

JANUARY – MARCH 2021 / VOL 30.1

UNITING THE GLOBAL WILDLAND FIRE COMMUNITY

WILDFIRE®

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



CALIFORNIA 2020
WORST FIRE SEASON EVER, AGAIN

FIGHTING FIRES IN THE UK

ESTIMATING WILDFIRE SPREAD

THE NEW FIRE PROFESSIONAL



The Missoula Fire Lab Quilters won the 2014 USDA Arts and Agriculture Competition Grand Prize from over 300 entries submitted from across the USDA. The winning quilt, made in 2010, commemorates the 50th Anniversary of the Missoula Fire Sciences Lab. The central pieced pictorial depicts an ecosystem before fire, during fire, and after fire. The outer blocks represent various scientific advances from the Fire Lab. The four corner blocks tie the quilt to the traditional quilting arts.

CALIFORNIA 2020: WORST FIRE SEASON EVER, AGAIN. NOW WHAT? AN EFFORT TO DISSECT THE CALIFORNIA FIRE QUILT

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	2013	2014	2015	2016	2017	2018	2019	2020
Estimated ac Burned	601,625	625,540	880,899	669,534	1,548,429	1,975,086	259,823	4,257,863
Number of Incidents	9,907	7,233	8,283	6,954	9,270	7,948	7,860	9,917
Confirmed Loss of Life	1	2	7	6	47	100	3	33
Structures Damaged/Destroyed	456	471	3,159	1,274	10,280	24,226	732	10,488

Source: Recent evolution of wildfire impacts in California. Source <https://www.fire.ca.gov/stats-events/>
Table 1. Annual fire statistics for California from 2013 to 2020.

"... WHAT MAKES CALIFORNIA'S FIRE SCENE DISTINCTIVE IS HOW ITS DRAMATICALLY DISTINCTIVE BIOMES HAVE BEEN YOKED TO A COMMON SYSTEM AND HOW ITS FIRES BURN WITH A CHARACTER AND ON A SCALE COMMENSURATE WITH THE STATE'S SIZE AND POLITICAL POWER..." --STEPHEN J. PYNE, CALIFORNIA: A FIRE SURVEY

We will remember 2020 for the terrible impact of COVID-19 worldwide. Within the wildland fire community, we will not forget that on top of the complexity of dealing with a pandemic, it was the year where more than 4 million acres burned, including some of the more pristine forests of California, doubling the area of the worst fire year in modern history (Table 1). This happened just after the tragic 2018 fire season when Paradise was devastated by the Camp Fire, and 2017 when Santa Rosa and the Napa Valley suffered the consequence of living in a fire-prone landscape.

Measuring the impacts of fires based on the burned area can be misleading. It is not only how many acres burned, but the severity of those fires, with the resulting effects on the soil. As Bob Martin and Dave Sapsis stated in 1992, followed by Scott Stephens' recent studies, the annual burned area in California prior to 1800 was between 5 to 13 million acres per year. Those were mostly low-intensity fires in general, and 2020 is the only season that gets close to that acreage in modern California history. Fires now burn mostly with high severity, referred to as stand replacement fires. These occurred mainly in Northern California, where the accumulation of large fuel loads from fire suppression was exacerbated by climate change, derived stress, and pest infestations. Seasoned firefighters are regularly observing that fires now burn with much greater intensity than any time in their career. A severity analysis of the largest events of this fire season shows that more than two-thirds of the area impacted was from

moderate to high severity.

It is not a problem of human-caused ignitions, as the flourishing litigation industry continually tries to demonstrate. A year like this proves that natural ignitions, not human, can create the worst fire season on record. It is a problem of propagation. California burns because it can. It has the fuels and the conditions to burn, and as Stephen Pyne says, it often conflagrates. This was 2020 in a nutshell.

A FAMILIAR SCENARIO, BUT AT A GRANDER SCALE

Coming from Spain, the California landscape looks familiar yet bolder to me. Everything is at a majestic scale. You can understand how the ecosystems have developed their potential in a land with all the components to sustain the most productive vegetation in the northern hemisphere. The tall redwoods on the North coast, and the largest and oldest conifers, the Sequoias and Bristlecone pines in the Sierras, are now suffering the effects of stressful climate and explosive pest infestations.

