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The Evolution of Wildland Fire Risk Management

An Undergraduate Thesis Proposal

By

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The Evolution of Wildland Fire Risk Management

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University of Nebraska-Lincoln, 2022

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Abstract

Wildland Fire risk management has long been a topic of much discussion. In the past we have focused on immediate danger and how to mitigate it, recently we have started to look at risk with a long-term view. Throughout this paper we will discuss the history of wildland fire, wildland fire policy, and how we got to where we are today. We will also look at how the two different styles of risk management and how we need to use them in a complementary fashion to provide safety to our firefighters, public, and the natural resources that we are protecting.

Introduction

The purpose of this study is to describe how the process of risk management in wildland fire has evolved to meet the demands of more complex wildfires, overstocked and diseased forests, and climate change. This is an especially important topic to upcoming natural resources professionals as at some point throughout their career, wildland fire will intersect with their daily responsibilities. Most likely they will be called upon to be a Resource Advisor (READ) on a fire in their area or they will be required to act as an Agency Administrator (AA). Both positions will

require them to evaluate risks not only to mitigate the damage done on local resources, but the risk imposed on the firefighters and the public as well.

Firefighting is an inherently dangerous job, and there is a certain level of risk that is accepted by all who participate. Wildland firefighting could be described as calculated risk taking, and the risk may or may not be acceptable after mitigation efforts have been implemented. Therefore, it is essential to understand the types of risk that firefighters face daily, as well as the different methods of mitigating said risk. Having a good understanding of how Incident Management Teams view risk and calculate for it in their daily operations is a crucial role of a READ or an Agency Administrator.

Figure 2: Camp Fire, Structure engulfed

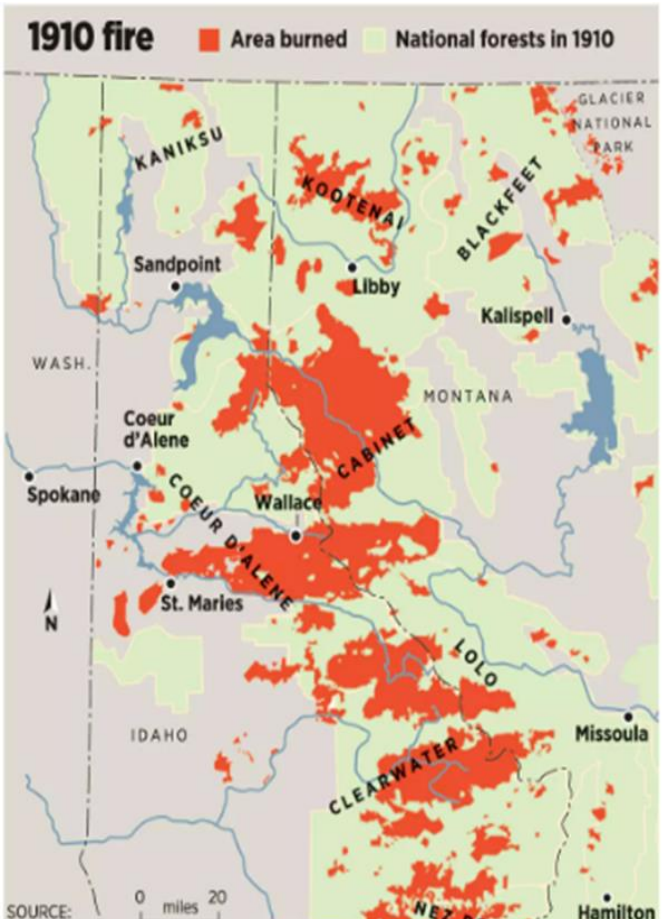

Figure 1 Map of Fires of 1910, the Big Blow Up

As fires seasons have become longer and urban areas have encroached into areas not having been previously developed. We are seeing more and more challenges in how we fight fire. Hence the implementation of thinking about Strategic Risk and approaching fires from a different point of view. Using

this system does not make the other system invalid, as they both have their places and both need to be used.You could look at the traditional method and everything that came out of those tragedy fires as a day to day guide for keeping people safe, and you could approach Strategic Risk as keeping a community safe with a long-term suppression approach.

Throughout this study we will dive into case studies of several of these fires, how they have shaped the landscape of wildland fire, we will look at where we are at today, and where strategic risk evaluation is taking us. I will also detail the outcomes of these fatality fires, how they have shaped the Incident Response Pocket Guide and how we use both of these methods in a complementary fashion.

Methods

The research paper will be a literature review of USFS Investigation Reports and investigative literature on wildfires during each of these policy periods and the impacts that significant fire events had on shaping policy, firefighter safety, and risk management. Much of this study will also be qualitative, as there is a lot of interpretation and subjectiveness that is built from experience and firsthand knowledge of the subject matter. I will proceed to summarize some of the more infamous fatality fires and what we learned from them. Then, I will compare them to the recent fatality reports. I will follow up with a discussion about Strategic Risk, Strategic Operations and compare them to previous methods and discuss why we need to use the traditional methods in conjunction with Strategic Risk Assessments as opposed to only doing things the same way that we have done it forever.

For my own contribution I will be adding charts and tables that better show the timeline that we are working with when these fires occurred, and what came out of these fires.

Limitations to this paper include evaluating subjective evaluations, for example, what I consider low risk another individual may view that as moderate to high risk. Another limitation within this study is that at times it could seem like armchair quarterbacking decisions that were made that had a deep and long-lasting impact upon individuals and their families. Through this study we will keep the findings as objective as possible and stay away from second guessing the decisions made in a stressful situation and under duress.

