WILDFIRE IMPACTS ON THE SOUTHERN PLAINS

Assessment Report
April 2019

FOCUSING ON THE RECENT 2016-2018 WILDFIRE EVENTS

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EXECUTIVE SUMMARY

Between 2016 and 2018, the U.S. Department of Agriculture (USDA) Southern Plains Climate Hub led a project to assess the impacts of the recent historic 2016 and 2018 wildfires on the Southern Plains. Titled the *2016-2018 Southern Plains Wildfire Assessment*, this project was coordinated with multiple agencies and organizations across the region including the Southern Climate Impacts Planning Program (SCIPP) a NOAA Regional Integrated Science and Assessment (RISA) team, University of Oklahoma's Center for Spatial Analysis, and the USDA Agricultural Research Service (ARS) Grazinglands Research Laboratory, among others. Elements of this project included three local stakeholder events across the affected region as well as a research component investigating characteristics of vegetation recovery within these areas. The findings of both are coupled in this assessment report to encourage the risk reduction measures of future wildfire recovery and preparedness efforts across the Southern Plains.

The stakeholder events included a large forum meeting in 2018, as well as both pre- and post-form local stakeholder listening sessions. The goals of these events were to learn about local impacts and recovery perspectives, discuss federal aid programs, encourage collaboration and communication amongst participants, assess past and future wildfire climatological conditions, and promote future agricultural and wildfire preparedness.

Common themes identified from these meetings include:

- Unprecedented wildfire events occurred in 2016 and 2018, and research reveals a trend towards less numbers of wildfires annually, but a larger amount burned when fire occurs.
- Meetings are most effectively held when created based on stakeholder interests, as revealed in the pre-forum listening session.
- Prescribed fire is an effective wildfire management strategy and aids in vegetation management, although it can carry varying opinions due to the fear that fire use can bring. Safe practice of this technique requires early preparedness as well as the collaboration through local avenues such as Prescribed Burn Associations.
- Transparency of funding guidelines and producer needs can increase and improve dialogue to recognize restrictions of federal programs, the needs of producers and the barriers to using funding.
- Increases in communication and collaborations amongst local, state and federal levels, both within and across state lines, will aid in preparedness and risk reduction efforts.
- It is encouraged to use a self-reliant and proactive approach towards wildfire events, in addition to government assistance, as situations can occur suddenly and initially out of reach to external assistance.

EXECUTIVE SUMMARY

- Communities are very supportive of each other and continue to host pro-active meetings, often consisting of volunteer efforts.
- Years with plentiful rainfall in the spring and late summer along with mild temperatures, often lead to the growth of large fuel amounts which are then available for fuel during the onset of later droughts.
- Water availability is one of the largest impacts of drought and post-forum meetings revealed that efforts to reduce long-term drought impacts included increasing education on the challenges of predicting and monitoring, address radar and instrumentation gaps, and leverage existing programs to expand coverage and new tools.

In addition to the outreach events, research on the occurrence and characteristics of vegetation recovery across the Southern Plains was analyzed. Two studies were initiated, one that examined the recovery of burned versus unburned areas and a second on the frequency of fire in the region.

The study of the fire sites examined three large fire complexes in 2016 and 2017 in the northeastern Texas Panhandle, northern Oklahoma, and southern Kansas. All three cases showed an expected drop in vegetation water content and biomass in the burned areas immediately after the fire. After about 6-8 weeks, though, the burned areas were nearly indistinguishable from similar, nearby, unburned areas. Furthermore, biomass during the summer following the fires was greater in the burned areas. The more rapid than expected recovery of severely burned areas suggested that cattle may be returned to such areas sooner than is typically advised.

The study of fire frequency covered fire events in Kansas, Oklahoma, and Texas from 2000-2017. The study used detection of active fires from MODIS satellite data and plotted on 1-kilometer resolution. Results showed that fires were more common in the eastern part of the region, with the number and frequency of fires dominated by prescribed burns in the Flint Hills in Kansas and northeastern Oklahoma during the springtime. The analysis showed that even though fire frequency was more common in the east, the potential size of wildfires is much greater across western parts of the states. Extensive wildfires in 2006, 2016, and 2017 were also detected in the climatology dataset.

INTRODUCTION

Devastating wildfire across the Southern Plains during 2016 and 2018 resulted in significant economic and environmental losses, with the agricultural sector among those most affected. In order to better ascertain future risk to agricultural systems in this region from wildfires, following these events, the USDA Southern Plains Climate Hub coordinated a project with the NOAA RISA Southern Climate Impacts Planning Program (SCIPP), the University of Oklahoma's Center for Spatial Analysis and the USDA ARS Grazinglands Research Laboratory, titled *the 2016-2018 Southern Plains Wildfire Assessment.* This project assessed the impact of the 2016-2018 fires, the past and projected influence of climate variability and change on wildfire occurrence, and the linkages to socioeconomic and environmental decision-making.

This project also included collaborations with additional organizations including the Redlands Community College and the National Integrated Drought Information System. The interactions and efforts amongst these organizations followed the project's four objectives below:

- *Review the meteorological, climatological, and land use causes of the 2016-2018 wildfires and assess future projections of wildfire occurrence in the region.*
- *Catalog the regional agricultural impacts of the wildfires, as well as USDA, federal agency, and other organizational responses.*
- *Identify and highlight indicators of post-fire recovery at community, agricultural system, and/or ecological scales.*
- *Determine lessons learned, including future risk of and vulnerability to wildfire occurrence and opportunities to inform and improve agricultural preparedness.*

The original geographical focus of the assessment was focused on regions impacted by the Anderson Creek (2016) and NW Oklahoma Fire Complex (2017) wildfires, with both fires beginning in Oklahoma and spreading into Kansas. However, during the initial stages of the project, it was found that the assessment should be expanded to include the surrounding regions impacted by these fires, notably Texas. Therefore, the region based on this assessment is on the three-state region of Oklahoma, Kansas and Texas. Additionally, several locally impacted cities were selected as host locations for on-site events held during the span of this project. The most prominent event was the 2018 Southern Plains Wildfire Forum held in Beaver, OK. Additional supplementary events included a pre-forum meeting held in Woodward, OK, a follow-up listening session held in Goodwell, OK, as well as others. The targeted individuals of these events included locally affected agricultural producers within the three-state region, key agricultural service providers, state agencies and local officials. This assessment is a compilation of the materials, outcomes and lessons learned during the duration of this project. This report also includes the summarized research findings that complements the key outcomes of the project.

PRE-FORUM MEETING / FORUM MOTIVATION

Motivation behind the Forum

The 2018 Southern Plains Wildfire Forum was preceded by an introductory meeting held in Northwest Oklahoma during December of 2017, in which a handful of local individuals were invited to discuss topics and questions of interest to outline the upcoming forum's agenda. Results of these discussions directly impacted the topics and presenters chosen for the forum and included topics such as weather conditions associated with wildfire and future implications, impact and recovery perspectives, management strategies to reduce future wildfire risk, and federal aid programs. Additionally, as the participants were heavily interested in an interactive forum with local perspectives on the topics above, such as having a prescribed fire panel, the forum agenda was adjusted to accommodate this desired content. Previous agenda items that were removed to make room for such panels included the supplementary research being conducted from the University of Oklahoma on vegetation recovery following wildfires. Therefore, a section on the goals, results and findings of this research has been included at the end of this assessment report.

