

AN EVALUATION OF THE EFFECTIVENESS OF MODERATED PEER-TO-PEER
LEARNING FOR EXTENSION OUTREACH TO LANDOWNERS

A Thesis

by

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ABSTRACT

Traditional wildlife and range extension programs offered to landowners and land managers provide information, knowledge, and tools for land stewardship. However, effectively educating today's landowners may require new methods. This project investigated the effectiveness of the Peers and Pros 360° teaching method, which is a moderated peer-to-peer learning approach. The objective of this teaching method is to create an interactive learning exercise that builds from the group's base level of knowledge. I designed, conducted, and evaluated 3 workshops for landowners in the Edwards Plateau ecoregion about prescribed fire to investigate the effectiveness of the Peers and Pros 360° method. In a Peers and Pros 360° workshop, participants exchange ideas within a framework prepared by professionals. This framework consists of a designated topic, themes, and statements. My program consisted of 8 themes, each with 3 associated statements. During the program, participants were asked to react to these statements. Landowners with more prescribed fire experience often led the discussions, while those who were not as familiar with the topic could ask questions and learn from their peers. Following the discussion, experts contributed additional information based on a list of predetermined talking points. The workshop was favored by participants; 93% of participants preferred the Peers and Pros 360° over traditional teaching methods and the average net promoter score was 90. The workshop was also effective; participants at all 3 workshops experienced an increase in knowledge and indicated high intent to adopt practices, with an average of 5 practices intended to adopt. However, response rates to the follow-up survey were low, so we could not draw conclusions about actual adoption rate. The Peers and Pros 360° teaching method will be useful to outreach and extension professionals for designing and conducting relevant, engaging programs and can be modified and used for a variety of educational groups.

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CHAPTER I.
INTRODUCTION AND LITERATURE REVIEW

History of the Cooperative Extension System

In the early 1800s, agricultural clubs and societies began to appear across the United States (National Institute of Food and Agriculture [NIFA], n.d.a.). In 1819 an agriculture and farm journal called *The American Farmer* was founded, wherein farmers reported their achievements and the methods they used to solve agriculture, horticulture, livestock, and economic problems (NIFA, n.d.a.). *The American Farmer* was focused on improving agriculture through application of scientific principles, just like modern-day extension services.

Leaders in agriculture such as Seaman A. Knapp and George Washington Carver shaped the movement that would eventually lead to formalized extension services. Both Knapp and Carver did much of their work on private farms conducting demonstrations (Gould, 2014). In 1862, the Morrill Act created land-grant institutions to provide more equal access to higher education, specifically education about farming and mechanical skills (United States Department of Agriculture [USDA], 2021; Wang, 2014). Knapp and Carver realized land-grant universities needed to reach beyond their classrooms if they were going to influence rural society and the broader public. These men worked hard to teach farmers about new technologies, both through field trips and home visits (Gould, 2014). Knapp used a mix of federal and private funds to hire field agents and do more demonstrations on private farms (Gould, 2014). In 1887, the Hatch Act, written with the help of Knapp, provided federal support for the creation of agricultural experiment stations to solve the problems of rural America (USDA, 2021). Knapp was famous for introducing rice as an alternative crop in the South and for helping farmers improve and protect their cotton crops (Gould, 2014). Carver was known for teaching southern farmers, especially African Americans, about the advantages of alternative crops (Gould, 2014). In 1914, the Smith-Lever Act

was introduced by Senator Hoke Smith of Georgia and Representative A. F. Lever of South Carolina to expand and improve agricultural, professional, and home demonstration educational efforts throughout rural America (Gould, 2014).

The Smith-Lever Act defined the future of extension by establishing the USDA partnership with land-grant universities (Wang, 2014). This partnership later helped fuel the American agricultural revolution, made possible in part by extension employees teaching producers about new technologies and techniques that drastically increased farm productivity (NIFA, n.d.a.). Extension services proved valuable at several critical times in American history. During World War I, labor shortages necessitated more efficient farm production, made possible with the help of extension employees (Wang, 2014; NIFA, n.d.a.). During the Great Depression, universities and the USDA taught farmers about marketing, organized buying and selling cooperatives, and taught women farmers new skills to help generate extra income for their families (Wang, 2014; NIFA, n.d.a.). During World War II, extension agents worked with farmers and 4-H members to increase production essential to the war effort (Wang, 2014; NIFA, n.d.a.). Today, there are over 100 land-grant colleges and universities with extension programs (i.e., educational efforts). In addition to continuous improvement of agriculture, these agencies now provide education in urban and rural areas regarding humans, plants, and wildlife. These institutes of higher education work in partnership with federal, state, and local governments to operate the Cooperative Extension System (CES), made possible by the Smith-Lever Act.

The general goals of modern-day extension are much the same as those of Knapp and Carver: to identify areas of need, to find or innovate solutions and answers, and to connect people with the information, tools, science, and technology that equip them to live healthy and successful lives (NIFA, n.d.b.). Due to extension's responsiveness to local needs and statewide community

integration, this institution also frequently provides aid during and after disasters and emergencies (NIFA, n.d.b.). Services provided by the CES include continuing education and experiential learning for farmers, ranchers, communities, youth, and families throughout the United States (NIFA, n.d.c.). Federal support is provided through NIFA, which supports universities and local extension offices that are part of the CES by providing grants to supplement state and county funds (NIFA, n.d.c.). Extension agents are stationed within most of the nation's counties and work with local citizens and groups to solve problems and provide them with the tools to respond to their needs (NIFA, n.d.c.).

Texas A&M University, originally called the Agricultural and Mechanical College of Texas, was the state's first public institution of higher education in Texas and was organized by the state legislature in 1871 under the Morrill Land-Grant College Act of 1862 (Texas A&M AgriLife Extension, 2014). The Morrill Act donated public lands to states for the purpose of starting colleges that would teach agriculture, mechanic arts, military tactics, and science and classical studies to working-class citizens (Texas A&M AgriLife Extension, 2014). In 1887, the Hatch Act provided federal support for the creation of agricultural experiment stations, where researchers worked to solve problems like Texas tick fever (Texas A&M AgriLife Extension, n.d.). In 1903, Knapp, who helped draft the Hatch Act, established community demonstration plots near Terrell, Texas, to implement and showcase new USDA recommendations for crops (Texas A&M AgriLife Extension, 2014). This demonstration was so successful, the following year he appointed 33 special agents to help Texas communities. After Congress approved the Smith-Lever Act in 1914, the Texas legislature organized the Texas Agricultural Extension Service in 1915 (Texas A&M AgriLife Extension, n.d.).

Today, the Texas Agricultural Extension Service is known as Texas A&M AgriLife Extension Service (AgriLife Extension) and provides a conduit for scientific information from Texas A&M University and Texas A&M AgriLife Research to farms and communities. AgriLife Extension provides educational opportunities centered around conservation and sustainable agriculture throughout the state. The agency comprises county agents, specialists, researchers, and volunteers who all provide science-based advice and assistance. AgriLife Extension hosts county, regional, and statewide events to educate landowners about best management practices, cost-assistance programs, current research, and the resources that are available to them. Interactions with producers, landowners, and the general public also allow AgriLife Extension to direct research efforts to subjects that are most needed.

Extension services in the natural resources field

Extension programs about natural resources are one means of environmental education for the public. Environmental education focuses on local knowledge, values, and experiences to encourage the public to align with conservation strategies presented to them through extension personnel (Ardoin et al., 2020). Quality environmental education as defined by Ardoin et al. (2020) involves several collaborators conducting and applying research where science, decision making, local cultures, and the environment overlap. Oftentimes, the intended outcome of extension and education programs in the natural resources field is environmental awareness and a change in attitude (Ardoin et al., 2015). Increasing environmental awareness within a community can promote individuals to implement best management practices, which in turn may motivate their neighbors to do the same. It is important that multiple members of a community implement best management practices to truly benefit the environment, support functional ecosystems, and improve biodiversity.

A literature review conducted by Ardoin et al. (2020) evaluated 105 articles across 51 journals in the fields of education, environmental education, conservation, and natural sciences from 1997 to 2016. Youth, adult, and youth/adult combination programs were included. Approximately 87% of studies measured a change in behavior as the result of an environmental education program. Additionally, approximately 46% of participants who attended a program took environmental action following the program. Some of these actions occurred only once or were short-term; however, other program attendees acted for greater lengths of time or changed their habits completely. About 39% of environmental education programs led to an increase in the community's or target group's capacity to address conservation issues through improved relationships among stakeholders, increased participation in programs, and establishment of environmental groups. Extension services play an important role in communicating with the public about conserving natural resources for the benefit of people and nature. Land-grant universities use extension services to act as mediators for researchers and universities, who may otherwise not be able to reach those outside of the scientific community.

Landowner demographics in Texas

Within the next decade, Texas will see the largest intergenerational land transfer and land use change to date (Lund et al., 2017). This land transfer will result in land fragmentation and impacts to the natural resources the land provides (Lund et al., 2017). From 1997 to 2017 the population of Texas increased by 48%, with a concomitant increase of approximately 1,000 new working farms and ranches per year (Smith et al., 2019). However, the average size of the land owned by each property owner has decreased, and small farms and ranches (<100 acres) now represent 58% of all ownerships (Smith et al., 2019). Of that 58%, only 4% consist of working lands, meaning that over half of the private lands in Texas are used for purposes other than farming,

ranching, and foresting (Smith et al., 2019). Mid-sized working lands (100-2,000 acres) have declined with larger mid-sized working lands (500-2,000 acres) experiencing the steepest decline at approximately 360,000 acres lost annually (Smith et al., 2019). These mid-sized properties are split up to form multiple small properties, combined with other properties to form large properties, or are converted to non-agricultural use (Smith et al., 2019). Small and mid-sized properties have been impacted by ownership fragmentation as the growing population pushes urban areas closer to rural properties (Smith et al., 2019). In total, Texas lost approximately 2.2 million acres of working lands to non-agricultural uses from 1997 to 2017 (Smith et al., 2019).

New landowners of all ages in Texas are increasingly focused on management of non-game wildlife and nature recreation, compared to past emphasis on game management and agricultural production (Sorice et al., 2013). Acreage dedicated to wildlife management has been on the rise since 1997 and in 2017 totaled approximately 5.4 million acres (Smith et al., 2019). In 1995, Proposition II amended Article VIII, Section 1-d-1 of the Texas Constitution and allowed for properties that are currently appraised as agricultural or timber lands to convert to appraisal based on wildlife management (Hegar, 2018). Landowners wishing to convert to wildlife management may apply by submitting an application and a wildlife management plan. If accepted, landowners have to implement 3 management practices on their properties, which can include habitat control, erosion control, predator control, providing supplemental supplies for water, providing supplemental supplies of food, providing shelters, and making census counts to determine populations (Hegar, 2018). The tax valuation of a wildlife management appraisal is the same as agricultural appraisal and does not preclude conservative use of livestock, so landowners may be incentivized to convert to wildlife management from a more intensive operation.

Many new landowners are considered lifestyle-oriented landowners, meaning they own or purchase land solely for recreational use. Lifestyle-oriented landowners may own property to experience rural living or to have somewhere to escape to from their busy urban lives (Sorice et al., 2013). The presence of a lifestyle-oriented landowner on a landscape can influence vegetation composition, ecological processes, and the associated ecosystem services (Sorice et al., 2013). This is because the goals for the property may change when the main use of the land is recreation. Although these modern, lifestyle-oriented landowners tend to have stronger pro-environmental attitudes, they are often not trained in basic ecological or rangeland management and may not have the same connection with the land as previous generations (Sorice et al., 2013). Lifestyle-oriented landowners are usually more willing to take on the expenses of implementing management practices, but often lack the knowledge to do so (Sorice et al., 2013). Furthermore, they are often unaware of traditional extension services as a source of information or are not drawn to traditional programs or information outlets.

Absentee landowners are those who do not live on their rural properties full-time; this segment of the landowner population in Texas has been growing throughout the years (Sorice et al., 2018). Absentee landowners may have less connection to their land or may not spend enough time on their properties to conduct management. Sorice et al. (2018) estimated that 43% of landowners did not reside primarily on their properties. These absentee landowners were less involved with their properties than those who lived on site full-time. In Texas, urban-absentee landowners have been on the rise since 1994 and have dominated rural land ownership (Redmon et al., 2004). This trend may be considered problematic because many of the new landowners do not have the basic training and knowledge needed to implement best management practices on their land (Redmon et al., 2004). This lack of knowledge can increase costs of managing the

property and thus has the potential to demotivate landowners from managing their property (Redmon et al., 2004). Urban-absentee landowners may be more likely to learn from natural resource experts; however, they are often not aware of the education opportunities provided by land-grant universities (Redmon et al., 2004).

It is important for educators to consider the changing landowner demographics in Texas when developing programs to effectively reach all landowners. Factors to consider include residential status (whether the land is the landowner's primary residence or not) and primary use of the land (e.g., recreation, ranching, conservation, etc.). Other demographics may also be important to consider (e.g., age, education level). Conservation efforts must acknowledge that people play a large role in making conservation initiatives long-term success stories (Bennett et al., 2016). Purposeful targeting of new landowner groups by extension services will allow more people to be reached, thus improving the health of the land.

Adult learning preferences

Research on outreach techniques indicates that adults prefer learning opportunities where they can use and share their own personal experiences and a two-way exchange of information occurs (Gootee et al., 2010; Phillips et al., 2017; Rothwell, 2020). Group interactions are preferred by most adults because this type of interaction is often associated with a two-way exchange of information (Rothwell, 2020). However, adults do not like to feel unintelligent or make mistakes in front of others, so it is important that the group setting is one of encouragement and support (Rothwell, 2020). Learning environments that are interactive and stimulating are preferred by adults over traditional learning environments where they are sitting in a lecture (Rothwell, 2020). When facilitators pose questions and provide just enough information for a discussion to start, participants can discuss among each other and learn through interactions with their peers

(Rothwell, 2020). High value is placed on this type of learning because it allows the individuals to build onto their own knowledge and experience and is focused on key ideas and the experiences of others (Gootee et al., 2010, Rothwell, 2020).

Adults are not receptive to professionals who regard them as “non-experts” or those who are not understanding of the challenges they have faced during their own experiences (Gootee et al., 2010; Phillips et al., 2017). The socioemotional selectivity theory emphasizes that as people age, their emotions play a larger role in their social cognitive processing (Carstensen et al., 1999). Adults, especially older adults, pay special attention to the way that they are treated during interactions with others (Carstensen et a., 1999). Adults respond negatively to professionals who are unwilling to understand or listen to the evidence or viewpoints that they share (Gootee et al., 2010; Phillips et al., 2017). It is difficult for adults to learn the information presented if it opposes what they have learned from their own experience (Rothwell, 2020). Therefore, it is very important for professionals to recognize adults’ experiences, knowledge, and beliefs. Adults prefer to be taught by those with applicable, real-life experience so they can trust the instructor as a credible source (Phillips et al., 2017). When information is presented by an individual who can share their own personal experience, this information may seem more relevant and make a better case for the management practice to be implemented.

It is critical that education and outreach professionals understand how adults best learn so that programs can effectively share information and recruit people within the target audience. Participants are deterred from sharing the information they learned or incorporating it into their own practices if it does not fall within the norms of those around them (Rothwell, 2020). However, adults who attend programs are more likely to spread the information they were taught and incorporate it into their own practices if it was presented in a way that was memorable and

interesting; was related to principles, theories, or descriptions; appealed to their senses; was relatable to what they already knew; and gave them the tools to solve a problem (Rothwell, 2020).

Peer-to-peer learning

Traditional extension programs teach landowners about the economic and ecological benefits of the management practice the program is trying to promote. This transfer of knowledge is typically done by a professional hosting a formal meeting with some type of lecture about a management practice. This traditional approach does not always promote widespread engagement in management practices and oftentimes only motivates landowners who are already committed to active management (Ma et al., 2011). Research on how to expand private lands conservation indicates that peer-to-peer learning may be an effective approach for information transfer and motivation of landowners (Kueper et al., 2013). Peer-to-peer learning is defined as the exchange of ideas from one peer to another. This approach to learning is highly contrasted with the classical approach of one-way information delivery, generally provided by subject matter experts (Kueper et al., 2013). Peer to-peer learning can be used to develop a working relationship between extension personnel and landowners.

Landowners who are already committed to active management, have knowledge about management practices, and/or those who already attend extension programs can play a large role in promoting best management practices in a peer-to-peer learning opportunity. Peer-to-peer learning can motivate the more experienced and knowledgeable landowners to continue to communicate their knowledge and expertise to their peers, even when the program is over. Providing landowners with peer-to-peer learning opportunities gives them the tools they need to not only learn from and teach their peers during the program, but it also gives them the confidence to lead their community outside of the program.

Landowners may be more receptive to learning from their peers because adults place a high value on learning environments that allow them to learn from the experiences of others (Gootee et al., 2010, Rothwell, 2020). Landowners' willingness to act on and implement management recommendations received is greatly influenced by their impressions of those delivering the information (Gootee et al., 2010). When professionals intimate an "expert to non-expert" relationship rather than a relationship based on mutual respect and open communication, that expert and the information they provided may not be well received (Gootee et al., 2010).

Peer-to-peer learning allows landowners to develop relationships and trust within their own peer group so that they can have open discussions and learn from one another. Moderated peer-to-peer learning allows for this type of learning to occur while still having a subject matter expert present to help guide the program by providing questions or discussion topics. By building trust and increasing awareness (which leads to increased adoption of practices; Wang, 2019), peer-to-peer education can have a large impact as neighbors work together to implement change. Community involvement can motivate individuals, especially in situations where they are confident in the knowledge and skills of their peers and instructor(s) (Davis, 1985).

