don't get in trouble… but I saw those signs that said 'white,' 'colored' and I would say 'Why?' And she would say again, 'Don't get in trouble. You will be beaten. You will go to jail. You may not live.' But the words of Dr. King and the actions of Rosa Parks inspired me to get in trouble and I've been getting in trouble ever since. Good trouble. Necessary trouble." Damn, but I love Lewis's idea of "good trouble!" Leadership requires risk. Leadership requires courage. Sometimes leadership requires a willingness to get in good trouble.

Damn, but I love Lewis's idea of "good trouble!" Leadership requires risk. Leadership requires courage. Sometimes leadership requires a willingness to get in good trouble.

Courage and Perseverance

Anyone reading this column for any time knows that I regard courage as a leadership essential. I've cited before an article by Bill George, a Senior Fellow at the Harvard Business School, who wrote about how courageous leaders boldly take risks and go against the grain, and that their boldness both inspires people and puts them and their organization in the position of leading societal change. In that article, George discussed how leaders needed courage to stick to their principles and not give in to the fear of facing criticism or even failing. Lewis took courageous leadership to an extraordinary level, having been arrested dozens of times, jailed, and brutally beaten more than once during the civil rights movement.

On "Bloody Sunday" Lewis and a colleague led a 600-person march from Selma to Montgomery where, after crossing the Edmund Pettus Bridge, they were attacked by Alabama State Troopers, one of whom fractured Lewis's skull. It is important to note that Lewis was a lifelong adherent to the principles of non-violence and that he was simply leading a peaceful protest march. The march and the events of that day, televised around the world, led directly to the passage of the Voting Rights Act. Lewis's courage included risking his physical safety, even his life to fight for what he believed. Said Lewis in a USA Today interview commemorating the 50th anniversary of the march, "It just reminds me that some of us gave a little blood on that bridge to redeem the soul of America, to make America better." Reflecting his belief in perseverance, Lewis once told supporters "Our struggle is not the struggle of a day, a week, or a year, it is the struggle of a lifetime. Never be afraid to make some noise and get in good trouble, necessary trouble." Leadership words to live by.

Inspirational

On John Lewis's death, Barack Obama observed that "…through the decades, he not only gave all of himself to the cause of freedom and justice, but inspired generations that followed to try to live up to his example." Academy award nominated film director Ava DuVernay, in a tribute to Lewis, recently wrote that she would "never forget what you taught me and what you challenged me to be. Better. Stronger. Bolder. Braver."

John Lewis's life reminds me of an anonymous quote, oft mis-attributed to John Quincy Adams, that I include in a set of encouragements that I leave for myself as a source of motivation and strength. "If your actions inspire others to dream more, learn more, do more and become more, you are a leader."

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.

2020 IAWF SCHOLARSHIPS

Each year the International Association of Wildland Fire (IAWF) awards two graduate-level scholarships typically valued at $3,000 USD to Master of Science (M.Sc.) 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.

Congratulations to the 2020 Scholarship Recipients.

Mary Armstrong, MSc Student, University of Florida

As a master's student at the University of Florida in the School of Forest Resources and Conservation, Mary is writing her thesis on the effects of season of prescribed fire on reproductive characteristics of several species in the Asteraceae and Poaceae families. After receiving her bachelor's degree in Environmental Studies from Eckerd College, she began her career in prescribed fire with The Nature Conservancy in southeast Georgia. Since then, she has worked on prescribed fire crews with The Department of Natural Resources in Georgia, Lake Travis Fire Rescue in Texas, and Wildland Restoration International in Florida. She has also worked wildfire suppression on an engine and helicopter crew in Helena, Montana. After four years of field work, she decided to continue her education at the University of Florida to expand her knowledge of ecosystems and prescribed fire, and to write a thesis that could assist land managers in their decision making. In her fire career, she learned that land managers across all four states have many similar research questions. Her goal is to conduct research to help answer these questions, beginning with timing of fire and its effects on the reproduction of groundcover plants.

Robert Scott, PhD Student, Sociology, University of Colorado Boulder

Robert received a BS in Sociology from Westminster College (Salt Lake City, UT) and an MA in Sociology from the University of Victoria (Victoria, BC). He is a PhD student in Sociology at the University of Colorado and has worked in various fire management positions (Type 1 Crew Member, Type 1 Crew Leader, Provincial Training Officer) for the Government of Saskatchewan.

For his doctoral research, Robert uses historical and interview methods to investigate how single- and multiple-fatality incidents involving firefighters affect the construction of self among other firefighters. The research includes a comparative analysis of Canadian and American firefighter fatalities that occurred in a 30-year period. Robert is especially interested in how firefighter fatalities influence who firefighters become in terms of their subsequent experiences and perceptions of risk. He anticipates his research will have significant value for the wildland fire community as well as occupations involving risk.

SAVE THE DATE FOR SAFETY SUMMIT AND HUMAN DIMENSIONS

Save the Date for our upcoming 16th International Wildland Fire Safety Summit and 6th Human Dimensions of Wildland Fire Virtual Conference.

Since 1997, the International Wildland Fire Safety Summit has been the

gathering place for members of the global wildland fire community to focus on how we keep our workforce and communities safe. This event is a time for us to discuss significant events and trends in safety, to promote best practices in safety training and operations, to share safety related research findings, and to explore new approaches to both firefighter and community safety. Likewise, since 2007, the Human Dimensions of Wildland Fire Conference has aimed to advance the knowledge and practice related to the social, political, economic, psychological, and other human aspects of managing fire prone landscapes.

This joint conference offers a forum where past experience and lessons learned are documented, current work showcased, and emerging ideas/technology presented to provide a strong foundation for reflection and action to set the future course of practice, management and research in response to local, regional and global challenges. The 2021 conference will place particular, but not exclusive, emphasis on the COVID-19 and its effects on wildland fire management and our communities around the world.

This Virtual Conference in May 2021 will allow us to reach a truly international audience, with global topics and speakers from around the world, on most continents and most time zones.

IN CASE YOU MISSED IT! 3RD INTERNATIONAL SMOKE VIRTUAL SYMPOSIUM (ISS3)

The 3rd International Smoke Virtual Symposium (ISS3) was held earlier this year and was very well received by everyone who joined! All the presentations were recorded and are available for viewing on the Virtual Conference Platform. We have reduced the registration fee to $125 ($55 for students). All presentations will be available through April 2021. https://www.iawfonline.org/event/3rd-international-smoke-symposium/

NOMINATIONS FOR THE IAWF 2021 AWARDS BEGIN SEPTEMBER 23

We encourage you to gather your information to nominate some very deserving folks for these prestigious awards! The recipient does not need to be an IAWF member to receive an award. If you have nominated someone in the past and they were not selected as the recipient, please do not hesitate to re-nominate them.

Ember Award for Excellence in Wildland Fire Science

The purpose of the IAWF EMBER AWARD is to acknowledge sustained achievement in wildland fire science. The name 'Ember' was chosen to reflect the fact that research and science often move slowly, and their benefits or impacts may not be apparent for years or more.

Firebreak Award for Excellence in Wildland Fire Management

The "Management Award" was established to honor achievements and excellence in the management of wildland fire programs. This award recognizes an individual who have made lasting contributions in program management and inspired others through their creativity, innovation, leadership, application, guidance, and communication in response to challenging and controversial wildland fire management issues.

Early Career Award in Fire Science

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

Early Career Award in Fire Operations

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

REVIEW: "PRESCRIBED BURNING IN AUSTRALASIA – THE SCIENCE, PRACTICE AND POLITICS OF BURNING THE BUSH"

Editors:
Adam Leavesley, Mike Wouters and Richard Thornton

Fire has been a force in the Australian landscape for millennia and prescribed burning has been practiced for at least 50,000 years by the First Peoples. And yet, here we are. Still debating its merits. Still trying to get the square peg of science into the round holes of community values, political ideology and entrenched operational practices.

The debates roared around prescribed burning in the Australian summer of 2019-20. Much of this book was written before those fires but the range of views provide a timely frame to review this historic year for fire and plan for what may lie ahead.

In the introductory chapter, editor Dr. Adam Leavesley declares that this book features a broad range of views on the science and practice of prescribed burning, but he adds, it is "not a social science study."

But it is through the lens of social science that makes this book most interesting. Prescribed burning is, to take the title of his opening, Different Things to Different People. The basic principle of putting fire into the landscape to reduce the risk of larger, uncontrolled wildfire is barely questioned across the 300 pages. The differences arise in how you burn, where you burn, why you burn. And those differences are told by 51 fire and land managers, and researchers, from across Australia and New Zealand.

There is much focus on the use of fire by Indigenous Australians and how much of it is misunderstood by the general population. As Leavesley calls it, it is part of the "whitefella dreaming conversation"; essentially a mythological view held by non-Aboriginal people on how the country was burnt pre-European colonization and how that type of burning can and should now be resumed by present day non-Aboriginal land managers. This is not the point of view of Aboriginal people still active in burning practices. Times have changed, the landscape is changed, but, argues Dean Freeman, a Wiradjuri man and a divisional commander in the ACT Parks and Conservation Service, fire management is often too inflexible.

Most of the traditional custodians of southern Australia recognize that times have changed and will be glad for the opportunity to work with conservation agencies and other land managers to manage and burn country within the frameworks that exist today. At the same time, it is hoped that the Australian community recognises that the use of fire was a fundamental skill of Aboriginal people and that the reintroduction of Aboriginal burning to southern Australia has the potential to deliver many benefits to society.

The core of the book has chapters grouped under Evidence-Led Management, with contributions from many of the current leading scientists and practitioners in this field in Australia and New Zealand.

The topics range from the broad to the local. Prescribed

Prescribed burning in South Australia, Ngarkat Conservation Park.

Prescribed burning in South Australia, Ngarkat Conservation Park.

burning on central Australian desert land, on the fringe urban settings of capital cities, and in the tropical savannahs. Burning for ecological outcomes. Burning amongst the fire sensitive plants in Tasmania. Burning under the growing influence of climate change. The impacts on forest carbon and water. The impacts on landscape erosion and on native fauna and ants.

This in-depth analysis is disrupted throughout the book by small Photo Focus features that rely on good photography and minimal text to make a point – on aerial ignition, ignition patterns, smoke management, forestry regeneration burns, burning for Gouldian Finches, the pioneering work of Alan McArthur, and more.