Of the topics suggested at the pre-forum meeting, the discussions of weather conditions associated with wildfire and expectations for the upcoming fire season were especially concentrated on and serve as a great explanation of the motivation behind the upcoming forum. Participants were interested in learning more about the science behind wildfire formation, the impacts of the El Nino Southern Oscillation, wildfire variability, and the weather variables conducive for wildfire. In order to support a broader depth of understanding on the motivation behind this project as well as on the content described in this assessment, these topics are explained in further detail below. A more in-depth explanation of this information was also presented at the February Forum.

WILDFIRE FORMATION

The vulnerability of wildfire formation can be summarized by three primary factors highlighted in Figure 1: human interaction with the environment (ignition), land-use changes (fuel), and climate and weather conditions. Although these three factors are intertwined and are often times complex, generally the increase of ignition sources and fuel supply, along with the appropriate

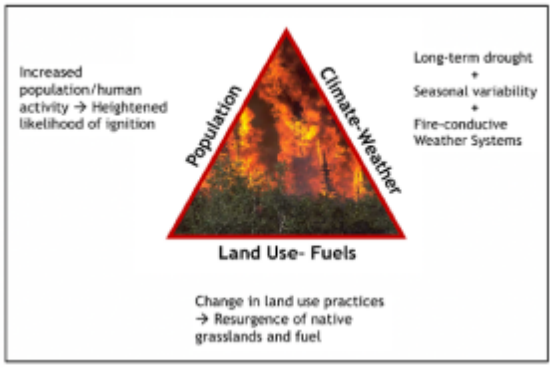

Figure 1: The three primary factors influencing wildfire formation.

meteorological environment, lead to the most conducive wildfire conditions.

The Southern Great Plains has high vulnerability in all three of these factors which throughout history has made the region susceptible to fire and undoubtedly shaped the land. The largest source of wildfire ignition in the region is from the increased human interaction with the environment. The region has experienced an increased vulnerability from human activity in recent decades due to infrastructure development, notably train tracks, vehicles, and the most common ignitor, power lines.

As land use changes with human interaction, the management practices of the land also tend to change. Prescribed burns (a controlled, intentional wildfire for land management and risk reduction practices) were performed on Oklahoma lands dating back before early settlement, however, there has been a decrease in performance since the early 1900's. The reduction of these burns has allowed an increase of native vegetation growth and invasive species (such as Eastern Red Cedar which have large diameters and often create high intensity fires) and has in return increased the vegetative fuels available for burning. The final factor, meteorological and climatological ingredients, is one of the most important factors that influence the onset, behavior and fate of fires. Among short-term weather ingredients, the most significant indices for wildfire conditions are low relative humidity (dries fuel), wind speed and direction (can drastically impact fire containment), warm temperatures (increases evapotranspiration) and a lack of precipitation (reduces moisture of soil and dead fuel, and influences drought). It is characteristic of the Southern Great Plains to experience a flux of values for each of these indices, and when favorable conditions occur together, this leads to the most at-risk days for wildfire.

WILDFIRE INTENSITY

Wildfire intensity throughout the Southern Great Plains varies based on these factors and leads to altering intensities of wildfire seasons, with the highest number of wildfires occurring between January and April and the highest total acres burned occurring in March and April. An analysis from the Oklahoma Climatological Survey conducted on these variables over the period from 2002 to 2017 reveal that the 2016 and 2017 wildfires burned more acres in Oklahoma and Kansas than any other year during that time period. Additionally, no trend was found in an increasing annual wildfire count, therefore signifying a trend for less numbers of wildfires annually, but a larger amount burned when fire occurs.

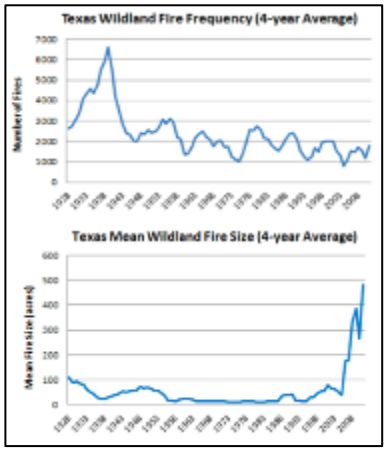

Figure 2: Texas' 4-year mean wildland fire frequency (top) and size (bottom) for 1925-2011. (Source: Todd Linley, NWS Norman)

These findings match the trends of the U.S. wildfire data between 1980 and 2015 and a regional study on Texas between 1925 and 2011, with the latter represented in Figure 2. Both of these findings show a decrease in annual frequency of wildfires but an increase in acreage burned.

IMPACTS OF THE EL NINO SOUTHERN OSCILLATION

The El Niño Southern Oscillation (ENSO) is defined as the warm (El Niño) and cold (La Niña) phases of the Pacific's sea surface temperatures that affect the position of the jet stream every few years. For the Southern Great Plains, La Niña usually leads to warm and dry conditions, which favors a more conducive fire environment by promoting higher temperatures and lower relative humidity. These impacts can often be felt most during winter, although effects can stretch from fall until spring.

During the late winter of 2018 when this information was provided at the Forum, the region was in a strengthening La Niña phase with warmer and drier conditions expected to continue into spring. As mentioned in the *Formation of Wildfires* section above, these variables are classified as two of the most significant indices for wildfire formation and they often correlate to a higher potential for ignition, fire spread, and large fire events (Vose et al. 2017). ENSO is just one example of the long-term climatological drivers of fire, with the other two consisting of dipole events (when a region experiences extremely dry to extremely wet conditions in one year) and drought. These three drivers all influence seasonal fluctuations of wet to dry periods and can help act as predictors of wildfire.

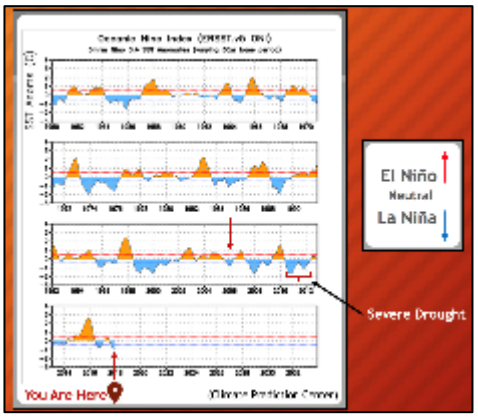

Figure 3: The Oceanic Niño Index represents signal changes between El Niño, Neutral and La Niña phases from 1950-present. Conditions as of February 2018 revealed a strengthening La Niña into spring.