In milder terrains, the Oak Woodlands are large enough to produce wine barrels that go to Europe. In Spain, we had maintained a resilient fire landscape (aka firescape), the Dehesa. The livestock that maintained this ecosystem now reside in northern European industrial farms. When the first Spaniards discovered this rich complex of shrubs and small trees in California, they called it Chaparral (shrubby oaks), an ecosystem that can sustain extreme

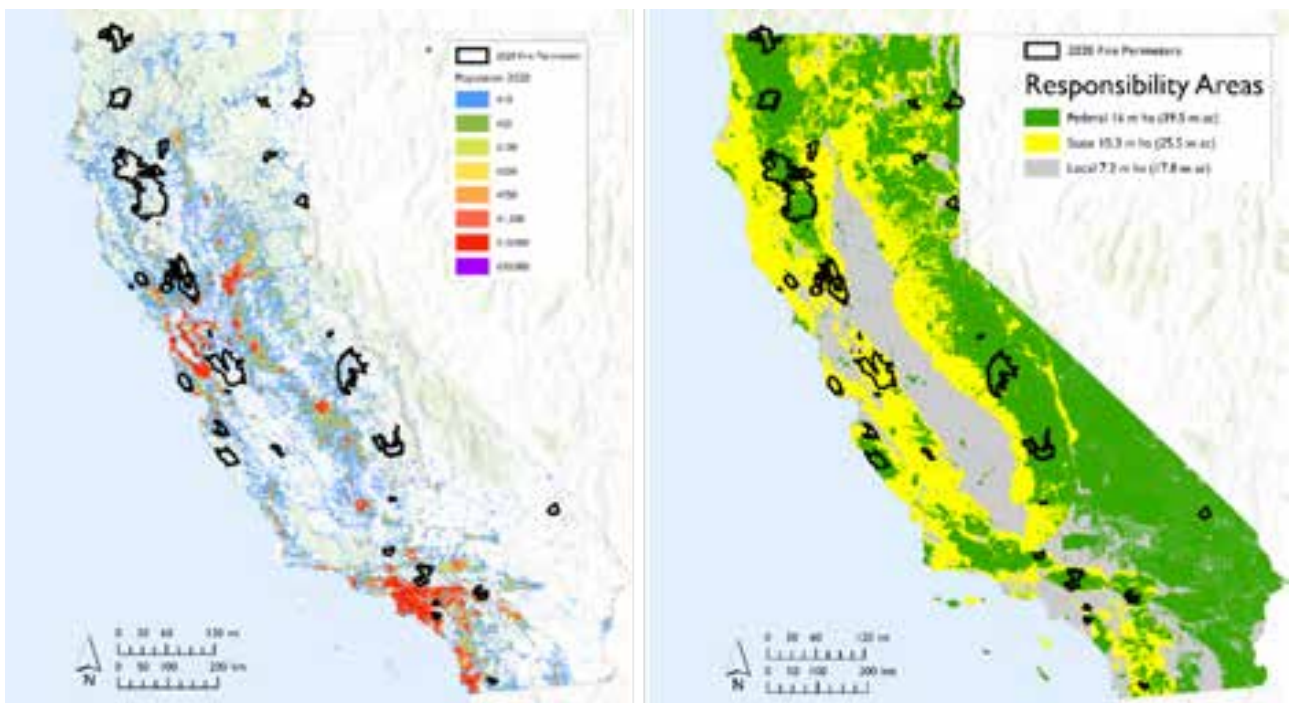


Figure 1. Population density of California and large fire perimeters of 2020. Responsibility Areas (Federal, State, Local). Source: NIFC Perimeters, FRAP, Esri

fire behavior during most of the year. Even the deserts sustain the magnificent Joshua Trees, creating dream landscapes that were also dramatically impacted by the fires this year.

Everything seems so familiar. Except for the extreme terrain, everywhere. In the Traverse Range, in Angeles, and San Bernardino National Forests, barely 50 kilometers from iconic Santa Monica beaches, there is a 3,000-meter elevation variation, which provides an impossible scenario for suppression from ground resources. Add the winds, the Santa Ana, the Santa Barbara Sundowners, and the Diablo farther north, that typically occur after the summer season, has prepared the fuels for extreme conflagrations, and you have an extreme scenario, like nowhere else, to sustain fires. All these firescapes burned this year, continuing the dramatic curve that started this century.

THE DYNAMIC HUMAN FACTOR

California, with a 3.2 trillion dollars of GDP in 2019, is the 5th largest economy in the world, just behind Germany. Three hundred and twenty-two Nobel prizes are affiliated with its universities, and it is home to the most innovative companies in the world. This is the birthplace of information technology.

