The United States Forest Service spends too much on fire suppression and not enough on fire restoration!

June 1st, 2020

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Introduction

The United States Forest Service spent approximately 2.2 billion dollars on fire suppression efforts in the 2020 Wildfire season. This estimate is about 1.8 billion more than the annual average cost of wildfires from 1985 to 1999. To add to the drastically increased costs throughout the last several decades, the 2017 and 2018 wildfire seasons cost 2.9 billion and 3.1 billion dollars according to the National Interagency Fire Center. As you can see in Figure 1. The Forest Service annual budget has been increasingly consumed by wildland fire costs. The extreme increase in these wildfire costs have made fire restoration and prevention efforts acquire a lower budget.

Fire suppression can be defined as "the activities aimed at restricting the spread of a wildfire after its detection." This tactic has been around since the early 1900s and has been ingrained in our culture and management agencies. Approximately 98% of wildfires are suppressed before they are greater than 300 acres. These fire suppression efforts have resulted in our more devastating wildfires that we have today. Having no fire on the landscape has caused understory fuels to build up over time. These fuels act as ladder fuels that help any wildfire grow and spread tremendously fast. To reduce these suppression costs, science based adaptive management strategies should be applied. This shift towards fire restoration would also help reduce the severity of future wildfires. If managers were to manage more for fuel load reductions, wildfire suppression costs would decrease in the long run.

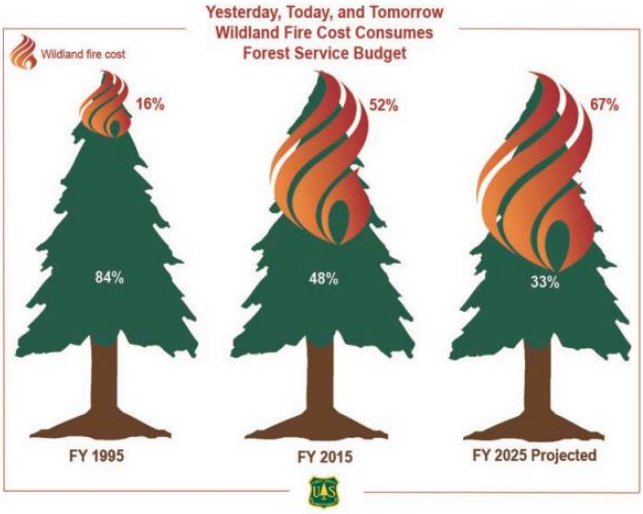

Figure 1. The cost of wildland fire (Preparedness, Suppression, FLAME, and related programs) as a Percentage of the Forest Service's Annual Budget

Fire restoration and prevention is the process of restoring fire to the landscape and managing the land with fire. The Native Americans used fire on the landscape for hunting, cultural practices, other food resources and to prevent wildfires from occurring. One way to bring this process back to the landscape is by prescribed or controlled burning. In addition, science based adaptive management techniques have been developed. Science based adaptive management uses not only fire but mechanical ways to reduce wildfire risk.

The issue at hand is that the United States Forest Service, along with other agencies, spend too much money on fire suppression costs and

not enough on fire restoration and prevention. These restoration and prevention management tactics don't have as large of a budget as fire suppression does. The United States Forest Service needs to increase the amount of prescribed fires and science based adaptive management to reduce wildfires and fire suppression costs. The director of the Wildfire Division at NFPA, Michele Steinburg says, "All this money spent on suppression means less money for prevention efforts, which is key to addressing the problem of wildfire losses."

Importance of the Issue

The importance of this issue is that fire suppression and its costs should decrease. More fire restoration and prevention management strategies should be put into place. The only way we will be able to reduce suppression costs is to apply science based adaptive management strategies. Additional important issues include the Wildland Urban interface, smoke regulations, fire suppression costs and benefits of fire restoration and prevention.

Wildland Urban Interface

More science based adapted management approaches will benefit people in the Wildland Urban Interface (WUI). The WUI is an area where human made structures and infrastructure are in or adjacent to areas prone to wildfire. Some of the different types of WUI lands are demonstrated in Figure 2. These WUI types are known as intermix and interface. Intermix areas are where housing and vegetation intermingle with 50% or more vegetative cover. The Interface area is where housing in the vicinity of contiguous vegetation or less than 50% vegetative cover. Wildland Urban Interface areas can include cell towers, schools, water supply facilities, and homes. In the United States, about 9.9% of the land base is in the WUI area. In Oregon, about 33% of the population lives in a Wildland Urban Interface area. Additionally, fire in the WUI area accounts for 30% of suppression costs. This is a large issue because these people are affected by devastating fires that only get worse from more fire suppression.