A book that is imbedded with so much evidence-based science dedicates its final 18 chapters - a third of the book, no less - to Expert Opinions. Can there really be that many opinions on how to do prescribed burning? Dr. Kevin Tolhurst, researcher and teacher, calls for more fire in the landscape but laments the lack of skills and resources to achieve this: "The complexity and importance of good fire management is not recognised in most of Australia. Instead, we have opted to use a response-driven management paradigm because it is easier for the public, politicians and media to understand and accept."

As bushfire took hold on much of the southeast Australian states early this year, the public and political voices, both informed and uninformed, suddenly had long-held opinions on prescribed burning and its impacts on uncontrolled wildfire. On any given day it was in equal parts raised as the solution and pilloried as the cause.

Meanwhile, this year as in any other year, writes co-editor Dr. Richard Thornton, "…many local land management authorities are just getting on with the job – and dealing with the equal mix of complaints and praise on a daily basis."

Several IAWF connections are present with Dr. Adam Leavesley a Wildfire Contributing Editor, former IAWF Board member Dr. Richard Thornton as a co-editor, and current Board members, Murray Carter and Naomi Stephens, submitting chapters. The immediate past president of the IAWF Alen Slijepcevic also writes.

This book is the final product of the National Burning Project, which brought together knowledge and practices from across Australia to build a more holistic and consistent approach to prescribed burning.

Buy from the AFAC Shop: https://www.afac.com.au/auxiliary/shop

Review by David Bruce, Communications Director for the Bushfire and Natural Hazards Cooperative Research Centre and IAWF board member.

DAUNTLESS AIR

WE FLY TO WIN

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.

There are so many reasons to become a member of the International Association of Wildland Fire!

All members can stay current on emerging issues by following our webpage, attending IAWF hosted conferences, reading Wildfire Magazine, and following the latest research in IJWF. You can also find a network of associates to share ideas and tools or work on common problems through our international membership.

MEMBERSHIP BENEFITS

- Subscription to **Wildfire** Magazine
- 25% discount on subscription to the **International Journal of Wildland Fire**
- Discount on **IAWF conference registration fees**
- Access to the contact information for all **IAWF members**
- Eligibility to hold a **Board of Directors seat**
- Eligibility for **student scholarships**
- Share your knowledge by participating in **IAWF's Mentoring Program** as a mentor, or take advantage of the vast array of knowledge and expertise as a mentee.
- Participate on an **IAWF Committee** and help shape the activities and polices of the association.
- **And most importantly, the opportunity to be a member of a professional association that is committed to facilitating communication and providing leadership for the wildland fire community.**

Visit www.iawfonline.org to join today.

International Association of Wildland Fire

For more information contact us:
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CRAFTING A FIRE SYSTEM FOR THE FUTURE

A perspective on matching modernization with changing complexity in our Wildland Fire Management System

BY TOM ZIMMERMAN AND JOE STUTLER

Tom Zimmerman and Joe Stutler are retired employees of the US Forest Service who were fortunate enough to have long careers in wildland fire management. Collectively, they have worked at all levels of the organization and served on Incident Management and Area Command Teams with a combined experience in excess of 100 years. What is offered here is by no means a full prescriptive analysis of the state of wildland fire management but represents the authors' observations, thoughts, and perspectives about the needs of our wildland fire management system in these changing times. Tom Zimmerman is Strategic Coordination Advisor and Past President of the International Association of Wildland Fire and Joe Stutler is Senior Advisor for Deschutes County, Bend, OR.

A CalFire PSA sign promotes Firewire readiness on Hwy 128 near Healdsburg, Calif., on the Kincade Fire in 2019. **PHOTO: Kari Greer.**

1. Today's situation, tomorrow's destination – a more challenging complexity

Today's society exists in a continuum of weather, climate, vegetation, social and economic values, and political concerns that places enormous influences on wildland fire. Understanding the interrelationships involved in this is a critical step in comprehending the complexity surrounding wildland fire management.

Significant changes are taking place today, most of which are dramatic and rapid. Modified wildland fuel complexes, expanded wildland-urban interface (WUI) areas, increased human-caused fire numbers, changing climatic conditions, altered fire regimes, and shifting social/cultural perspectives provide little doubt that we are in a period of worsening complexity. These changes are triggering extensive and uncompromising, shifts in the behavior, extent, and effects of wildland fires and it can be easily seen that the degree of difficulty in accomplishing wildland fire management objectives is becoming immeasurably more complicated.

The subsequent wildland fire impacts to social, management, economic, and political values present far-reaching management challenges. Demands on and expectations of decision-makers and responders are rapidly mounting and firefighter risks and suppression costs are reaching unprecedented levels. These trends are not necessarily new, but the erratic nature and speed of change now taking place are becoming increasingly alarming.

To more effectively respond to complexity, the wildland fire management program must be viewed as a wildland fire management system and evaluated in terms of how well it can meet future challenges. The state of the program may be considered well positioned to move into the future as fire knowledge; science, technology, and operational capability; policy maturation level; and the understanding of management strategies and tactics have never been more complete. But, while many actions have been planned and implemented with countless successes realized, the future is necessitating

intensified and diversified actions to keep pace with changing conditions and shifting complexity. The wildland fire management system must be modernized at a rate greater than that of increasing complexity. Decisions and actions must be adapted, the body of knowledge must be enlarged, experience must be expanded, and capabilities boosted. There is much that can and should be done to ensure sustained stability and success in the wildland fire program.

What the future challenges will be and how they will be responded to are powerful and thought-provoking unknowns. While the answers are uncertain at this time, this paper offers questions about capability, discusses wildland fire management as a fire management system, and provides thoughts on opportunities for advancing the wildland fire management system to keep pace with changing complexity and better meet future challenges.

2. A Wildland Fire Management System – anchored in Cohesive Strategy

A number of elements influence wildland fire management. Those that shape program direction, program structure and function, and planning and implementation are most influential. These include the framework of policies, strategic plans, land and resource management plans, and other guiding documents. They provide program guidance, expanded flexibility, and the structure to keep pace with a dynamic situation, while embodying the state of the knowledge, the state of the art, and the latest science and technology.

Flexibility in program direction is extremely important since a viable one-size-fits-all management option does not exist and even if it did, is not desirable.

Each year, escalating complexity and experience bring "new firsts" that increase appreciation of change and awareness that wildland fire management must be viewed as a complex system. While other articles discuss this approach, (Thompson et.al. 2018: Christiansen 2019), we frame our discussion of this system in terms of three principal components: strategic goals as system outcomes; functional drivers of the system; and factors limiting the system (Figure 1).

The strategic goals from the National Cohesive Wildland Fire Management Strategy (USDI-USDA 2014) can be viewed as outcomes from the wildland fire management system and comprise the top portion of Figure 1, shown in a patterned fill. These goals provide a full range of flexible outcomes, set the stage for a wide range of actions, promote multi-focus thinking, and provide for a range of comprehensive objectives.

We identify three functional elements as primary driving factors of the system (Figure 1). They consist of strategic thinking; decision-making; and tactical actions and full use of available options, which are shown in the center of the figure in white. It has been stated that outcomes of the fire management system are driven by a suite of environmental, social, political, financial, and cultural factors (Christiansen 2019). But, we view these in terms of realities that are highly important due to their influence in restricting program development and advancement. These consist of management realities, social realities, and ecological realities, shown in the lower portion of Figure 1 in solid colors.

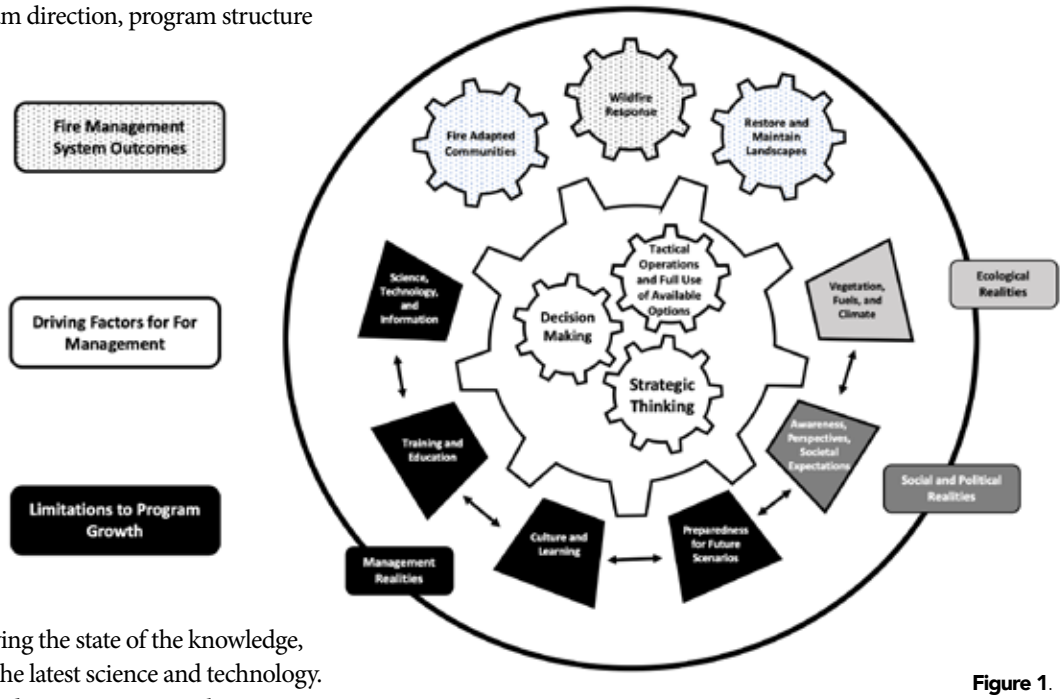


Figure 1. The Wildland Fire Management System showing interrelationships of program elements of strategic thinking, decision-making, and tactical actions with National Cohesive Strategy goals and perceived limitations to program advancement.

From this view of the fire management system, it is clear that the desired range of outcomes is dependent on the three primary driving factors. These driving factors are highly intertwined and must function in coordination with each other to make the system work efficiently. But they can be limited by many aspects of management, social and political,

and ecological realities. These realities, individually or in concert, can very quickly become barriers to program function by limiting any of the three driving factors (Figure 1).