This incredible achievement of Californians just happened in the last 70 years. In 1900, the population of the State was around 1.5 million. In 2020, that population multiplied almost 26 times to reach close to 40 million. In the same period, Spain's population grew 2.5 times. This fast pace of growth created a



Figure 2. 2020 Fire season, with fires larger than 5000 ac. Source: <https://data-nifc.opendata.arcgis.com/> & Wildfire Analyst.

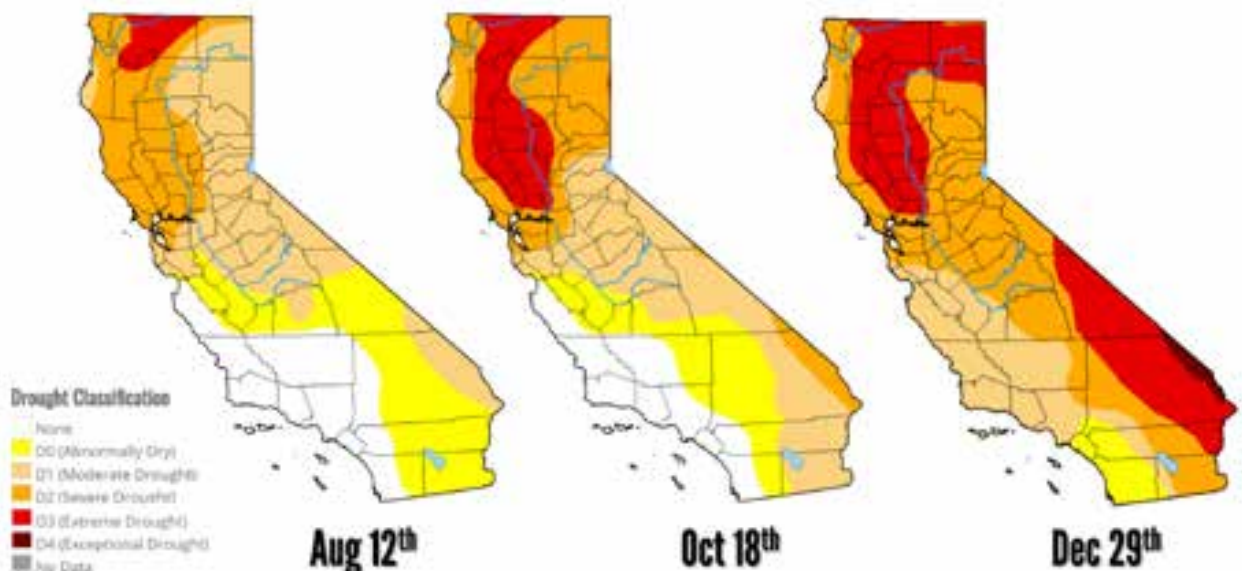


Figure 3. US Drought Monitor. 55% of California was on D1 to D4 categories during the August lightning event. Conditions kept worsening until the end of the year. Source: <https://droughtmonitor.unl.edu/>