Research Objectives

Determining whether moderated peer-to-peer learning is an effective method for outreach will produce valuable information for future extension and education programs in the natural resources field. The objective of my research was to evaluate the "Peers and Pros 360°" teaching method, a moderated peer-to-peer teaching method originally developed in 2015 by Smith and Jackson, Penn State Extension (S. Smith, personal communication, 2020). My aim was to determine whether moderated peer-to-peer learning can effectively teach landowners about management practices and motivate adoption of those practices. Specifically, I investigated 1) the

knowledge change associated with the Peers and Pros 360° teaching method; 2) whether moderated peer-to-peer teaching methods such as Peers and Pros 360° were preferred by attendees; 3) the extent to which Peers and Pros 360° motivated participants to implement the management practice introduced (intent to adopt); and 4) whether participants actually implemented the management practices learned during the Peers and Pros 360° workshop. This study will help education and outreach professionals better communicate and teach management practices so that wise land stewardship decisions are made by landowners. Results from this study will help educators determine more effective ways of imparting knowledge so that landowners understand and incorporate improved management practices into their short- and long-term land management plans. Improving extension program effectiveness is essential for encouraging science-based, relevant, and continuing education that fosters long-term, positive change.

CHAPTER II.
DEVELOPMENT OF A PEERS AND PROS 360° PROGRAM FOR PRESCRIBED FIRE
EDUCATION

Abstract

Range and wildlife extension programs in Texas provide information, knowledge, and tools for land stewardship to landowners and land managers. However, effectively educating today's landowners may require a change from the traditional lecture approach to new teaching methods. This project investigated the effectiveness of a moderated peer-to-peer learning approach for extension outreach to landowners. I used the Peers and Pros 360° teaching method to design, conduct, and evaluate 3 workshops about prescribed fire for landowners in the Edwards Plateau ecoregion. I investigated the knowledge change associated with the Peers and Pros 360° teaching method and whether moderated peer-to-peer teaching methods are preferred by attendees. The Peers and Pros 360° workshop at Kerr Wildlife Management Area (WMA) recruited 16 participants, Mason Mountain WMA recruited 25 participants, and Spicewood Ranch recruited 13 participants from the surrounding areas. Results from surveys completed immediately after the workshop indicated that 93% of participants preferred the Peers and Pros 360° teaching method over traditional methods and participants at all 3 workshops reported a self-assessed increase in knowledge. Perception of risk involved with prescribed fire decreased following the workshop for 88% of participants at Kerr, 81% of participants at Mason Mountain, and 75% of participants at Spicewood. The level of comfort associated with prescribed fire increased for 94% of participants at Kerr, 100% of participants at Mason Mountain, and 83% of participants at Spicewood. All participants at Kerr, 95% of participants at Mason Mountain, and 92% of participants at Spicewood increased their understanding of the advantages and disadvantages involved with prescribed fire.

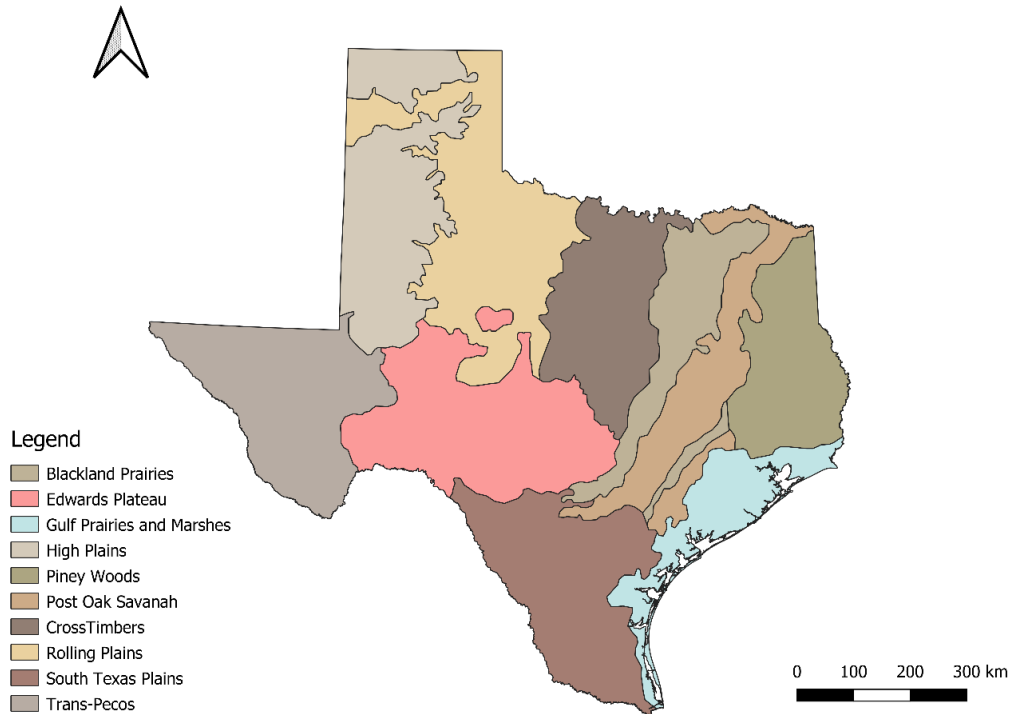
The results of this study suggest the Peers and Pros 360° teaching method is an effective tool for imparting prescribed fire knowledge to landowners and land managers.

Introduction

Moderated peer-to-peer learning

This study investigated the effectiveness of moderated peer-to-peer learning for increasing participant knowledge about a topic. Specifically, I evaluated the Peers and Pros 360° teaching method by conducting and evaluating 3 workshops (i.e., events) for landowners about prescribed fire as a land-management tool in the Edwards Plateau ecoregion (Hill Country) of Texas (Figure II.1). Peer-to-peer learning is defined as the exchange of ideas from one peer to another. This approach to learning is highly contrasted with the classical approach of one-way information delivery, generally provided by subject matter experts (Kueper et al., 2013). Peer-to-peer learning can be used to develop a working relationship between educators, such as extension personnel, and participants, such as landowners. The Peers and Pros 360° teaching method allows peers who have knowledge about a particular topic to take a leadership role within the program. Peers who are not as familiar with the topic have the opportunity to ask questions and learn from their peers. This back-and-forth communication among peers enables a relationship of trust to be built within the peer group and allows for open communication and learning. In contrast to unmoderated peer-to-peer learning, the Peers and Pros 360° teaching method outlines a formal role for professionals who can help guide discussions. Professionals can also summarize themes, gently correct misinformation, or answer any questions that the peer group could not answer among themselves.

Figure II.1. Ecoregions of Texas; the Edwards Plateau ecoregion was the focus of this study.



Peers and Pros 360° teaching method

The Peers and Pros 360° teaching method is designed to build on the knowledge of a group of participants, referred to as “peers.” To begin the workshop, participants are asked to organize themselves into a circle while the “pros” (subject matter experts or leaders) hand out program-specific numbered statement cards (Appendix A – Statement Cards). Not every participant is required to have a card if there are not enough; however, this teaching method works best with 10 to 25 participants (S. Smith, personal communication, 2020), so each participant will usually have 1 or 2 cards. The subject matter is arranged into themes and each theme has 3 associated statement cards. After cards are distributed, the pro instructs the participants who received the numbered cards for the first theme (i.e., cards 1, 2, and 3) to read their statements out loud. Once all 3 statement cards have been read, participants are asked to share their opinions, thoughts, and

reactions relative to the statement. For example, participants might respond with how they would react if one of their peers said this during an everyday discussion. Participants are encouraged to express their thoughts regardless of their level of knowledge. The participants who read the cards out loud are not required to comment on those statements, and the group should contribute to the discussion. An example of a statement created for this program is “I wait to burn until after the first freeze,” categorized under the “Timing” theme.

The pro is instructed not to speak even if inaccurate information is presented during the discussion. Following the discussion, the pro contributes additional knowledge and comments based on a list of predetermined talking points (Appendix B – Talking Points for Pros). The talking points are intended to support the pro, especially in the case that he/she is not a subject matter expert (e.g., county extension agent/educator who does not specialize in the topic). The pro may gently correct any misinformation that was presented during the discussion at this time although he/she may also choose not to do so. The individual who presented the inaccurate information is often made aware of this during the discussion with his/her peers. If the pro feels it is necessary to correct some of the information presented, he or she should do so in a sensitive and polite manner. The individual who presented the inaccurate information should not be called out and the pro or expert should correct the misinformation in a way that does not target or embarrass the participant. The purpose of this teaching method is to allow free discussion and peer-to-peer learning, which is why it is important that the participants feel comfortable and willing to share. Once the pro is done contributing additional information, discussion moves to the next theme as the pro instructs for the corresponding cards to be read aloud. This process continues until the end of the program. Typically, a 1-hour program can cover 3 to 4 themes and a 2-hour program can cover up to 8 themes.

Prescribed fire

Prescribed fire is a management tool that can be used to improve and maintain wildlife habitat. Before European settlement, fire was a natural event that occurred across much of the Great Plains of the United States, including Texas (White & Hanselka, 2019). This ecological phenomenon is important to native vegetation because it suppresses woody vegetation and enables native grasses and forbs to thrive (White & Hanselka, 2019). Grasses have been the dominant vegetation type of the Great Plains for the past 5,000 to 8,000 years (Twidwell et al., 2013). Historically, fire occurred regularly in the Great Plains due to high fuel loads and frequent ignition events, both natural (lightning) and human-caused (i.e., Native American activities; Ansley & Rasmussen, 2005). Pre-settlement fires west of the Mississippi occurred approximately every 1 to 6 years in much of the Great Plains, which was important because junipers (*Juniperus* spp.) become fire resistant when fire is absent from the landscape for more than 6 to 8 years (Ansley & Rasmussen, 2005). Pre-settlement fire frequency in the Edwards Plateau ecoregion of Texas is difficult to determine because of the lack of data; however, it is estimated that there was high variability (less than every 10 years to every 20 or 30 years) because of the region's diverse topography (Stambaugh et al., 2014). Modern-day human interference on the landscape has led to widespread control and suppression of fire. This suppression has been a contributing factor in the shift from grass-dominated to woody-dominated ecosystems and the depletion of essential grassland ecosystem services across the Great Plains (Twidwell et al., 2013). Wilsey et al. (2019) estimated that only 11% of tallgrass prairies, 24% of mixed grass prairies, and 54% of shortgrass prairies that once covered the continent still remain.

Across most of Texas, landowners and land managers experience woody plant encroachment. Primary factors driving this vegetation change include suppression of fire,

overgrazing, and the distribution of woody plant seeds by livestock (Thurow & Hester, 1997). Dense canopies of woody plants lead to increased evapotranspiration, decreased groundwater recharge, and decreased biomass of grasses, which correlates with decreased livestock production (Thurow & Hester, 1997). Additionally, woody encroachment can negatively affect habitat quality for wildlife species that rely on grasslands. Grassland birds have been especially impacted, with 74% of grassland species in North America experiencing population declines (Rosenberg et al., 2019). Additionally, of the 19 grassland species designated as a conservation priority by Audubon, 84% are declining 84% of those spend part of their lives in Texas (Wisley et al., 2019). The Edwards Plateau ecoregion of Texas is comprised of an ecologically unique oak woodland/mesquite savannah grassland (Wilsey et al., 2019). Woody encroachment decreases the abundance and richness of grassland species that are essential to grassland birds (Twidwell et al., 2013).

Prescribed fire is a tool that can reduce the physical presence and the competitive impact of junipers on native grasses in Texas (Ansley & Rasmussen, 2005). Some of the other ecological benefits of fire include improved pasture accessibility; improved soil health; increased production, availability, palatability, and nutrition of forage and browse; decreased abundance of brush, cacti, and undesirable and invasive vegetation species; improved herbaceous composition; improved grazing distribution for livestock and wildlife; and improved nutrient cycling (White & Hanselka, 2019; Ansley & Rasmussen, 2005). Fire is also an affordable tool for landowners and, while it is not a perfect tool, it can be useful for maintaining and restoring native grassland ecosystems. Downsides to the use of prescribed fire include the risk of escape, use restricted by weather conditions, smoke hazards, and the potential to increase invasive species (Simmons et al., 2007). Landowners may be concerned about having to remove cattle from pastures, losing income,

losing forage, legal liability, damaging their soil, or not having sufficient knowledge to conduct a burn (Harr et al., 2014). Educating landowners and land managers about the misconceptions associated with prescribed fire and empowering them with the knowledge to make good management decisions is essential for ensuring prescribed fire is used in the correct situations and in a way that enables them to reach their management goals.

The Prescribed Burn Alliance of Texas is a coalition of Prescribed Burn Associations (PBA) across the state. There are 8 total PBAs located across Texas: Coastal Bend, Edwards Plateau, South Texas, South Central Texas, Southern Rolling Plains, Southwest Texas, Texas Panhandle, and Upper Llanos. The Edwards Plateau PBA (EPPBA) has several chapters that cover the counties within its designated area (Prescribed Burn Alliance of Texas, n.d.). These chapters include Burnet-Lampasas, Central Basin, Cinco, Cross Timbers, Gillespie, Heart of Texas, and Mills County. The EPPBA has more than 200 members who collectively represent more than 1,000,000 acres of rangeland. The mission of the EPPBA is to apply prescribed fire on rangelands to improve wildlife habitat, water quality and yield, and carrying capacity for domestic livestock, and to restore historical plant diversity and production. Prescribed Burn Alliances give members access to information, equipment, and personnel that help them conduct effective and safe prescribed burns.

Methods

Study Area: Edwards Plateau ecoregion

Prior to European settlement, the Edwards Plateau ecoregion of Texas (Figure II.1) was a grassland savannah maintained by grazing bison (*Bison bison*) and pronghorn antelope (*Antilocapra americana*), as well as frequent natural and human-caused fires (Smeins, 1980). This region supported a vast array of forbs and grasses with juniper (also called “cedar”) species

restricted to riparian corridors or other areas where fire did not frequently occur (Smeins, 1980). The western portion of this ecoregion, referred to as the Hill Country, consists of limestone rock formed during the Cretaceous period of the Mesozoic era (Gustafson, 2015). These rocks were formed below sea level and later uplifted to form the Edwards Plateau, which rises about 610 meters above sea level. The rock of these limestone layers has been gradually eroding and dissolving for millions of years (Gustafson, 2015), forming canyons, plateaus, hills, and caverns.

European settlers introduced fences, cows, sheep, and goats to the landscape and worked to suppress fire (Ansley & Rasmussen, 2005; White & Hanselka, 2019). Fences prevented the natural movement of some native wildlife species while overgrazing of livestock prevented adequate rest and recovery for native plants (Smeins, 1980). By the 1900s, overgrazing and the suppression of fire had converted this region from a grassland to a brushland (Smeins, 1980). Today, the Edwards Plateau is dominated by many poor-quality browse, forb, and grass species (TPWD, n.d.). Ashe juniper (*Juniperus asheii*) and redberry juniper (*Juniperus pinchotii*; both colloquially called cedar) have become the dominant plant species in the Edwards Plateau (Thurrow & Hester, 1997). Rainfall in this ecoregion is highly variable and ranges from an annual average of 86 cm in the eastern portion to 38 cm in the west (Heilman et al., 2009). Drought is frequent in this region and can have long-term effects on wildlife populations and habitats (TPWD, n.d.).

Texas is predominately privately owned, with around 95% of land statewide in private ownership (Smith et al., 2019). Educating landowners is critical to ensuring that prescribed fire is effectively applied, but this can be challenging because of the perceived risks and the lack of knowledge regarding this tool. In a study of the Edwards Plateau and Rolling Plains ecoregions, Kreuter et al. (2008) found the use of prescribed fire was positively correlated with property size, residence on the land, annual household income, proportion of income derived from the land, and

positive perspectives about the effects of prescribed fire. Concerns about legal liability and lack of resources and assistance while conducting a burn deterred landowners from using prescribed fire as a management tool. Members of the EPPBA had more positive attitudes about the role of prescribed fire and were more likely to apply this tool. Edwards Plateau PBA members had significantly higher response values than nonmembers to questions about the ecological effect and use of fire. Interestingly, some members of the EPPBA reported being opposed to prescribed fire before joining the organization but had joined to learn more. After joining they became ambassadors for prescribed fire once they learned about its benefits.

Curriculum Development

Development of the statements and themes for this thesis were guided by the Extension faculty who helped conceptualize Peers and Pros 360° (Smith, 2018). Subject matter experts were recruited via email and included 1 AgriLife Extension range specialist who focuses on prescribed fire, 2 AgriLife Research faculty who specialize in prescribed fire, and 1 fire biologist from a non-governmental organization (NGO). I recruited these individuals to be part of the development phase of the program so that the curriculum (i.e., the product of the expert meeting) would be based on expertise from prescribed fire specialists. These professionals provided statements that they commonly hear from landowners and land managers regarding the use of prescribed fire. I learned the Peers and Pros 360° development process, created the meeting agenda, and moderated the meeting.

I chose to invite an AgriLife Extension Specialist to our expert group because these professionals regularly conduct outreach programs, interact with our target group, and frequently hear feedback from that audience about their perceptions and beliefs. Additionally, I hoped that this program would be used to train county agents how to use the Peers and Pros 360° teaching

method so that the reach of the program can be expanded across the state. I invited 2 researchers who specialize in prescribed fire and 1 fire biologist from an NGO to ensure that there was a diverse group of experts able to bring their own expertise, experiences, and insights about the thoughts and perceptions of prescribed fire commonly held by landowners and land managers. The configuration of experts recruited to contribute to this program could be adjusted to fit the needs of individual program goals. For example, if Peers and Pros 360° was going to be used for a garden club curriculum, the individuals who help with development could include a club leader, someone from the horticulture department at a nearby university, a Master Gardener, and an extension agent involved with the Master Gardener program. The number of individuals invited to develop a curriculum can vary; however, when too many people are involved, it can be difficult to stay on track and be efficient, and for this reason fewer than 6 is recommended.

I chose to hold 2 separate meetings to develop the “Peers and Pros 360° Prescribed Fire” curriculum because I estimated each would take about 2 hours. The first meeting was held on March 4, 2021, and the second was held on March 22, 2021. While our meetings were held virtually using Zoom, development meetings can be held in-person, virtually, or hybrid. The goals for our first meeting were to 1) define the peer group, 2) brainstorm statements, 3) organize the statements into themes, 4) write the talking points for one statement, and 5) assign themes to each professional to create talking points.