WEATHER VARIABLES CONDUCIVE FOR WILDFIRES

Associated with the climatological drivers that promote fire seasons, the set of weather variables that influences any given wildfire development include *low relative humidity, high winds, warm temperatures,* and *low precipitation.* The analysis of these variables across the Southern Great Plains over the last few decades show that there are thresholds for each variable that lead to the most conducive fire seasons. For instance, findings show that there is a strong correlation

Weather Variable	Value	Fire Danger Expected
Relative Humidity	35- 85%	Increasing fire danger as relative humidity decreases
	20- 35%	Containment becomes difficult; quick ignition; spot fires increase
	< 20%	Extreme fire behavior; spot fires frequent
Wind Speed	> 20 mph	Higher speeds cause increased fire danger and spread rates; winds and gusts over 20 mph become increasingly problematic
Temperature		In general, higher temperatures increase fire danger

Figure 4: Established wildfire thresholds for wind speed, temperature and relative humidity. (Source: OK Fire)

between years with a high number of low relative humidity days (less than 35%) and severe fire years. Additionally, years consisting of well above average spring temperatures and a recent shift from above average to below average precipitation, correlate strongly with intense wildfire years. Ultimately, the years that tend to experience the most devastating fire seasons consist of all four of these conditions, such as what occurred in the spring of 2016 and 2017.

RECENT EXTREME WILDFIRE EVENTS

One of the most devastating recent Southern Great Plains wildfire outbreaks occurred on March 6, 2017 across portions of western Kansas and the Panhandles of Oklahoma and Texas. Following

Figure 5: Firefighters from across Kansas and Oklahoma battle a wildfire near Protection, Kansas, Monday, March 6, 2017 (*Bo Rader/ The Wichita Eagle via AP)* (left), and the GOES-16 satellite image on March 6, 2017 (right).

the event in 2017, the National Weather Service (NWS) revealed that 32 major fires occurred and nearly 1.3 million acres burned. Further, a case study by Lindley (2018) explained that the ingredients of this outbreak followed high intensities of the three factors listed above and was described as "the perfect fire storm".

Lindley further explained that this storm was unique in that it was an occurrence of multiple megafires, defined as fires burning over 100,000 acres (NWS 2017), and resulted in many high intensity, high damaging fires. There have only been 10 megafires documented over the Southern Great Plains in the modern era, which makes the 32 megafires during this event unprecedented. The most known megafire, the Starbuck fire, occurred on the border of Oklahoma and Kansas and burned over 660,000 acres (NWS 2017). The outbreak of these megafires drastically impacted individuals, property and livestock, and exhausted resources from across the region. Strong local support was prevalent across the communities and bordering states, and various neighboring response personnel including firefighters, emergency managers, and burn associations offered their assistance in combating the events.

2018 SOUTHERN PLAINS WILDFIRE FORUM

Following the pre-forum meeting in Woodward and along with the insight that the recent large wildfires in 2017 led to strong local support across communities between the three states, in February of 2018 the *2018 Southern Plains Wildfire Forum* was held as an opportunity to build upon these local efforts and aid in the efforts to increase preparedness and resiliency to wildfires. Located in Beaver, OK, this event was hosted by the USDA Southern Plains Climate Hub, SCIPP, and the Redlands Community College.

This meeting brought together over 100 local participants across western Oklahoma, western Kansas, and the panhandle of Texas, with the goal of facilitating the collaboration of participants and increasing awareness and preparation of wildfire resiliency efforts. Discussion focused on the recent 2017 wildfire events and provided participants the opportunity to share experiences and identify the impacts, challenges, lessons learned, and opportunities for collaborations and risk reduction strategies regarding future wildfire events.

Figure 6: Over 100 participants across OK, KS and TX participated in the 2018 Wildfire Forum in Beaver, OK on February 13, 2018.

The forum in February 2018 consisted of both presentations and panel discussions covering the topics learned from the pre-forum meeting such as weather conditions associated with wildfire and future implications, impact and recovery perspectives, management strategies to reduce future wildfire risk, and federal aid regulations, as well as discussing the benefits and safe practices of using prescribed burns as a management strategy, the importance and benefits of joining a local burn association, the importance of self-reliance, and the need to increase transparency and communication across various local and state entities. Additionally, a panel consisting of federal program representatives encouraged open dialogue of sharing perspectives on funding topics between the local and federal levels. This section summarizes the meeting's presentations, discussions, and outcomes.

PRESENTATION SUMMARIES

The meeting consisted of four presentations. Each provided content on various aspects of wildfire including the weather and climate variables conducive for wildfire formation, the upcoming seasonal wildfire outlook, and management practice guidelines for conducting prescribed burns, patch-burn grazing and reducing soil erosion. Each of the four presentations are summarized below.

WEATHER AND CLIMATE FIRE INDICATORS AND THE MARCH 6, 2017 OUTBREAK

This presentation introduced the weather and climate indicators of fire and reviewed a case study of the March 2017 outbreak. The contents of this presentation are described in the *Motivation Behind the Meeting* section of this report (pages 2 and 3).

CONSIDERATIONS FOR CONDUCTING PRESCRIBED BURNS

The use of fire as a land management practice dates back to the Native Americans. Since the 1700's fire occurred frequently and helped shape the landscape. Various photos of these landscapes were shown, revealing the lack of trees during this time due to the use of fire. It was then explained how the concern of liability arose as development increased. Overtime, the suppression of fire management led to the woody invasion growth of species such as Juniper trees, now one of the most invasive species in the region. It was then discussed how liability is often viewed as a perceived risk, inhibiting the use of prescribed fire. However, it was shown that liability should be viewed as an acceptable risk, such as the risk taken when driving an automobile.

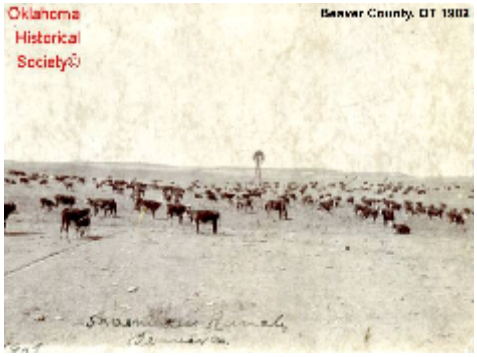

Figure 7: An example of the treeless landscape in Beaver County, OK in 1902.

This presentation urged individuals to acknowledge the facts of prescribed fire use and accept the risk, as it is the best financial option in wildfire management. Further, it was discussed that the most important reason why prescribed fire should be used is because fire is a part of the natural ecological system, third in line behind sunlight and rainfall. It was revealed how the Southern Great Plains is in a "fire drought" and that prescribed fire needs to be incorporated to reduce the risk of future events. The presentation ended with providing the proper conditions and guidelines for conducting prescribed fire.

MANAGEMENT STRATEGIES I: PATCH-BURN GRAZING

Patch-burn grazing is a specific prescribed fire management practice. This presentation described the details of what patch-burn grazing is and how it is performed. First, an overview of how grasslands work and interact with fire was given. Over a century ago, fire and grazing used to

Figure 8: An example of the patch-burn grazing technique.

interact often, but now they seldom do. The term heterogeneity management was mentioned often and was explained as the variability of the rangelands and that fire and grazing are an important key to creating this landscape. Fire and grazing are most productive in creating heterogeneity through the practice of patch-burn grazing. The process of how it is performed was then explained, dividing up the land in patches and burning a different patch each summer and spring, constantly for 6 months.

A recent study was then shared where GPS units were placed on cattle and observed if patch-burn grazing altered their behavior. Results showed that the animals congregated on areas of previously burned patches, as they like to graze on short, regrowth grass. This finding revealed that patch burn grazing can also help assist in protecting cattle during wildfire events. The burned portion of the rangeland is where the cattle will congregate to, with a secondary impact of protecting them from the flames. Additionally, as portions of the land are burned, this will reduce the amount of fuel a wildfire may spread to. The presentation concluded with some possible limiting factors, such as the necessity to couple the practice with good land management and knowledge of the quantity of animals.