Protecting WUI areas is a critical job that fire managers must worry about. However, there are programs that help people in the WUI prepare the best they can before a fire occurs. For instance, a program called "Firewise'' helps communities improve their wildfire resistance. This program focuses on "defensible space," which is to prevent direct home ignition, prevent firebrands, and provide space for firefighters.

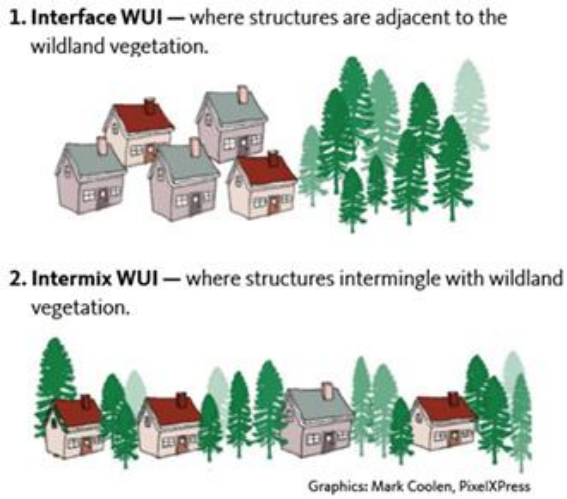

Figure 2. Image interpreting interface and intermix WUI areas.

Smoke

Smoke is another issue that everyone faces when dealing with a fire. This is an issue because smoke can cause problems regarding human health. This may be an issue, but many people within the public don't know that prescribed fire smoke is much healthier than wildfire smoke. This is one of the reasons why getting the public on the side of prescribed fires and fire restoration is so difficult. The public sees fire and smoke as bad, no matter where it comes from. Wildfire smoke is much less

healthy because it often occurs when air dispersal is poor, burns non-plant material such as structures, is often a large area and can burn for longer durations. On the other hand, prescribed fire smoke is generally conducted when air dispersal is good, only burns plant material, only occurs in small areas and short durations.

What are fire suppression costs?

The cost of suppression can be defined as the money spent on suppression activities. These suppression activities have gotten increasingly expensive over the last few decades. In Figure 3. you can see the increase in fire suppression costs from 1985 to 2012. This increase in fire suppression costs is due to the increase in the price of individual resources used as well as the amount of resources used.

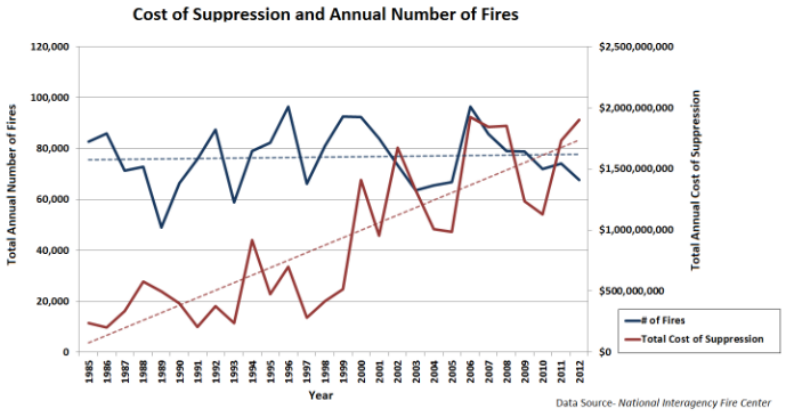

Figure 3. Image shows the annual number of fires since 1985 to 2012 as well as the increased cost of suppression since 1985.

Resources that are used during suppression efforts typically involve hand crews and engines. However, there are a lot more resources that go into fire suppression tactics. In Table 1. There is a list of resources and their daily rates that are typically used on wildfire suppression efforts. This list includes expenses such as catering, aircraft drops and chippers.

Table 1. Lists the daily rate for fire suppression resources used during a wildfire.