3. Is modernization needed to meet challenges and match complexity?

A solid framework and the right tools and processes currently exist, but continued forward movement must build on emerging tools and processes to modernize capabilities. Progress must be monitored and assessed to ensure focus is not lost and energy is not wasted. Every opportunity must be evaluated and acted on. Failing this, the program will lapse into passive management fueled by a flawed thought process. This faulty approach will not succeed in the future; it will allow challenges to overwhelm managers and force reactionary decisions and responses without sufficient forward-thinking.

Awareness of this situation is increasing. Christiansen (2019) highlights opportunities to improve the wildland fire management system, states that a new approach is needed and reinforces how the Cohesive Strategy is providing more opportunities for improvement. Bosworth and Williams (2018) advocate for a more imaginative approach to wildland fire management and Thompson et al. (2018) support reevaluation of the fire management system.

To be progressive in management and implementation, there are some certainties that cannot be ignored if specific answers about future direction are to be found. Table 1 provides a list of these certainties associated with wildland fire management today and pertinent questions for the future.

To answer these questions, attention must be given to the three driving elements of the wildland fire management system to provide clarification that modernization must be reflected in these areas and priorities must be identified.

Strategic Thinking: Strategic thinking enables focus and drives active, progressive, and long-term assessment and action. It powers both decision-making and implementation of tactical actions. Without strategic thinking, decision traps such as over-reliance on past experience, over-emphasis on a specific tool or process, seeking a single and simple answer or a "one size fits all" management action, or lapsing into single-focus thinking and action will result.

Table 1. Uncommon certainties of today and questions surrounding tomorrow's wildland fire management.

CERTAINTY	QUESTIONS FOR THE FUTURE
Over-indoctrination with unwise information places excessive pressure to see truth.	• Is the changing complexity of wildland fire management fully understood? • Is changing complexity being ignored due to historic fire management culture?
Change is hard and pervaded by reluctance to accept, and put into practice. Repeated practices do not cease to be ill-advised simply because they have long been accepted as the norm.	• Does the capability, and will, for developing and implementing the necessary operational change exist? • Is a passive management stance letting changing conditions drive decisions and actions or is active decision-making being used to influence change and help field better responses? • Are new perspectives being heard and recognized?
Investing in the future is not foolish but is perhaps the most valuable contribution.	• Are employee skills and agency capabilities being advanced? • Are future skill, education, and training needs being anticipated and prepared for?
Great leadership does not mean ignoring reality.	• Is the wildland fire management system being modernized at a rate commensurate with increasing complexity? • Are strategic thinking, precise tactical actions using all available options, optimal use of prescribed fire and fuel treatments, science and technology, up-to-date and imaginative training, and upgraded processes to improve decision-making and implementation being incorporated into management at the proper rate? • Are new capabilities, knowledge, and opportunities being endorsed? • Are decisions reflecting commitment to safety by actively incorporating risk management? • Is active learning occurring and based on the best information?

Decision Making: Decision making directly influences tactical actions and provides feedback to strategic thinking. Completing the most thorough review of a situation, developing a set of potential actions, and making risk-informed decisions are dependent on the collection and analysis of information. New strategic and tactical paradigms, recent advances, and lessons learned must be valued, communicated, and understood by decision-makers, their organizations, and the public.

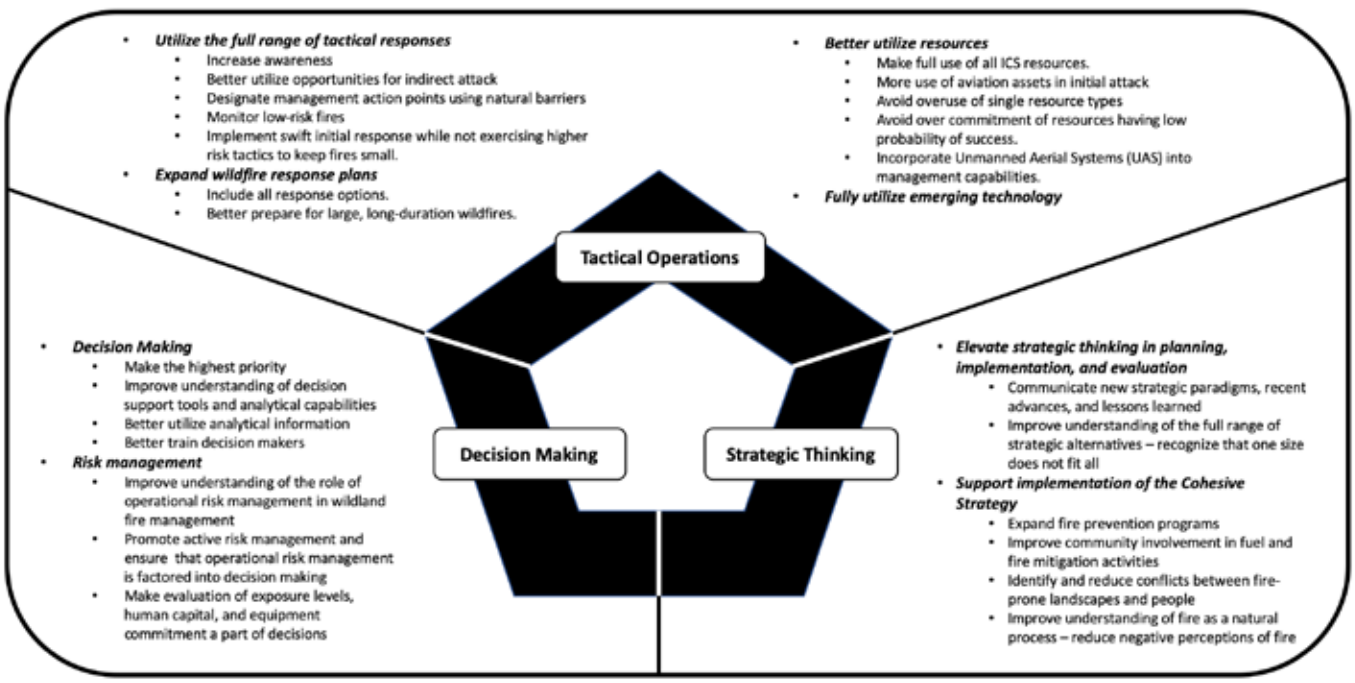
A principal limitation of decision-making support is not the direct weakness of information but comes from the emphasis placed on it and its degree of use. It is far too easy to overlook, misunderstand, or resist applying the best available information. Time constraints can negatively affect decision creativity, foresight, and quality. It has not been uncommon for decision-makers to review and superficially embrace decision support information, which might be unmistakably relevant, then fail to incorporate or utilize it in the decision process simply because it is new, outside an experience zone, or spontaneously considered too hard to understand. Also, while a review of historic activity can also be extremely important, many decision-makers do not have the luxury of personal knowledge of past events in a particular area. Consequently, they may get caught up in a contemporary bias that places too much emphasis on the most recent or immediate information and fails to recognize potential precedent-setting earlier events, a temporal tradeoff where sufficient actions are not done quickly enough, or a decision transfer where belief in alternative action sets is given too much weight, regardless of available information.

But, there is also a downside that must be considered. Information availability must be balanced so that information overload or overemphasis can be avoided. Decision making must not become a burden on managers. It should not be pervaded with inflow of so much information that it becomes a question of "what do I have to know?" It should be about acquiring information to answer the question of "what can I use to advance my awareness, understanding, and make better decisions?"

Tactical Actions and Full Use of Available Options: Wildland fire response capability has grown to become very sophisticated and efficient and accomplishes early control of most unwanted wildfires. Despite strong capability and efficient operation, a small percentage of fires escape initial response and become large and often, long-duration fires. This proportionately small number of fires are responsible for a disproportionate amount of area burned, damage to homes and infrastructure, personal injuries and loss of life, and incur the bulk of annual suppression costs.

Tactical responses to wildland fires must be coordinated, well thought out, and efficiently directed to safely accomplish desired objectives. Initial responses can be successful within their designed capabilities, but for those fires that escape initial actions, specific situational analysis and use of the full range of options must be considered and applied. Continuing to apply failed tactics or over-utilizing a particular tactic or type of firefighting resource, regardless of the specific situation, does not further protection objectives, but increases costs and exposes firefighters and equipment to increased risk and exposure. Employing costly tactics repeatedly and increasing

Figure 2. Areas where modernization efforts can be applied to advance strategic thinking, decision making, and tactical operations in the wildland fire management system.



expenditures have not been shown to increase suppression effectiveness (Calkin et al., 2014).

Changing conditions do not alter the direction for safely and effectively extinguishing fire when needed; using fires where allowable; and managing our natural resources by making use of all available options.

It is clear that within these three driving factors, there are a number of opportunities for modernization efforts. Many, but likely not all, are shown in Figure 2.

4. Today's realities, tomorrow's impacts lead toward modernizing the Wildland Fire Management System

Changing conditions and emerging situations are challenging conventional thinking and standard practices. This is not unique to the United States, but one that is pervasive to all fire organizations around the world. The magnitude of change that is taking place has brought us to a point in time warranting a hard and in-depth look at whether forward program movement is commensurate with changing complexity or if operation under an old model continues. There are a number of reports that contend that changes are not being responded to purposefully and quickly enough (Thornton 2020; Kolden 2019; Raines and Harbour 2018; Thompson et al., 2018; Calkin et al., 2015).

The most recent fire season in Australia in 2019-2020, one that exceeded all others, has already and continues to generate considerable introspective analysis of the overall fire situation and response capability. Thornton (2020) offers a commentary on this fire season and believes that what is needed is a quantum shift in thinking. He emphatically submits that to pursue the same path under the current system is merely a simple solution to a complex problem, and wrong!

Raines and Harbour (2018) state that current and past practices in wildland fire have contributed to an untenable and unstable situation that without important changes will not remain static but will worsen. They submit that change is coming, either through natural on-the-ground events or through organization shifts; the status quo will not continue.

Other authors have stated that without significant social and managerial changes, the future of wildland fire management in the western United States will perpetuate "business as usual" (Calkin et al. 2015; Ingalsbee 2017), and likely result in continued increases in costs, damages, and serious injuries (Thompson et al. 2016). Such outcomes only stifle opportunities for meaningful change and represent the rationale for rethinking the wildland fire management system (Thompson et al. 2018). In addition, continuing with the current system as is will not support heightened integration of risk assessment and management but lead to prioritization of management for short-term risks during wildland fire events (Schultz et al., 2019).