Results

What I found throughout this study was that in spite of new checks and balances in the fire world, i.e. the Incident Response Pocket Guide, the 10 Standard Firefighting Orders and the 18 Situations that shout Watch out, the Downhill Line Construction Checklist, etc.; we are not losing firefighters in a new ways. We are still killing firefighters in the same manner that we have been since the early 1900s. We are still losing them to tree strikes, vehicle accidents, burn overs from predicted weather patterns, etc. In some respects certain forms of incidents have decreased, but at this point there is no legitimate reasoning that makes a fire fatality acceptable. In 2022 over the span of two weeks in July we lost two firefighters to two separate tree strikes and one to a heart attack all on the same fire.

Wildland Fire Policy

Wildfire policy has long been shaped by reaction to events that happen during and around fire seasons. I will dive into the fires and the policies that came from them in this next section to

share how they affected how we are mitigating risk and where we are going in regards to the future of wildland firefighting.

Early 1900s

Fire has long been used as a land management tool by indigenous people, settlers and many others. Prior to 1910 fire was a common sight on the landscape of North America. In the summer of 1910, also known as the Big Blow up, over three million acres burned in a span of two days (August 20th and 21st) across Idaho, Montana, and Washington. This fire fundamentally changed the way that we viewed fire as a society and greatly assisted with development of federal firefighting resources. (Eagan) At the time fire was still viewed as a tool for clearing land, hunting, etc. After the Big Blow Up, the United States Forest Service (USFS) a federal agency in its infancy was charged with fire suppression in addition to its other responsibilities.

> ***The Big Blow up of 1910.*** During the summer of 1910, there was widespread drought, high winds, and numerous dry lightning storms. Widespread fires over Idaho and Montana in the beginning of August culminated on August 20-21st to create a firestorm the like of which he hadn't seen before. During this time, 1700 fires burnt over 3 million acres of timber, at least 85 people were killed, several towns were lost. Nationally over 5 million acres were burnt. The result of this fire season was that Chief Henry Graves and Ferdinand Silcox called for aggressive fire prevention and complete elimination of fire from the landscape. There was also a call for the expansion of the funding for the USFS as well as an expansion of its mission as well (Eagan, 2010).

1930s to 1970s

After several large, destructive fires, the USFS adopted a policy known as the 10AM rule in 1935. This new policy stated that every fire had to be extinguished by 10AM the following day and if it wasn't the deadline rolled over to 10AM the next day. The perception of fire being an evil thing was prevalent throughout the Western United States and directly influenced the next century of fire suppression and resource management. The next several decades were followed by numerous fires that changed the way that we look at attacking fires and implemented several policies to keep people safe.

Event	Date	Number of firefighter deaths
Blackwater Forest Fire Shoshone National Forest, Wyoming	August 21, 1937	15
Hauser Canyon Fire Cleveland National Forest, California	October 1, 1943	11
Mann Gulch Fire Helena National Forest Helena, Montana	August 5, 1949	13
Rattlesnake Fire Mendocino National Forest Fire Willows, California	July 6, 1953	15
Inaja Fire Cleveland National Forest, California	November 24, 1956	11
The Loop Fire Disaster Forest Fire Los Angeles, California	November 1, 1966	12

Table 1 Fatality Fires (NWCG, 2022)

The fires listed above are six of the top ten fatality fires and they all came during this period where we are trying to defeat fire like we are in a war. These fires are important in that they have directly influenced the perception of firefighters and the public in regard to how wildland fire is fought, and the dangers that firefighters face while out there. They also have continued the perception that all fires are bad, and we still need to suppress all of them at any cost.

The Blackwater Fire, 1937. The Blackwater Fire though relatively unheard of due to its location played a major role in what firefighting looks like today. ON August 18, 1937 a lightning strike started this fire west of Cody, Wyoming in a remote area of the Shoshone National Forest. The Blackwater Fire blew up due to a cold front that caused the winds to shift and the fire behavior to increase exponentially. The Blackwater claimed the lives of fifteen firefighters and injured 38. This fire has the distinction of killing more firefighters than any other fire between 1910 and 2013. Although there was a great loss of life and many injuries, there were many good things that came out of this fire. The USFS began looking for ways to provide a more immediate response to wildfires, the most notable being the creation of the Smokejumper program in 1939 (Brown A.A., 2003)

The Mann Gulch Fire, 1949. In August of 1949 in Central Montana, 13 Firefighters lost their lives running from a fire that was in the Missouri River Breaks. From this fire we invented the 10 standard firefighting orders and the 18 Situations that shout watch out. (Maclean, 1993). Another innovation to come out of this fire was the advent of using fire to escape. Wag Dodge the Jumper foreman used fire to light the grass ahead of the fire so that he could get into the black and not get burned over. While this was successful several of his subordinates did not trust this theory and tried to outrun the fire. Wag ultimately survived in his burnout. (Maclean, 1993)

The Rattlesnake Fire, 1959. The Rattlesnake Fire was started by an arsonist in July of 1953 and ultimately claimed the lives of 15 firefighters. (Maclean, 2018). The firefighters were caught unaware of an uncontrolled spot fire while eating lunch. The fire made an unexpected downhill run and caught fifteen of the crew while nine of them barely escaped through the heavy chaparral and steep terrain. This fire behavior was unusual due

to the downhill wind shift and the speed at which the fire ran downhill towards the fire personnel the Rattlesnake Fire led to changes in training and awareness of fire weather and fire behavior. It also resulted in increased safety standards for wildland firefighters. (Maclean, 2018)

The Loop Fire. 1966. The Loop Fire occurred on November 1, 1966. A flare up from this fire overran the USFS El Cariso Hotshot Crew, killing ten and inflicting many injuries on the remaining twelve individuals. This fire was unusual in that for the time of year the fire behavior was very intense and from this fire came many of our Standard Operating Orders and Guides for example from the Loop Fire we developed the Downhill Line Construction Checklist, the number and type of radios per crew, providing Personal Protective Equipment (PPE) and making it mandatory to wear, continue development of fire shelters and make them standard PPE, and do more pre-suppression work (i.e. hazardous fuels reduction and prescribed burning). This fire also was a perfect example of why we teach Firefighters to not fight fire in chimneys and box canyons (Gabbert, B. 2016).