Daily Fire Suppression Resource Rate

Resource	Daily Rate
Aircraft (call when needed)	$46,341
Aircraft (Exclusive use)	$30,150
Hand Crew (20-person)	$10,500
Mobile showers	$3,000
Skidgine	$2,340
Strip Mulcher/Masticator	$2,250
Engine	$2,179
Mulcher/Masticator - Boom Mounted	$2,025
Fuel Tender	$1,980
Feller Buncher	$1,890
Chipper	$1,789
Potable Water Truck	$1,665
Mechanic w/Svc Truck	$1,170
Water Tender	$1,156
Gray Water Truck	$1,080
Timber fallers (2)	$1,080
Weed Washing Unit	$865
Handwashing Station	$630
Refrigerated trailer	$270
Passenger Van	$261
Stake side Truck	$256
Pickup Truck	$256
SUV	$252
Catering (per person)	$55

Benefits of fire restoration and prevention

Benefits of reintroducing fire onto the landscape vary widely. Some benefits from prescribed fire techniques include fuels reduction, restoring of forest density, composition, nutrient cycling, and water availability.

When conducting prescribed fires or controlled burns, one of the main reasons is to reduce fuel loads. Reducing fuel loadings is essential to reduce future wildfire risk. Fuel reduction removes vegetation to lessen wildfire threat. The US National Park Service stated that "Fuel reduction projects and vegetation treatments have been proven as a means of lessening wildfire hazards, catastrophic fire and its threat to public and firefighter safety, and damage to property."

Restoring density and composition structure of the forest is beneficial to help restore our fire resilient and fire resistance forests. If we can restore our forest densities and compositions to historical fire regimes, we could have forests that are less susceptible to future wildfires.

Nutrient cycling occurs when a forest fire burns through the landscape, plant and organic materials are burned and reintroduced to the ecosystem as nutrients. These nutrients are beneficial to our ecosystems. Nutrient cycling can play an important role in ecosystem function. Living and nonliving organisms are linked between the flow of nutrients.

Water availability is beneficial because we consume water. Water availability is the "quantity of water that can be used for human purposes without significant harm to ecosystems or other users" (Sustainable Jersey, 2013).

Fire Policy History

Fire Policy History is crucial to our understanding of current and future fire policies. In the past, fire policies have changed dramatically. Fire policies began in the early 1900's after multiple big fires occurred. After those destructive wildfires, the shift from ecological burning to fire suppression was born. After the era of fire suppression, more environmental and ecological restoration approaches took place. These eras will be described as well as more recent fire policy eras.

1900-1960s

As more European settlers moved to the western United States fire regimes were altered and changed due to the needs of the settlers and their misunderstanding of fire on the landscape. For thousands of years Native American burning was a common practice for many ecological and resource benefits. This traditional burning ceased to continue as European populations increased in the west.

In the late 1800s, pressure grew to preserve the vast forests of the west from over extraction from big timber and mining companies. President Theodore Roosevelt, Gifford Pinchot, John Muir, and many others surveyed the western forests to establish the Forest Reserves. Following the Forest Reserves was the Transfer Act of 1905. This act transferred the forest reserves from the Department of the Department of Agriculture. During this time there were several major recorded wildfires in the U.S., but the 1910 fire called the Big Burn was an event that drastically changed perspectives on wildland fire in the west. Using fire as a management tool was not practiced anymore. Although, light burning was particularly prevalent in the Southeast. A contrasting approach supported by Pinchot advocated a policy of fire control that

emphasized fire suppression and had no place for fire use (Donovan 2005).

In 1911, the Weeks Act allowed the use of federal funding to purchase land for conserving forests and its timber. After this, the “need” for fire suppression and a more aggressive initial attack on wildfires became greater with the intention of protecting valuable timber. In 1935, the 10 AM Policy came into place which forced crews to put out any fire ignition by 10 AM. This policy was embodied in 1944 by the successful Smokey Bear public education campaign and was accompanied by the authority to use emergency firefighting funds to pay for pre-suppression (Donovan 2005). Following World War II, the Civilian Conservation Corp provided a surge in fire protection efforts. Fire suppression was now in full swing.

1960s - 1970s

In the 1960s the Forest Service began to somewhat waver from the policy of aggressive wildfire suppression. As indicated by the passage of the Multiple-Use Sustained-Yield Act (1960), the Wilderness Act (1964), and the National Environmental Policy Act (1970), attitudes concerning public land management had begun to shift (Donovan 2005). Therefore, management actions began to change as well. The 10 AM Policy was amended and eventually revoked, the “let it burn '' policy took place in designated Wilderness areas, plus the economic costs and ecological legacy of prolonged suppression demanded the reintroduction of fire on landscapes. Additionally, the first computerized fire planning and budgeting tool was formulated in 1979 called the National Fire Management Analysis System (NFMAS). Other federal agencies began to adopt the NFMAS.