During the first meeting I asked experts to define the target audience for the curriculum. When defining the target audience, experts were asked to consider several factors, including the geographic location of where the workshops would occur, the level of experience and knowledge participants at the workshops should have, and the target age group. Once the target audience was defined, experts were asked to brainstorm statements commonly heard by professionals from the

target audience. The experts were told these statements could be true, false, or contain a mix of fact and falsehood. To start, I prompted the experts to brainstorm and list out loud 20-30 common things they hear from landowners or land managers who contact them for advice, attend workshops, or communicate in another method. Experts were encouraged to keep the statements more conversational, as if a landowner was saying it directly to them, rather than formal or scientific. I then organized the statements into themes and reviewed and edited the statements as a group. Some statements were combined or omitted until each theme had 3 associated statements. Next, I created the talking points for one of the statements. I explained to the experts that these talking points would serve as a guideline for the designated expert(s) at a workshop. Talking points should be detailed enough that an educator who does not specialize in prescribed fire (e.g., a county agent) could still lead a workshop. Additionally, the talking points can serve as a guideline for someone who is an expert because it allows them to make sure the important points are covered for each theme. After working through several examples of talking points, I assigned themes to the subject matter experts so they could create the associated talking points and have them ready for review at the next meeting.

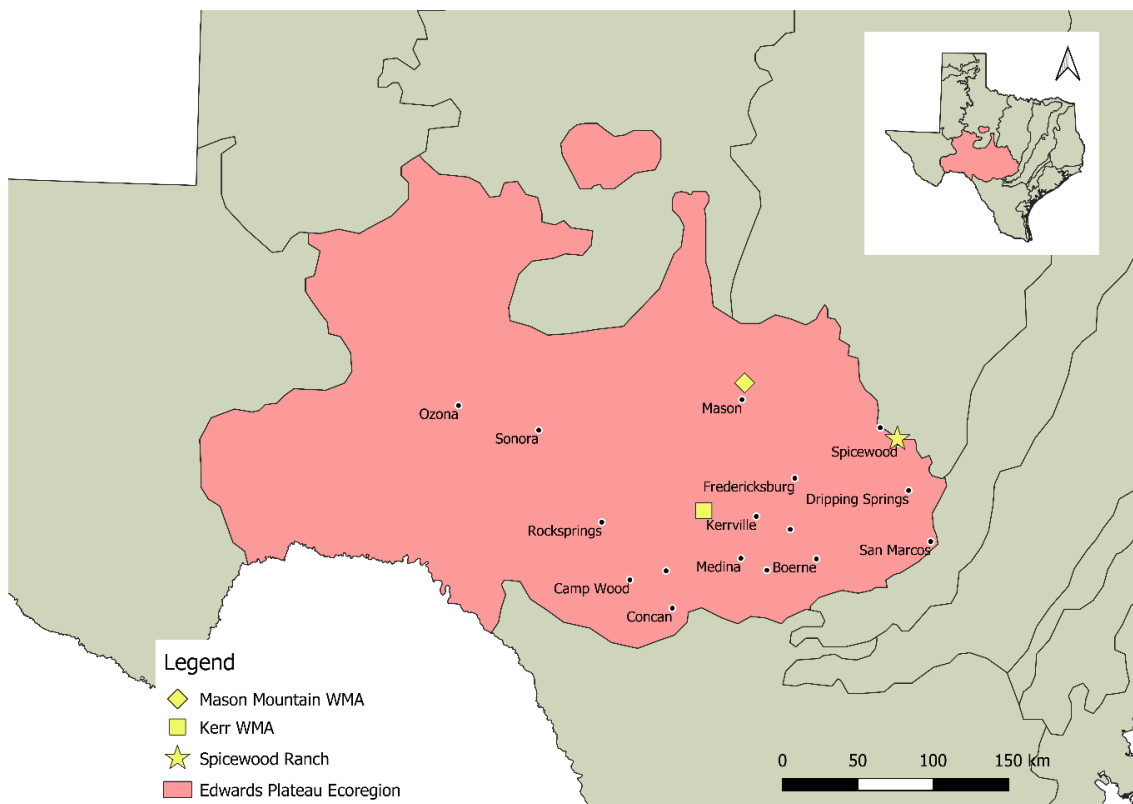
An additional meeting was held to finish the curriculum. Talking points created by the subject matter experts were presented to the group for review. Each statement and the associated talking points were discussed among the group until broad consensus was reached, and I produced a final draft of the curriculum.

Peers and Pros 360° - Prescribed fire workshop (2021)

I organized 3 Peers and Pros 360° prescribed fire workshops in the summer of 2021. Participants included peer landowners and land managers with various levels of knowledge regarding prescribed fire. The workshops were held at Kerr Wildlife Management Area (WMA),

Mason Mountain WMA, and Spicewood Ranch (Figure II.2) on May 7, 2021, May 13, 2021, and July 30, 2021, respectively. These dates were chosen based on availability of properties and subject matter experts. I visited each host site once before the workshop to learn about the property and choose locations within the property where themes would be discussed. Host sites were chosen for their current and previous use of prescribed fire; at all host sites, participants could see the results of different burn frequencies and timing. The workshops could be held at different times of the year in the future, especially if the property has conducted a recent burn or the results of a burn done the season before are visible to participants.

Figure II.2. Locations of Peers and Pros 360° prescribed fire workshops (n=3) in the Edwards Plateau ecoregion of Texas in 2021.



Kerr WMA and Mason Mountain WMA are both owned and operated by TPWD. The primary focus of Kerr WMA, located in Hunt, Texas, is to manage habitat and populations of

native wildlife. Kerr WMA also serves as a site for research on wildlife and habitat management. Results from this research are provided to local land managers, landowners, and other interested people. Mason Mountain WMA, located in Mason, Texas, is dedicated to studying the effects of exotic species on local vegetation and the interactions between these exotic species and native wildlife. This WMA focuses its research on wildlife management on private lands, especially for new nontraditional landowners whose goals are shifting toward recreation. Both WMAs provide hunting opportunities for the public through a draw system. The third Peers and Pros 360° program was held outside Spicewood, Texas, at Spicewood Ranch. This property is privately owned and managed by a land manager who has incorporated prescribed fire into his management plan. Prescribed fire has been frequently used on the property to control woody brush species and restore native grasses. The goals for this private property are to protect and improve regional water quantity and quality, restore native vegetation, and facilitate ecological research.

Participants were asked to check in upon arrival for each workshop and were given a name tag. Each workshop began with an introduction to the program type and location, including safety awareness. The professionals who served as designated experts at each workshop introduced themselves. The time allotted for each program was advertised as being 2 hours; participants were asked to let someone know if they needed to leave for any reason because we would be moving locations. For each workshop I chose 4 locations in advance that would correlate with the theme or themes that would be covered there. For example, if there was a field that had been burned during the winter next to a field that was burned during the summer, we discussed the theme Timing next to those fields to supplement the discussion with a real-life example. Participants were transported to each site by a hayride and were not responsible for driving themselves during the workshop.

During the workshop, qualitative data about the flow, length of each theme, peer participation, etc. were recorded by an AgriLife Extension program aide who observed each workshop. Following each workshop, participants were given a handout with additional information on the topics discussed, as well as contacts and resources on how to learn more (Appendix C – Program Handout, Kerr WMA & Mason Mountain WMA; Appendix D – Program Handout, Spicewood Ranch).

Surveys

Participants were asked to complete a survey immediately following the workshop they attended (Appendix E – Post-survey). My goal for the survey was to assess 1) if the program increased participant knowledge on the management practice(s) discussed, 2) participant intent to adopt the management practices discussed, and 3) participants' feelings and perceptions toward the practice introduced. All participants were handed a paper copy of the survey and were asked to complete and turn it in before leaving the site. Survey questions included Likert scale, multiple choice, short answer, and demographic questions. Surveys were anonymous and did not ask for participants' names. This survey was approved by Texas A&M University's Institutional Review Board (IRB2021-0548M).

Results

Curriculum Development

The first curriculum development meeting lasted slightly longer than 2 hours. I explained the Peers and Pros 360° process to the experts, and we accomplished the following goals: 1) defined the peer group, 2) created statements, 3) organized all statements into themes, 4) created the talking points for one statement, and 5) assigned themes to each professional to complete talking points.

Experts defined the peer group they normally reach when teaching or talking to individuals about prescribed fire in the Edwards Plateau ecoregion as adult landowners. These adult landowners represent a range of ages; however, experts reported seeing younger generations returning to the land. The experts discussed that in the future, they want to help develop a program geared for high school-aged youth who have some basic knowledge from learning about prescribed fire through camp or education programs such as 4-H and would like to learn more. Youth were not included in the target peer group for this specific program because of the different knowledge levels they would have and because they do not own or manage land. Experts reported encountering landowners and land managers whose experience ranges from basic to experienced. Landowners with a basic level of knowledge understand the effects of fire on brush and that fire can be used as a tool to manage juniper and mesquite. Landowners with more experience and knowledge understand seasons of fire and prescribed burn techniques, and how to be an ambassador for fire to their neighbors.

The group of subject matter experts produced 32 statements about prescribed fire that they commonly hear. These were organized into 8 themes: wildlife, livestock, timing, vegetation, cost, liability, resources, and benefits of prescribed fire. The statements were evaluated, revised, and reduced to 24 total statements (3 per theme). We then created all the talking points for 1 statement. Finally, I assigned 2 themes to each expert to create talking points. The notes taken during the first meeting, including the statements and themes developed, can be found in Appendix F – Program Development, Meeting 1 Notes.

The final meeting was scheduled to be 2 hours; however, we were able to review all talking points and finalize the curriculum in a little over 1 hour. The experts were told when and where all 3 workshops would take place and were invited to participate as workshop subject matter experts.

The results of the second meeting and the associated notes can be found as Appendix G – Program Development, Meeting 2 Notes.

Peers and Pros 360° – Prescribed fire workshops

The Peers and Pros 360° workshop at Kerr WMA recruited 16 participants from the surrounding area. The designated experts for the program were the NGO fire biologist who helped us develop our statements and a biologist from the WMA. The NGO biologist participated in all 3 programs along with a person who worked at each host site. The first workshop began at 9:06 am, and the first theme covered was “Benefits of Prescribed Fire” at a site near check-in. Discussions for the first theme were carried out by 2 peers who seemed to be experienced with the topic and lasted 9 minutes (Table II.1). Discussions for the second theme, “Wildlife,” were carried out by the 2 peers who spoke during the first theme and 1 additional participant; these 3 people are hereafter referred to as the “lead peers.” Some participants looked to experts to answer questions; however, experts redirected them to their peers and guided them to learn from one another until the discussion was over and the expert could summarize the theme and answer any questions the group still had. The third theme covered was “Livestock” and 2 new people contributed to the conversation with several others chiming in with small remarks and questions. Once this theme was closed, the group was relocated to a site that better supplemented discussion for the next theme, “Vegetation.” Several participants contributed to the conversation who had not done so before, and most of their questions were answered by the lead peers. The fifth theme, “Liability,” interested the group and participants asked the lead peers multiple questions. At the closing of this theme, the group was transported to a third location for the sixth theme, “Timing.” This theme had a slower discussion than the previous and the lead peers struck up most of the conversation until the expert closed the theme. The group then relocated to the last location where they first discussed

“Cost.” Participants immediately started talking and the group seemed to be comfortable with each other as the lead peers continued to answer questions others could not. The last theme discussed was “Equipment” and the workshop ended at 11:40 am. In total, 10 of the 16 participants contributed to conversations during the workshop.

The Peers and Pros 360° workshop at Mason Mountain WMA recruited 25 participants from the surrounding area. The designated experts for this program were an NGO fire biologist and the TPWD regional fire coordinator. The themes were discussed in the same order as at Kerr WMA, beginning with “Benefits of Prescribed Fire” at 9:16 am near the check-in site. Two participants started the discussion and multiple others joined. A single participant answered 4 separate questions that were asked. The next theme, “Wildlife,” consisted of several participants asking and answering questions. The “Livestock” theme was slow to start, and experts asked for statement cards to be reread. Once discussions began, the theme was led mostly by 1 participant. At this point in the workshop, it became clear that there were several participants with experience regarding prescribed fire and that many were part of their local PBA. Participants were transported to the next site to cover the theme “Vegetation.” One participant led most of the discussion; however, some new participants contributed and asked questions. One participant had to leave the workshop during this theme. Experts summarized the theme and gently corrected misinformation that was presented. There was a good discussion among participants for the next theme, “Liability,” and several talked about being part of their local PBA. Three participants took the lead role in answering liability questions for the rest of their peers. At the closing of this theme, participants were moved to a third location to discuss “Timing.” The group was not as engaged for this theme and experts had to ask participants to reread statements to encourage conversation. The group was then transported to the last location and the theme “Cost” was addressed with

participation from a large portion of the group. The experts clarified some comments made during the discussion and then moved to the final theme, "Equipment." This theme had participation from peers who had not previously spoken. Members of the PBA stepped in and discussed more benefits of joining the organization. In total, 13 peers participated in the discussions and the workshop ended at 11:50 am.

The Peers and Pros 360° workshop at Spicewood Ranch recruited 13 participants from the surrounding area. The designated experts for this program were an NGO fire biologist and a local TPWD wildlife biologist, and the themes followed the same order as the previous workshops. We began at 8:05 am with the first theme, "Benefits of Prescribed Fire," near the entrance to the ranch. Several participants immediately took part in the discussion. New participants chimed in and there was a good flow of discussion for the second theme, "Wildlife." While there was discussion during the "Livestock" theme, several participants voiced that they did not own or desire to own livestock. The group was relocated to the next site and addressed the theme "Vegetation." Participants took turns asking and answering questions with new participants contributing to the discussion. At this point, all but one participant had contributed to discussions. At the closing of this theme, experts answered several questions from participants. For the next theme, "Liability," the group asked each other several questions. Two participants answered most of the questions, and the group was transported to the next site to address the theme "Timing." There was not a lot of discussion for this theme and most questions were directed toward the landowner. The landowner was participating in the workshop and had knowledge on when the 2 fields at the theme site had been burned. The group was transported to the final site and the theme "Cost" was addressed with discussion among most participants. The experts had to ask participants to reread statement cards for the last theme, "Equipment," to encourage conversation. One peer began to answer most

questions and talked about how being in a PBA allows you to borrow equipment and have access to help. All 13 attendees participated in this workshop, and it ended at 11:21 am.

Table II.1. Theme duration for Peers and Pros 360° workshops about prescribed fire held at 3 locations in the Edwards Plateau ecoregion of Texas in 2021.

Theme	Duration (min)			
	Kerr	Mason Mountain	Spicewood	Program Mean
Benefits	9	9	6	8
Wildlife	10	8	9	9
Livestock	13	11	13	12
Vegetation	16	14	27	19
Liability	26	15	26	22
Timing	12	16	18	15
Cost	16	19	7	14
Equipment	18	16	24	19
Program Total ¹	120	108	130	118
¹ Total does not include time spent traveling from one location to the next				

Surveys

All 16 participants at the Kerr, 21 of 25 participants at Mason Mountain, and 12 of 13 participants at Spicewood turned in surveys. Results from the survey completed immediately following each workshop indicated 93% of participants preferred the Peers and Pros 360° teaching method over traditional methods (Table II.2). The average net promoter score for the workshops was 90. Participants at all 3 workshops experienced an increase in knowledge about all themes (Table II.3), with the largest percentage of participants increasing their knowledge on how to offset prescribed fire costs (76%) and resources for implementing prescribed fire (78%). Some participants provided additional comments (Appendix H – Survey Response Comments).

Table II.2. Method preference and Net Promoter Score for Peers and Pros 360° workshops about prescribed fire held at 3 locations in the Edwards Plateau ecoregion of Texas in 2021.

Workshop	Preference for Peers and Pros 360° teaching method (%)	Net Promoter Score
Kerr	100 ¹	88
Mason Mountain	89 ²	96
Spicewood	91 ³	85
Program Mean	93	90
¹ n = 15, 1 participant did not respond. ² n = 19, 2 participants did not respond. ³ n = 12, 1 participant did not respond.		

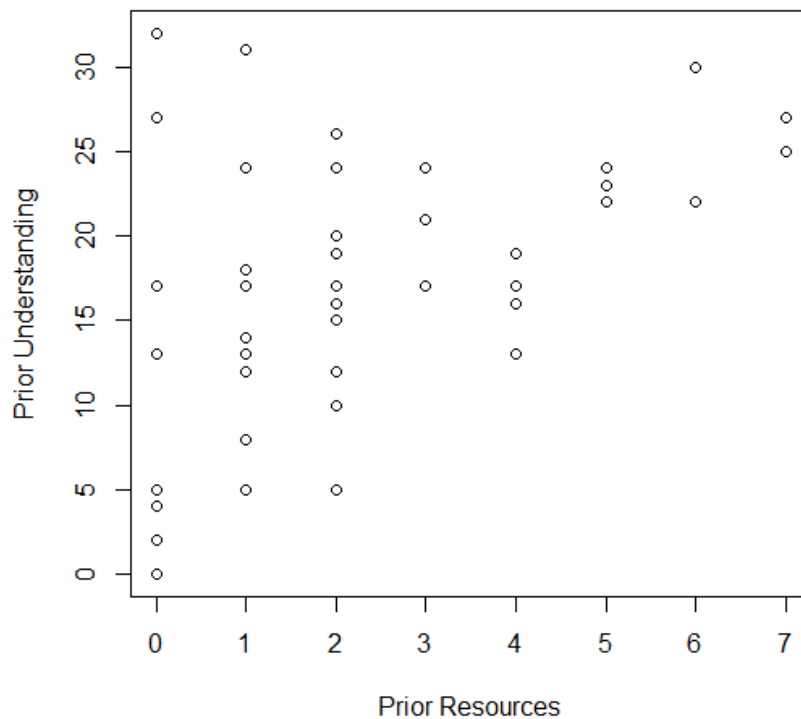
Table II.3. Self-reported knowledge change for Peers and Pros 360° workshops about prescribed fire held at 3 locations in the Edwards Plateau ecoregion of Texas in 2021.