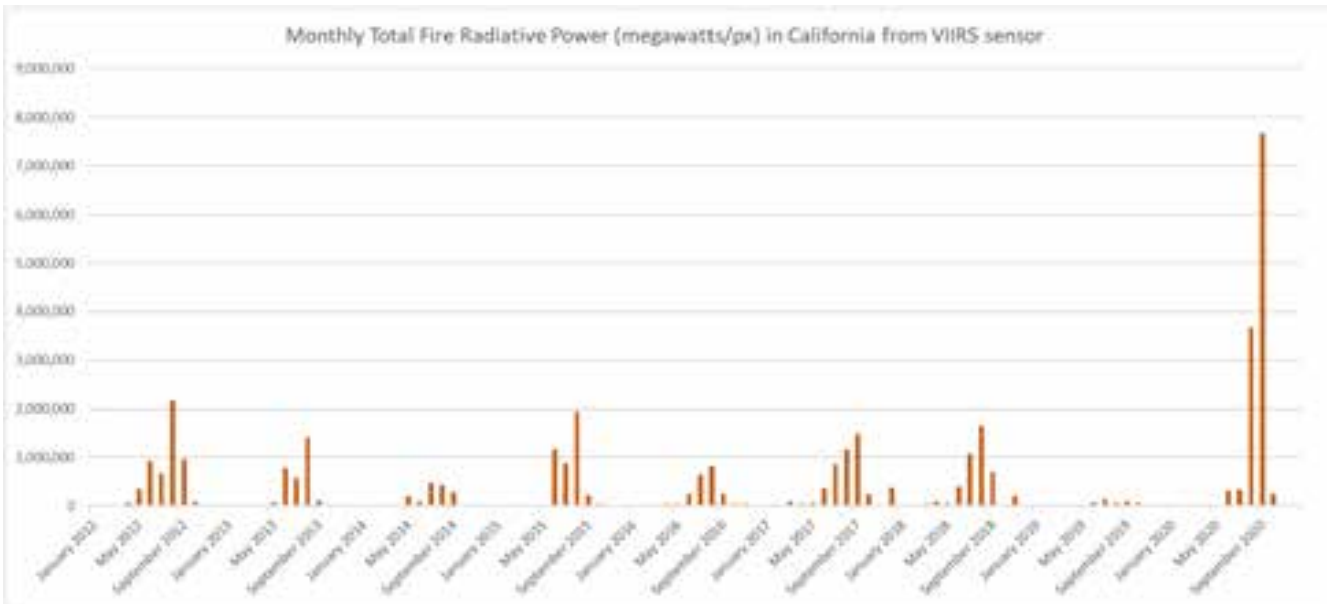


Figure 4. Monthly Total Fire Radiative Power Released by Wildfires measured from VIIRS satellite hotspots (megawatts/pixel). September 2020 stands out as the most extraordinary month since 2012.

housing demand framed in regulations that result in California being one of the most expensive places to live in the United States. And around 30% of that population live in the Wildland Urban Interface (WUI). Communities keep growing, creating the most relevant factor of the California Fire Quilt: urban encroachment into the fireescapes. The following figure shows population density overlaid with 2020 fire perimeters.

This is the dynamic scenario that has been the last 20 years facing a constant mantra of “this will be the worst season in history” - every year. Well, 2020 definitively was.

THE 2020 FIRE SEASON

Conditions were set with an extremely dry January and February, followed by rain in March and April. It was just enough rain to create a fresh crop of fine fuels that quickly ignited but not enough to help dry heavier fuels recover. While not the worst drought in history, it was enough to get California ready to burn.

With this scenario, an unusual lightning event occurred. Until August 10th, around 4,500 fires had burned 51,892 acres (21,000 hectares), doubling the numbers of the previous year. Firefighters were quickly and successfully suppressing fires. Then, starting on August 13th, more than 14,000 lightning

12 LARGEST WILDFIRES IN CALIFORNIA	12 MOST DESTRUCTIVE WILDFIRES IN CALIFORNIA
1. August Complex (2020) 1,032,264 ac (417,898 ha)	1. Camp (2018) 18,804 structures lost
2. Mendocino Complex (2018) 459,123 ac (185,800 ha)	2. Tubb days (2017) 5,636 structures lost
3. SCU Lighting Complex (2020) 396,624 ac (160,508 ha)	3. Tunnel (1991) 2,900 structures lost
4. Creek (2020) 365,714 ac (153,738 ha)	4. Cedar (2003) 2,820 structures lost
5. LNU Lighting Complex (2020) 363,220 ac (149,990 ha)	5. North Complex (2020) 2,352 structures lost
6. North Complex (2020) 318,930 ac (129,068 ha)	6. Valley (2015) 1,955 structures lost
7. Thomas (2017) 289,893 ac (114,078 ha)	7. Witch (2007) 1,650 structures lost
8. Cedar (2003) 273,246 ac (110,579 ha)	8. Woolsey (2018) 1,643 structures lost
9. Rush (2012) 271,911 ac (110,038 ha)	9. Carr (2018) 1,614 structures lost
10. Rim (2013) 257,314 ac (104,131 ha)	10. Glass (2020) 1,520 structures lost
11. Zaca (2007) 240,207 ac (97,208 ha)	11. SCU Lighting Complex (2020) 1,491 structures lost
12. Carr (2018) 229,351 ac (92,936 ha)	12. LNU Lighting Complex (2020) 1,490 structures lost

Table 2. Largest and most destructive fires in California. 2020 fires highlighted in red. Source: CAL FIRE

strikes hit Northern California in an area with a historically low lightning density and little recent fire history. During an extreme heatwave, and record temperatures in the North, more than 600 individual fires ignited, and many of them exhibited very active behavior. The fire agencies faced the worst-case scenario- extreme fires, everywhere.