To most efficiently bolster the wildland fire management system, attention must be focused on those areas having the strongest influences on the system. Looking at factors that limit the ability of strategic thinking, decision making, and tactical operations to function at high levels, it is readily apparent that management realities, social and political realities, and ecological realities surface as the prime foci that can quickly limit or block efficient operations.

Management Realities. Management realities consist of factors having strong influence on management activities and arise from management structure and function. There are four main areas of management realities that we would like to touch on which include: research, science, technology, and information systems; training and education; culture and learning, and preparedness for future scenarios.

Research, science, and technology, and information systems: Throughout the history of fire management, research, through systematic investigation, information collection, and analysis, has communicated enormous quantities of new science and technology, positively informed action, validated policy development, supported management programs, and shaped the understanding of wildland fire. Notwithstanding these gains, current and future challenges dictate that knowledge of wildland fire and its interrelationships with the environment and society; its foundational inclusion of risk management, its support to strategic direction, and its influence on overall management capability must be increased (Hall et al., 2018).

This is a time where decreased attention and commitment to research is untenable. Making science, technology, and information management significant leverage points in support of program implementation must be a priority goal (Thornton 2020; Cissel and Zimmerman 2018). Accelerated and well-conducted research programs are more vital to the success of wildland fire management endeavors than ever before. Science, especially research conducted in a cooperative manner, will assist in strengthening fire and land management (Hall et al., 2018).

What can be done?

- Present a strong and definitive leaders' intent to make continuing and accelerating research a greater priority so wildland fire science can move forward as an organized body of knowledge and improve the application of science information for practical purposes.
- Increase research program budgets to support continued and accelerated work.
- Increase science delivery and translation across agency programs and make outcomes more accessible, useful, and actionable.
- Update data sets, advance technology, and expand audiences so that wildland fire science can more readily support and improve planning, implementation, and decision-making processes.

- Continue research to identify ways to contain/manage large wildfires more efficiently and identify where large, long-duration wildfires are likely to occur.

Training and Education – Advancing Knowledge: Better preparation of personnel to meet emerging challenges must involve greater diversity in training delivery methods as well as on-the-job training and education based on the most current and relevant information. Decision makers and planners must be prepared to manage the complex risk management and strategic planning tasks associated with response to wildland fires. Serious questions exist whether this is occurring through appropriate training and experience (Schultz et al., 2019). The COVID-19 pandemic and its ramifications to moderate to large group gatherings renders the traditional training model where trainees gather at a single location for in-classroom training mostly unusable. Greater use of virtual training delivery and off-site education will have to be pursued if training and certification standards are to be met.

What can be done?

- Ensure that training and education courses provide current information; relate to current situations; match knowledge, technology, and practices with fire complexity; and that coursework is developed/revised as situations warrant in a timely and proactive manner.
- Update training courses on a more frequent schedule to be more inclusive of changing situations and emerging information.
- Rapidly identify new or additional skills needed.
- Prepare tailored learning to fill skill gaps.
- Make full use of all available training delivery methods – give equal or greater emphasis to virtual training and remote self-study.
- Adopt fully digital approaches to re-create the best in-person learning through live video and social sharing (Agrawai et al. 2020).
- Reskill workforces to better prepare to live in a new working environment – train for work in a digital and remote environment.
    - Expand the ability to operate in a fully digital environment – "stay ahead of the curve."
    - Strengthen awareness of digital collaboration.

Culture and Learning: To better respond to a changing and challenging paradigm, it is important to advance knowledge levels, facilitate and take advantage of learning opportunities, and heighten all management capabilities. Wildland fire management must be a true knowledge and learning program where constant attention is given to emerging information, new knowledge, past experiences, historical documentation, and lessons learned.

Over-reliance on passive management, characterized by over-dependence on historical experiences and hindsight bias; failure to accept new processes; continued use of failed strategies and tactics; dated training and education; and slow learning or total disregard for lessons learned must be avoided. Knowledge, training, and education must reflect the state of knowledge and experience and information must be accessible and communicated to the greatest extent possible.

Organizational culture is the collection of assumptions, values, beliefs, and principles which gives a clear picture and motivation to people as how they and the organization behave. It includes an organization's vision, mission, guiding documents, stories, values, beliefs, policies, and habits. It affects the total motivation of people. Wildland fire management culture arose from early beliefs that all wildland fires were detrimental to natural resources. This was fed by policy establishing fire exclusion as the single goal. Over the years, knowledge has dramatically increased regarding the natural role of fire in natural ecosystems and that fire exclusion is not sustainable and desirable. But, the wildland fire management culture has not grown accordingly.

Today's wildland fire management culture is seemingly blurred between two contrasting perspectives. On one hand is the belief that all wildland fires are bad and should be treated as emergencies. In this perspective, swift, aggressive suppression is viewed as the only acceptable response to every fire, with no regard given to vegetative type, location, values threatened, and resource management objectives. On the other hand, realizing that some fires can benefit ecosystems warrants evaluation of site-specific conditions and objectives. Appropriate responses developed on a case by case basis, when conditions allow, support land management and broader objectives. A culture built on a fire service suppression-only program is not consistent with land and resource management and the guiding framework set forth in the National Cohesive Strategy. Simply put, the relationship of the Cohesive Strategy goals and land management to our culture is undeniable. It has be realized that in the complex wildland fire management system, the Cohesive Strategy has become the foundational doctrine (Christiansen 2019). A more comprehensive culture reflecting all the goals of the Cohesive Strategy must be embraced.

What can be done?

- Strengthen the learning process.
- Increase awareness of the importance of learning to management programs.
- Make lessons learned and important experiences more accessible to wildland fire management personnel and translate their applicability to future scenarios into training and education.
- Expand wildland fire management culture to be more inclusive of the interrelationships of wildfire response, fire-adapted communities, and landscape restoration and maintenance.

Preparedness for Future Scenarios: Falling prey to hindsight bias while trying to understand how the present relates to the past and tending to display overconfidence in the ability to identify and anticipate future outcomes occur too often. The luxury of planning for just a single desired future state while moving forward into such a rapidly changing future cannot be afforded. Future scenarios must be predicted and how work will be done must be reimagined. Wildland fire management must be expected to continue to present new and unique situations that involve increasing fire environment changes and associated issues. A range of futures, some uncontrollable, that could result from interactions among a number of factors must be imagined and prepared for. Simply put, a closer look into the imaginable spectrum of future wildland fire scenarios is needed and knowledge, experience, and perceptions must be challenged with new ideas put into practice.

Unimagined and unprepared scenarios are already becoming commonplace. Recent fires are exceeding historical fire behavior experience. The most recent Australia fire season left a path of extensive destruction far beyond what was imagined. The current worldwide COVID-19 pandemic has occurred with unforeseen swiftness and severity that is forcing every fire management organization around the globe to adapt protocols to ensure continuity in wildland fire management capability. A true evaluation of the full effects of this pandemic on wildland fire response sustainability will not be possible for a year or more. But it is a certainty that response protocols and many aspects of wildland fire management will change from historical norms.

What can be done?

- Imagine and identify future scenarios and effects on wildland fire management.
- Plan and prepare for eventualities associated with climate change, abnormal fuel accumulations, socially impactive issues, other possible external influences, such as pandemics, and the impacts of politicization of fire management and oversight during periods of crisis.
- Support research to help identify future scenarios.
- Think outside the box and develop new ranges of appropriate strategies and tactics (Roper 2020).

Social and Political Realities. Society is an increasingly important stakeholder in wildland fire management decisions and actions. Fire management is no longer a remotely-based program primarily associated with wilderness, roadless, and remote areas. It has become and forever will be part of a population-based paradigm associated with urban areas, wildland-urban interface areas, and managed public lands mostly visible by much of society. There is greater threat to and involvement of structures in unplanned fires today and, it is likely that for most careers, this threat will never be this low again. Social awareness of wildland fire is rising and with it, expectations are greater than ever before. Political attention, scrutiny, and involvement are higher than at any previous time and can only be expected to heighten into the future.

Social and political expectations have substantial effects on management options. They drive unwise actions that may compromise risk management and increase exposure to firefighters and equipment, escalate expenditures, and conflict with ecological objectives. More frequently, society is expecting protection, fire suppression, and the use of airtankers, regardless of the situation.

Adapting to, overcoming, and learning to deal with social and political influences as a norm is imperative. Anticipating, responding appropriately, and incorporating these influences in wildland fire management must be routine. The COVID-19 pandemic is a graphic example of the onset of a new external social influence that abruptly and dramatically increased challenges. It forced new thought processes to identify and put into practice new protocols, both for the protection of firefighters and the public (Roper 2020).

What can be done?

- Adapt to working in an environment based on social – ecological – and political interrelationships.
- Expect and anticipate significant social influences to develop as realities that increase current and future challenges.
- Reimagine the influence of future social realities and prepare for these eventualities.

Ecological Realities. Ecological realities facing fire managers today include the interrelationships of climate, vegetation, and fire and how they affect the fire environment. Vegetation structure and composition and fuel accumulation are significantly important areas. In a large number of national reports discussing wildfire problems and future actions, a common assertion is that the most extensive and serious problem related to the health of wildland areas is the over-accumulation of vegetation and burnable fuels. This situation is partly responsible for the increasing number of large, intense, uncontrollable and highly destructive wildland fires (USDA-USDI 2014).

Changing climatic conditions are setting the stage for worsening fire seasons. Drier conditions during winter precipitation periods coupled with longer, hotter summers favor earlier starting fire seasons with longer durations. Climate models are projecting these conditions as a common pattern in coming years.

In recent years, increases in record breaking temperatures and recurring droughts have led to shifts in wildland fire around the world. Ample evidence already exists of climate-driven fire regime change and resultant worsening effects. Annually, reports describing the severity of fires and fire seasons are appearing more frequently. In 2020 and 2019 striking headlines about wildfires were frontpage in

Australian news releases. In 2019 and 2018 news releases highlighted the frequency and severity of fires across Sweden, Russia, Greenland, Canada, California, and Alaska with the most expensive and largest fire years ever recorded in 2018 in California and British Columbia. Climate change consequences are here today, not in the distant future, and they are escalating.

Fuels are the only element in the fire-vegetation-weather-topographic dynamic that managers are able to modify. Improving protection capability involves treating fuels, reducing potential fire behavior, and increasing the likelihood of successful fire suppression efforts (USDI-USDA 2014). A range of vegetation manipulation techniques and fuel treatment options exist for this purpose.