Workshop	Self-reported Knowledge Score (points) ¹			Prior experience utilizing prescribed fire (%)
	Pre-workshop	Post-workshop	Knowledge change	
Kerr	14.3	23.9	9.6	33 ²
Mason Mountain	18.1 ³	25.2 ³	7.1 ³	53 ⁴
Spicewood	16.6 ⁵	27.8 ⁵	11.2 ⁵	50
Program Mean	16.3	25.6	9.3	45
¹ Points possible = 32. ² n = 15, 1 participant did not respond. ³ n = 20, 1 participant did not respond. ⁴ n = 19, 2 participants did not respond. ⁵ n = 11, 2 participants did not respond.				

Participants were asked to indicate what unique resources, if any, they had used to learn about prescribed fire prior to attending the workshop. These resources included face-to-face AgriLife seminars, virtual AgriLife seminars, seminars hosted by another agency or organization, AgriLife fact sheets or publications, publications from another agency or organization, county extension agents, TPWD wildlife biologists, Natural Resources Conservation Service biologists, private consulting biologists, and other. The most-used resources by participants at the Kerr were TPWD biologists (31%) and other (31%). The most-used resources by participants at Mason

Mountain were TPWD biologists (57%), face-to-face AgriLife seminar (38%), and seminar hosted by another agency or organization (38%). The most used resources by participants at Spicewood were county agent (42%), publications from another agency or organization (25%), and other (25%). Survey results indicated the more unique resources a participant used prior to attending the workshop, the more likely they were to have a higher level of understanding before the workshop. However, prior understanding for those who did not use any resources varied drastically from little to considerable understanding (Figure II.3). Twenty-three of the 39 participants who used any resource reported using a resource produced by AgriLife.

Figure II.3. The number of unique resources participants used prior to the workshop as related to their self-reported prior understanding score (32 points possible) at Peers and Pros 360° workshops about prescribed fire held at 3 locations in the Edwards Plateau ecoregion of Texas in 2021.



Participants were asked to indicate how their perception of risk and their knowledge of prescribed fire changed following the workshop. All questions were organized on a Likert scale, with 1=strongly agree, 2=agree, 3=somewhat agree, 4=neither agree nor disagree, 5=somewhat

disagree, 6=disagree, and 7=strongly disagree. For analysis, I collapsed strongly agree, agree, and somewhat agree into 1 category, agreed. Eighty-eight percent of participants at Kerr, 81% of participants at Mason Mountain, and 75% of participants at Spicewood agreed that their perception of risk involved with prescribed fire had decreased (Table II.4). Ninety-four percent of participants at Kerr, 100% of participants at Mason Mountain, and 83% of participants at Spicewood agreed that their level of comfort in applying prescribed fire had increased. All participants at Kerr, 95% of participants at Mason Mountain, and 92% of participants at Spicewood agreed they experienced an increased understanding of the advantages and disadvantages involved with prescribed fire. All participants at Kerr and Mason Mountain and 92% of participants at Spicewood agreed that the knowledge they gained was applicable to their future use of prescribed fire.

Table II.4. Perception of risk regarding use of prescribed fire following Peers and Pros 360° workshops about prescribed fire held at 3 locations in the Edwards Plateau ecoregion of Texas in 2021.

Workshop	Percentage of Participants						
	Strongly agree	Agree	Somewhat agree	Neutral	Disagree	Somewhat disagree	Strongly disagree
<i>My perception of risk involved with prescribed fire has decreased.</i>							
Kerr	24	44	19	6	0	0	6
Mason Mtn.	19	52	10	5	10	0	5
Spicewood	8	50	17	17	0	0	8
<i>My comfort level with the application of prescribed fire on my property has increased.</i>							
Kerr	44	38	13	6	0	0	0
Mason Mtn.	29	43	29	0	0	0	0
Spicewood	33	33	17	8	0	0	8
<i>I have an increased understanding of the advantages and disadvantages involved with prescribed fire in general.</i>							
Kerr	56	38	6	0	0	0	0
Mason Mtn.	33	52	10	5	0	0	0
Spicewood	33	50	8	0	0	0	8
<i>The knowledge I gained from this program is applicable to my future use of prescribed fire.</i>							
Kerr	63	38	0	0	0	0	0
Mason Mtn.	48	48	5	0	0	0	0
Spicewood	58	25	8	0	0	0	8
<i>May not add up to 100% due to rounding.</i>							

Fifteen of 16 participants at Kerr, 20 of 21 participants at Mason Mountain, and all 12 participants at Spicewood who turned in surveys indicated they owned or managed land in the Edwards Plateau ecoregion. Participants primarily used land for ranching, personal recreation, or private residence (Table II.5, Connally, 2020). There was a range in property sizes across all three workshops (Table II.6). While small-acreage properties (<200 acres) were common, approximately half of participants owned more than 200 acres of land.

Table II.5. Designated land use(s) of property owned or managed by Peers and Pros 360° prescribed fire workshop participants. Workshops were held at 3 locations in the Edwards Plateau ecoregion of Texas in 2021.

Land Use	Number of Participants			
	Kerr	Mason Mountain	Spicewood	Total
Private Residence	8	11	9	28
Farming or Crop Production	2	1	0	3
Ranching - Domestic Livestock	8	19	7	34
Ranching - Native Wildlife	8	14	6	28
Ranching - Exotic Wildlife	8	0	1	9
Personal Recreation	10	14	8	32
Lease Hunting	2	6	0	8
Natural Gas or Oil Exploration	0	1	0	1
Timber Production	0	0	0	0
Other	2	1	1	3

Table II.6. Size of properties owned or managed by participants at Peers and Pros 360° prescribed fire workshops held at 3 locations in the Edwards Plateau ecoregion of Texas in 2021.

Workshop	Number of Participants				
	0-50 acres	50-100 acres	100-200 acres	200-500 acres	500+ acres
Kerr	1	2	6	0	6
Mason Mountain	0	3	1	5	11
Spicewood	3	1	1	3	4
Program Total	4	6	8	8	21

Five participants at Kerr (31%) used prescribed fire as a management tool prior to attending the workshop. These participants reported that they conduct burns every 1-6 years. Two participants conducted burns only in the winter, 1 during all seasons, and 2 only during the spring.

Three of the 5 participants who already used prescribed fire were part of their local PBA (19% of total participants). Ten participants at Mason Mountain (48%) used prescribed fire as a management tool prior to attending the workshop. These participants reported that they conduct burns every 1-4 years. Two participants conducted burns only during the winter, 1 during all seasons, 3 during spring and winter, 1 during summer and winter, 1 during fall and winter, and 2 only during the summer. Six out of the 10 participants who conducted burns prior to the workshop were part of their local PBA (29% of total participants). Six participants at Spicewood (50%) used prescribed fire as a management tool prior to attending the workshop. These participants reported that they conduct burns every 1-5 years. Four participants conducted burns only during the winter and 2 conducted burns during the summer and winter. Two of the 6 participants who conducted burns prior to the workshop were part of their local PBA (17% of total participants).

When asked about the benefits of this teaching method, a majority of participants who attended the workshops at Kerr indicated they enjoyed learning from their peers (100%), getting to know fellow landowners (88%), being able to discuss freely and participate (88%), and not having a professional lecture (56%). All participants at Mason Mountain indicated they enjoyed learning from their peers (100%), and a majority reported that they enjoyed getting to know fellow landowners (95%), being able to discuss freely and participate (86%), and not having a professional lecture (62%). When asked what the disadvantages of this teaching method were, 6% of participants at Kerr indicated professionals were not able to share enough information and 6% indicated they did not learn enough from their peers. At Mason Mountain, 33% of participants indicated professionals were not able to share enough information and 5% of participants indicated they did not learn enough from their peers. Participants at Spicewood were not able to answer this portion of the survey due to printing errors. Several participants provided comments indicating

additional benefits or disadvantages of the teaching method (Appendix I – Benefits and Disadvantages).

A majority of participants who attended the workshops (61%) were born in the 1950s and 1960s (Figure II.4). Most participants (82%) possessed a bachelor’s degree or higher, and all participants who answered the question graduated from high school (Figure II.5). A majority of participants at each workshop were male (mean 65%; Figure II.6).

Figure II.4. Age groups of participants at 3 Peers and Pros 360° prescribed fire workshops in the Edwards Plateau ecoregion of Texas.

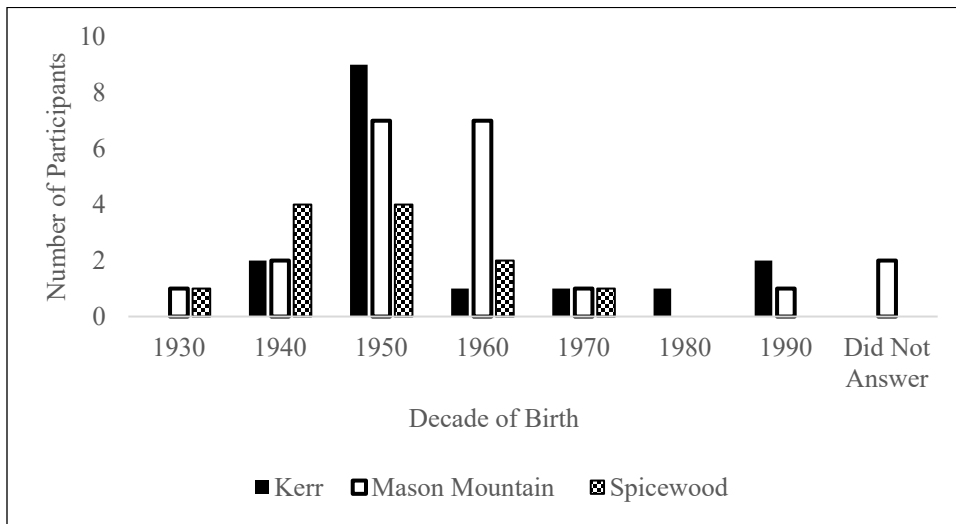


Figure II.5. Education level of participants at 3 Peers and Pros 360° prescribed fire workshops in the Edwards Plateau ecoregion of Texas.

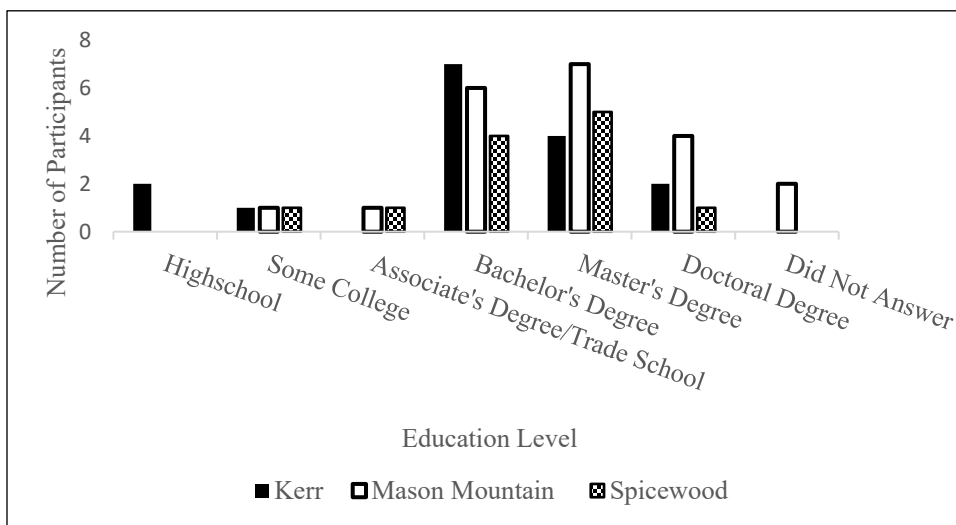
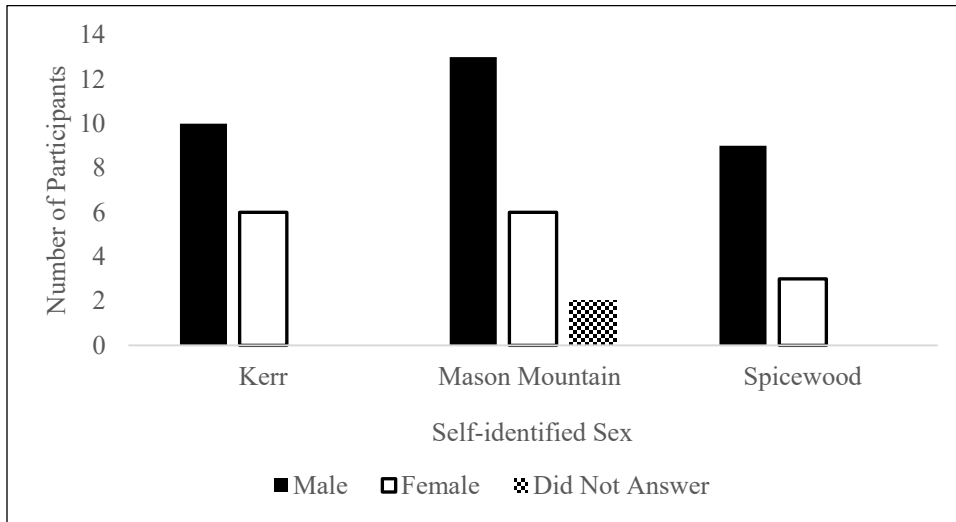


Figure II.6. Sex of participants at 3 Peers and Pros 360° prescribed fire workshops in the Edwards Plateau ecoregion of Texas.



Discussion

General Discussion

At each workshop I chose to open with the “Benefits of Prescribed Fire” theme because it was very broad and touched on information that would be further addressed throughout the workshop. I chose this theme anticipating participants might be hesitant to contribute to discussions at the beginning of the workshop and that conversations would likely have more substance once participants felt comfortable with the new format. Participants were relatively quiet at first but opened up and became more vocal throughout the workshop. The benefits of prescribed fire were discussed throughout the entirety of each workshop; therefore, I was satisfied that this theme was sufficiently addressed. I anticipated that the duration of each theme would vary because the workshops were peer-led, and the peers determined how long they discussed each theme. When participants at a workshop were interested in a theme, they took longer to discuss than if they were not interested or needed more guidance from the pros.

The high rate of participants who preferred the Peers and Pros 360° teaching method over traditional methods and the high mean Net Promoter Score indicate that this workshop format was

well-received by participants. The high self-assessed increases in knowledge indicate that this workshop is an effective method for teaching landowners about prescribed fire. I was surprised that participants at all 3 workshops reported an increase in knowledge. While participants at Kerr had less familiarity with fire before the program, approximately half of the participants at Mason Mountain and Spicewood had prior experience with fire and involvement with the local PBA was highest for participants at Mason Mountain. A majority of participants at each workshop agreed their perception of risk involved with fire decreased, their level of comfort with the application of prescribed fire on their property increased, and they had an increased understanding of the advantages and disadvantages of prescribed fire. This is exciting because it indicates that the Peers and Pros 360° teaching method is an effective teaching method for positively impacting landowners' perceptions about prescribed fire.

The Peers and Pros 360° teaching method was well-received, with all participants indicating they enjoyed learning from their peers and a majority indicating they enjoyed getting to know fellow landowners, being able to discuss freely and participate, and not having a professional lecture. While a majority did indicate they enjoyed not having a professional lecture, the percentage of participants who agreed with this statement was the lowest for both Kerr and Mason Mountain. Therefore, a moderated peer-to-peer approach may have an advantage in this regard over an unmoderated peer-to-peer approach.

Forty-seven of the 49 participants who turned in surveys indicated they own or manage land in the Edwards Plateau ecoregion, indicating that the program reached my intended target audience. Participants primarily used land for ranching, personal recreation, or private residence. This is consistent with our hypothesis and with the changing demographics in Texas documented in other studies. I was surprised, however, that approximately half of participants owned more than

200 acres of land, given the increase in property fragmentation. Landowners who have larger properties may be more willing to implement prescribed burns and therefore more likely to attend a workshop about prescribed burning. Participant age and education demographics were consistent with my expectations, although I was not expecting 14% of participants to have a doctoral degree. Participants with higher levels of education may be more likely to seek knowledge or have prior knowledge regarding prescribed fire or other management tools. They also may be more able to afford to purchase property as 100% of those with a doctoral degree indicated their income was over \$75,000.

Limitations and Concerns

Some individuals may be hesitant to participate in a new style of learning or surprised at the level of participation that is required during a moderated peer-to-peer workshop. On the other hand, the target audience (a balanced representation of the demographics of landowners in this region), may be more attracted to this type of program. We were able to recruit participants by involving local County Extension Agents and PBAs, and by advertising on social media and AgriLife Today. Additionally, we recruited several partners with strong reputations for providing a credible source of information in Texas, including TPWD, Natural Resources Conservation Service, and Oaks and Prairies Joint Venture. These partners helped market the program to their contacts in the local area of each workshop.

Two workshop locations were on public property, and one was on private land. Mason Mountain could potentially have recruited more participants than Kerr because although it is public land, Mason Mountain is not regularly open to the public. Spicewood is private land and is also not regularly open to the public; however, Spicewood is not as known as Mason Mountain. Results could have been influenced depending on whether participants attended a workshop on private or

public land. The public land sites have been conducting burns longer than the current owner at Spicewood has. The landowner being present at Spicewood could have influenced results because he was present to answer specific questions participants had, he was a peer of theirs, and he was not a prescribed fire professional but had knowledge and experience on his own property.

Future Research

While this study showed a positive response to the Peers and Pros 360° teaching method, evaluation of programs on other topics would be beneficial. Comparing my results to Peers and Pros 360° workshops on other topics will help ensure that it is an effective teaching method across a broad range of applications. This teaching method should also be evaluated in locations other than the Edwards Plateau ecoregion of Texas. The talking points resource for professionals is meant to support leaders who may not be experts in the workshop subject, but research is needed on the base level of knowledge for a pro to effectively conduct a Peers and Pros 360° workshop. For example, feedback from county agents will help evaluate whether they can serve as an effective pro even if they have limited experience in the designated topic.

Implications for Extension Services

The experience that landowners will gain through this program may lead to enhanced land management outcomes by improving their knowledge about the management tools and techniques presented. Additionally, this program can build relationships among landowners as well as between landowners and extension personnel. With these relationships comes trust between landowners and extension personnel, which encourages landowners to turn to extension services for information.