By September 6th, it was already the worst fire season in history, with 2.2 million acres burned. During a weekend in which numerous California places reached record high temperatures, the Creek Fire found a moment to explode in a 45,000-ac run from noon to midnight of August 5th, with hundreds of campers evacuated by helicopter in dramatic fashion.

Two days later, a record wind event occurred. Both the August Complex and Bear Fire (North Complex) exploded driven by record winds for that day. North Complex grew in 12 hours over 183,000 ac, spreading at an average of 2 mph. It was the single-day record for most activity detected by satellite hotspots from the VIIRS and MODIS sensors.

Southern California had the Apple, Lake and Valley Fires, the Bobcat Fire in Angeles NF, and the deadly El Dorado Fire, where Charles Morton, a Big Bear Interagency Hotshot Squad boss, lost his life on September 17th. In December, the Silverado, BlueJay, and Bond fires kept burning until Christmas. The fire season was still active in Southern California in mid-January 2021. A year-round fire season.

At the end of the 2020 fire season, there were 30 incidents over 3,000 acres (1,000 hectares), and only 0.3% of fire starts burned 3,716,465 acres (1,504,000 hectares), 88% of the total amount. Half of the smoke pollution in the US came from wildland fires this year. Facilitating good fire practices needs no more justification than this.

Implementing safety protocols to face this fire season was a significant challenge, but this is the land where ICS was born back in the 1970s. On May 3rd, the Wildland Fire Response Plan for COVID-19 Pandemic was implemented, and protective measures and best practices were defined for initial and extended attack incidents. The impact in the firefighters' community has been around 2%, an incredible achievement that shows professionalism in action.

The response was massive. All the CAL FIRE and Federal Incident Management Teams were active. Personnel from Texas and South Carolina to Alaska, and firefighters from Australia, Canada, Israel, and Mexico joined the effort.

The numbers of this fire season can hide the tremendous efforts of firefighters, who went from large fire to large fire, through non-stop assignments for five months straight in exhausting shifts. They definitively made a huge difference. About 8,100 fires never made the news, as they were suppressed at less than 10 ac. So, I think that the fire paradox is true: "the better we are (at fighting fires), the bigger they get (we cannot suppress on initial attack)".

We have to invest in vegetation management to create a safer environment for firefighters to engage where they can. Communities must be part of the solution and not a constant drain of resources because of poor risk planning and lack of mitigation. To achieve that, we need to use all the tools within our reach. Let's try to identify the patches of this quilt to address this challenge.

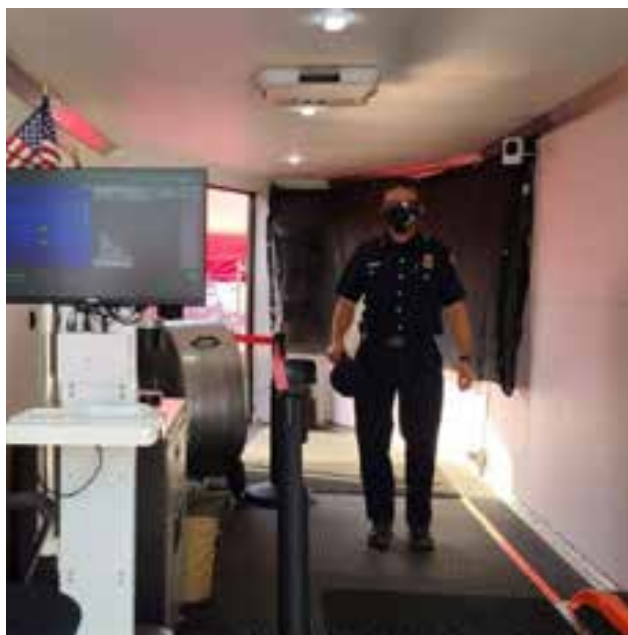


Figure 5. Daily updates of the resources assigned to the response. Source: CAL FIRE. Access to August Complex West Branch ICP.