MANAGEMENT STRATEGIES II: THE EFFECTS OF FIRE ON SOIL EROSION RISK

The final presentation focused on a tangential problem with prescribed fire, addressing the question of how prescribed fire impacts soil erosion risk. It was explained that this management practice can increase the risk of soil erosion by altering the soil characteristics resulting from the reduction of canopy and ground cover. The highest window for impact occurs right after a fire, especially if the grasslands have transitioned into a woodland. Factors increasing the risk for erosion were discussed and included the type and health of the vegetation, the timing of the fire, and the steepness of the landscape. The presentation concluded with the findings that vegetation of good health, less sandy soil, gentle slopes and good post-fire conditions will reduce the risk of erosion.

Figure 9: Sandy soils are most likely to form after fire in woody communities, especially if the leaves are waxy.

PANEL DISCUSSION OUTCOMES

Overview

The workshop provided an opportunity for open dialogue between participants in an effort to increase awareness of wildfire formation, and the use of management strategies and coordination efforts moving forward. This interaction ultimately occurred across two groups: (1) between a variety of local and state individuals and (2) between local individuals and federal representatives. The dialogue took place during open discussion throughout the presentations, as well as from three open panel discussions. The diversity of individuals within these discussions encouraged a broad range of perspectives to learn about and discuss wildfire issues and opportunities.

Panel Discussion Outcomes

The majority of the forum's discussion focused on three interactive panel session topics, each of which is explained in more detail below. The topics were:

- Local Perspectives on Prescribed Fire Use
- Technical Assistance I: Program Perspectives
- Technical Assistance II: Risk Reduction, Tools and Strategies

Each panel consisted of an opening statement of each panelist's experience on the respective topic, followed by an open dialogue of questions and answers from the audience. It was through these panels that the attendees could share various perspectives and insight on wildfire impact and management issues, across the various levels of local, state and federal individuals.

Panel 1: Local Perspectives on Prescribed Fire Use

The first panel discussion occurred following the morning presentation *Considerations for Conducting Prescribed Burns*. This panel, titled *Local Perspectives on Prescribed Fire Use*, included perspectives and lessons learned from four local land managers across southwest Kansas who were impacted by the recent wildfires. Drawing from Dr. Weir's presentation, this management practice can bring upon varying perspectives and opinions. The panelists shed light to this fact and acknowledged the fear that wildfires can bring, and that learning the safe practice of prescribed burning can reduce this fear and lead to a healthy risk reduction method. Topics that were focused on during this session included prescribed burn's role in vegetation management, preparation techniques and collaborative efforts.

PANEL DISCUSSION OUTCOMES

VEGETATION MANAGEMENT

It was discussed how land management practices, including grazing management and prescribed fire, can positively help grass regrowth during recovery. One panelist mentioned that following the 2016 fires, those who engaged in such preparedness practices recovered at a faster rate, and with taller grass growth. Additionally, prescribed fire can be used to eliminate or control the spreading of invasive species such as Cedar trees, as they are often the source of fast-spreading fires. However, it was noted that the use of this practice can become prohibited due to drought conditions. Additionally, the audience discussed the misperception that summer is an unfitting time to conduct burns, where in fact burns performed during this time often include greenery (from spring rain) mixed with dry vegetation, reducing the ignition potential.

PREPAREDNESS TECHNIQUES

It was conveyed across all panelists that preparedness is key to reducing one's impact to future wildfires. It was stressed that in addition to the importance of theorizing a drought and preparedness plan for wildfire, it is necessary to have the specific contents of the plan written down. Contents of the plan should include items such as mapping out predetermined escape routes and areas of refuge. It was noted that prescribed burn spots can help identify and harbor such locations. For example, one panelist moved cattle over these regions and contributed that to their safety during the duration of the fires (also associated with patch-burn grazing).

COLLABORATIVE EFFORTS

The final topic of discussion amongst the panelists was the importance of collaborating with others, as local knowledge is incredibly valuable. Prescribed Burn Associations were noted as a valued opportunity to both learn and assist in wildfire prevention measures. As these groups are often formed based on location, they frequently consist of neighbors and nearby individuals who help increase local preparedness by teaching others based on experience or knowledge. This can include strategies and methods for conducting prescribed burns, proper equipment uses, identification and strategies to deal with various types of fires (i.e. flank or head fires) and best practices on how to save your home, equipment and livestock. Additionally, individuals within each group, as well as other nearby associations, commonly assist in battling fires, saving property and lives, and putting out flames. It was of interest from the audience to further discuss examples of such firefighting battle techniques and included an explanation of removable equipment on trucks.

PANEL DISCUSSION OUTCOMES

Panel 2: Technical Assistance I: Program Perspectives

The second panel group discussion shifted from local fire use perspectives to external, program level perspectives. Panel representatives from USDA federal programs focused on fire prevention and management included the Oklahoma Farm Service Agency, both the Oklahoma and Kansas Natural Resources Conservation Services, as well as Oklahoma's Cooperative Extension Service. The purpose of this discussion was to increase the communication between local and federal individuals on topics such as federal program services and regulations, and local issues and perspectives pertaining to the recent 2016-2017 wildfires. Topics of discussion included regulation matters and potential future modifications.

REGULATORY MATTERS

A vast majority of this session's discussion was based on increasing the transparency between federal regulation guidelines and producer needs. Producer attendees explained how often times the funding application guidelines are not well representative of their primary needs. One example is how the current guidelines do not thoroughly cover the support requests for one of the region's most threatened species, the Lesser Prairie Chicken. As each panelist represents a larger federal program, it was expressed that their managing duties on a local level are regulated federally, therefore there is limited ability to alter guidelines based on request. However, the panelists conveyed their understanding of the producer's interests and shared examples of their managing boundaries. This included the limitation to appropriate funds only in the spring, a lack of funding, and a lack of control over absentee land. Open dialogue allowed participants to recognize the restrictions of federal programs, the needs of producers and the barriers to using funding, as well as increased the communication between the two levels.

FUTURE MODIFICATIONS

Efforts were discussed on how to increase the utilization of funds in the future including addressing legislature, increasing the awareness of regulations, and expanding the knowledge of financial coverage (federal versus producer) for all current program offerings. For example, it was discussed that federal support covers 75 percent of new fencing, and also some producers received labor donations without knowing it is not eligible for reimbursement. Question and answer topics focused on clarifying the regulations for receiving financial support post event. Producers learned that for both property and livestock, documentation is needed of pre-disaster conditions. Examples of this include describing the correct registration guidelines for cattle (having documentation of ownership and quantity) and fences (locations and loan rates).

PANEL DISCUSSION OUTCOMES

Panel 3: Technical Assistance II: Risk Reduction, Tools & Strategies

The third and final group discussion focused on individually based strategies for wildfire management. This panel consisted of emergency managers from both Kansas and Oklahoma, an Oklahoma private land owner, and the Oklahoma Forestry Services, all who brought knowledge about tools and strategies that one can use at the independent, local level to help reduce future wildfire risk. Topics included developing self-reliance, learning about individual programs and tools, increasing cooperative efforts, and focusing on life safety.