1990-2000s

Fire science about the legacy of suppression is clear: wildfire behavior will and has increased, especially in the western U.S. With this information and wildland fire ecological knowledge new programs have arisen. The first Federal Wildland Fire Management Policy of 1995 emphasized the natural role of fire in wildland management and recognized the need for prescribed fire and for allowing some lightning fires to burn, and not just in wilderness areas (Donovan 2005). However, in 1995 many found the Federal Fire Policy remained incomplete in many areas, especially those that involve collaboration, coordination, and integration across agency jurisdictions and across different disciplines. Furthermore, in the southeastern U.S. the National Interagency Prescribed Fire Training Center was established in 1998 providing maximum opportunities for state, federal, and tribal agencies to build skills and knowledge of prescribed fire use in the field.

2000 - present

In 2000, the National Fire Plan began a well-funded effort to, among other things, reduce hazardous forest fuels. The plan allows for prescribed burning but focuses on mechanical treatments, especially thinning. The Healthy Forest Restoration Act of 2003 expedited the planning and approval process for carrying out the work (Donovan 2005). As more people resided in western forested areas, there began an increasing concern about the Wildland Urban Interface (WUI). In 2009, the Federal Land Assistant, Management and Enhancement (FLAME) Act was passed in order to model the National Cohesive Wildland Fire Management Strategy (2009) entailing a collaborative process which mandates all and any government interagency, holistic approach to fire management. The strategies included restoring and maintaining fire resilient landscapes, creating fire-adapted communities, and a more efficient wildfire response.

Though the science, training, knowledge, and skills were available, initial attack fire

suppression practices continued and proved to be very costly across many spectrums. The U.S. General Accounting Office (GAO) estimated in 1999 that fuel reduction on national forest lands at high risk of fire could cost a total of $12 billion by the end of fiscal year 2015 (Busenburg 2004). Meanwhile, more numerous, severe, wildfires continued to burn destroying property, lives and ecosystems that are not resilient to intense wildfires.

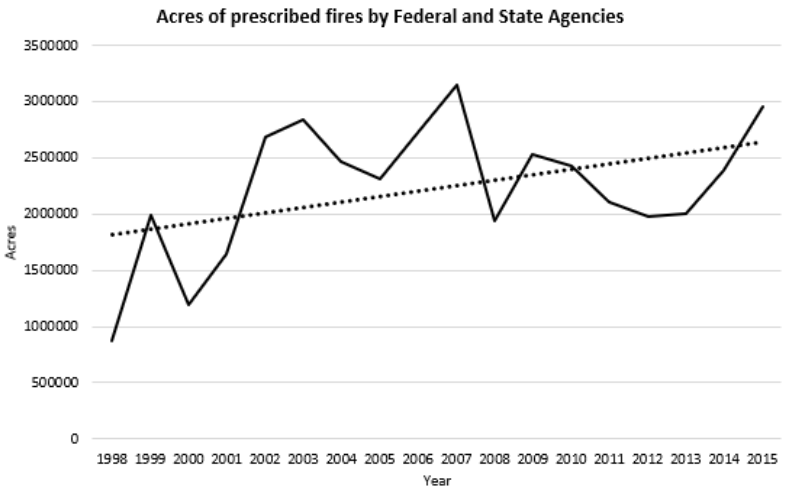

Figure 4. The acres of prescribed burns by State and Federal Agencies from 1998 to 2015.

An effective policy designed to counteract the escalating risk of severe wildfires will require sustained investments in both fire suppression and fuel-reduction programs. Wildfire risks will remain high until the heavy accumulations of fuel in American wildlands are reduced, and effective fuel reduction will require a major investment of resources over a period of many years (Busenburg 2004).

Science Based Adaptive Management

Adaptive management in forests is essential to reduce high intensity fires, high severity fires, and promotes healthy ecosystems that have more resilience to wildfires when they happen. According to Stankey et al (2005), “adaptive management is a central element of the Northwest Forest Plan and there is a need for an informed understanding of the key theories, concepts, and frameworks upon which it is founded.” The fact that there is a need for more forest managers that need help understanding the key theories, concepts, and frameworks of adaptive management is a huge issue and must be addressed in order to start implementing the key ideas behind the practice. It is because of this lack of understanding that has led to the continuation of past fire suppression practices that have led to forests becoming densely vegetated with compositional changes. Species that would otherwise be controlled by fire are able to spread freely, and fire resilient species are being crowded out which changes the resilience of the ecosystem.