CHAPTER III.
IMPACTS OF A PEERS AND PROS 360° PRESCRIBED FIRE PROGRAM ON
PARTICIPANT BEHAVIOR

Abstract

Extension programs, such as those about range and wildlife management for Texas landowners, are designed to increase participants' knowledge. Increased knowledge is often assumed to increase adoption of practices; however, that assumption is not always evaluated. This project investigated the effectiveness of a moderated peer-to-peer learning approach for extension outreach to landowners. I evaluated 3 Peers and Pros 360° workshops about prescribed fire to investigate the extent to which participants were motivated to implement the management practice introduced (intent to adopt) and whether participants actually implemented management practices. Demographics, property size, and prior knowledge were evaluated for their effect on how likely participants were to intend to adopt practices. Participants at all 3 workshops indicated high intent to adopt all practices introduced at the workshop. On average, participants across all workshops indicated they intended to adopt 5 practices. Response rates to the follow-up survey were low; therefore, I could not draw conclusions about actual adoption rate. This study documents both the potential impacts of extension outreach and the challenges in measuring actual impacts.

Introduction

Behavior Change Theories

Education and an increase in knowledge do not necessarily lead to increased support for an environmental issue. For example, Kellert (1990) indicated that an increase in knowledge about wolf ecology did not lead to an increase in public support for wolf restoration activities. In a study done in Sweden, there was also no relation between knowledge and support for wolves (Ericsson & Heberlein, 2003). However, there are stronger links between attitudes and behaviors (Gifford &

Sussman, 2012). While knowledge consists of an individual's awareness of facts, information, and skills, Breckler (1984) describes attitudes as having three parts. The first part is the thoughts regarding an object, the second is the feelings about an object, and the third is the behavioral intentions and actions concerning the object. Attitudes are not easily changed, but when people gain experiences, they are more likely to change their attitudes toward a topic (Heberlein, 2012).

The theory of planned behavior tries to predict behaviors from attitudes and explain how the two variables are linked (Oreg & Gerro-Katz, 2006). This theory suggests that the best predictor for behavior is behavioral intentions, which are made up of three parts. The first is the extent to which individuals hold a positive attitude toward a specific behavior, the second is the individual's perceptions of the norms that are associated with the behavior, and the third is the degree to which the individual believes the behavior is under his or her control (Oreg & Gerro-Katz, 2006).

The value belief norm model is used to understand and explain environmentally significant individual behaviors. Pro-environmental behaviors originate from personal values, a belief that the environment is being threatened, and that the individual can take actions that will help lessen that threat (Stern et al., 1999). Social movements may strive to change attitudes and behaviors in relation to environmental issues. For a social movement to be successful, it must be supported by strong activists and have support from the general public (Stern et al., 1999). There are 3 different types of public support: citizenship actions, policy or political support, and personal behaviors. As state agencies, extension programs must remain apolitical and thus, most strive to influence personal behaviors.

Post- and Follow-up Surveys

Planned behavior theory can be used to change attitudes and thus gain social support for movements such as the reintroduction and support of prescribed fire. Surveys are commonly used to evaluate changes in knowledge, attitudes, and behaviors after participants have completed a program. Traditional survey methods include the pretest model (participants are given a survey only before the workshop) and the posttest model (participants are given a survey only after the workshop). These survey models do not assess knowledge change or change in behavior because they only assess participants' knowledge or behavior either before or after the workshop. Another traditional survey method style is the pretest-posttest model, where participants are given a survey before a workshop and then given the same survey after the workshop to assess their knowledge change, attitude change, confidence change, etc. The pretest-posttest model can be used in extension because it measures program effects (Rockwell & Kohn, 1989). An advantage of the pretest-posttest model is that it provides more information than the pretest and posttest models. Additionally, it can capture skill, knowledge, and perception change. Some disadvantages of the pretest-posttest model include the time it takes to administer 2 separate surveys and incomplete evaluation of participants who may not be present at the very beginning or very end of a workshop. Response-shift bias is another concern associated with this type of survey model because participants must use the same frame of reference to compare themselves against before and after the workshop (Howard, 1980). There is potential for participants to overestimate or underestimate their knowledge before a workshop.

The retrospective survey model design is different than the previous models discussed because the pretest and posttest surveys are administered concurrently in one survey at the end of the workshop. This survey model asks participants to recall their knowledge, behavior, and

perceptions prior to the workshop and compare those to after the workshop. Allen and Nimon (2007) indicates retrospective surveys provide a more accurate measure of pre-intervention behavior. A retrospective survey takes less time, is less intrusive, and, for self-reported change, it avoids pretest sensitivity and response shift bias that can result from pretest overestimation or underestimation (Pratt et al. 2000; Rockwell & Kohn, 1989). The strengths of a retrospective survey include reducing or eliminating response shift bias, survey type versatility, and convenience (Howard, 1980, Howard et al., 1981). Some potential weaknesses of a retrospective survey include self-reporting bias and the lack of research over the best way to design this type of survey. Additionally, participants have to rely on the recall process to remember what their knowledge or comfort level was before the workshop (Pratt et al., 2000).

While pretest-posttest and retrospective surveys measure the immediate effects of education efforts, understanding the mid- to long-term impacts of a workshop is important to agencies for program evaluations. One way to evaluate the mid- to long-term impacts of a workshop is by sending a follow-up survey to participants. Follow-up surveys can measure behavior change and collect data on whether participants implemented the management practices introduced. Follow-up surveys can be distributed via the web, postal mailings, or telephone calls. These surveys can also be distributed using a mixed-mode model where there is a combination of web, postal mailing, and telephone communication.

Web-based surveys avoid the costs associated with postal mailings and avoid the time-consuming nature of telephone communications (Hill, 2013; Israel, 2011). In a study done by Israel (2011), participants responded quicker when they were sent an email requesting that they complete an online survey than if they received a survey in the mail or received a mail invitation to complete an online survey. Additionally, participants who provided an email address and were sent a survey

link via email had response rates almost identical to those who were sent the survey via postal mail. With this similar response rate, the major advantage of sending survey links in emails is the significant monetary savings (Israel, 2011). One disadvantage of sending surveys via email is the potential for participants to not have access to email or the internet (Israel, 2011). In a literature review study done by Daikeler et al. (2020), the average response rate for web surveys was 12% less than mail surveys, but web surveys conducted in the United States had higher response rates (9% less than mail surveys) than those in other countries.

Fan and Yan (2010) suggested combatting low response rates by piloting the survey, avoiding unnecessarily long surveys, ensuring correct formatting, making it easy to find and open the web survey, knowing if your audience is comfortable using a computer and the internet, and avoiding technical failures (which will substantially decrease response rate). Further research is needed on survey completion and survey return, and on various techniques or behaviors that increase response rates (Fan and Yan, 2010). Different web survey platforms also need to be compared and assessed.

Prescribed Fire in the Edwards Plateau ecoregion

Prior to European settlement, the Edwards Plateau ecoregion of Texas was a grassland savannah maintained by grazing bison (*Bison bison*) and pronghorn antelope (*Antilocapra americana*), as well as frequent natural and human-caused fires (Smeins, 1980). This region supported a vast array of forbs and grasses with juniper (*Juniperus* spp.) species restricted to riparian corridors or other areas where fire did not frequently occur (Smeins, 1980). European settlers introduced fences, cows, sheep, and goats to the landscape and worked to suppress fire (Ansley & Rasmussen, 2005; White & Hanselka, 2019). Fences prevented the natural movement of some native wildlife species while overgrazing of livestock prevented adequate rest and

recovery for native plants (Smeins, 1980). By the 1900s, overgrazing and the suppression of fire had converted this region from a grassland to a brushland (Smeins, 1980). Today, the Edwards Plateau is dominated by many poor-quality browse, forb, and grass species (TPWD, n.d.). Ashe juniper (*Juniperus asheii*) and redberry juniper (*Juniperus pinchotii*; both colloquially called cedar) have become the dominant plant species in the Edwards Plateau (Thurow & Hester, 1997).

Prescribed fire is a tool that can reduce the physical presence and the competitive impact of junipers on native grasses in Texas (Ansley & Rasmussen, 2005). Some of the other ecological benefits of fire include improved pasture accessibility; improved soil health; increased production, availability, palatability, and nutrition of forage and browse; decreased abundance of brush, cacti, and undesirable and invasive vegetation species; improved herbaceous composition; improved grazing distribution for livestock and wildlife; and improved nutrient cycling (White & Hanselka, 2019; Ansley & Rasmussen, 2005).

In a study of the Edwards Plateau and Rolling Plains ecoregions, Kreuter et al. (2008) found the use of prescribed fire was positively correlated with property size, residence on the land, annual household income, proportion of income derived from the land, and positive perspectives about the effects of prescribed fire. Concerns about legal liability and lack of resources and assistance while conducting a burn deterred landowners from using prescribed fire as a management tool. Members of the Edwards Plateau Prescribed Burn Association (EPPBA) had more positive attitudes about the role of prescribed fire and were more likely to apply this tool. Interestingly, some members of the EPPBA reported being opposed to prescribed fire before joining the organization but had joined to learn more. After joining they became ambassadors for prescribed fire once they learned about its benefits. A study done in Texas in 2013 found that lack of skill, knowledge, and access to equipment, and membership in a PBA were more important

factors than risk perceptions in affecting landowner decisions to use prescribed fire as a management tool (Toledo, 2014).

Educating landowners and land managers about the misconceptions associated with prescribed fire, empowering them with the knowledge to make good management decisions, and providing them with the resources they need to find information, helping hands, and equipment is essential for ensuring prescribed fire is used in the correct situations and in a way that allows them to reach their management goals.

Research Objectives

Determining whether moderated peer-to-peer learning is an effective method for increasing adoption of management practices introduced will produce valuable information for future extension and education programs. This research sought to evaluate whether participants at a Peers and Pros 360° workshop about prescribed fire were motivated to adopt new practices that were introduced (intent to adopt) and actually implemented those practices. Results from this study will help educators determine more effective ways of imparting knowledge so that, when applicable, landowners can incorporate improved management practices into their short- and long-term land management plans. Improving extension program effectiveness is essential for encouraging science-based, relevant, and continuing education that fosters long-term, positive change.

Methods

Study Area

I evaluated 3 Peers and Pros 360° prescribed fire workshops throughout the summer of 2021. Participants included peer landowners and land managers with various levels of knowledge regarding prescribed fire. The workshops were held at Kerr Wildlife Management Area (WMA), Mason Mountain WMA, and Spicewood Ranch on May 7, 2021, May 13, 2021, and July 30, 2021,

respectively. Host sites were chosen for their current and previous use of prescribed fire; at all host sites, participants could see the results of different burn frequencies and timing. Each workshop began with an introduction to the program type and location, including safety awareness. Participants were informed that this event was part of my study, but that they did not have to participate in the surveys that provided the actual study data.

Post-survey

After the program was designed and research objectives were identified, I began post-survey design and development. When designing the post-survey, I considered 4 research questions: 1) did knowledge change after participation in the Peers and Pros 360° teaching method; 2) are moderated peer-to-peer teaching methods such as Peers and Pros 360° preferred by attendees; 3) did Peers and Pros 360° motivate participants to implement the management practice introduced (intent to adopt); and 4) did participants actually implement the management practices learned during the Peers and Pros 360° workshop. I chose to design and conduct a retrospective survey; this survey was approved by Texas A&M University's Institutional Review Board (IRB2021-0548M; Appendix E – Post-survey). I printed paper copies of the survey to handout to participants immediately following each workshop. Post-surveys were anonymous.

I asked participants to indicate how likely they were to adopt 7 specific practices associated with prescribed fire within 6 months of the workshop, rated on a Likert scale from 1=extremely unlikely to 5=extremely likely. These practices included: using prescribed fire to create food plots for wildlife, using prescribed fire to create heterogeneous vegetation, changing stocking rates or rotation patterns to build up fuel, using prescribed fire to manage encroaching brush, working with the local PBA to conduct a burn, applying for cost assistance through a cost-share program, and

contacting Texas A&M AgriLife, Oaks and Prairies Joint Venture, or Texas Parks and Wildlife Department (TPWD) for information on prescribed fire.

Follow-up Survey

The follow-up survey was distributed to participants approximately 6 months following each workshop (Appendix J – Follow-up Survey). This survey was distributed through the email participants provided when they signed up for the workshop. Participants were asked to complete a survey generated using Qualtrics software (Qualtrics 2022). The email sent to participants included a link that directed them to their workshop’s corresponding survey and also instructed them to let us know if they would prefer a paper copy mailed to them. These surveys were anonymous and demographic questions were asked again because there was no way to link responses to the post-survey. The follow-up survey evaluated whether the landowner implemented any new management practices because of attending the workshop. Follow-up surveys were intended to be sent 6 months following each workshop, but actual distribution was delayed. Surveys were sent to Kerr WMA and Mason Mountain WMA participants on November 29, 2021, and to Spicewood Ranch participants on February 1, 2022.

Statistical Analysis

All statistical analysis were conducted using Program R (R Core Team, 2022). I built and evaluated linear models to assess participants’ intent to adopt prescribed fire practices. The response variable was a Likert score that summed the scores of intent to use prescribed fire to create food plots for wildlife, intent to use prescribed fire to create heterogeneous vegetation, and intent to use prescribed fire to manage encroaching brush. I used ANOVA to determine if there were differences in the Likert scores for intent to adopt prescribed fire among the 3 workshops before combining them for analysis. I considered a predetermined set of models that included

variables on their own and combinations of variables that were non-correlated (Pearson's correlation $r > 0.45$, $p < 0.001$; package Hmisc). Variables included workshop preference, land use, property size, demographic information, and PBA membership. I used second-order Akaike's Information Criterion (AICc) to evaluate the top models, using package MuMin. I calculated the variance inflation factor for the top model using package car, and Cronbach's alpha using package ltm.

I also built and evaluated linear models to assess participants' intent to seek assistance. The response variable was a Likert score that summed the scores of intent to work with the local PBA to conduct a burn, intent to apply for cost assistance through a cost-share program, and intent to contact Texas A&M AgriLife, Oaks and Prairies Joint Venture, or TPWD for information on prescribed fire. I used ANOVA to determine if there were differences in the Likert scores for intent to seek assistance among the 3 workshops before combining the scores. I considered a predetermined set of models that included variables on their own and combinations of variables that were non-correlated (Pearson's correlation $r > 0.45$, $p < 0.001$; package Hmisc). I considered workshop preference, working use, demographic information, and PBA membership. I used second-order Akaike's Information Criterion (AICc) to evaluate the top models, using package MuMin. I calculated the variance inflation factor for the top model using package car and Cronbach's alpha using package ltm.

Results

Post-survey Analysis

All 16 participants at the Kerr, 21 of 25 participants at Mason Mountain, and 12 of 13 participants at Spicewood turned in their post-survey immediately following their workshop. Participants at all 3 workshops indicated high intent to adopt all practices (all means above 3.8).

All participants at Kerr and Spicewood indicated they would adopt at least 1 practice. All but 3 participants at Mason Mountain indicated they would adopt at least 1 practice, 2 of whom could not adopt any new practices because they reported already using the practices listed prior to the workshop. Kerr and Spicewood participants indicated they would most likely contact a state agency or NGO for information about prescribed fire (mean score of 4.7 for both workshops). Mason Mountain participants indicated they would most likely work with their local Prescribed Burn Association (mean score of 4.8). On average, participants across all workshops indicated they intended to adopt 5 practices (Table III.1).

The mean Likert score for intent to adopt a prescribed fire practice was not different across the 3 workshops ($F(2,32) = 1.66, p = 0.21$), so I combined the scores for my analysis. The maximum possible Likert score (all practices marked as extremely likely) was 15. The mean Likert total score was 12.6 which indicates high intent to adopt (Cronbach's alpha = 0.80). This average took into account only the 34 participants who answered the question, did not already report using prescribed fire practices, and did not mark "unsure." Participants had higher intent to adopt prescribed fire practices if they were not already a member of a PBA and had a higher income (Table III.2.). Membership in a PBA was not strongly correlated with income ($r = -0.22, p = 0.33$). The relationship between income and intent to adopt ($\beta = 1.11, p = 0.31$) was stronger than between intent and PBA membership ($\beta = -0.89, p = 0.59$), although neither was particularly strong.

The mean Likert score for intent to seek assistance was not different across the 3 workshops ($F(2,31) = 0.34, p = 0.70$), so I combined the scores for my analysis. The maximum possible Likert score (all practices marked as extremely likely) was 15. The mean Likert score was 13.1 which indicates high intent to adopt (Cronbach's alpha = 0.61; may indicate low reliability, Warmbrod, 2014). This average took into account only the 34 participants who answered the question, who did

not already report seeking assistance, and did not mark “unsure.” Participants were more likely to intend to seek assistance if they were not already a member of a PBA and had a higher income (Table III.2). The relationship between income and intent to adopt ($\beta = 1.22, p = 0.05$) was stronger than that between PBA membership and intent to adopt ($\beta = -0.40, p = 0.72$).

Intent to modify stocking rates was not modeled because we only asked one question regarding this practice; therefore, the score was not a true Likert score. The average intent to change stocking rates or rotation patterns to build up fuel was 4.17 (a score of 5 was the highest possible).

Table III.1. Participant intent to adopt practices introduced at Peers and Pros 360° prescribed fire workshops held at 3 locations in the Edwards Plateau ecoregion of Texas in 2021. Results are expressed as percent¹ of participants marking that answer.

How likely are you to:							
Extremely Unlikely	Unlikely	Neutral	Likely	Extremely Likely	Unsure	Already Do This	N/A
...use prescribed fire to create food plots for wildlife?							
2	2	8	41	33	2	10	2
...create heterogeneous vegetation?							
0	2	8	35	33	4	16	2
...change stocking rates or rotation patterns to build up fuel?							
0	2	12	29	29	0	16	12
...use fire to manage encroaching brush?							
0	2	8	29	43	4	14	0
...work with your local Prescribed Burn Association (PBA) to conduct a burn?							
0	2	8	12	51	4	16	6
...apply for cost assistance through a cost-share program?							
0	8	14	24	41	2	8	2
...contact Texas A&M AgriLife, Oaks and Prairies Joint Venture, or TPWD for information on prescribed fire?							
0	2	4	22	63	2	6	0
¹ May not add up to 100% due to rounding.							