Prescribed fire, the application of fire under a planned ignition to meet specific objectives to treat natural fuels has emerged as a keystone land management process. Prescribed fire is widely advocated for reducing wildfire hazard and has a long and rich tradition rooted in indigenous and local ecological knowledge (Kolden 2019). It can reduce potential fire behavior, increase the potential success of suppression efforts, and maintain and improve ecosystem health and resiliency. It can be completed at scales ranging from site-specific to landscape and range from single to combinations of treatments, and single to multiple applications over time.

As a result, prescribed fire is highly versatile. But current application levels are failing to have major impacts on widespread fire behavior. Seventy percent of prescribed fire in the US has been reported to be in the southeastern portion of the country, equating to over twice the amount as the entire rest of the country between 1998 and 2018 (Kolden 2019).

Managing unplanned fires for resource objectives and ecological purposes refers to a strategic choice to use unplanned ignitions to achieve resource management objectives (USDI-USDA 2014). This management option has strong potential but has failed to be applied in many potential areas of opportunity. But, while an extremely useful tool for managing fire-adapted ecosystems and achieving fire-resilient landscapes, it has never received uniform endorsement and does have limited potential in some land ownerships because of statutory constraints.

What can be done?

- Improve awareness of the value of prescribed fire and other fuel treatments.
- Improve capability to plan and implement prescribed fire and fuel treatments.
- Improve the ability to plan, implement, and evaluate ecological effects of prescribed fire treatments in achieving short- and long-term objectives at all spatial and temporal scales.
- Develop a better understanding of the relationship of prescribed fire to human values.
- Improve communication and collaboration activities among governmental units, the public, and partner organizations.
- Establish and maintain a strong and efficient link between research and management.
- Accelerate the application of prescribed fire, managing wildland fire for resource objectives, where possible, and non-fire fuel treatments.
- Better prepare communities to withstand wildfire.

5. Evolving our system to face the future

This analysis is by no means meant as a criticism of wildland fire management. Instead, it is intended to help illuminate considerations and possible steps to build a more efficient and comprehensive pathway for the future. It is a synopsis of perspectives on how the fire management system should respond to changing complexity with focus on areas were attention is warranted. In the course of program history, many successes have been realized, many milestones have been achieved, and many efforts and activities have been well-directed, passionate, and committed. But, it cannot be overemphasized that resting on these gains while conditions continue to change will be unproductive and place the program and its people at a severe disadvantage.

Tendencies indicative of tomorrow's wildland fire environment underscore a need to broaden wildland fire management latitude. Proactive actions are and always will be necessary. Increasingly frequent and damaging wildfires cannot simply be accepted as unavoidable events. Knowledge, experience, and perspectives must be continually challenged. Accelerated learning must occur and drive planning,

A Twin Falls District BLM firefighter lighting during the West Cinder prescribed burns of 2010, southern Idaho. **PHOTO: Kari Greer.**

preparedness, and implementation for a range of future scenarios, some that may be outside of our control. Expanded ecological knowledge must not go unnoticed, and must be used in the shaping of management activities along with other scientific and technological advancements.

Fire management cannot fall victim to hindsight bias while trying to understand how the future may relate to the past. The ability to identify and anticipate future outcomes and avoid planning for a single desired future state must be expanded. Expecting that the business of wildland fire management will continue to present new and unique situations; being aware that the fire environment will continually change; and being prepared to encounter associated unforeseen issues has to become the standard. Simply put, constantly looking into the imaginable spectrum of future wildland fire scenarios must become the norm. Actively seeking to not be surprised, striving to anticipate most, if not all, potential future scenarios, and planning proactively need to be the reality. Future scenarios will directly influence all aspects of management realities, be closely tied with social and political realities, and affect the ability to maneuver through ecological realities. Moving ahead, there is much that can be done. As is commonly said, thinking must occur "outside the box."

The wildland fire management system is a complex system. The emphasis here has been to illuminate the importance of preventing the system from falling into stasis, or worse – to face these changing and increasing risks by multiplying the strategies and tactics inherited from the past, because they once worked and because, quite frankly, there are challenges in our fire future that appear insurmountable. Continual advancement and modernization based on infusion of emerging science and technology with the best available information, support tools, and processes is needed. Adapting to change, overcoming obstacles, and expanding capabilities – with reliance on historic approaches when appropriate is vital. But if the current fire management system, renowned for innovation and success amid adversity, is to transition to a system prepared for future success, then our energies, talent, and funding must be directed into developing and sustaining greater overall capabilities.

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Image: Pep Serra.

Incidents within Incidents: social perspectives on the global pandemic and wildfire

BY BETHANY HANNAH, ISABEAU OTTOLINI, KATHLEEN UYTTEWAAL, ISRAEL RODRÍGUEZ GIRALT, MÍRIAM ARENAS, AND NÚRIA PRAT GUITART

A social science lens can provide valuable insight into the current context of socio-ecological disasters, such as the effects of COVID-19 and uncontrollable wildfires, among others. Lessons from this unique moment in history include reflecting upon whether disasters are purely natural, changing the ways we talk about disasters, and the importance of inclusive community engagement, to cultivate more resilient societies.

Open up any newspaper, switch on your TV, or log into social media, and you'll likely be overwhelmed within seconds with news on COVID-19. It seems that these months, all our attention goes out to this global crisis.

However, while COVID-19 keeps us busy, it is by far not the only disaster we are facing. For instance, the southern hemisphere just ended the worst fire season ever recorded (with events like the Australian Black Summer Fires), though all the world's attention has bottlenecked to COVID-19. Concerningly, these kinds of fire seasons may become more frequent as the climate emergency worsens. And while the northern hemisphere is prioritizing fire containment and crew safety above all else in the face of COVID-19, it leaves many open-ended questions for many communities facing high levels of manufactured poverty and social injustice that make them more vulnerable to COVID-19 and fires, all taking place within the long-term disaster of climate change.

If we only keep our eyes glued on COVID-19, and do not consider all these factors combined, we can be caught by surprise, unprepared and vulnerable to these disasters again and again. In other words, the more we focus only on one risk, the riskier other risks become. For example, since the start of the global pandemic, there have been tornados in the US, earthquakes in Croatia and Iran, floods in Indonesia and Kenya, all of which have been exacerbated due to COVID-19. As we enter drought and fire season in some areas, hurricane season in other areas, and monsoon season in still others – all of which will occur under and will be influenced by the COVID-19 pandemic – it is imperative that we consider how these disasters intersect with each other and with our social, cultural, and political frameworks.

Looking at disasters as social-ecological entanglements

There are no "natural" disasters

First of all, let's pause and rethink the term "natural disasters." The term puts us on the wrong foot: disasters are rarely, in fact, purely natural. Rather, we can speak of disasters as processes emerging through technological and social processes (including cultures, policies and economies) that interact with the natural world (#NoNaturalDisasters, n.d.). In the context of wildfires, this means embracing the fact that fire's context is rooted not just in ecology or the arrangement of fuels, but also in our cultural conditions, politics, socio-economics, and even the language we use to describe fire itself (Wuerthner, 2006).

Once we understand that most disasters aren't so natural at all, we can reflect upon humanity's relationship with nature: we are deeply entangled. However, in an attempt to distinguish ourselves from it, as well as to manage and control it, our westernized cultures tend to create all sorts of human – nonhuman distinctions (Herrero, 2015). This creates the notion of an "other," opposing force that "we" need to rally "against." In the case of wildland fire, even though fire remains an essential component of land management, and certainly is a necessary part of the natural world, wildland fire is often portrayed and understood to be our adversary (i.e., when we are fighting a fire, we are fighting a foe) (Ingalsbee, 2006).

This is not a war (language matters)

Within the field of disasters, one way of creating distinctions between humans and nature is by using war metaphors. Often, when something is difficult to describe, people reach for metaphors and various other figures of speech, using comparison to illustrate context and put abstract concepts into something concrete or relatable.

For example, the comparison of wildland firefighting with fighting a war (e.g., battling the flames, punching in the fireline, suppressing the fire) is prevalent throughout fire literature and media coverage (Pyne 2004). Likewise, with COVID-19 we talk about "controlling, attacking, fighting, war…." For instance, Costanza Musu explains why using these metaphors are so compelling: "It identifies an enemy (the virus), a strategy ("flatten the curve," but also "save the economy"), the front-line warriors (health-care personnel), the home-front (people isolating at home), the traitors and deserters (people breaking the social-distancing rules)." (Musu, 2020)

This framing, both in the context of wildfires and the pandemic, creates a paradigm that pits us against an adversary and creates a sense of fear, as well as a sense of duty (Hauser, 2015). And yet, several studies and literary works discuss the need to stop using the war metaphor in many fields, because it limits how we examine problems; it creates unrealistic and simplistic pictures of complex, dynamic interactions and in some cases can hurt certain prevention behaviors (Sontag, 1979).

By drawing these strong lines between "we" (humans) versus "others" (nature), we tend to re-naturalize disasters: media outlets have largely treated COVID-19 as if it's a natural phenomenon because it's a virus, without linking it both to the context that allowed its creation and global proliferation. It is in fact our extractive industrial economies and globalized food system that cause biodiversity loss and deep societal inequality, and which further provoke the unfolding social and economic disaster (e.g. widespread contagion in care homes, economic upheaval which affects the most socially vulnerable first...).

Again, we can draw a parallel here with wildfire: it is widely known that climate change aggravates the global

fire crisis, together with other societal processes like rural abandonment, which often leads to more homogenous forest compositions, especially in Mediterranean landscapes (Chergui et al, 2018). And yet, many popular media and political outlets still frame climate change as nothing more than natural variation in weather.

Overall, we bypass the links of such risks with society, distracting ourselves with thinking of disasters as natural phenomena and placing these beyond the social arena. But we do really need to think about the interactions. And not only think differently, but also talk differently: by changing the discussions, we also change the interactions. If we no longer speak in terms of "natural disasters", if we no longer use metaphors of war portraying humankind's struggle to dominate nature, things can change. For instance, a current Twitter hashtag, #ReframeCovid, precisely aims at searching for better ways to talk about – in this case – COVID-19. As Arran Stibbe calls it, we need to search for new narratives and stories to live by (Stibbe, n.d.).