California Fire Statistics 1988 - 2020

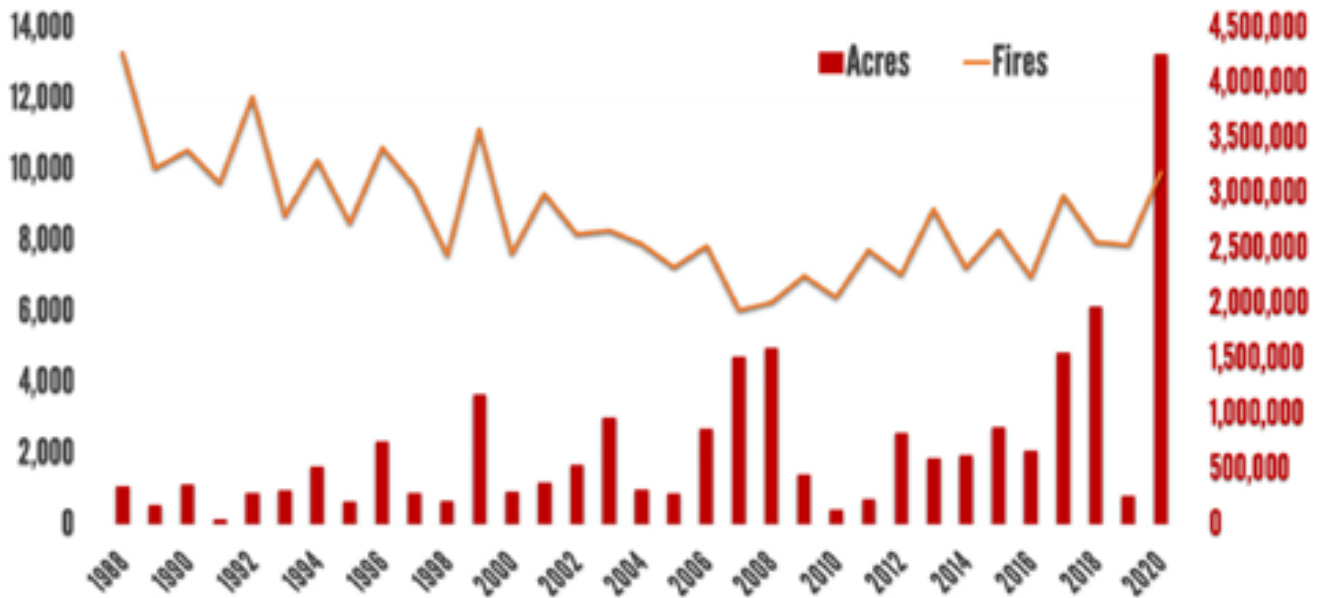


Figure 6. California Fire Statistics 1988-2020. Source: CAL FIRE

A STRATEGIC LOOK AT THE CALIFORNIA FIRE QUILT

We will look back many times to this extraordinary fire season. We have more data than ever to try to understand how and why this happened.

In my position at Technosylva, I have a daily job where I see California burn virtually every day with over 145 million fire simulations. All of it will eventually burn, because it can burn. We have to work on how it will burn. So, let's have our favorite conversation between students of fire. How can we solve this? More precisely, what do we want to solve? Fireproof California? Eliminate ignitions? The biggest problem is high-intensity fires impacting our communities. It is not only the number of acres we need to reduce but also the impacts that need to be mitigated.

During the fire season, we witnessed the many different points of view at the highest political levels. This is not an easy problem, and there are no easy solutions. The different aspects of the California fire scenario are well documented and understood by the technical and scientific community. We are lucky to have a long tradition of researchers, scholars, and practitioners that have analyzed the problem from every aspect possible. As a grateful new Californian, I felt I could include a simple exercise in this article, putting together the ideas in a way it could stimulate critical thinking. For that, I will use a powerful tool, a SWOT analysis.

A SWOT is an acronym for "Strengths, Weaknesses, Opportunities, and Threats." It is a high-level strategic planning

model that helps organizations identify where they're doing well and where they can improve, both from an internal and external perspective.

This analysis' best outcome would be to create conversations that could help decision-makers define strategies to improve the actual California Quilt. To complete this SWOT analysis, I had the support of several of my California mentors. These individuals are seasoned experts, fire behavior specialists with considerable scientific and practical experience fighting fires in the West. So, we had that conversation, and the result is a personal and incomplete list of factors that can help depict all this complexity.

As a reader, you too can get involved. We present the list of items in our SWOT analysis for you to review. Which are your top factors for every category? Are we missing others? If so, what are they? Which of these factors apply to your Fire Quilt in other parts of the world?

You can participate and evaluate this SWOT analysis at <http://bit.ly/CaliforniaSWOTForm>

And hopefully, in the next IAWF conferences, we will have the chance to have that conversation in person. As CAL FIRE's Chief Thom Porter says, "the benefit of the actions we start now would be for our grandchildren."