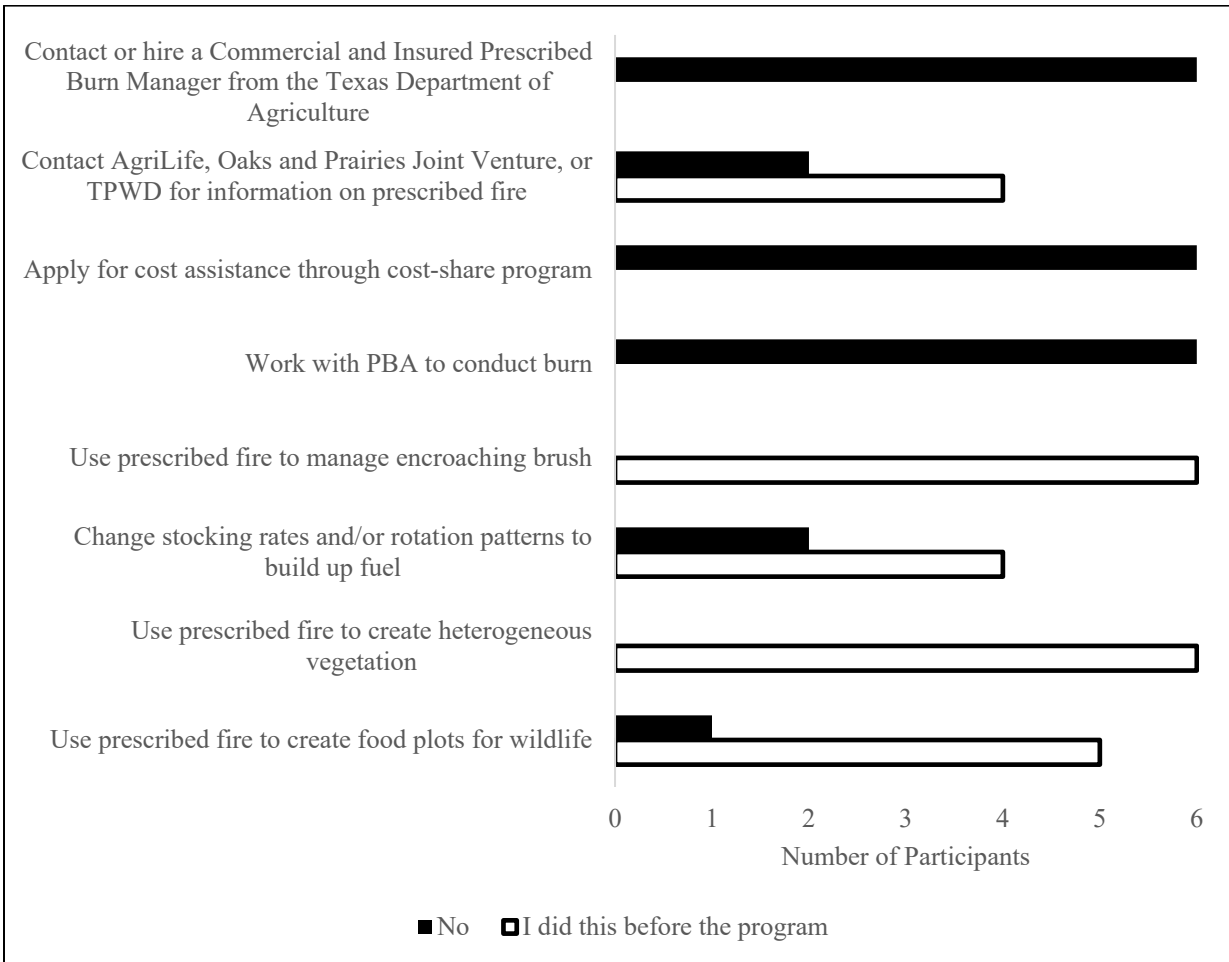
Table III.2. Top models for intent to adopt practices after Peers and Pros 360° prescribed fire workshops held at 3 locations in the Edwards Plateau ecoregion of Texas in 2021. Reported values include degrees of freedom (df), second-order Akaike’s Information Criterion (AICc), difference in AICc scores (Δ), and AICc weights (Weight).

Top Models	df	AICc	Δ	Weight
Intent to adopt prescribed fire practices as related to:				
PBA membership + Income	4	71.4	0.00	1
Workshop preference + PBA membership	4	94.4	22.92	0
Intent to seek assistance as related to:				
PBA membership + Income	4	57.7	0.00	0.997
Workshop preference + Income	4	69.6	11.97	0.003

Follow-up Survey Analysis

Six participants (37.5%) who attended the workshop at the Kerr completed the follow-up survey. None of these respondents were members of a PBA. Four respondents indicated they utilized prescribed fire on their property within 6 months of receiving their survey and had plans to do so before attending the workshop (Figure III.1.). All 4 of these respondents also indicated they had plans to use prescribed fire in the next 6 months and had plans to do so before attending the workshop. Two respondents did not implement prescribed fire within 6 months of receiving the survey; 1 of those indicated they were planning on utilizing prescribed fire in the next 6 months and had plans to do so before attending the workshop. Five of the 6 respondents owned land that was at least 500 acres and 1 owned land 0-50 acres in size. Time of land ownership ranged from less than 1 year up to 22 years. All respondents were male, had received a bachelor’s degree, and 5 out of 6 were white. Two respondents were born in the 1950s, 2 in the 1980s, and 2 in the 1990s. Income ranged from \$35,000-49,000 to \$75,000-99,000.

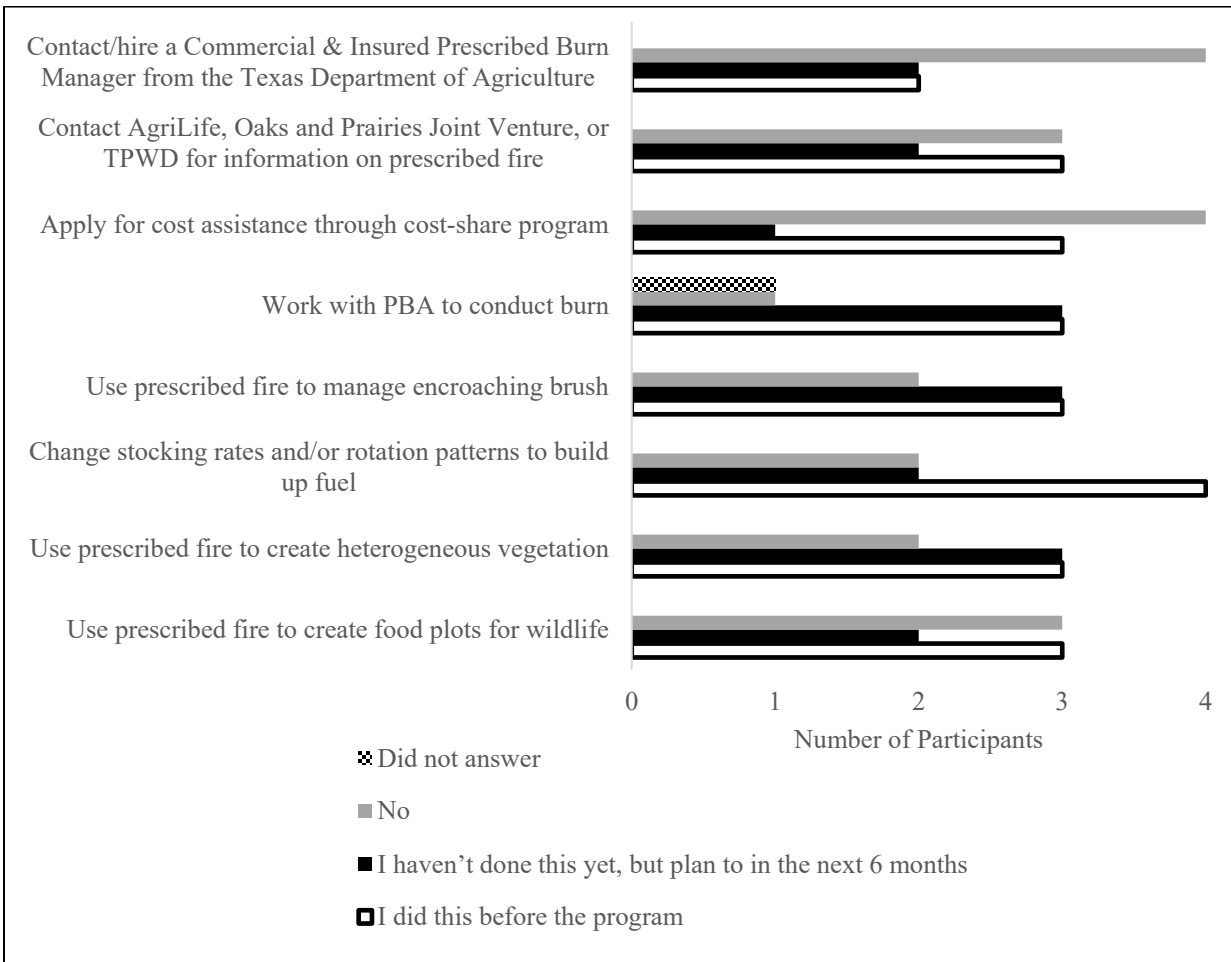
Figure III.1. Practices implemented by participants at the Kerr Peers and Pros 360° workshops about prescribed fire in the Edwards Plateau ecoregion of Texas in 2021 (n=6).



Eight participants (32%) who attended the Mason Mountain workshop completed the follow-up survey. Five of these respondents indicated they were members of a PBA prior to attending the workshop and 3 indicated they were not members. One respondent indicated they utilized prescribed fire on their property within 6 months of receiving the survey and had plans to do so before attending the workshop (Figure III. 2.). This respondent also indicated they had plans to implement a prescribed fire within the next 6 months and had plans to do so before attending the program. Three additional respondents indicated they had plans to implement a prescribed fire within the next 6 months and had plans to do so before attending the workshop. One respondent indicated they had plans to implement a prescribed fire within the next 6 months because of what

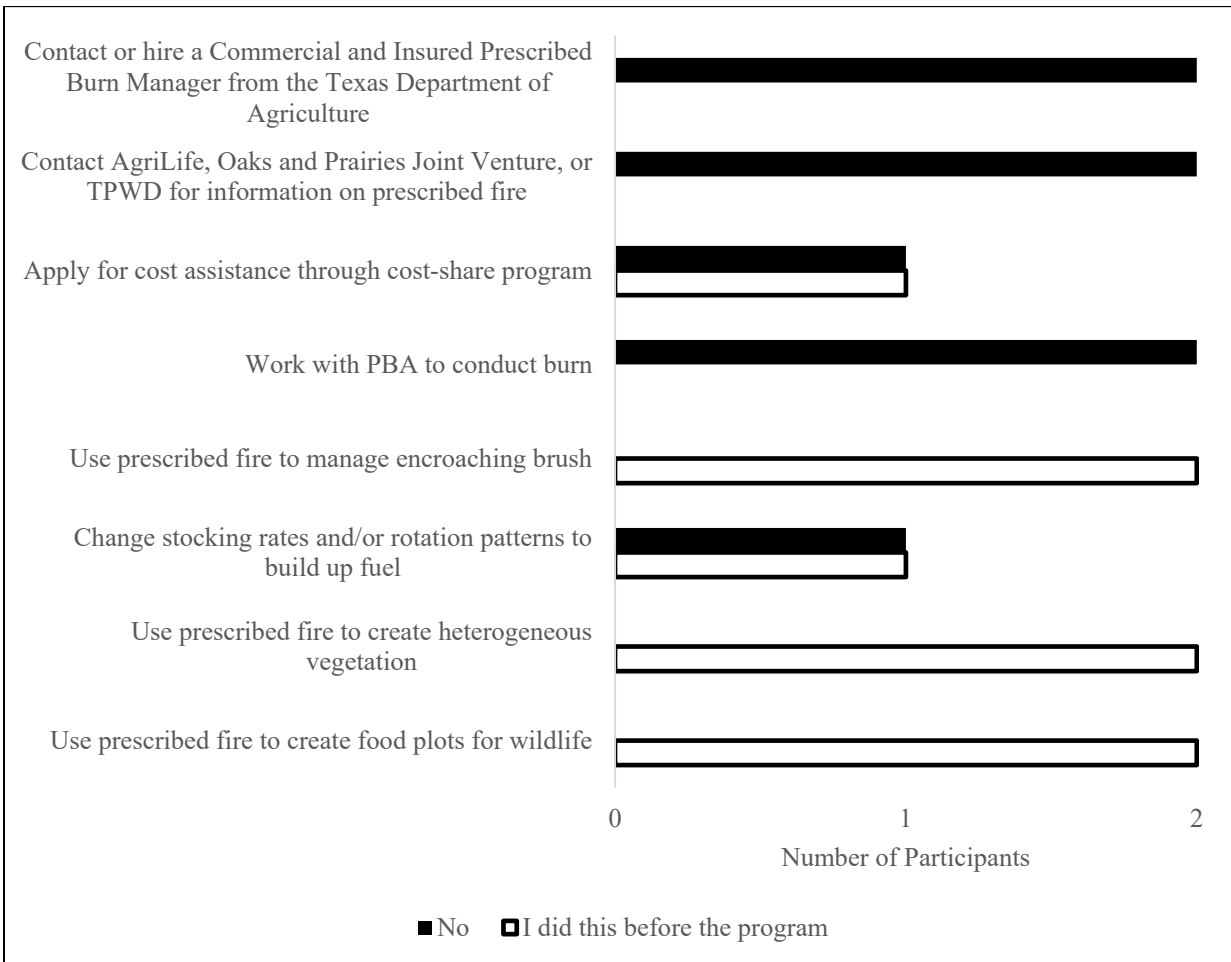
they learned at the program. Three respondents owned more than 500 acres, 2 owned 200-500 acres, 2 owned 100-200 acres, and 1 owned 50-100 acres. Respondents had owned their land for 2 to 80 years (presumably family land). One respondent was born in the 1930s, 3 in the 1950s, and 4 in the 1960s. Two respondents were females and 6 were males. The 7 respondents who indicated their ethnicity were white. Three respondents had received doctoral degrees, 2 had master's degrees, 2 had bachelor's degrees, and 1 attended some college. Income ranged from \$75,000-99,000 to over \$100,000.

Figure III.2. Practices implemented or planned to implement by participants at the Mason Mountain Peers and Pros 360° workshops about prescribed fire in the Edwards Plateau ecoregion of Texas in 2021 (n=8).



Two participants (15.4%) who attended the workshop at Spicewood completed the follow-up survey. Neither of these respondents was a member of a PBA. Additionally, neither respondent implemented prescribed fire within 6 months of receiving the survey; however, 1 indicated they plan on using prescribed fire within the next 6 months and had plans to do so before attending the program (Figure III. 3.). One respondent owned 200-500 acres and owned their land for 32 years and the other owned at least 500 acres for 65 years. These respondents were born in the 1940s and 1950s and were both white males. One respondent obtained a bachelor’s degree and the other a doctoral degree. Income ranged from \$75,000-99,000 to over \$100,000.

Figure III.3. Practices implemented or planned to implement by participants at the Spicewood Peers and Pros 360° workshops about prescribed fire in the Edwards Plateau ecoregion of Texas in 2021(n=2).



Participants were asked to indicate what unique resources, if any, they used to learn about prescribed fire within 6 months of receiving the follow-up survey (Figure III.4). Respondents from the Kerr workshop reported using Oaks and Prairies Joint Venture biologists (67%), a seminar hosted by another agency or organization (33%), and TPWD biologists (33%) more than other options. Respondents from the Mason Mountain workshop reported using TPWD Biologists (63%), AgriLife fact sheets or publications (34%), and NRCS Conservationists (34%) most often. Both respondents from Spicewood indicated they had used no resources since attending the workshop. Additionally, participants were asked to indicate the designated land use or uses of their property (Figure III.5, Connally, 2020).

Figure III.4. Resources used to learn more about prescribed fire by participants at 3 Peers and Pros 360° prescribed fire workshops in the Edwards Plateau ecoregion of Texas. Follow-up survey was administered approximately 6 months after each workshop (n=16).