Where do we go from here? Embracing the Entanglement

By accepting our role within disasters we can start taking responsibility for their emergence or aggravation, as well as become empowered to create more long-term, sustainable societal changes. Though the idea of managing wildland fire response under COVID-19 is daunting, it does create a rare opportunity to truly examine every facet of wildland fire management and policy–and even more broadly, disaster and emergency management–with a broader perspective. It's a chance to step back and look at our relationship and understanding of our history with these processes. We must consider that many valuable lessons can emerge from examining the social and cultural conditions within which disasters occur.

In fact, we have learned some fascinating provisional lessons from COVID-19 so far: this global crisis is being addressed most directly through societal measures, the most important of which is social distancing. While rife with issues in and of itself (regarding social, economic, and emotional well-being to name a few), it is an effective and low-technology method in containing the pandemic. Perhaps more social measures, while paying special attention to alleviating social vulnerabilities, may provide some of the most important tools when facing intersecting crises in the years to come. For instance, prioritizing the care of elderly or impoverished citizens during the COVID-19 pandemic, or offering free legal support to undocumented immigrant workers who have evacuated wildfire areas in California, provide critical examples of social measures that also create more resilient societies in the midst of recurring disasters.

Some good news is that many wildland fire management teams are rapidly integrating what we're learning about the COVID-19 crisis as it unfolds, adapting their approach for what is sure to be a challenging fire season. Fire chiefs and management teams, fire ecology researchers, social scientists, and the general public seem to arrive at similar conclusions when it comes to overcoming the pandemic, this challenging wildfire season, and creating more resilient societies (Moore et al. 2020, Rojas Briales 2020). Across the board, highly participatory and educational actions will be crucial in managing this uncertain future, while relying more heavily on highly mechanized technologies like airplanes and helicopters is met with far more dispute.

These conclusions, described in more detail below, include the need for better communication, recognizing and reducing vulnerability, and fostering collaboration and knowledge exchange.

- **Let's improve our communication.**
  How we communicate crises makes a large difference between a vulnerable and resilient society. Prioritizing honesty, transparency, and trust-building can be just as useful while managing fire on-site, as in communicating emergency information to the public. Meanwhile, misinformation, illegitimate news sources, and an "infodemic" can have devastating effects. This year we are called to communicate the uncertainty of the situation with humility and with thoughtful, deliberate language choice. Precautionary approaches that focus on the utmost safety of fire crews and civilians are prioritized. Meanwhile, extensive educational efforts are critical, paired with challenging but necessary dialogue between sectors and citizens.
- **A call for recognizing and reducing vulnerabilities.**
  How can we transform emergency response into long-term resilience? COVID-19 and wildfire crisis experts agree that these phenomena are aggravated by wider social processes like rural depopulation and biodiversity loss. Additionally, populations most vulnerable to COVID-19 are also disproportionately affected by fires: these include disenfranchised rural and indigenous communities, or inner city racialized populations with high rates of asthma, respiratory issues and compounding health issues with low access to healthcare (Davies et al. 2018). As such, it is essential to include people in vulnerable and marginalized situations in planning both for COVID-19 and the fire season. In a sense, this particularly disruptive year also provides an opportunity for change in a direction that centers social equity.
- **Fostering collaboration and knowledge exchange.**
  It is paramount to consult expert knowledge from multiple disciplines and sources, including listening to people in the field. If these crises demonstrate anything, we must collaborate across disciplines, and from local to national

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"Even just a slight change in how the firefighting community frames our understanding of 'natural disasters' may help us better understand what we face this year."

levels. Special importance is placed on our adaptive capacity to changing conditions--knowing how to deal with uncertainty. This year, emergency services require improvisation and flexibility, facing challenges proactively, learning as we go, and prioritizing care and safety over a "tough it out" culture. Many countries in Europe and North America already are calling for public solidarity and responsibility in containing wildfires (i.e. refraining from lighting campfires anywhere), due to less efficient resource allocation this year in containing wildfires, and fears that smoke particles could aggravate COVID-19 symptoms.

This global pandemic has demanded that all of us, in some capacity, turn inward and reflect. And while the complexities of current and future "disasters" feel daunting to say the least, perhaps we can sit with a bit of solace just for a moment, as we realize that many answers already lie directly in front of us and within us: our capacity for acting collaboratively, with honesty and empathy, never goes away and indeed amplifies even in the most dire situations (Solnit 2009).

Once we recognize our role in social-ecological systems (and therefore disasters) we can start to change our language around these processes and consider interruptions in our "normal" society as opportunities for empowering community engagement. Even just a slight change in how the firefighting community frames our understanding of "natural disasters" may help us better understand what we face this year. In fact, we might think of wildfires as an "incident within an incident." The fire incidents we experience lie within a larger context of COVID-19 and of climate change, spurred by social, cultural, and economic processes. It is time to recognize our interconnectedness and act, proactively, upon it. The lessons from COVID-19 and wildfire seem to be pushing us toward a special and urgently needed opportunity to cultivate resilient societies and foster justice through more democratic communication, diminishing risks, and collaborating in unprecedented ways.

Note on further readings: For more information on wildfires and COVID-19, check out a compilation of resources on the Lessons on Fire Platform, listed in the COVID-19 Wildland Fire Management "Community."
https://lessonsonfire.eu/en/community/covid-19-wildland-fire-management

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Governing Wildfire
A GLOBAL INQUIRY

PHOTOS BY HARRISON RAINE. The boreal forests of Canada are fire-dependent ecosystem susceptible to climate change. Advancing research in their mechanisms is a crucial step in mitigating natural hazard and carbon sequestration.

A yearlong global fellowship sends a student of governance who's spent the summers as a wildland firefighter to explore our changing approaches to wildfire governance. Harrison Raine visited seven nations before the COVID-19 pandemic brought him home early. Here's what he's learned of our global practices—from the command-and-control suppression approach to a transition to integrated fire management. After returning to his home base in the United States, Raine is working this summer on the Logan (Utah) Interagency Hotshot Crew.

BY HARRISON RAINE

GENESIS OF A JOURNEY

November 8th, 2018 marks a tragic moment in California history. In the midst of calamity from a midnight mass shooting, California's first and sixth most devastating wildfires began. Despite occurring in vastly different landscapes, the wildfires unfolded in remarkably parallel fashion, simultaneously achieving tragic proportions. In both, decrepit utility infrastructure catalyzed ignition in matchbox-dry fuels. Driven by climate change-strengthened adiabatic winds and fine fuels from invasive species, fire behavior quickly exceeded response capabilities. Firefighters were overwhelmed and forced triage decision-making to reduce loss of life. Hasty, congested evacuations manifested anxiety and uncertainty. Decades of disregard for interconnected natural hazards and fire ecology played out once again as "firebelt suburbs" were incinerated or spared serendipitously. The Camp and Woolsey fires incinerated the communities of Paradise and Malibu, leaving traumatic wakes in the ashes. In the latter, the mountains and streets I had roamed as a child raged and smoldered. I spent the days following the disaster mopping up around the shells of the structures that had been my neighbors' homes.

Growing up in the Malibu hills, my sister and I were influenced by wildfire-incited terror and ecological bloom. Despite no formal connection to the world of fire other than living among within a highly-combustible ecosystem, we were both drawn to it. She became a shepherd, running her sheep for fuel reduction. I joined a fire crew for the U.S Forest Service. The day before the Woolsey and Camp Fires began, I applied for a Thomas J. Watson Fellowship to study wildfire

governance. I was thrilled a few months later to receive notification that my project had been accepted.

The Fellowship, which supports 40 undergraduates per year, sponsors projects of all disciplines — the only similarity being that they must be conducted beyond U.S borders for one year. My particular project, "The Ecological and Societal Balance of Wildfires," aimed at garnering a global perspective of how governance systems handle the duality of fire. It took me to Canada, Greece, Spain, Portugal, the UK, South Africa, and then to Australia, where I was at the onset of the global pandemic that suspended further research in Australia and South America. My self-designed project aimed to traverse biomes and their human dimensions: fire history in montane and boreal forests, community resiliency in Mediterranean oak savannas, wildland opera- tions in fynbos, fuels management in broadleaf and mixed forests, and ecological restoration in temperate rainforests.

One concept I sought to explore, in the context of wildland fire, is that environmental governance is not the same as management. In the arena of human-environmental challenges, management comprises operational objectives to achieve specific out- comes. Conversely, environmental governance is a broader paradigm consisting of multi-scale distribution of decision-making processes, across public and private actors, through which societies affect the environment (Armitage et al 2012). Frameworks of governance include scientific institutions and civil communities working in regulatory processes, which support an adaptive capacity to progress beyond "command and control" systems. For wildfire contexts, environmental governance may be the paradigm that comes after a reliance on full suppression policies.

Growing beyond antagonistic wildfire strategies to include the environmental and hazardous protection qualities of fire necessitates the need for governance structures to match ecological systems (Steelman 2016). The power imbalance between fire-adapted ecology, its increasingly volatile fire behavior, and suppression agencies is becoming ever more salient. Recognition among professionals, some organizations — and to a limited degree, the media — reveals that our preferred tool of mechanized suppression may be coming insufficient; indeed, in many ways, it may have become a failure long ago. Suppression agencies provide are essential, but they alone do not constitute governance. Constructing governance systems that promote communication among agencies, communities, and research is an uncertain process, but provides opportunities for innovation.

The answer commonly proposed for a holistic approach is the implementation of integrated fire management (IFM). Although nestled in management terminology, IFM pursues goals closely tied to building transformative resilience in social-ecological systems (SES), such as the creation of fire-adapted communities, adaptive approaches to incident response, and ecological restoration (Steelman 2016,

"My time in South Africa showed me that environmental governance does not necessarily follow a linear path, that there is no one-size-fits-all approach in wildfire policy and management …. Governance cannot be imposed in the same way that management can sometimes be. Governance is more a system of relationships than a system of rules."

South Africa is working to bolster its wildland fire operational capacity through the adoption of the Incident Command System (ICS) and international firefighter exchange. Use of ICS has allowed for the dissemination of common terminology and structure, allowing for various suppression groups to work fluidly. South African crews that work abroad, primarily in North America, compile skills and "slides" to increase their understanding of fire behavior and tactics. This greater cohesion and knowledge strengthen credibility in the country's wildfire sector and contributes trust during stressful situations.

McWethy et al 2019). To realize IFM, a range of theoretical and applied strategies must coalesce, ranging from:

- analysis of ecological fire regimes
- implementing appropriate fire policies
- improving fire use methods (prescribed burning, cultural burning, etc.)
- strengthening or maintaining suppression capabilities, and enacting post-fire recovery and restoration.