1970s to 2000s (Let Burn)

During this time period the USFS, as well as other fire agencies began to see how fire could benefit the landscape and began to dive into the field of fire science. We now how people studying fire weather, fire behavior, how prescribed fire works on the landscape to reduce catastrophic fire. However we still had a long way to go. We started seeing how fire could be beneficial if left to its own devices, we called these fire use fires, now they are termed *Fire for Resource Benefit.* Through the fires during this era we initiated many new safety standards that are still implemented today.

The Battlement Mesa Fire, 1976. On July 17th, 1976, three members of the newly formed Mormon Lake Hotshots off of the Coconino National Forest in Arizona lost their lives forty miles North of Grand Junction, CO. The extreme fire behavior was attributed to a late frost that killed the fuels but left them still looking lush and green as if they wouldn't burn rapidly. But they were primed for ignition. This fire took place in very steep topography with poor communications. In addition to the firefighter deaths, the preceding day hosted a large airtanker crash, which resulted in some of the fire supervision as well as fire resources being diverted to assist with that incident. The result of the Battlement Creek fire was that we implemented the standards for survival and fire shelters became highly recommended. Fire shelters are essentially an aluminum tent that is intended to reflect heat from the fire away from the firefighter. There are many things that go into deploying a shelter such as trying to find a flat spot, being away from a heavy accumulation of fuel (trees, brush, etc.) and digging the ground to bare dirt. In the Standards for Survival, it states that a firefighter must be in his/her fire shelter in 20 seconds, which is not a lot of time to assess the above factors. (Peterson, 1976)

The Dude Fire, 1990. The Dude Fire took place outside of Payson Arizona in June of 1990. This fire caused by lightening claimed the lives of six firefighters from the Perryville Department of Corrections Inmate Crew. At the time of this fire Arizona had been in a three-year drought. Temperatures were extremely high for that time of year with recorded temperatures of 122° in Phoenix and 106° in Payson. Due to the heat and the topography the fire grew from 50 acres at 1330 to over 100 acres at 1615. The fire also transitioned from a type 4 fire (local control) to a Type 2 and then a Type 1 fire by

that evening (1800). By the following morning it was over 1900 acres and threatening subdivisions in the Payson, AZ area. The afternoon of the fatalities the smoke column developed into a thunderstorm and soon collapsed causing erratic, gusty winds and extreme fire behavior over the fire area. As crews used their escape routes to get to safety several inexperienced firefighters from the Perryville crew were overran. Eleven crew members deployed their fire shelters out of which six perished. The Dude Fire once again brought fire shelters to the forefront, after this fire they became mandatory, as well as Look Up, Look Down, Look Around training and Lookouts, Communications, Escape Routes, and Safety Zones (L.C.E.S.)training.

The South Canyon Fire, 1994. The South Canyon Fire in 1994, is probably one of the most influential fires in North America. On July 5, 1994, a fire that had been burning for 3 days was attacked by local firefighters. Initially there were 5 local firefighters who were joined by several smokejumpers that afternoon. The following day, July 6th Prineville Hotshots joined the resources on the ground and proceeded to go direct on the fire. That afternoon a dry cold-front passed over the fire area, resulting in strong erratic winds and increased fire behavior. The fire spotted below them and ran up the steep terrain, overrunning the firefighters, this resulted in the deaths of 14 firefighters in Western Colorado only 50 miles from the Battlement Creek Fire from 1976. This tragic fire resulted in an increased awareness of weather and topographic influences on fire, LCES, chain of command within the smokejumper organization, and fighting fire with the highest probability of success. (Magnan, 1994)

2000s to Current (National Cohesive Fire Plan)

As we moved into the 2000s, we were presented with several new issues, widespread drought across much of the western United States, overstocked forests that are susceptible to bug infestations that kill much of the forests making them prime for catastrophic wildfire. These fires were larger, more resistant to control and more complex than ever before due to the previously mentioned factors as well as the expanding Wildland Urban Interface.

The Thirty Mile Fire, 2001. Four firefighters lost their lives in this fire that took place in Central Washington on July 9, 2001. The Thirty Mile Fire was started by an abandoned campfire. Due to a lack of resources during an abnormally busy fire season for the area it took awhile to get resources on scene. Once the crews were on scene it was already too late to be effective during the initial attack phase. With so much happening at the same time the Crew Boss/ Incident Commander lost track of the situation as well as his people. Four individuals tried to use a rock slope for safety and it ended up costing them their lives. This was a landmark fire in our history in that the Crew Boss was found guilty for criminal negligence (Maclean, 2008).

Figure 3 Thirty Mile Fire Fatalities

The Esperanza Fire, 2006. The Esperanza Fire was an arson fire that was started on October 26, 2006. It burnt 41,173 acres by the time that it was contained on October 30th, 2006. Five firefighters died defending a vacant house that was ultimately lost. There were 54 outbuildings lost during this fire along with five fatalities along with twelve injuries. This fire was a late season fire that was human caused, the fire behavior was intensified

by the local Santa Ana winds and terrain. There is much to noted about this fire most striking the location of the structure that they were protecting is at top of a large chimney on the mountainside making it very susceptible to extreme fire behavior. Also not having a good ingress/ingress route to use as an escape route to get to their safety zones. And finally not having good situational awareness and not giving themselves enough time to escape to safety. This also marked the beginning of an agreement between the USFS and NASA to use satellite mapping software on wildfires (Maclean, 2014).