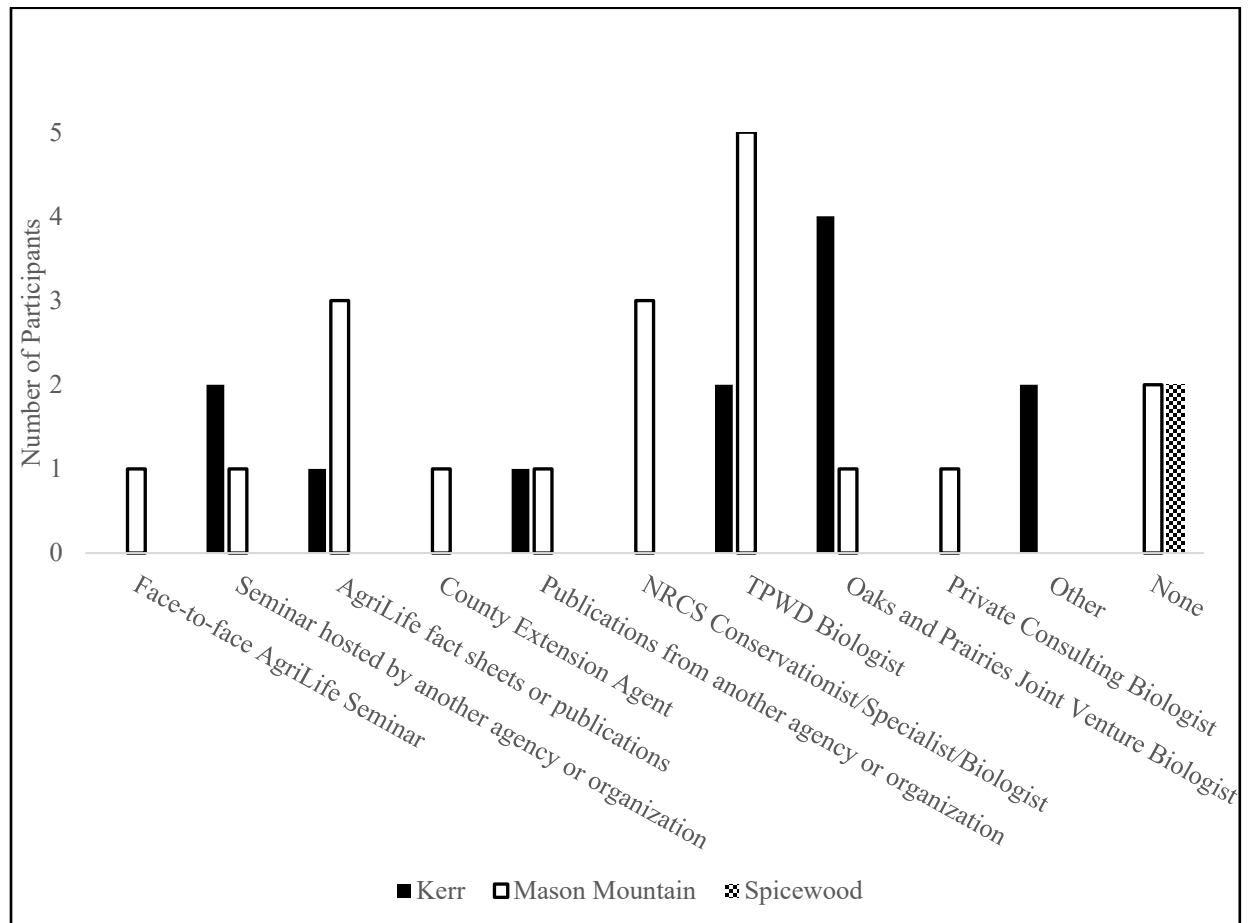
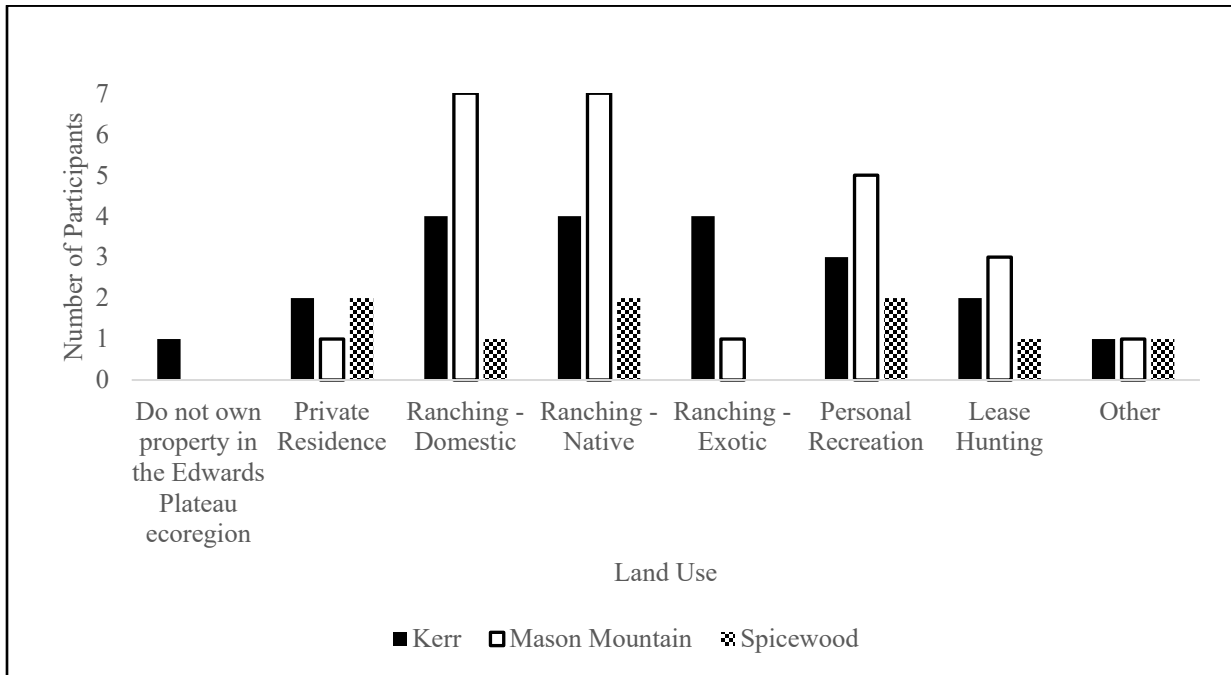


Figure III.5. Land use(s) of participants at 3 Peers and Pros 360° prescribed fire workshops in the Edwards Plateau ecoregion of Texas (n=16).



Income reported by respondents for the follow-up survey was not representative of respondents from the post-survey ($t = 21.60, p < 0.001$). However, PBA membership reported by respondents for the follow-up survey was similar to that of respondents from the post-survey ($t = 1.29, p = 0.20$).

Discussion

Post-survey

A majority of participants at all 3 workshops turned in the post-survey handed to them immediately following their workshop. I anticipated most would be filled out because enthusiasm at the end of each workshop was high and participants were eager to share comments with me orally. Results from the post-survey indicated that participants at all 3 workshops had high intent to adopt all practices introduced. This is exciting because it indicates that the Peers and Pros 360° teaching method is an effective teaching method for motivating participants to implement management practices introduced.

Intent to adopt prescribed fire practices was weakly related to PBA membership and income. Participants who were not already members of their local PBA likely had higher intent to adopt prescribed fire practices because many of those who were in a PBA already had implemented these practices and thus were excluded from analysis. Higher income may make it easier for individuals to buy equipment and hire help to implement prescribed fire practices. Intent to seek assistance was also weakly related to PBA membership and income. Participants who are not members of a PBA may have had higher intent to seek assistance because those who were members already have contacts and relationships with people who can help them, and they may also have already had knowledge on the topics the workshop covered. The relationship between income and intent to adopt was stronger than PBA membership. It is possible that those with higher income are more likely to seek assistance because they will have the funds to implement the management practice once they have the knowledge they need to do so.

Follow-up Survey

The response rates for Kerr, Mason Mountain, and Spicewood were 38%, 32%, and 15%. The response rates for Kerr and Mason were in the range I expected; however, I was surprised by the low response rate from Spicewood participants because participant engagement during that workshop was higher than any other (100% participation in discussion).

Across all the follow-up surveys, only 1 participant listed the workshop as the reason they had plans to implement a prescribed fire within 6 months of receiving the survey. Most respondents indicated that they had or were planning on implementing prescribed fire, they just had plans to do so before attending the workshop. Only 4 respondents (25%) from the follow-up survey had not implemented prescribed fire in the past 6 months and were not planning on implementing the management tool in the next 6 months. Two of the 4 of these participants indicated they had used

some of the prescribed fire practices before attending the workshop, so perhaps they do not plan to utilize prescribed fire within the year but plan to doing so at another time.

PBA membership reported by respondents from the follow-up survey was representative of the post-survey. Participants who were part of a PBA prior to the workshop may have already used prescribed fire. Survey responses may not have captured participants who were not already part of the PBA and may have implemented prescribed fire as a result of attending the workshop. Income reported by respondents for the follow-up survey was not representative of respondents from the post-survey which is important because income was an important factor regarding intent to adopt. Income was skewed high in the follow-up survey which could have biased results. Respondents to the post survey also reported a higher level of education. Those with higher income and higher education may have been more likely to complete the follow-up survey. Given this bias, results of the follow-up surveys should be interpreted with caution. The post-survey indicated the workshop resulted in high intent to adopt management practices, but I cannot conclude whether actual adoption was low or whether I did not receive enough representative follow-up responses to determine actual adoption.

Limitations and Concerns

Follow-up survey response rates are a common problem in extension. Low response rates can affect results because they may not be representative of the group, especially if those individuals who responded are actually the outliers in the group. We attempted to combat this by emailing participants an online follow-up survey using the address they provided upon registration. Additionally, the follow-up survey was short, participants were given the option to have a paper copy mailed to them if they did not want to fill it out online, and participants were sent a reminder email with the survey link.

Future Research

Future research may include investigating the disconnect between intent to adopt and actual adoption. It is important for extension services to do more than give people the knowledge to want to implement management practices. Rather, extension services need to be able to increase actual adoption of these management practices by providing the knowledge, tools, and resources to do so. Additionally, future research may investigate what makes participants more likely to complete follow-up surveys in extension programs. Achieving better representation of the participants in a follow-up survey will ensure that results are not biased toward one group of participants.

Implications for Extension Services

The experience that landowners will gain through this program may lead to enhanced land management outcomes by increasing adoption rates of management practices introduced. Additionally, this program can build relationships among landowners as well as between landowners and extension personnel. With these relationships comes trust between landowners and extension personnel, which encourages landowners to turn to extension services for information.

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APPENDIX A – STATEMENT CARDS



1



2

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country

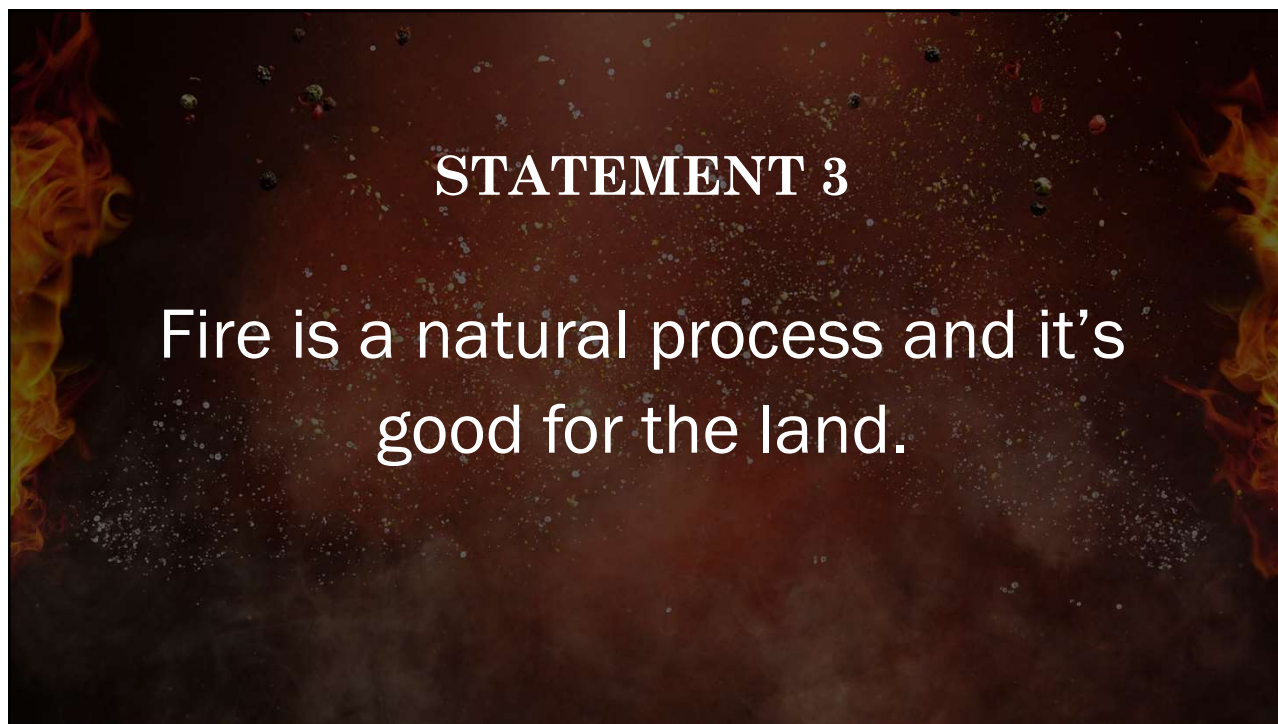


3

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country



4



STATEMENT 3

Fire is a natural process and it's good for the land.

5



STATEMENT 4

Ring fires can trap fleeing wildlife.

6

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country



7

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country



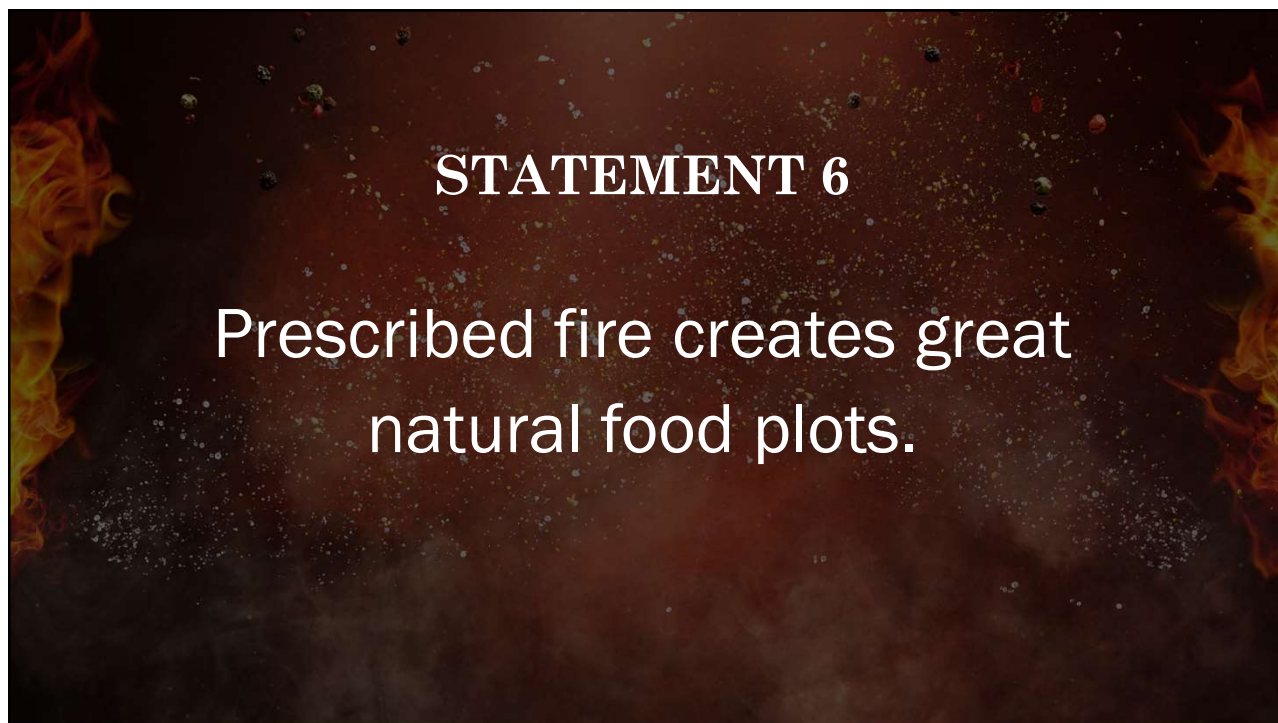
8



STATEMENT 5

Fire leaves wildlife with no place to hide.

9



STATEMENT 6

Prescribed fire creates great natural food plots.

10

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country

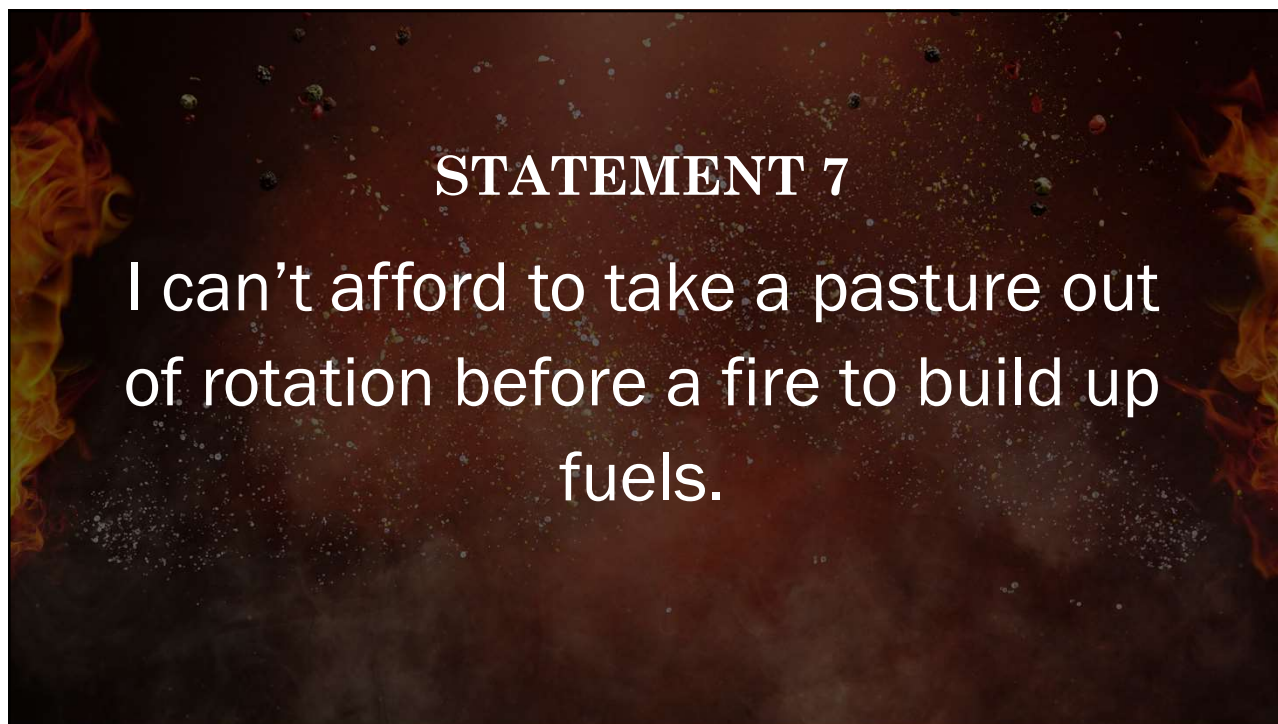


11

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country



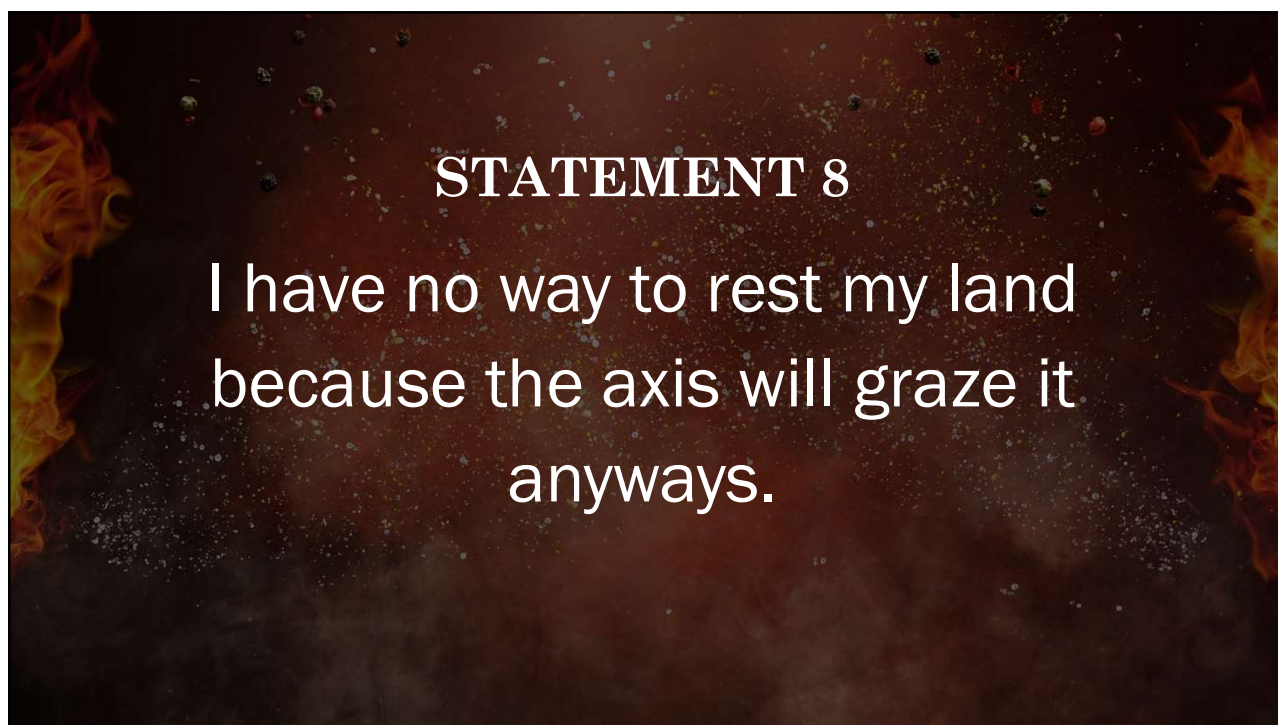
12



STATEMENT 7

I can't afford to take a pasture out of rotation before a fire to build up fuels.