Government agencies may possess the deepest banks of wildfire knowledge, but realization of these strategies relies on facilitation through broader social systems — the mixing of communities, managers, scientists, policymakers, and practitioners. The key to achieving IFM goals may reside in governance frameworks, and some countries may already possess mechanisms and narratives that equate to a holistic approach.

When I began my project in July 2019, my experience limited me to knowledge of mop-up, ecosophical ideals of deep ecology, deep-seated memories of a devastating wildfire. When I set out on my scholarly travels, the terms "wildfire governance" and "adaptive resilience" were only figments of academic papers from my studies. But as my journey progressed, they began to make "real world" sense as it became distinctly clear that each society has unique legacies and confrontations with their relationships to their environment and wildland fire. Gradually, I came to realize that similar conversations persist across geography and that they fill the thoughts of those who are passionate about protecting people and stewarding nature. These are the conversations that arise in coffee breaks at the district office, social hours at conferences, community-wide meetings, and downtime on the fireline. Having intensively explored and spoken with those who guide and apply governance of wildfires, from various points in our global fire community, I will share my observations of governance frameworks and their narratives that percolate the globe.

The lodgepole pine forests in the Canadian Rockies are adapted to high-intensity, stand-replacing crown fires and benefit from prescribed burning.

The boreal forests of Canada are a fire-dependent ecosystems susceptible to climate change. Advancing research in their mechanisms is a crucial step in mitigating natural hazard and carbon sequestration.

CANADA

The Canadian connection to fire is inextricably linked to its pyrophytic ecology, history of First Nation firesticks, and most recently, the mechanization of its forests. The Chinchaga Fire of 1950, at 1.4 million hectares and possibly the single largest fire recorded in forests, showed the world the gargantuan wildfire potential of North America's boreal forests. Enveloped in the lodgepole, jack pine, and black spruce stands that crave extreme fire are key Canadian industries — oil, gas, and timber. The incendiary nature of the boreal biome and the economic opportunities within largely define Canada's fire relationship. Sophisticated suppression agencies, equipped with the finest technologies and firefighter capabilities, have been molded to hold an ever-shifting and contentious line between ecology and socioeconomy. However, compounding variables of forest health degradation, exposed communities and industrial infrastructure, and climate change are pushing fire behavior beyond suppression capacity.

Free floating around Canada as an independent fellow allowed me to observe a few of their wildfire institutions. I covered over 8,000 kilometers, speaking with over 75 professionals inside Alberta Wildfire, British Columbia Wildfire Service, and the scientific communities that support them. My experience exposed me to experimental burns in the Northwest Territory, fire history surveys with the Mountain Legacy Project, and fire effects monitoring with Parks Canada in the Banff backcountry. With what I was told, and what I experienced, I formed an image of a concentrated governance system – with stand-alone agencies being responsible for mitigating human-environmental conflict. A system in which agency personnel hope to develop other strategies beyond suppression but are saddled by societal and organizational leadership holding high expectations for rapid response.

Fire agencies in in Alberta and British Columbia appear to realize that the dominant grip of their preferred tool of suppression is shifting. Northern Alberta experienced this reality in 2016, British Columbia in 2017 and 2018, and Alberta once more in 2019. As one high ranking Alberta Wildfire officer stated, "the continuation of our resource use is sustainable, but the ability of our resources to suppress fires is not." Canada's systems of wildfire governance are established in their historically proficient suppression agencies; expanding the framework beyond readiness and response is a predominant obstruction. In talking to wildland fire management staff, persistent sentiments arose, including the need for development of "preventative measures" and "new narratives with the public". The wildfire professionals I spoke with represent a community that has come to realize that other actors are needed, but they lack the communication platforms to generate discussion, both among their own organizations and with the greater Canadian public.

Wildfire governance in Canada resembles a house with exceptional weight placed on a single, central support beam. Other beams are being constructed, such as The Canadian Partnership for Wildland Fire Science and FireSmart Canada. The Partnership strives to prioritize longer-term planning through innovative research in fire ecology, behavior, indigenous knowledge, and community resilience. Supporting these forms of research and their integration into management actions appear to be greatly broadening the understanding and application of adaptive governance objectives and processes. Similarly, FireSmart Canada, a nationwide initiative to promote residential awareness and protection against destructive wildfire, encourages a greater onus on homeowners in the governance system. Strengthening Canada's approach to wildfires hinges on the ability to draw greater involvement from communities, government ministries, and industries into frameworks governance.

MEDITERRANEAN

In the Mediterranean, landscapes that were once rich in human activity and diverse land-use have emptied, with fire-loving vegetation irrupting across vast areas. In a wildfire predicament that strongly contrasts with North America, in Mediterranea, migration from rural to sprawling urban areas has depleted landscapes of their management, and thus of both their ecological as well as economic mosaics. The gradual decline in pastoralist and agricultural societies has led to increasingly continuous, volatile fuel loads. Rural communities have lost their buffers and now have a higher vulnerability in landscapes that crave fire. On this leg of my trip I visited Greece, Portugal, and Catalonia to understand varying forms of governance in this unique pyrophytic region.

The Mati Fire's path of destruction was similar to that of the Woolsey Fire. It began in the overgrown Mediterranean hills, and driven by strong adiabatic winds, it burned a path to the sea. Along the way, homes and businesses that had been constructed with little regard for fire risk were unsalvageable. In both, it was all firefighters and residents could do to get out of the fire's path.

The decimation of Matí in 2018 was an inspiration for me to conduct my fellowship project. The similarities of wildfire in Matí and the Santa Monica Mountains prompted me to look beyond the U.S borders to understand the complexities and ideas of wildfires in different cultures.

Speaking with survivors of Greece's 2018 destructive blaze in Matí, the social costs of a fragmented governance system became clear. The story of the blaze resonated deeply – it began in surrounding unmanaged hillsides and then raced to the sea — driven by seasonal winds, surprising firefighters and panicking residents. This reminded me of the fires back home, of the Woolsey Fire, and the town of Paradise. In Greece, the procedures for ecological and social recovery are slow; the charred remains of vegetation and homes abound in the narrow streets. Residents heaped scorn on state and local governments, having little faith that any advancement will be made to prevent another catastrophe. The community itself felt powerless to mitigate future risk, instead being forced to rely on firefighters that may or may not arrive. The burns suffered by the populace of Matí are twofold — increasing

Knowledge exchange and building relationships are crucial aspects of improving wildfire governance. Here Norwegian firefighters and foresters learn from their Catalonian contemporaries about strategies for operational burning.

The Pau Costa Foundation is committed to teaching the next generation about climate change, land and fuel management, and wildfire risk. Here students observe the importance of fire prevention and the ineffectiveness of suppression efforts against large wildfires in unmanaged fuels.

susceptibility of communities to natural hazard, and more distinctly, the social ramifications of an absent governance system.

One hopes that from disaster arise opportunities, and the tragic wildfires of 2017 in Portugal have spurred an innovative form of governance. Portugal is developing a novel approach to wildfire governance through redefining a wildfire agency. Portugal's Agency for the Integrated Management of Rural Fires, or AGIF, is a wildfire organization built upon the premise of extending wildfire risk governance beyond firefighting bodies. It completely rejects the previous notion that wildfires should be confined or "siloed" to a single ministry. In its inaugural year, AGIF engaged with: the Ministry of Justice to navigate confusion of land ownership in high-risk areas; the Ministry of Education for a defensible space awareness campaign; the Ministry of Economics for rural economic development and land-use planning; and the Ministry of Defense to coordinate emergency management response. The agency has placed its regional offices on or near university campuses to ensure close linkage between research and management. While it lacks fire suppression resources and equipment, AGIF officers serve as the coordinating and overhead personnel for large incidents. Successful governance relies on effective dispersal of decision-making processes, and AGIF, an institution of wildfire knowledge, is a facilitator to help other actors discover and weigh options.

I witnessed an excellent snapshot of governance in action on a crisped hillside outside the small town of Ribera d'Ebre in Catalonia. In a post-fire discussion sponsored by the Pau Costa Foundation, a gathering of firefighters, researchers, local politicians, and landowners met to discuss the events of the fire and what should happen next. The gathering was a platform for exchange of not just information, but also perspectives, with firefighters describing operational tactics, ecologists providing insight into research, and citizens debating over how to reduce the future risk. Post-fire community engagement is a crucial point in the recovery process, but it can be emotionally difficult. The transparency exhibited on that Catalonian hillside was diametric and more, as it furthered the public conversation on proactive forms of fire management. Facilitating post-fire conversations among representatives from management, research, and community represents a critical recovery moment in governance.

SOUTH AFRICA

From Europe, I pressed on to my third continent — Africa. The endemic nature of South Africa is present in its unique environment and seeps into all aspects of life here. Diverse cultures contrast with one another on a landscape renowned for its biodiversity. In a similar fashion, wildfires and environmental governance in South Africa follow slightly different rules than in other nations visited.

The use of Fire Protection Associations (FPAs) in conjunction with agencies and environmental institutions contributes a participatory element to wildfire remediation. These organizational bodies include mostly landowners, but include or collaborate with insurance companies, utilities, suppression

In the Nhlazuka Valley of KwaZulu - Natal, members of a FireWise Team discuss and learn from Bono Czaibe, a community leader and FireWise Leader. The conversation shown here touches on the rationale behind invasive fuel treatments surrounding residences, and the associated wildfire prevention and natural resource benefits.

"Nations that are faring far better — in managing the pandemic and their wildland fire challenges — seem to be those that are able to disseminate knowledge from research, communicate innovative ideas, instill individual responsibility of risk, and progress collectively."

resources, or local government. Their emphasis is risk reduction through fuels management and they provide legal protection against wildfire negligence.

The Cape Peninsula FPA encompasses the complex stakeholders of the greater Cape Town area that accompany a metropolitan wildland urban interface. CPFPA helps members navigate the burn permit process and designs individual wildfire management plans. Richmond FPA coordinates corporate and private foresters to ensure wildfire prevention and provides fuel management and wildfire detection services. Richmond also supports natural resource projects to remove flammable alien vegetation in remote communities.

It became clear to me that FPA's offer critical platforms for knowledge exchange and coordinated fire management efforts. South Africa's method of cultivating fire-adapted communities through the FPAs is a far more direct, and possibly sharper, tool than other forms of community engagement, and is a tool increasingly needed in these times of rising fire risk. Fire Protection Associations offer serious potential in redistributing risk management and engaging wildfire-prone landowners.