Rate the importance of each: 1 = VERY IMPORTANT 2 = MEDIUM IMPORTANCE 3 = NOT VERY IMPORTANT

STRENGTHS Internal, positive attributes of the California Wildfire Community. These are our things that are within our control	
1.	Wildland fire agencies have meaningfully evolved based on lessons learned from past fire incidents and are very advanced on many fronts: organization, resources, tactics, safety, and technology.
2.	Fire agencies have huge social support, fundamental for political support on new policies and budgets
3.	Collaboration between first responders in operations is at the highest standards. ICS was developed in California in the '70s from here expanded worldwide
4.	Robust Mutual Aid system to quickly mobilize and reinforce limited local personnel and equipment
5.	A paradigm shift within agencies to reporting accomplishments, such as homes and people saved, rather than traditional perspective focusing on impacts (houses lost, people injured), caused by leveraging new technology improvements to intel and operations.
6.	Applied research and technology implementation are world-class with CAL FIRE, improving real-time decision-making.
7.	The understanding of the wildfire phenomena problem is probably better documented than anywhere in the world. Data, science-based analysis and world-class technological solutions support decision-making.
8.	There are growing examples of community engagement, as in the FIREWISE and Community Wildfire Protection Plans and programs, reflect an increasing awareness and responsibility from homeowners
9.	A State-led training and certification program for private prescribed fire burn bosses is in the works. Together with community-based Prescribed Burn Associations (PBAs), the 'good fire' army is growing.

WEAKNESSES Negative internal factors that detract from our strengths. These are things that we might need to improve	
1.	The social attitude to the fire phenomena. that "All fire is bad" or/and "I think that fire needs to be reintroduced to the environment, but not in my backyard" are only two representative examples.
2.	Urban planning is frequently disconnected from the surrounding wildfire risk exposure
3.	Local engagement is high during incidents, but not so much in the prevention phase. Mitigation and evacuation plans could be better funded and implemented
4.	Prescribed burning annual acres are very small, far from making a substantial impact. Regulations, risk avoidance, public perception, and lack of resources limit the ability to conduct meaningful landscape-level vegetation treatments
5.	Air Pollution Control Boards and their policies for "Burn Days" weighted to reduce particulates in the air, limiting the days that prescribed burns can be done
6.	Vegetation Management Projects need to grow in strategic areas and need to be maintained or will create ladder fuels
7.	There are insufficient funds to address the VMP problem at the community buffers, at the landscape level (both need local involvement) as well as a need to work cross-boundary.
8.	Fuels accumulation is growing at a faster pace than the traditional practices to manage guilds. Ignitions in areas without recent fire history during the peak of the season can create large fires during the first hours
9.	Invasive grasses and other non-native weeds can create flammable fuels bed will need to be addressed as more burning takes place
10.	Fire behavior of convective fires is unpredictable with the science available today, and fires like Carr or Creek are more common every year
11.	More work is needed to understand fire progression within structures and work that needs to be done to have better fire-hardened houses and communities
12.	Sometimes there are different strategies in firefighting in Federal and State lands. The "modified suppression" vs "aggressive firefighting"; strategies have to be dynamic, and also consistent cross boundaries, and based on forecasted conditions
13.	Reduced number of available hand (inmates) crews (196 to 75 this year in the State) by a combination of regulations, shorter sentences, budget cuts, and the COVID impacts

OPPORTUNITIES

External factors in our environment that are likely to contribute to our success

1.	A strong economy that can support a relevant increase of investments in sustainable forest management practices	
2.	Climate change initiatives are in the first line of the political agenda, and the fire situation is closely associated with climate change by most	
3.	Growing understanding on the society of the difference between good fire vs bad fire	
4.	General Media is moving from the news that only highlight the epic of firefighting to supporting a debate of what is needed to change the fire situation	
5.	There is a growing generation of specialists that evolve from the traditional suppression mindset only approach to a more holistic one	
6.	Research and technology implementation is moving full speed to support wildfire risk reduction and community needs	
7.	Increased collaboration from vested stakeholders, such as electric utility, is driving forward the science and operationalization of solutions based on these scientific improvements	
8.	Remote sensing is giving us new and novel ways to predict risk and monitor ongoing incidents	
9.	Forest Products Industry, good management practices through policy is needed.	
10.	Benefits of wildfire risk mitigation practices include increased water flow in watersheds (with increased vegetation thinking), reduce the risk of landslides, pests, and the effects of drought on healthier trees	
11.	Policy shift to create more grant monies for previous VMP projects and reduce ladder fuels, and "train" the plants	
12.	Healthier rangeland with the removal of Medusahead and other non-native annuals	