SELF-RELIANCE

In addition to federal and local government assistance, this panel highlighted that individuals need to take a self-reliant and proactive approach to events, as some situations occur quickly and aren't able to receive external assistance. Examples of proactive measures reflected the insight shared during the prescribed burn panel and included topics such as burning and clearing brush, purchasing appropriate equipment, and having a plan for both people and livestock. Panelists encouraged that at most times an individual can perform these proactive measures and easily reduce wildfire risk. For instance, removing dead fuel loads prior to adverse wildfire conditions will reduce the risk of fire spreading towards a building or pasture.

INDIVIDUAL PROGRAMS AND TOOLS

Various programs were shared that support this self-reliant approach, as it increases both individual safety and supports local responder efforts. The Oklahoma Forestry Services offer two programs to promote individual preparedness. They are the "Ready, Set, Go" Program and the Firewise Program.

The "Ready, Set, Go" Program outlines the steps individuals living in high risk areas need to take to best prepare themselves against future fires.

The Firewise Program educates local leaders within the Wildland Urban Interface on how to proactively protect communities.

Additionally, prescribed burns were highlighted again as a positive land managing technique and panelists encouraged the movement for more fire departments to identify the proactive and preventative rewards to allow prescribed burning

PANEL DISCUSSION OUTCOMES

MULTI-LEVEL COMMUNICATION

It was expressed that cooperative efforts for fighting wildfires are ongoing across state lines. Equipment, resources, and man power are shared frequently between Kansas, Oklahoma and Texas. Recent wildfire events have improved the communication and response capabilities between these three states and moving forward they have identified the main goals of furthering coordination, cooperation and communication at both the state and local levels.

Local level communication is very valuable in improving first responder efforts and communication and trust is the key to improving these relationships. One panelist mentioned an incident where firefighters were trapped between fire lines due to a lack of communication from local groups of what locations they were lighting fires. Examples of proposed local actions are to increase the communication when lighting fires, as well as having farmers and ranchers provide a map of their property or marking gates to help fire fighters during an active event, improving life safety and reducing the cutting of fence lines. Also, communicating between industries and communities to address issues, such as railroad sparks, can potentially prevent future ignition of wildfire.

PRIORITIZE LIFE SAFETY

It was expressed that the first priority in wildfire preparedness should always be life safety. As the panel session came to a close, the discussions about a self-reliant approach, using programs to increase individual preparedness, and increasing cooperative efforts all converged to emphasis the importance of life safety. Additionally, it was noted that to assist in the safety of others, outside help such as individuals volunteering their time or resources often occur. Panelists concluded that the most important objective for individuals or first responders is that everyone goes home.

ACTIVITIES FOLLOWING THE FORUM

As the trend for larger and more intense wildfire events continue, this event was one way to assist locals in their planning efforts to reduce risk for future wildfire events. Furthermore, the forum was a very timely topic as the 2018 wildfire season was historic as factors such as fuel source (from an abundance of dormant grasses and red cedars encroached within them) and dry, warm and windy meteorological conditions were abundant across the region. Wildfires during the week of April 9th and April 16th included two megafires (resembling the ones that occurred in 2016 and 2017) that damaged over 373,000 acres across southwestern Kansas and the OK and TX Panhandles, especially in regions participants represented at the forum. Along with these events the topics presented and discussed during the forum fostered the development of new relationships and expanded discussions and have led to several short-term activities that have occurred following the forum. They are described below.

NW REGIONAL TASK FORCE MEETING

Following the Forum, Oklahoma's assistant state climatologist was invited by Beaver's Emergency Manager and Slapout's Fire Chief, participants of the Forum, to the NW Regional Taskforce Meeting in Beaver, Oklahoma. The meeting was on the one-year anniversary of the March 6, 2017 fire outbreaks, which included the Starbuck and Perryton Fires. Prior to the meeting, Oklahoma's assistant state climatologist was given a tour of the region burned during the March 6, 2017 Starbuck fire and was shown how the land was impacted by these fires and how it was becoming conducive for future fires due to drought, regrowth, and dead fuel. Additionally, the time was spent meeting a variety of firefighters, farmers, ranchers and land managers with discussion centered around impacts and their personal experiences with firefighting and fire management in the Panhandle.

Figure 10: Landscape photo of Beaver, OK in March 2018 during the tour. This region burnt badly from wildfires in 2017 and is still recovering. Regrowth can be seen throughout the area.

The meeting occurred in the evening and consisted of both individual guest speakers and panel discussions, with an audience of over 50 firefighters/managers throughout the region. Topics covered included health and safety in fighting fires, the use of heavy equipment, working with outside private resources, and experiences and lessons learned from previous fire outbreaks. The information shared during these meetings continued to improve the region's resiliency and preparedness efforts in combating the current and future wildfire events.

ACTIVITIES FOLLOWING THE FORUM

PANHANDLE STAKEHOLDER LISTENING SESSION

Following the Forum, the 2018 spring season continued to consist of extreme drought conditions and spawned a new project from the USDA National Institute of Food and Agriculture titled the *Ogallala Water Coordinated Agriculture Project*. As the Southern Plains highly depends on the water from the Ogallala Aquifer, this project focuses on developing and sharing science-based information to promote best-management practices of using this water across the region. To assist with this project and to continue the discussion and relationships made within the Southern Plains, there was an event held on May 22, 2018 in Goodwell, OK to discuss such topics. The event, funded through the USDA National Institute of Food and Agriculture, included roughly 12 producer and agricultural professionals representing various USDA programs, conservation and groundwater districts, as well as local ranchers.

With a structure similar to the Woodward pre-forum event, the day consisted of discussions revolving around the current drought status of the region and the impacts of water availability, as well as proposed outcomes from participants on how the government programs can better assist locals with increasing drought and water resiliency in the Southern Plains.

The session began with Oklahoma's State Climatologist providing an explanation of the current worsening drought conditions and the expected continued trend towards La Niña. It was reminded how drought is impacted by both precipitation and temperature and that if the region doesn't experience precipitation soon (May is the wettest month) then drought will continue to intensify. Participants revealed that the High Plains commonly experiences rapid shifts between wet and dry cycles, and that these cycles consist of some unique characteristics often only understood by locals. Due to the climatological conditions in this region, for example, an inch of rain during drought conditions will disappear within a few days due to the high wind and evaporative rates of desiccated soils. Building upon what was explained at the February Forum, it was then discussed how years (such as 2018) with plentiful rainfall in the spring and late summer, and mild temperatures, lead to large fuel amounts available for fire during the onset of drought.

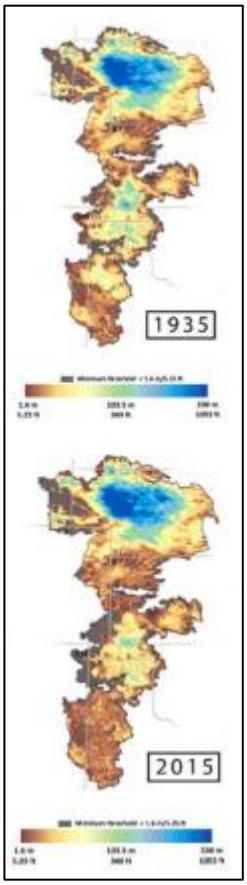

Figure 11: Saturated thickness snapshots of the Ogallala Aquifer in 1935 (top) and 2015 (bottom). *Source: Lacey Moore via Haacker et al. 2016.*

Further, the state of the science for future wildfire conditions revealed a lack in confidence in predictions, however, looking at past events, trends show that extremes are getting more intense for both dry periods and

heavy rainfall patterns. These increases in extremes, along with population increases, will continue to place a threat to infrastructure and agricultural practices and further stresses the importance of improving risk reduction strategies.