Tree thinning is the process of tree removal in a stand to reduce tree density and tree-to-tree competition, and encouraging increased growth of fewer, high quality trees (WFPA, 2020). This not only allows for economic sustainability for local communities by giving logging opportunities but creates a disturbance regime that removes dense fuel loads in forest stands. This creates a more complex forest structure that allows for new growth, more complex horizontal and vertical structure composition, and more space for desired trees to grow. Horizontal and vertical structure is the caps in tree canopy, the understory growth, different generations of trees growing, and dead wood such as snags and logs that increase the functionality of an ecosystem. This goes a long way in protecting a forest by increasing its resilience to disease and insects as weaker trees are removed, crowding is lessened, and tree stressors are reduced. It is important to have this level of management gain community support by creating jobs, with increased thinning the economy is supported, and it creates good will for support on future projects. It also prepares the stand for future burn prescriptions as the heavy fuel load is removed and safer burns will be a cheaper management option in the long run.

Prescribed fire is one of the most effective management tools available to land managers but is underutilized due to constraints in social, economic, and administrative issues. It is because of these constraints that has caused the use of fire for management to be minimal and changing this is a slow process. “There are many benefits to using prescribed fire such as: reducing fuels loads, controlling low-quality undesirable competing vegetation, improving wildlife habitat, improving aesthetic values, increasing soil nutrients, managing insects and disease, improving access to timber operations, and improving forage for grazing opportunities (Maggard et al, 2018).” Frequent interval fires need to be added back into ecosystems that depended upon fires to control vegetation and fuel build up. Using prescribed fire will reduce management costs, keep forests ecosystems healthy, and reduce severe fire risk significantly. There are some downsides to prescribed burning as well, if done too frequently in an ecosystem that is adaptive to it, the ecosystem might not be able to recover fully, and the structure can change from historical norms. Below, Figure 6. shows how a southern pine forest ecosystem changes with no burn, a 1-year interval burn, a 2-year interval burn, and a 3-year interval burn. This is important because it shows how stand density changes from a no burn to different burn frequencies and how the forest structure and composition changes to different management prescriptions.

There is a need to focus on restoration efforts after fires as well, whether they are prescribed burns or wildfires one important management goal should be to replant desired species to enhance resilient structure and compositions of forests. With wildfires becoming more severe there needs to be plans to restore forests more readily after these burns when seed banks are depleted, and recovery would struggle. With the utilization of a combination of these management strategies, it will allow for more creative and effective forest management that better helps forest health, biodiversity,

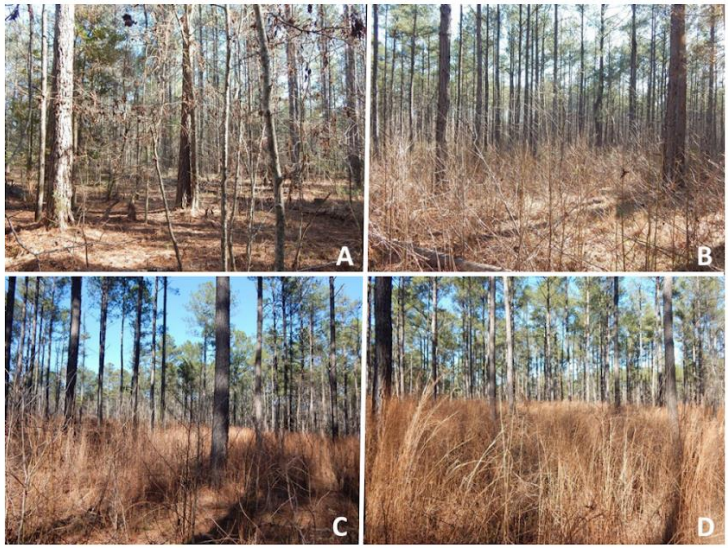

Figure 5. Structural characteristics of a southern pine forest from different intervals of prescribed burning: (A) control–no burn, (B) prescribed burn on a three-year interval, (C) prescribed burn on a two-year interval, and (D) prescribed burn on a one-year interval.

structure, and resilience for the future. All these strategies can fit into an adaptive management approach that can be adjusted for each ecosystem type to create the best plan for each. Although adaptive management can be beneficial for finding the best solution, there can be some downsides to adaptive management approaches as well, especially if there is a lack of information to make sound decisions on a specific ecosystem. Things like the overuse of certain approaches like prescribed burns (example: burn intervals too frequent), only learning through trial and error which can be more costly to fix in the future, changes to agency policies and missions is incredible hard and slow work, and the focus of management doesn’t address every issue in the ecosystem but only the most known. Even though there are disadvantages to adaptive management, it is still a very useful tool when it comes to using innovative solutions to help improve an ecosystem as more and more information is always becoming available to learn from and improve management practices.