I began my three-month stay in South Africa by joining NCC Environmental Services, a conservation company working in the wildfire sector, to observe their fire crew operations and the challenges of fighting fire in the fynbos. Surveying the adoption of Incident Command System (ICS) in the Western Cape showed that management and governance advancement are linked, and that the rise in firefighting capacity and common organizational language has bolstered credibility in wildfire governance.

While volunteering with Landworks NPC, a non-profit focused on environment and community, I saw a form of governance connecting global-level institutions to community-based fire management support. These prevention-based projects receive international support from FireWise USA, financial assistance through state public works, sponsorship and oversight from the regional FPA, and coordination through the NPC. It is a multi-tiered initiative that disseminates knowledge from the global level to action on a community level. While wildfire information flows from the top, action occurs from the ground in the Nhlazuka Valley in KwaZulu-Natal, as traditional Zulu leadership maintains decision-making power for the fuels related projects. A tribal council directs the placement of FireWise treatments, selects community members for teams, and encourages the adoption of defensible space. The benefits are both environmental and economical as removal of alien vegetation improves water resources and mitigates wildfire while providing jobs in an area where rural employment opportunities are scarce. This type of governance connects groups at multiple tiers to focus on risk reduction strategies while supporting communities to take ownership of environmental goals.

My time in South Africa showed me that environmental governance does not necessarily follow a linear path, that there is no one-size-fits-all approach in wildfire policy and management. Governance encompasses the ecology and

Fire Protection Associations provide services and guidance to landowners interested in fuel management through applied fire. The FPAs put forward best practices on fuel treatments, ensure safe and adequate fuel breaks, and provide burn advisories and fire detection services and train and support crews. This burn here is under the supervision of the Richmond FPA.

human dimensions of an area, and while outside elements may contribute to success, the area's identities must be not only considered, but incorporated. Governance cannot be imposed in the same way that management can sometimes be. Governance is more a system of relationships than a system of rules.

AUSTRALIA

The last leg of my trip around the world took me to another southern hemisphere country, and the Australian summer of 2020 pulled back the curtain and revealed to me the implications of the Pyrocene Epoch we have created. The staggering decimation of land, forests, economies, and lives from fire is a jarring reality. These most recent Australian mega fires ignited political rhetoric, as the debate regarding land-use versus climate change raged, even when both variables are exacerbating wildfire trends. While my time in the country was short, hampered by the precipitating pandemic, the turbulent emotions of Australians towards fire was apparent. The fires had receded, but a strong sense of "unfinished business" radiated from my conversations and interviews. The area that I had hoped to delve into was the recognition, appreciation, and encouragement of indigenous fire management. But C-19 halted those endeavors. I plan to follow that line of inquiry in the future.

In a hasty departure from Tasmania and Ben French's doctoral research field work, I reflected on the vast knowledge of and identities built on fire in Australia. The conversations I had there offered a refreshing depth, even if they were at times garbled by political bias. Conversations in Australia are evolving and I hope to be able to return to participate in the future.

MANY CHALLENGES – MOVING TOWARD WILDFIRE GOVERNANCE

The fuels, fire behavior, and climate of tomorrow will no doubt exacerbate wildfire complexities and increasingly stress the places and people that experience them. Biogeographical alterations to landscapes and the concomitant changes in wildland fire will necessitate socioecological changes. Governance systems of the past are being challenged, as stand-alone agencies strain

to manage larger conflagrations and engage other entities to recognize risk accountability.

Our COVID-19 influenced global state of affairs has parallels with the world of wildland fire — the management of the virus is not only a healthcare issue, it is a social undertaking. The United States may in some ways possess the foremost technology and tools to mitigate a health crisis, but in its state of fractured governance, these advantages have been squandered. Nations that are faring far better — in managing the pandemic and their wildland fire challenges — seem to be those that are able to disseminate knowledge from research, communicate innovative ideas, instill individual responsibility of risk, and progress collectively.

I reckon that the take-home for me, what resonates most now that my project is done, is this: Disasters such as the COVID-19 global emergency create societal pressures that can be used to catalyze and create opportunities, and perhaps this pandemic has provided opportunities for us to reflect on a worldwide scale and to improve the way we deal with wildland fire, the ecosystems and biomes that global fire impacts, and the people who depend on these landscapes. Epidemiologists are vital in providing public health expertise and advice, and conventional wildfire management paradigms have a role, as well, but should not be dominant. Only through healthy, participatory social systems will any country be able to reduce human suffering caused by this pandemic and to learn from the experience. Science and policy must be not only connected to but embraced by the public if we are to fare well in the challenging times ahead.

For more on this research project and related content, please visit **Harrisonraine.com.**

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The FireWise teams in Nhlazuka work within their own communities to reduce fire hazard and raise natural resource protection. It is a form of governance that occurs at the local level but is supported by international institutions.

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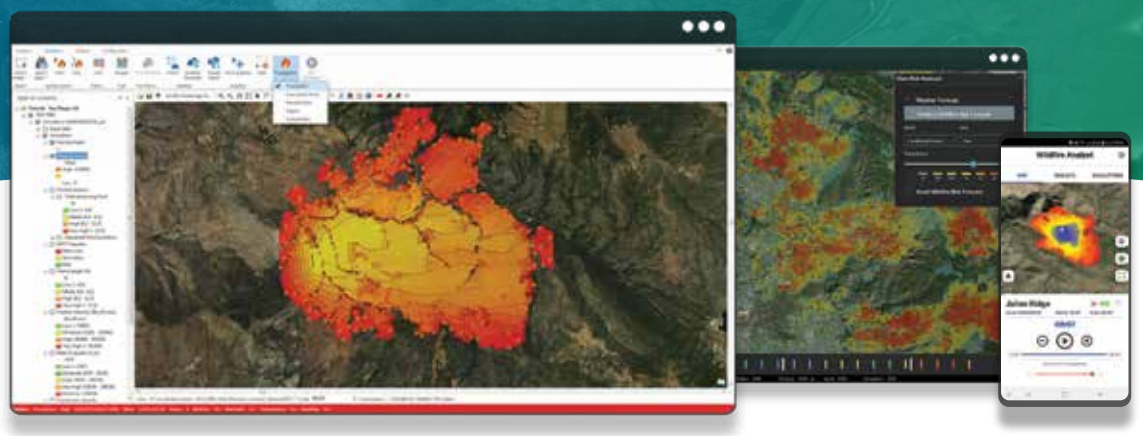

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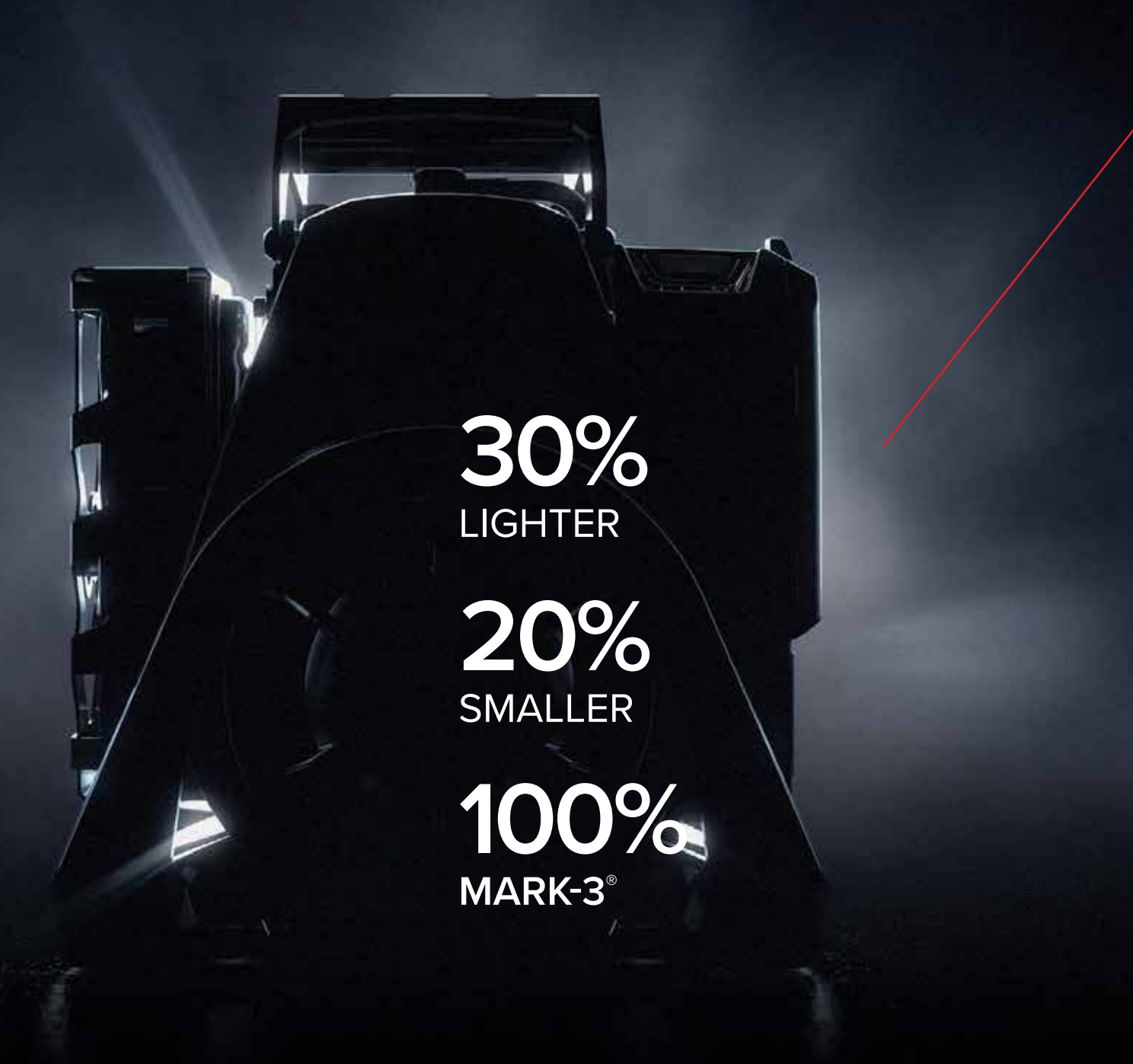

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