Discussion then transitioned to one of the largest impacts of droughts, the lack of water availability. Participants shared what types of information and programs would be beneficial in improving long-term drought risk in the Southern Plains and the day concluded with recommendations such as better education on the challenges of predicting and monitoring, to address radar and instrumentation gaps, and leverage existing programs to expand coverage and new tools.

FUTURE LOCAL TOWN HALL EVENTS

Expanding on the local perspectives of the 2018 Southern Plains Wildfire Forum, three future townhall events will be held, each at a local venue of the three states impacted (OK, KS and TX). These meetings will provide a more in-depth view of how locals are impacted by wildfire and other extreme events, and what types of tools, information and assistance is needed to aid in reducing future risk.

RESEARCH CORRELATIONS

Related research projects were conducted to assess physical changes in frequency and impacts of large fires. One study involved an examination of burned and unburned areas during three large wildfire events – Anderson Creek (2016), Starbuck (2017), and Perryton (2017). All three cases showed an expected drop in vegetation water content and biomass in the burned areas immediately after the fire; however after about 6-8 weeks, the burned and unburned areas were nearly indistinguishable. Furthermore, biomass during the summer following the fires was greater in the burned areas.

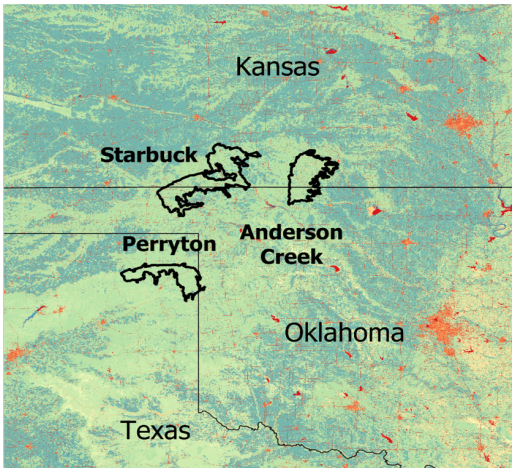

Figure 12: Locations of large wildfires used in the ecological impacts study. Anderson Creek occurred March 23-27, 2016; Starbuck March 6-12, 2017; and Perryton March 6-12, 2017.

In the second study, a climatology of fire events was created for Kansas, Oklahoma, and Texas. The number and frequency of fires was dominated by prescribed burns in the Flint Hills in Kansas and northeastern Oklahoma during the springtime, but extensive wildfires in 2006, 2016, and 2017 were also detected.

ECOLOGICAL IMPACTS AND RECOVERY

The 2016 and 2017 spring fire seasons in the southern Great Plains were extremely active, with the three megafires examined in this study burning a combined total of about 1.2 million acres of mostly pasture and grazing land. In addition to killing thousands of head of cattle and hogs, the three fires were directly responsible for the deaths of two people. As fires, over the past century, have become less frequent but more intense, it is important to understand the ecological conditions that follow high-intensity fires. The decreasing fire return interval leads to many farmers and ranchers being increasingly unsure about best practices to restore burned land to maximum productivity. The goal of this study was to shed some light on ecological recovery rates using remotely sensed (satellite) products that are freely available online.

We examined the post-wildfire biomass recovery characteristics using the Land Surface Water Index (LSWI) to measure liquid water in vegetation and a derivative of Gross Primary Productivity (GPP), a proxy for biomass amount. Burned and nearby unburned sites were selected for direct comparison. We found that the fire's immediate effects were best shown using LSWI, and a moisture deficit was seen in the burned areas of all three fires until

approximately early June. In the summer following each fire, almost all burned areas had a consistently higher GPP than their paired unburned areas.

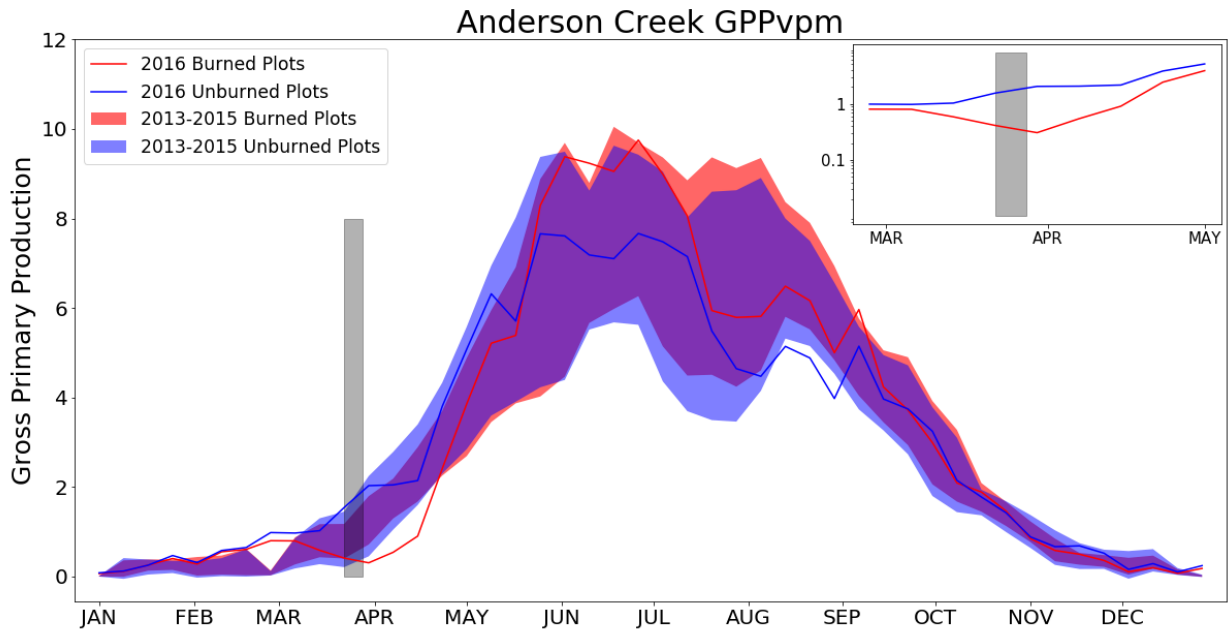

Figure 13: Gross Primary Production (biomass) in the area burned by the Anderson Creek fire in 2016. The shaded areas show the+/-1 standard deviation of GPP from the average in the 3 years preceding the fire for areas that were burned in 2016 (red) and unburned (blue). Lines indicate GPP values in 2016 for the burned (red line) and unburned (blue line) areas. The burned (red) line shows a sharp decrease in GPP following the fire during the Spring, but by summer it surpasses the unburned (blue) line, indicating more productive vegetation in the areas that were affected by the fire.