THREATS

External factors that we have no control over. Contingency plans might be needed for dealing with them

1.	Climate change pace is putting cold and temperate forests in extreme conditions for what used to be normal years	
2.	Precipitation amounts and over which areas they are occurring continues to evolve with climate change and upper-level atmospheric patterns	
3.	Tree mortality due to bark beetle is transforming the Sierras. Between 2012 to 2019, over 100 million trees died due to drought that weakened the trees and left millions of acres of forestland highly susceptible to insect attacks	
4.	Even with regular conditions, the topography is extreme and making it difficult and expensive for both operations and management	
5.	Extreme wind events are more frequent and extend beyond traditional fire seasons	
6.	These extreme wind/weather events put pressure on Utility providers to shut down power grids. People living in areas of frequent shutdowns are buying generators that may become potential ignitions	
7.	Particulate Air pollution and its health effects	
8.	The housing crisis is not slowing, so new developments continue to encroach into wildland areas adjacent to hazardous fire terrain	
9.	There is active resistance from a part of the conservationism and research community to create appropriate-scale projects to reduce fuels putting at-risk citizens and first responders	
10.	Insurance companies are not renewing policies for people that live in rural areas, instead of creating an incentive for homeowners to harden their homes.	
11.	The growing Wildfire Litigation industry is doing big business by focusing the problem on ignitions, not on fire propagation that is characteristic of the California firescape	
12.	Private Wildfire fighting business is growing for the selected few, but only on the suppression side, raising coordination concerns, not on mitigation needs	
13.	Lack of cellular networks throughout much of the wilderness areas - wildland fire areas reduces efficiencies - the inability to utilize technologies due to coverage	

LIGHT AT THE END OF THE TUNNEL: CALIFORNIA'S WILDFIRE AND FOREST RESILIENCE ACTION PLAN

Then, some very good news went unnoticed during fire season. One day before the lightning strike event that started this series of extreme fires, on August 12th, Governor Newsom and the USFS Chief Vicky Christiansen signed the promising and ambitious Shared Stewardship Agreement of California's Forest and Rangelands. This MOU outlines six principles that will drive the collaboration between the State and the Pacific Southwest Region of the US Forest Service:

1. Prioritize public safety
2. Use science to guide forest management
3. Coordinate land management across jurisdictions
4. Increase the scale and pace of forest management projects
5. Remove barriers that slow project approvals
6. Work closely with all stakeholders, including tribal communities, environmental groups, academia, and timber companies.

The plan is that both entities commit to making these game-changing actions:

1. Treat one million acres of forest and wildland annually to reduce the risk of catastrophic wildfires (building on the State's existing 500,000-acre annual commitment).
2. Develop a shared 20-year plan for forest health and vegetation treatment that establishes and coordinates priority projects;
3. Expand use of ecologically sustainable techniques for vegetation treatments such as prescribed fire;
4. Increase pace and scale of forest management by improving ecologically sustainable timber harvest in California and grow jobs by tackling structural obstacles, such as workforce and equipment shortfalls and lack of access to capital;
5. Prioritize co-benefits of forest health such as carbon sequestration, biodiversity, healthy watersheds, and stable rural economies;
6. Recycle forest byproducts to avoid burning slash piles;
7. Improve sustainable recreation opportunities;
8. Enable resilient, fire-adapted communities; and
9. Share data and continue to invest in science.

The recently created Forest Management Task Force has published the California's Wildfire and Forest Resilience Action Plan, which will guide the actions needed to accomplish this transformational project.

It turns out that, when it was time to look for strategies resulting from our SWOT analysis, we find this initiative, with all the ingredients to set up a more balanced scenario between our landscapes and our communities. The actions proposed need to be embraced at all levels. Achieving the participation of local governments, adding the same energy to address vegetation management in their areas of responsibility, and getting citizens involvement in being part of the solution, is essential for a future

more resilient California Fire Quilt. Let's communicate efficiently to get the citizen's support. This historic (again) fire season is the opportunity to break many barriers that got us here. Californians can do that, and more.



Figure 7. California's Wildfire and Forest Resilience Action Plan. Source: California Forest Management Task Force

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