Yarnell Hill Fire, 2013. In June of 2013 a fire in Central Arizona claimed the lives of 19 firefighters. The fire was in steep, rugged terrain, that was covered in heavy volatile brush. As the Granite Mountain Hotshots were making their way across the valley they were caught by a windshift and burnt over by the fast moving fire. The entire Granite Mountain Hotshot Crew lost their lives, except for their lookout who had made his way bay to the crew vehicles and listened to the incident over the radio.There is much to be learned about this fire, however it is mostly lost to us as the all of the witnesses perished in the fire.

Wildland Urban Interface (WUI) Fires

The Wildland Urban Interface is becoming more and more of an issue for Firefighters as we expand our urban boundaries and move into the outskirts of developed and undeveloped areas. When we encounter these fires there are additional hazards that Firefighters are exposed to powerlines, traffic from evacuations, upset and emotional public, toxic fumes and other substances that are harmful to breathe in, and fire behavior that differs from a normal wildland fire. These fires cause a lot of Post Traumatic Stress issues for firefighters as well as causing some to go above and beyond in their efforts as it is now someone's house that they are saving or

working on. Sometimes Wildland Firefighters even work outside of their training by attempting to put out a structure fire which they are neither equipped nor trained to do. There are many resources that the public can use to give their property a better chance of survival in these situations; Firewise, Hazardous Fuels Specialists from the state and federal agencies, etc. However, none of these resources will fully guarantee that their home/property will survive the inferno. We have several examples of these fires right here at home with the Chadron and Valentine fires in 2012, the Carter Canyon Fire, Road 739 and Road 702 Fires from this past fire season (2022). These fires have led to many changes in training, strategy, tactics, and perceptions of fire.

The Rodeo-Chediski Fire, 2002. The Rodeo-Chediski fire was initially two fires (the Rodeo and the Chediski Fires) that grew together. They both started in June of 2002. They grew together on June 23, 2002 to become the largest fire in Arizona history (until 2011 when the Wallow Fire surpassed it). The fire consumed over

Figure 4 Rodeo-Chediski Fire from Payson, AZ

450,000 acres in the largest continuous Ponderosa Pine Forest in North America. Over 19,000 people were evacuated from their homes and the fire destroyed the town of Show Low, Arizona burning 426 buildings. The Rodeo-Chediski Fire while not having any fatalities was one of the first fire to be termed “Mega-Fires” and began to usher in a new era in firefighting.

The Camp Fire, 2018. The Camp fire sometimes also known as the Paradise fire took place in November of 2018. This was the first time that firefighters had ever seen anything like this. The last time destruction like this was seen in the fires of 1910. In 24 hours over 18,000 structures were lost, another 700 structures were damaged, and there were 85 fatalities. (Butte County 2022) The Camp Fire was started by faulty powerline infrastructure and fueled by high winds and drought conditions it was an unstoppable force of nature. Although firefighters have been fighting fire in the Wildland Urban interface for many decades, but this was different. Teams had to determine other factors to realize containment outside of just the fire. They had downed infrastructure, mental and emotional health, search and

Figure 5 Camp Fire Structure

rescue/recovery, and a lack of resources to assist due to the time of year. (Maranghides et al.) The Camp Fire is also a good representation of can happen anywhere in the United States when conditions are right.

Strategic Risk and a New Way of Doing Business

To talk about Strategic Risk Assessment firest we have to look at how we have operated in the past. Historically, fires at the Type 1 or Type 2 (Type 1 being the most complex) have several positions that influence the plan for attacking that fire. The ones that probably have the most direct influence are the Operations Section Chief and the Safety Officer. They are directly responsible for completing the ICS-215A (Incident Safety Analysis) and other processes to ensure the safety of firefighters. The 215A is used to catalog and mitigate the hazards that firefighters encounter on the fireline during an operational period. Using this this tool the team can accept or reject the risk and accountability for the firefighters underneath them. The Incident Safety Analysis directly accounts for the hazards on the ground and how they are mitigated. Strategic Operations and Risk Assessment is another way of looking at the risks that fires pose to the firefighters, communities, and the natural resources. This allows Fire Managers to evaluate the risks with the evaluation metric being risk vs. reward.

Many times when a wildland incident occurs there is a shared jurisdiction between many agencies. Along with this comes some extra responsibilities as well as the need for understanding the FMAG grants. A Fire Management Assistance Grant is available through FEMA to states and local communities in the event of an incident. These grants pay up to 75% of the State share of the cost of the fire. The issue with these is that as soon as a fire is determined to be contained/controlled the access to the money ends. This really began to change during the Marshal Fire (12/31/2021). Due to some quick thinking and problem solving the Operations

Section Chiefs and Incident Commanders of the Rocky Mountain CIMT1 came up with a different way to assess this instead of using the traditional methods of determining containment. Strategic Risk Assessment helps the fire personnel (with input from the Agency Administrators) narrow down the priorities. This is limited to seven main priorities that are listed with severity of the outcome. The reason that it is limited to seven is that when there are several jurisdictions involved it makes the individual agencies prioritize their values at risk and gives clear task, purpose, end state to the Incident Management Team. What really happens through this process is a determination of the critical values at risk and an assessment of the risk to responders. These are then charted and evaluated, which helps the Team choose an appropriate course of action. This helps fire managers make the best decisions possible, with an adequate amount of time to implement the plan and to prevent the loss of life and property.

The intent behind this new movement of Strategic Risk Management is not to replace the Risk management tools that we have used in the past, but to build upon them and provide the ground personnel a tool that they can use quickly and easily. With the visual nature of the Strategic Risk Assessment it is very easy to visualize why the Incident Commander, Planning Section Chief, and the Operations Section Chief are making the decisions that they are. It also provides a purpose to the mission.