We believe these findings have a few practical implications: First, that dead vegetation is killed off and new forage growth is shown to be more plentiful and nutritious in post-fire grassland environments gives yet another case for strategic springtime prescribed burning. For example, many ranchers affected by the Anderson Creek fire noted that the death of red cedar trees in their pastures led to plentiful amounts of water in creeks the following summer. Second, LSWI in particular has promise as a monitoring tool to measure the recovery and post-fire health of grasslands over a large area. Accessibility is often an issue in remote and rugged terrain, and having reliable proxies for recovery conditions readily available will save producers time, money, and labor. Using such tools may allow producers to return cattle to severely-burned areas sooner than normal. Products such as LSWI and GPP are freely available, so increasing use of such tools may give producers and others more ability to monitor the health of their grazing lands.

RESEARCH CORRELATIONS

FIRE CLIMATOLOGY

The second study, a climatology of fire events, examined fire extent, frequency, intensity seasonality, and interannual variations of burned areas across the Southern Great Plains (Kansas, Oklahoma, and Texas). The project used MODIS satellite data, recorded every eight days, to identify active fires, burned area, and monthly fire locations. Fires were identified for each month and year, 2000-2017 and plotted on 1-kilometer resolution. Results showed that fires were more common in the eastern part of the three states, and particularly in eastern Kansas extending into northeastern Oklahoma (in and around the Flint Hills region of Kansas). Prescribed burning is a commonly-used management tools in this region.

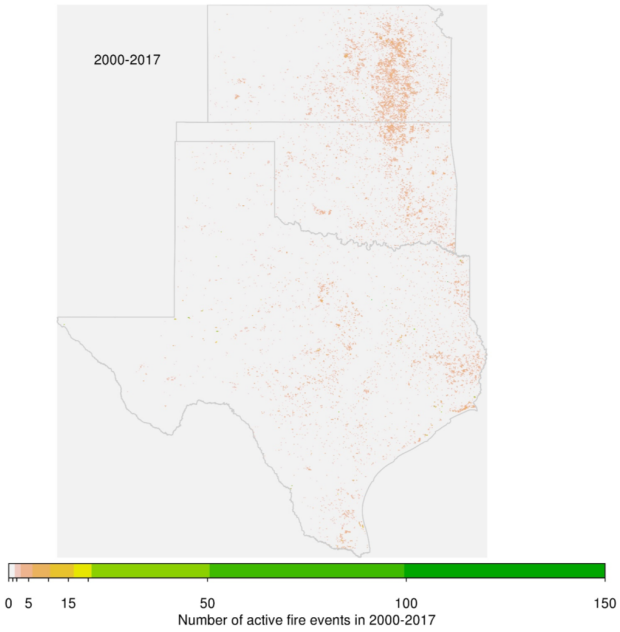

Figure 14: Each dot shows the location of one or more fires that occurred in the Southern Great Plains between 2000 and 2017.

The analysis also showed that fires have occurred in every part of the three states. Even though they may be less common in western areas, the analysis of burned area showed that the potential size of such fires is much greater across western Oklahoma, Kansas, and Texas, while fires in the eastern parts are usually much smaller. The analysis also showed a strong seasonal component to fires, with a spring maximum due to the most common time to conduct prescribed burns.

RESEARCH CORRELATIONS

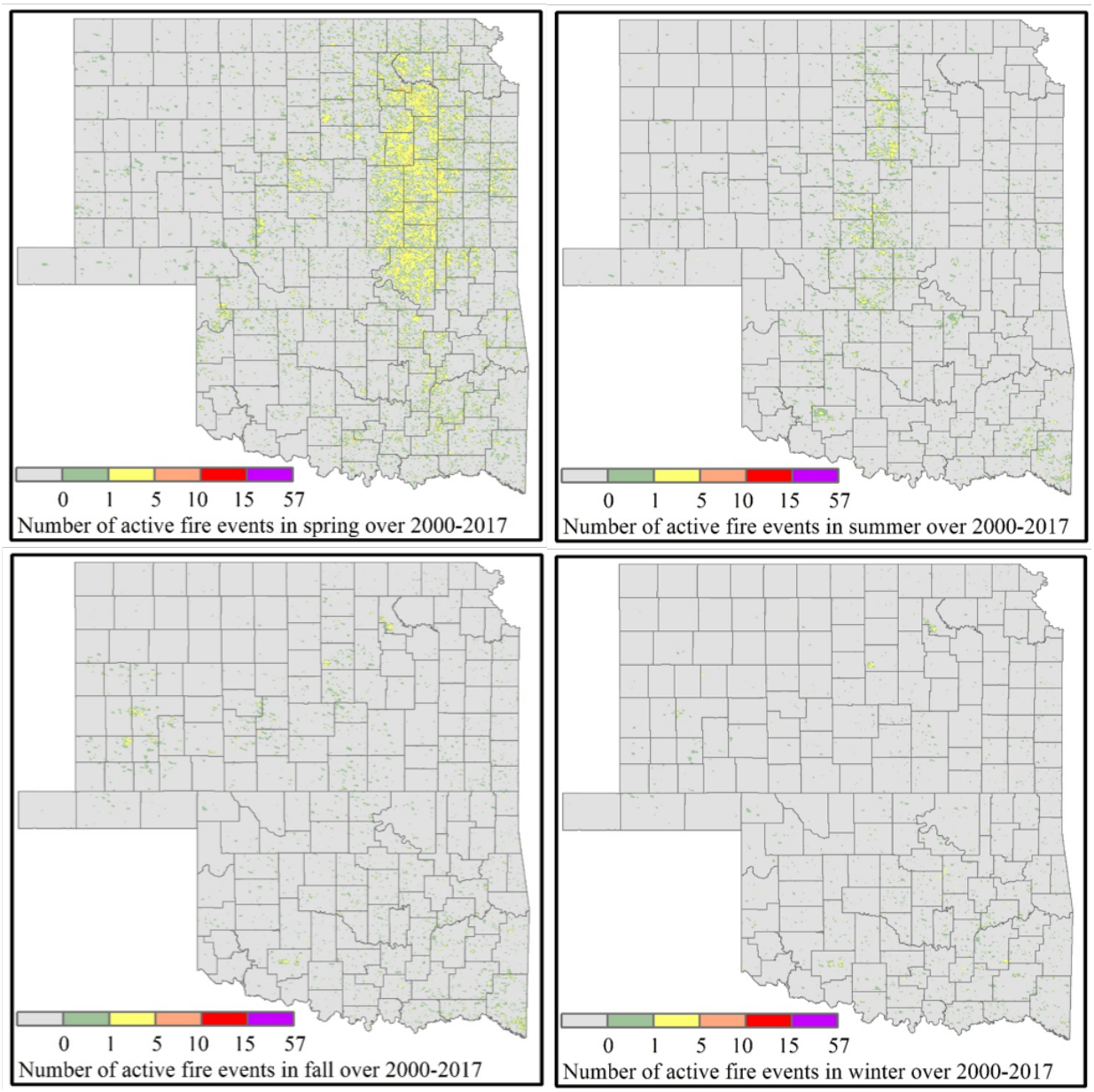

Figure 15: Number of fire events in Kansas and Oklahoma by season, 2000-2017.