Policy Recommendations

There needs to be changes in fire policy when it comes to smoke regulations, education and outreach, suppression costs, more prescribed fire personnel and adaptive management. Smoke regulations have been too restrictive to allow for higher uses of prescribed burning and has restricted land managers from treating more land each year. Education and outreach have been an area in fire suppression/management that has been severely lacking and is just now getting more attention brought to it, too many landowners in rural areas don't know any better or understand WUI around their homes. Suppression costs have gotten out of control in the Forest Service, and this has caused other departments to suffer from lack of funding as funds get pulled from their departments. Adaptive management is the main focus for policy recommendations, all of these different recommendations can fall under adaptive management to include new ways to approach forest management and implementing new ideas that work for each ecosystem. It needs to be implemented more consistently on different forests, there usually isn't enough diverse types of management being applied and forests are suffering from lack of natural disturbance regimes.

Smoke Regulations

Decreased smoke regulations to allow for more prescribed burning and an increased amount of air pollution allowed for a burn. Prescribed fire smoke is healthier than wildfire smoke because prescribed fires are conducted when air dispersal is good while wildland fire occurs when air dispersal is poor, smoke sits around and condensed in valley floors, and is heavier.

Education and Outreach

Education for private property owners on prescribed fire, Wildland Urban Interface, fire wising, and restoration. 30% of fire suppression costs go to the WUI area to protect homes that have no fire mitigation procedures done around the house, this can be changed with proper education and outreach programs to help private citizens protect their homes in future fire events. There needs to be a focus on programs that outreach private citizens, help fund Firewise programs, and educate older and younger generations on the importance of fire in ecosystem management. "defensible space," which is to prevent direct home ignition, prevent firebrands, and provide space for firefighters.

Suppression Costs

Reducing fire suppression costs by utilizing more prescribed burning and adaptive management practices. Initially, the cost for these policy changes will increase, but in the long run the suppression costs should start going down as management changes are made and practices are implemented. To get costs to go down there will need to be an implementation of different management tools, prescribed burning will reduce fire severity of wildland fires, and management steps are taken to ensure that forests are more resilient to fires making it easier to control. This can allow more money to go to fire mitigation and restoration which can help the issue of fire suppression on all levels as more preventative measures are taken and more restorative measures are implemented. With better forest management, less severe and intense fires will happen, which means less restoration is needed. Once the issue is addressed and adaptive management strategies are implemented, then fire suppression activities can start to decrease.

More Personnel for Prescribed Burning

There needs to be more people hired for prescribed burning to fulfill the needs of manpower on each forest. The main problem

with many offices in the Forest Service is there isn't enough time for the fire personnel in charge to complete their tasks, whether it is prescribed burning, burn piles, and any of their other duties. Either extend Forestry Technician duties to be included in tasks that are being postponed due to lack of personnel and time or add specific jobs that focus on the needed tasks.

Adaptive Management

Start implementing adaptive management to prescribe treatment to diverse forests to account for changing conditions and needs. Start educating forest managers on the key concepts of adaptive management to effectively implement the idea. Not every forest needs just one prescription type, whether it is prescribed fire or tree thinning, it is better if there are multiple methods used on a forest to get the best results and maintain ecosystem health. This will be one of the hardest recommendations to implement because making changes to agency policies, budget, and increasing demands is an incredibly slow process that takes time to negotiate and implement those changes. Changing the mission of an organization is not an easy task.

Conclusion

The history of wildland fire policy has a trend of failing the reality of complex issues surrounding fire and forest management. As knowledge, experience, and perspectives change, so do policies. The USDA Forest Service should incorporate policies reflecting the need for more forest restoration. In doing so, monies could be redirected from fire suppression to forest restoration actions such as fuels management and prescribed burning while using science based adaptive management.

The rise in population and the desire to live in rural places also increases the importance to better protect wildland urban interface zones. Through education, outreach, forest restoration, collaboration, and shared responsibility communities and governments can build fire resilient, fire resistant spaces that are "Firewise" and safe. By considering new policy recommendations, a lot of hard work, and time there could be major shifts towards less wildfire severity and damaging megafires. Thereby, in the long run, American tax dollars will be better utilized and not burned up in ridiculous costs by fire suppression practices which have proven to be unsuccessful through time.

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