> ***The Beaver Creek Fire, June 2017.*** The Beaver Creek Fire in Northern Colorado started in June of 2017. It started in an area that had a heavy infestation of Mountain Pine Beetle 10 years prior. As a result of this infestation, the forest was standing, dead timber. The decision was made to not send any resources in to put it out and to instead let it clean up the forest floor and wait for it to come out where the probability of success to catch it was high as well as safer. This fire transitioned at that point from being a local Type 4

incident to a type three over the course of the fire it went up to a Type 2 fire, back down to a three and back and forth through the various levels of complexity until it was declared contained in October of 2017 and finally declared out in November. There were many sensitive issues with this fire: historic cabins (Dwight D. Eisenhower's family cabin), threatened and endangered species in the watersheds, multiple agency and state jurisdictions. This fire was deemed to be complex and severe enough to warrant the "*Let it Burn"* or *"Fire for Resource Benefit"* policy and implement perform point protection around the structures and sensitive areas. The issue with this fire is that it was a demonstration in the transference of risk. By not sending an Engine crew of 3-5 individuals in to take care of the fire initially we spent millions of dollars and thousands of miles on the road and hundreds of hours of flight time. So we saved the engine crew from being struck by a snag or injured by the fire; however we exposed the rest of the firefighters that responded as well as the Incident Management Teams to a lot more risk.

Figure 7 Marshall Fire Structures

The Marshall Fire, December 2021. On New Year's Eve 2021, the Marshall Fire started in Boulder, Colorado. This fire only lasted one day as a blizzard arrived and complicated the incident, it put the fire out but left a host of other issues in its wake. The fire destroyed 1100 structures, several

Figure 6 Marshall Fire Boulder Neighborhood

shopping centers, and a lot of the municipal infrastructure. If the Incident Management Team had called the fire contained/controlled there wouldn't have been any funding to secure the incident. The team working out of a shopping mall and working with the Agency Administrators came up with different metrics to determine containment for the fire. Among these metrics were number of 911 calls responded to (the team was running 911 through the incident command post), looking at different quadrants secured, etc. This is the age that we live and work in now, we not only have forest fires to contend with but we are increasingly having to manage incidents within city limits, out of the normal areas, and that are exhibiting more intensity than ever before. How do we manage that while protecting firefighters?

Conclusion

The fires in this study are not the only tragedy fires that we have experienced over the long history of wildland fire suppression in North America, however they are a handful of the ones that have brought about the greatest changes in how we operate and what we do on the fire line. One could look back over the last 100 years and list many fires where there have been fatalities or major incidents, but they have not had the impact that we have seen from the above fires. The only way that we will stop injuring and killing firefighters is if we take all the tools at our disposal and utilize them how they were meant to be used, become students of fire and really understand the causal factors behind wildland fire fatalities and the human factors involved with each incident. We have made progress with how and where we fight fires, in large part to many of the case studies that I have referenced in this study, but also to a growing awareness of

As future Firefighters, Agency Administrators, and Resource Advisors, this is the task that we are faced with, reducing/mitigating risk for our Firefighters on the line and protecting our natural resources for future use. Once we start managing fires like we are fighting a war and stop believing that we are invincible and start fighting fire in a manner commensurate with the risk involved and make decisions commensurate with the values at risk, can pat ourselves on the back for a job well done, until then we need to do better.

References

Brown, A.A. (2003). "The Factors and Circumstances That Led to the Blackwater Fire Tragedy" (PDF). Fire Management Today. U.S. Forest Service.

Egan, T. (2010). *The big burn: Teddy Roosevelt and the fire that saved America*. Houghton Mifflin Harcourt.

Fidler, M. (2022, August 10). *SRA/Strategic Operations*. ArcGIS StoryMaps. Retrieved September 29, 2022, from https://storymaps.arcgis.com/stories/7e0b757bc6a4480cad008218d6448212.

Gabbert, B. (2016). "Wildfire Today "50th anniversary of the Loop Fire commemorated". *Wildfire Today*.

Karels, J. (2013). *Yarnell Hill Fire, June 30, 2013: Serious accident investigation report*. Arizona State Forestry Division.

Maclean, J.N. (2003, June 2). *Fire and Ashes: On the Frontlines of American Wildfire (1st ed.)* Henry Holt & Co.

Maclean, N. (1993, September 29). *Young Men and Fire (12th printing)* University of Chicago Press.

Maclean, J.N. (2014, January 7). *The Esperanza Fire: Arson, Murder, and the Agony of Engine 57. (1st ed.).*Counterpoint.

Maclean, J. N. (2009, December 8). *Fire on the Mountain: The True Story of the South Canyon Fire* (Reprint). Custom House.

Maclean, J. N., Will, D., & Greer, K. (2018, September 4). *River of Fire: The Rattlesnake Fire and the Mission Boys*. Maclean Land & Tackle and Andersson Publishing.

Maclean, J. N. (2008, May 27). *The Thirtymile Fire: A Chronicle of Bravery and Betrayal* (First). Holt Paperbacks.

Magnan, D. (1994). *Report of the South Canyon Fire accident investigation team*. FRAMES. Retrieved November 23, 2022, from https://www.frames.gov/catalog/11683

Maranghides, Alexander, et al. “A Case Study of the Camp Fire - Fire Progression Timeline.” *NIST*, 1 Mar. 2021, https://www.nist.gov/publications/case-study-camp-fire-fire-progression-timeline.

National Interagency Fire Center. (2022). *Incident response pocket guide*.

NIFC. (2003). *Lookouts, communications, Escape Routes, safety zones*.

NWCG report on Wildland firefighter fatalities in the United States ... (n.d.). Retrieved November 24, 2022, https://www.nwcg.gov/sites/default/files/publications/pms841.pdf

Putnam, T. (1990). *Accident investigation report: Dude fire incident, multiple firefighter fatality, June 26, 1990*. Forest Service.