CONCLUSIONS

Each of these outreach events generated an avenue for building capacity on the current and future wildfire trend conditions, as well as promoting the increase of wildfire management capabilities to reduce future risk. Presenters and participants both learned from each other during their interactions and discussions and shared a variety of shared perspectives related to building resiliency towards future wildfire risk.

Examples of common discussion themes included:

- **Increasing communication and collaborations amongst the local, state and federal levels**
- **Improving the transparency of funding guidelines and producer needs**
- **Encouraging a self-reliant and proactive approach**
- **Using prescribed fire as a management strategy**
- **Joining and utilizing the local Prescribed Burn Associations**
- **Increasing efforts to reduce long-term drought impacts on water availability**

Additionally, the discussion and information shared at this event was especially important to facilitate as changing climate conditions favor a warmer and drier environment, and the trend for the Southern Great Plains to experience wildfires is projected to continue into the future. However, it was noted that wildfire trends are not necessarily increasing in quantity (trends show a decrease in the frequency of fires) but are increasing in size and severity. This is likely due to an increase in fuel sources, despite the advancement in tools and increase in management strategies.

As the trend for larger and more intense wildfire events continue, these efforts were one way to assist locals in their planning efforts to reduce risk for future wildfire events. Actions such as sharing information, improving collaborations and adapting management strategies through avenues like local meetings and increased planning efforts is critical for increasing resiliency to wildfire events as they continue to impact the region amongst a changing climate both now and in the future.

APPENDIX A: PRE-FORUM MEETING AGENDA

2016-2017 Kansas and Oklahoma Wildfire Assessment – Stakeholder Listening Session
USDA-ARS Woodward
December 13, 2017

10:00am	Welcome and introductions	*Stacey Gunter* *USDA-ARS Woodward*
10:15am	Context for today's meeting	*David Brown* *USDA Southern Plains Climate Hub*

- Brief overview of USDA-OU wildfire assessment project objectives
  - Assess the impacts of the 2016 and 2017 large grass fires
  - Identify opportunities to promote post-fire ecological and economic recovery, and management practices to reduce future risks of wildfire
  - Promote regional partnerships to effectively respond to wildfire to promote recovery and build resilience after disaster
- Purpose of today's listening session:
  - What would the community like to see as outcomes of this project?
  - Who else should be brought into the discussion?
  - Is the content for the February 2018 Wildfire Forum on target?

10:30am	Discussion #1	*Clay Pope* *USDA Southern Plains Climate Hub*

- Perspectives and experiences from recent wildfires

11:45am	Break and lunch (catered)	
12:30pm	Wildfire in weather and climate context	*Mark Shafer* *University of Oklahoma*
12:45pm	Discussion #2	*Leah Kos* *University of Oklahoma*

- Looking ahead: February 2018 Wildfire Forum
  - Is the content for the Forum on target?
  - For the panel sessions, what topics and speakers would resonate most with stakeholders and management officials?
  - Who (individuals and organizations) need to be invited?

1:30pm	Discussion #3	*Corey Moffet* *USDA-ARS Woodward*

- Wildfire mitigation and recovery: research and extension opportunities

2:30pm	Adjourn

APPENDIX B: FORUM MEETING AGENDA

2018 SOUTHERN PLAINS WILDFIRE FORUM

February 13, 2018
Beaver County Fairgrounds, OK
9:00am-3:30pm

Agenda

8:30am	Registration and Refreshments
9:00am	Welcome *Karl Jett, Oklahoma Conservation Commissioner, Area 1* *David Brown, USDA Southern Plains Climate Hub*
9:15am	Weather and Climate Fire Indicators and the March 6, 2017 Outbreak *Monica Mattox, Assistant Oklahoma State Climatologist* *Xiaomao Lin, Kansas State Climatologist*
9:45am	Considerations for Conducting Prescribed Burns *John Weir, Natural Resource Ecology & Management, Oklahoma State University*
	Panel Discussion: Local Perspectives of Prescribed Fire Use *Ted Alexander (KS), Bill Barby (KS), Tom Carr (KS), Eva Yearout (KS)*
10:40am	Break (Sponsored by Oklahoma Cattlemen's Association)
11:00am	Management Strategies I: Patch-Burn Grazing *Samuel Fuhlendorf, Natural Resource Ecology & Management, Oklahoma State University*
11:30am	Management Strategies II: The Effects of Fire on Soil Erosion Risk *Corey Moffet, USDA Woodward Agricultural Research Service*
12:00pm	Lunch (Sponsored by Farm Credit of Western Oklahoma)
1:00pm	Panel Discussion, Technical Assistance I: Program Perspectives *Joy Alspach (OK FSA), Gary O'Neill (OK NRCS), Loren Sizelove (OK Extension), Dusty Tacha (KS NRCS)*
2:00pm	Break (Sponsored by Oklahoma Cattlemen's Association)
2:20pm	Panel Discussion, Technical Assistance II: Risk Reduction, Tools and Strategies *Don Button (KS EM), Mark Goeller (OFS), Cody Sander (OK), Keith Shadden (OK EM)*
3:15pm	Next Steps & Closing Remarks
3:30pm	Adjourn

SCIPP Farm Credit Western Oklahoma USDA United States Department of Agriculture Southern Plains Climate Hub

APPENDIX C: PANHANDLE MEETING AGENDA

May 22, 2018

Oklahoma Panhandle Research and Extension Center
1/2 mile northeast of Goodwell, OK on Highway 54, 73939

Agenda

9:00 am
Welcome and introductions

David Brown
USDA Southern Plains Climate Hub

Purpose of today's listening session:
- Review the context of recent extreme events (drought, wildfire)
- Understand the challenges producers and agricultural professionals in the Panhandle region are currently responding to
- Place current challenges within long-term context (e.g., water availability)
- Identify opportunities for USDA and its partners to better respond to ongoing extreme events and longer-term challenges

9:15 am
Context for today's meeting

Gary McManus
Oklahoma State Climatologist

- 2017-2018 drought
- 2016, 2017, and 2018 wildfire seasons
- Historical context and long-term challenges

10:00 am
Discussion #1:
Current extremes: Drought and wildfire

Clay Pope
USDA Southern Plains Climate Hub

- Available resources (digitally accessible, financial)
- Managing heat stress in livestock
- Research and mitigation initiatives and opportunities
- Lessons from Woodward?
- Other needs (what can be done to address them in the near term)

-- 11:30 am Lunch Provided --

12:00 pm
Discussion #2:
Long-term challenges: Water availability

Amy Kremen
Ogallala Water CAP

- What's the current situation re: aquifer drawdown
- Cover practical applications and related research/outreach re: extending the productive life of the aquifer—feature producers, Extension effort, USDA field personnel, other?

1:30 pm
Next steps

Elizabeth Weight
NOAA/National Integrated Drought Information System

- What would the community like to see as outcomes from this discussion?
  - e.g., a larger public meeting (à la Beaver OK Feb 2018)
  - e.g., science/research investments
- Who else should be brought into the discussion?

-- 2:00 pm Adjourn --

USDA Southern Plains Climate Hub
U.S. DEPARTMENT OF AGRICULTURE

NOAA NIDIS OgallalaWater.org

APPENDIX D: REFERENCES

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SUGGESTED CITATION:
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[Available online at http://www.southernclimate.org/documents/Wildfire_Report.pdf]

United States Department of Agriculture
Southern Plains Climate Hub

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