Peterson, M. (1976). *Accident report, Battlement Creek Fire Fatalities & Injury, July 17, 1976*. U.S. Dept. of the Interior, Bureau of Land Management.

The Camp Fire Public Report - Butte County, California. (n.d.). Retrieved November 3, 2022, https://www.buttecounty.net/Portals/30/CFReport/PGE-THE-CAMP-FIRE-PUBLIC-REPORT.pdf

Appendix

A

ICS 215A

Risk Assessment Worksheet Instructions
Incident Master Record

The Incident Risk Assessment (IRA) Worksheet will identify the hazards associated with the incident or project, initial risk, mitigations and post mitigation risk. The Incident Commander, Project Manager or Agency Administrator will review the IRA and mitigation strategies to ensure risk is at an acceptable level for task or activity. The leader of the incident/project/task will brief employees on associated hazards.	
Blocks 1-4	**Self explanitory**
Block 5	**Pre-Control:** What hazards are involved with the project or activity
Block 6	**Control or Abatement Strategy:** What mitigation or abatement strategy will minimize risk or exposure (ex. engineering, administrative, PPE, Avoidance, education, etc.) Genertic control measures will auto populate this field based on the hazard. Double click in the box to edit. To add aother line, press "Alt Enter"
Block 7	**Post-Control:** What hazards and risk associated with hazards are still present following mitigation or abatement strategy
Block 8	**Location**: Where on the incident the hazard and risks have been identified (i.e. Division A, ICP).
Block 9	**Hazards:** What hazards exist with project (ex. hazard trees, driving, rolling debris, heat, etc.) Click drop down box and select or type in a new hazard
Block 10	**Hazard Probability:** What is probability a hazard will be encountered during project or activity. Select from drop down box.
Block 11	**Severity Code:** What are the consequences should an unplanned event occur. Select from drop down box.
Block 12	**Risk Level:** A Pre-control action level will be automatically assigned.
Block 13	**Hazard Probabilty:** Following mitigation or abatement actions the probability of exposure or risk. Select from drop down box.
Block 14	**Severity Code:** Following mitigation or abatement actions the severity or consequences associated with task or project. Select from drop down box.
Block 15	**Risk Level:** A post control action level will be automatically assigned.
Block 16	**Acceptable Level Yes/No:** Is level of risk acceptable following mitigation or abatement actions, decision should be made at appropriate management level
Export yes/no	Select yes for the hazards that are pertinent for the operational period to be included in an operational215a.
Export (Blue)	Click in this box to export to another worksheet for current operations period. When asked for "Name" Type in date and operational period. Incident Safety Analysis 215a
<u>Operational Period RAC and 215a</u>	
	This is saved as a new tab with the operational period and date. This tab will allow you to reevaluate the hazards given the current changes in fire activity, weather, operations, etc. When you have reevaluated the

	hazards, click on the export to 215a button. This will create a three column 215a for that operational period.
Risk Assessment Code (RAC)	
Severity Code	
Catastrophic	Imminent and immediate danger of death or permanent disability.
Critical	Permanent partial disability, temporary total disability.
Significant	Hospitalized minor injury, reversible illness.
Minor	First aid or minor medical treatment.
Hazard Probability	
Frequent	Immediate danger to health and safety of the public, staff or property and resources.
Likely	Probably will occur in time if not corrected, or probably will occur one or more times.
Occasional	Possible to occur in time if not corrected.
Rarely	Unlikely to occur; may assume exposure, will not occur.
Definitions	
Probability	The likelihood that a hazard will result in a mishap or loss (Exposure in terms of time, proximity, and repetition)
Severity –	The worst credible consequence that can occur as a result of a hazard
Hazard –	Any real or potential condition that can cause injury, illness or death of personnel, or loss and damage to equipment
Risk –	An expression of possible loss in terms of severity and probability (associated with human interaction)

		Severity			
		Catastrophic I	Critical II	Significant III	Minor IV
Probability	Frequently A	Critical	Critical	Serious	Moderate
	Likely B	Critical	Serious	Moderate	Minor
	Occasional C	Serious	Moderate	Minor	Negligible
	Rarely D	Moderate	Minor	Negligible	Negligible

Severity Code	
Catastrophic	Imminent and immediate danger of death or permanent disability.
Critical	Permanent partial disability, temporary total disability.
Significant	Hospitalized minor injury, reversible illness.
Minor	First aid or minor medical treatment.
Hazard Probability	
Frequent	Immediate danger to health and safety of the public, staff or property and resources.
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Clear and Create new Workbook **Incident Risk Assessment Worksheet**				**1. Incident Name/Number**		**2. Location** Delete Current Row				
Identification of Hazards and Risk Assessment				**3. Name and Title of Analyst**		**4. Date**				
5. Pre-Control					**6. Control or Abatement Action (Engineering, Administrative, PPE, Avoidance, Education, etc)**	**7. Post-Control**				Click to Export
8. Location	**9. Hazard**	**10. Hazard Probability**	**11. Severity Code**	**12. RAC**	**Actions** (double-click in cell then click alt + enter to add a line) Click to update current cell baed on hazard	**13. Hazard Probability**	**14. Severity Code**	**15. RAC**	**16. Acceptable (Yes/No)**	**Export (Yes/No)**
				No Data	Chainsaw	Likely B	Catastrophic I	Critical	Yes	No

Appendix

B

Strategic Risk Assesment

Incident Strategic Risk Assessment		
Purpose. The purpose of the Incident Strategic Risk Assessment (SRA) is to aid the IMT in completing a strategic analysis to identify missions, critical values at risk, probability of success, firefighter risk and uncertainty in the decision making process. This worksheet facilitates risk analysis and communication between agency administrator, incident commander, safety, operations, and other incident personnel. The worksheet is best utilized in the planning phase in conjunction with a 24/48/72-hour meeting and for AA/IC meetings. This strategic risk process is a discussion that occurs regularly.		
Preparation. The SRA process gathers current intelligence and evaluates critical values at risk against responder risk when analyizing strategic actions. What are the host unit's ordered priorities that we are protecting? Clear communication regarding what is being protected and why needs to be highlighted to ensure proper assessment and acceptance of risk involved in each mission. Using available analytics (ex: RMA products), captured objectives (WFDSS), and communications around the selected strategy developed by IMTs with Agency Administrators (AA), risk can be accurately communicated to the firefighter on the ground. Feedback from the field, IMT functions, and others, further validates and strengthens the effectiveness of the assessment conversation and product. The process is ongoing, with a core group holding regular risk-based conversations to assess and track risk evolution throughout the life of the incident.		
Intel Sites	Risk Management Dashboard	https://nifc.maps.arcgis.com/apps/MapSeries/index.html?appid=c5bc811ee22e4da0bde8abec7c20b8b4
	Enterprise Geospatial Portal	https://egp.nwcg.gov/sa/#/%3F/%3F/37.8269/-95.1945/5
	Suppression Difficulty Index Map	https://nifc.maps.arcgis.com/home/search.html?t=content&q=suppression%20difficulty%20index
	Potential Control Lines Map	https://nifc.maps.arcgis.com/home/search.html?t=content&q=potential%20control%20lines
	Medical Extrication Map	https://nifc.maps.arcgis.com/home/item.html?id=3effe003974641c3ab563390ffb5b099
	Snag Hazard Map	https://nifc.maps.arcgis.com/home/search.html?t=content&q=snag
Block Number	**Block Title**	**Instructions**
Strategic Actions & Critical Values at Risk: See instructions for blocks 1-6		
1	**Details**	Strategic Action statements are phrased as a Task-Purpose-End State and help create a link with the WFDSS decisions or incident objectives.

2	**Location**	Describe where this work is being conducted by personnel or resources. This may be specified as a Branches, Divisions, or Groups.
3	**Resources**	List the personnel required to complete the Strategic Action.
4	**Duration**	List the anticipated duration in days to complete the Strategic Action.
5	**Action Probability of Success**	Enter the Probability of Success the strategic action has at protecting the critical values at risk.
6	**Summary**	This box is a narrative to describe and track the conversation highlights. Capture things to monitor, changes, questions, past successes or considerations that were weighed in the decision making. Note things that would be forgotten or unknown to others if not captured.
Critical Values Risk: See instructions for blocks 7-10		
7	**Critical Values**	List **critical** (not all) resources and assets at risk to be considered. Critical Values should come from the agency administrator/representative in a prioritized way. Other sources may be: READs, WFDSS, LMP, and a variety of maps.
8	**Impact Severity**	Select from a 4-tiered drop-down using the same descriptors as the 215R: Catastrophic, Critical, Moderate or Negligible.
9	**Probability of Impact**	Select the probability of an event occurring from a 5-tiered drop-down using the same descriptors as the 215R: Almost Certain, Likely, Possible, Unlikely, or Rare.
10	**Risk Rating**	Auto populates with one of 4 ratings based on data entered in previous boxes: Extremely High, High, Moderate or Low
Responder Risk: See instructions for blocks 11-14		
11	**Major Risk Influences**	This Block shows the 6 risk influencers to consider during the conversation: Ground Transportation, Large Fire Growth, Hit-by Hazards, Aviation, Human Factors, Medical Response Infrastructure, and write-in significant responder risk.
12	**Severity of an Event**	Select the severity level of an event (IF IT WERE TO OCCUR) from a 4-tiered drop-down using the same descriptors as the 215R: Catastrophic, Critical, Moderate or Negligible.
13	**Probability of an Event**	Select the probability of an event occurring from a 5-tiered drop-down using the same descriptors as the 215R: Almost Certain, Likely, Possible, Unlikely, or Rare.
14	**Risk Rating**	Auto populates with one of 4 ratings based on data entered in previous boxes: Extremely High, High, Moderate or Low
Risk Mitigations: See instructions for block 15		
15	**Risk Mitigations**	List hazard mitigations and control actions to reduce the probability and/or severity for identified hazards to eliminate or minimize responder risk.
Strategic Action Risk Profile		

Ranked Risk Summary	This section auto populates based on input into other boxes. It displays the spectrum of risk associated with this strategic action in two formats.
	When weighing critical values at risk with the risk to firefighters do alternative missions need to be developed and evaluated?
Summary Overview	This tab auto-populates and can help evaluate strategy as a whole, or alternatives against one another in terms of the balance of risk to critical values and responders.

Strategic Action

Incident Strategic Risk Assessment (SRA) Incident Name: Road 702 Fire Date: 4/27/2022

Strategic Action 1

1. Details	2. Location	3. Resources		4. Duration	5. Probability of Success (%)
Provide full suppression to minimize impacts within the fire area by containing and holding the fire to the current perimeter. Fire intensity is significantly reduced and does not threaten to escape the fireline and values at risk.	Road 702 Fire Perimeter	1 - Type 3 Team 10 - Type 6, 4 or 3 Engines 2 - Watertenders	Personnel Total: 30-40	2-3 shifts	90%

6. Discussion Notes:	Short term fire modeloing indicate that fire growth outside current perimeter on 4/26/22 is minimal due to 74% containment. Full containment is expected by 4/29/22. Fire behavior is expected to be moderated over the next 2-3 days due to lower winds and increasing humidity and probability of rain, however fire potential remains elevated due to existing drought conditions and delayed green up.

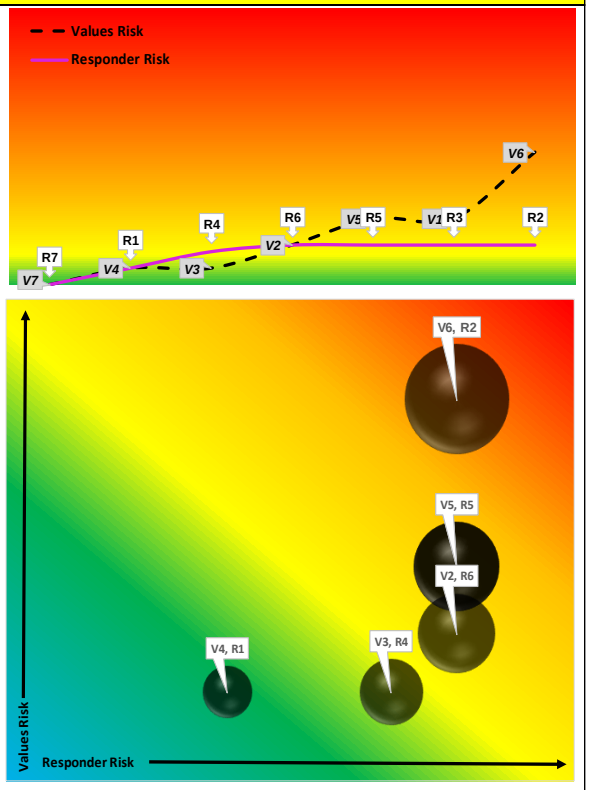
Critical Values at Risk

	7. Critical Values	8. Severity of Impact	9. Probability of Impact	10. Risk Rating
V1	Agriculture Lands	Catastrophic	Unlikely	High
V2	Road Infrastructure	Critical	Unlikely	Moderate
V3	Utility Infrastructure (Powerlines, Gas lines)	Moderate	Unlikely	Low
V4	Railway systems	Moderate	Unlikely	Low
V5	Communities (Wilsonville, Cambridge)	Catastrophic	Unlikely	High
V6	Communities (Hendley, Holbrook)	Catastrophic	Rare	Moderate
V7				*No Data*

Responder Risk

	11. Major Risk Influencers	12. Severity of Event	13. Probability of Event	14. Risk Rating
R1	Ground Transportation	Moderate	Unlikely	Low
R2	Rapid Fire Growth	Critical	Unlikely	Moderate
R3	Hit-by Hazards	Critical	Unlikely	Moderate
R4	Aviation Operations	Moderate	Rare	Low
R5	Human Factors	Critical	Unlikely	Moderate
R6	EMS Response Capability	Critical	Unlikely	Moderate
R7				*No Data*

Ranked Risk Summary



15. Risk Mitigations & Rationale

Suppression operations are based out of Cambridge reducing overall travel times for responders. Fire perimeter has been 87% contained and moderating fire weather conditions reduce the potential for rapid fire growth. Overhead hazards only exist within the Republican River corridor and most have been mitigated by the use of heavy equipment. Nearly all powerlines have been repaired. Aviation resources have been released from the incident, however the use of drones may still occur to help identify hotspots. Human factors are reduced due to managing fatigue concerns that occurred early in the incident, however consideration need to be given to complacency due to fire being in a patrol and mop-up phase. EMS response has some limitations. There is a well established medical response plan and local ambulances are staffed by volunteers. 911 works well over the majority of the fire area, but there will be no incident EMS personnel assigned.

Do alternatives need to be developed?	Yes	Participants:	Todd Legler, Rob Powell, Matt Holte, Earl Imler

Responder Risk Assessment Matrix		Probability Likelihood of Event Occurring				
		Almost Certain (expected to occur or is happening now)	**Likely** (Will occur frequently/very realistic to occur)	**Possible** (could occur under specific conditions & some of those conditions are currently evidenced)	**Unlikely** (Remotely possible but not probable, could occur but deemed unfeasible)	**Rare** (Improbable; but has occurred in the past)
Severity **Consequence if Event Occurs**	**Catastrophic** (Imminent and immediate danger of death or permanent disability; major damage)	**Extremely High**	**Extremely High**	**Extremely High**	**High**	**Moderate**
	Critical (Permanent partial disability, temporary total disability)	**Extremely High**	**Extremely High**	**High**	**Moderate**	**Moderate**
	Moderate (Hospitalized minor injury, reversible illness)	**High**	**High**	**Moderate**	**Low**	**Low**
	Negligible (First aid or minor medical treatment)	**Moderate**	**Moderate**	**Low**	**Low**	**Low**

Critical Values at Risk Assessment Matrix		Probability Likelihood of Event Occurring				
		Almost Certain (expected to occur or is happening now)	**Likely** (Will occur frequently/very realistic to occur)	**Possible** (could occur under specific conditions & some of those conditions are currently evidenced)	**Unlikely** (Remotely possible but not probable, could occur but deemed unfeasible)	**Rare** (Improbable; but has occurred in the past)
Severity Consequence if Event Occurs	**Catastrophic** (asset is destroyed or unusable for months, will permanently affect the natural environment (irreversable), threat to survival of fauna/flora/cultural heritage)	**Extremely High**	**Extremely High**	**Extremely High**	**High**	**Moderate**
	Critical (asset is destroyed, unusable or restricted for weeks, medium- to long-term impact that can be remediated with dedicated resources)	**Extremely High**	**Extremely High**	**High**	**Moderate**	**Moderate**
	Moderate (some portion is unusable or restricted but can be replaced within acceptable timeframe, short-term impact that is able to be addressed through existing processes)	**High**	**High**	**Moderate**	**Low**	**Low**
	Negligible (minor damage or only temporarily unavailable or restricted, little to no action needed to mitigate post event)	**Moderate**	**Moderate**	**Low**	**Low**	**Low**