13



STATEMENT 8

I have no way to rest my land because the axis will graze it anyways.

14

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country

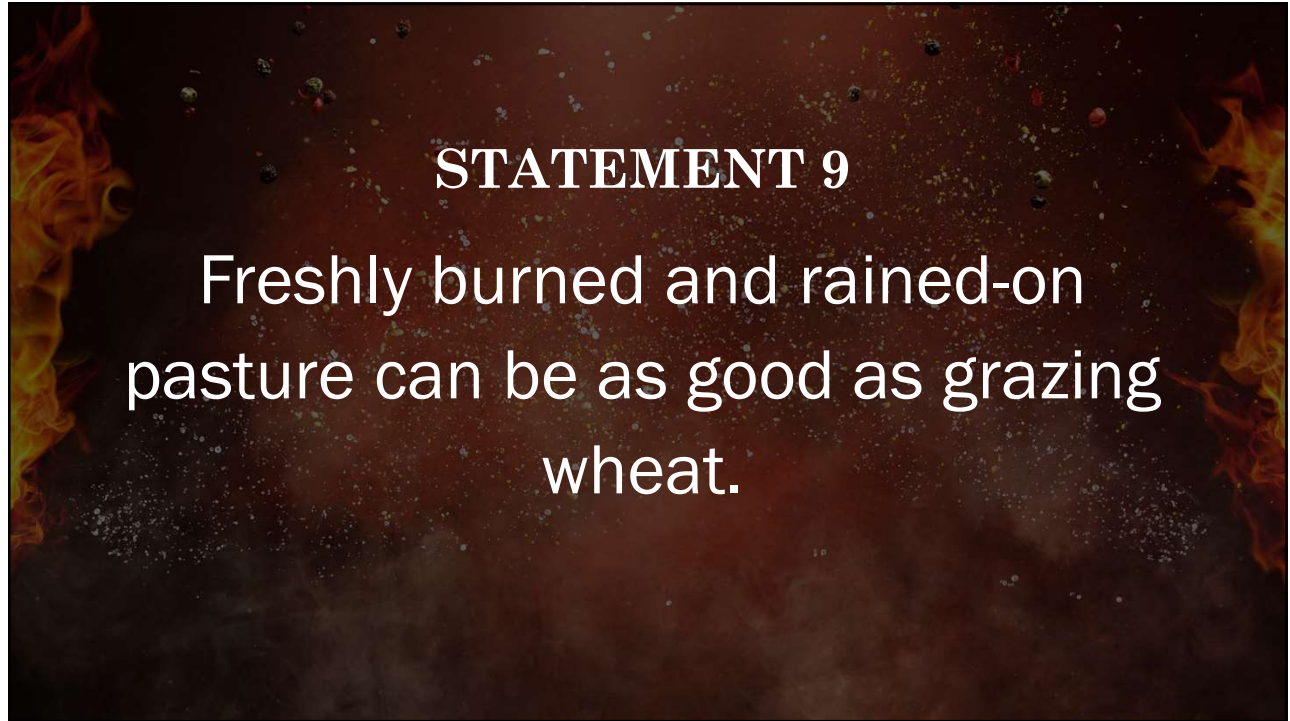


15

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country



16



STATEMENT 9

Freshly burned and rained-on
pasture can be as good as grazing
wheat.

17



STATEMENT 10

Invasive plants will take over after
a fire.

18

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country



19

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country



20



STATEMENT 11

Burning and grazing have helped us control Texas wintergrass.

21



STATEMENT 12

I'm scared to use fire because I have too many trees/my junipers are mature and dense.

22

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country

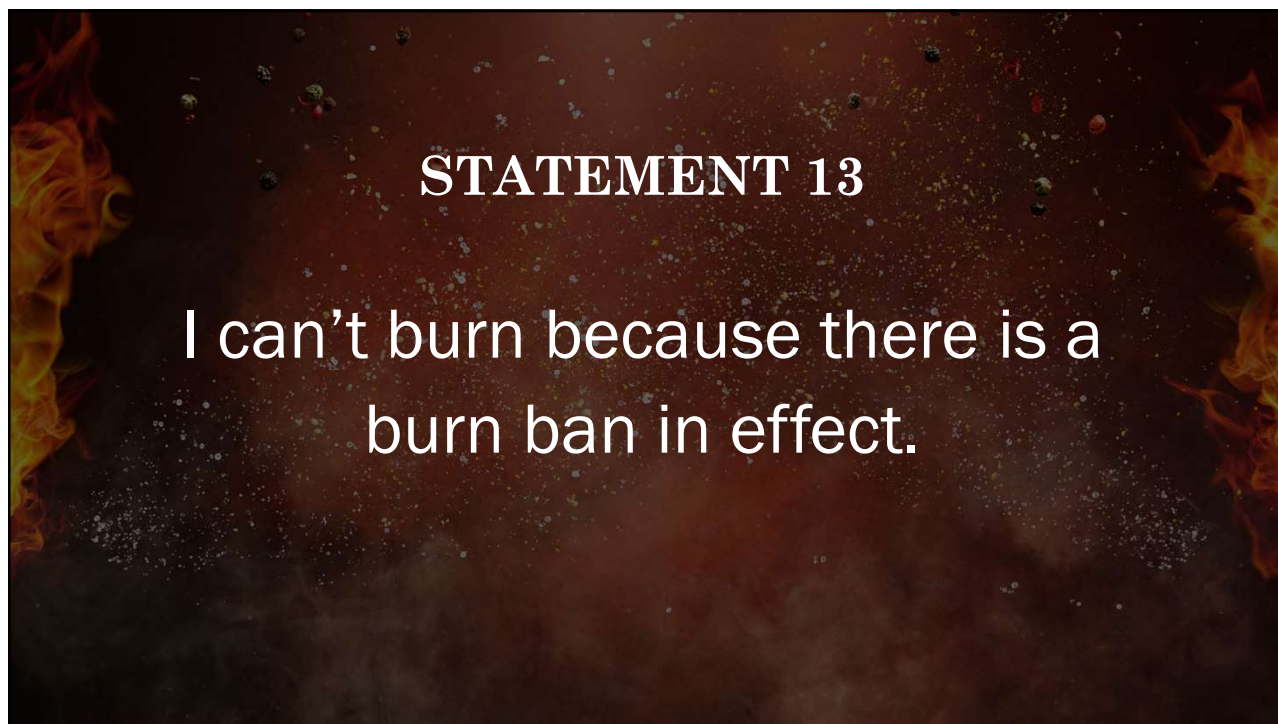


23

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country



24



STATEMENT 13

I can't burn because there is a
burn ban in effect.

25



STATEMENT 14

I can't burn because my ranch is
next to town.

26

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country

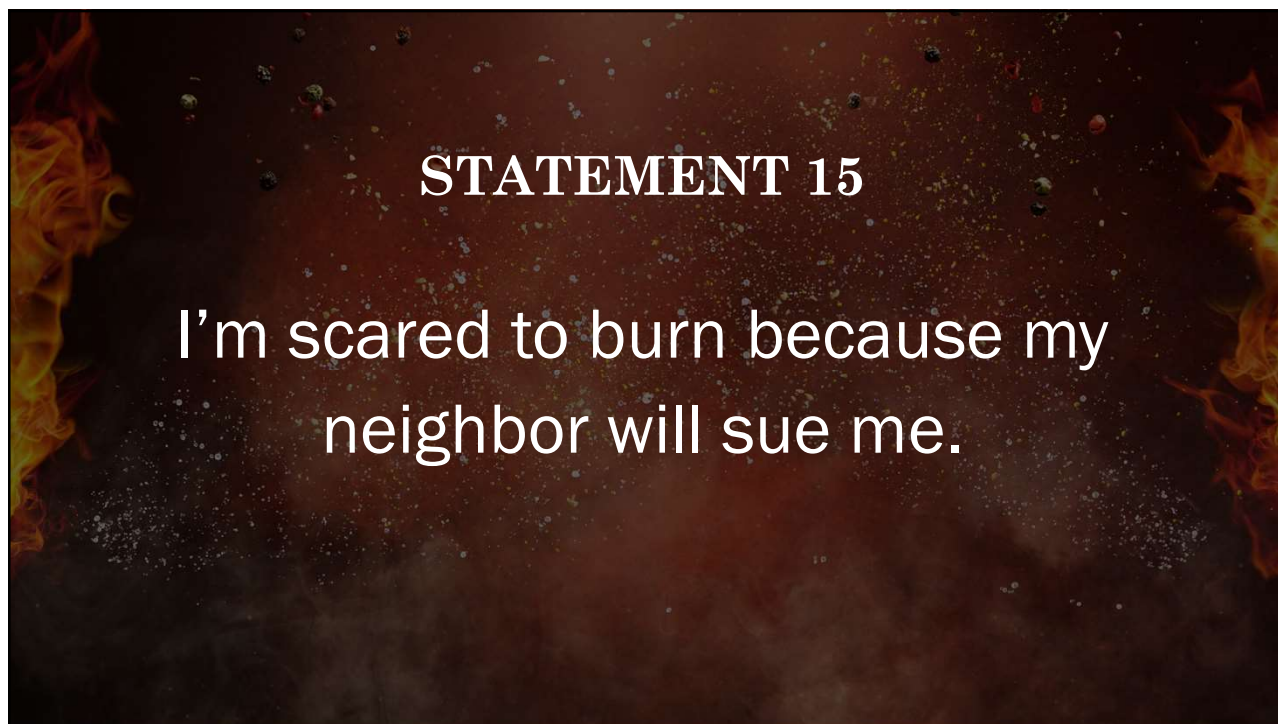


27

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country



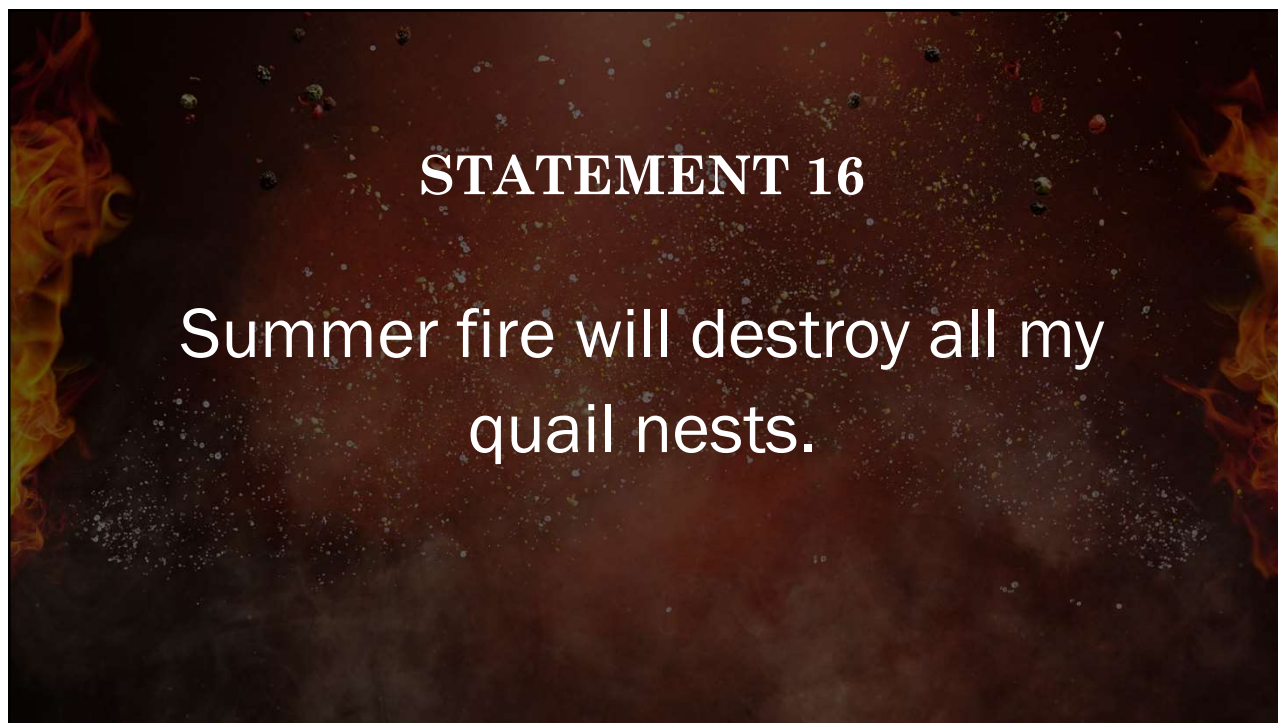
28



STATEMENT 15

I'm scared to burn because my neighbor will sue me.

29



STATEMENT 16

Summer fire will destroy all my quail nests.

30

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country

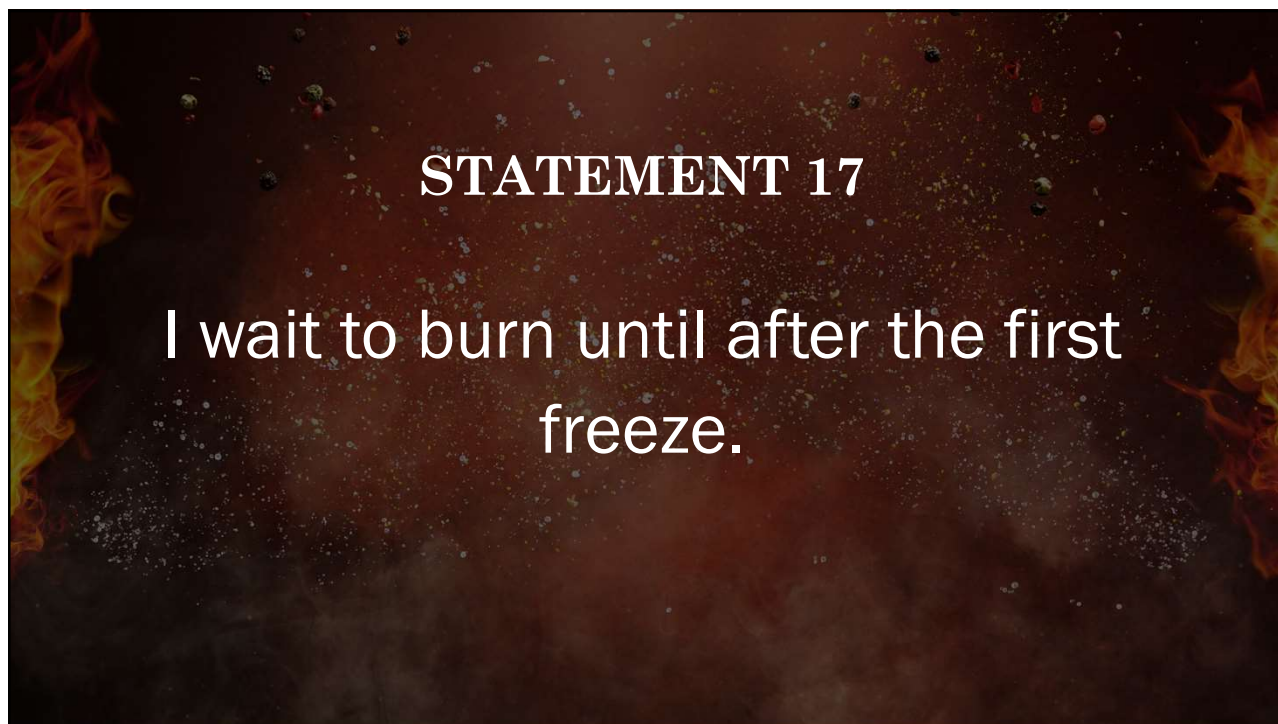


31

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country



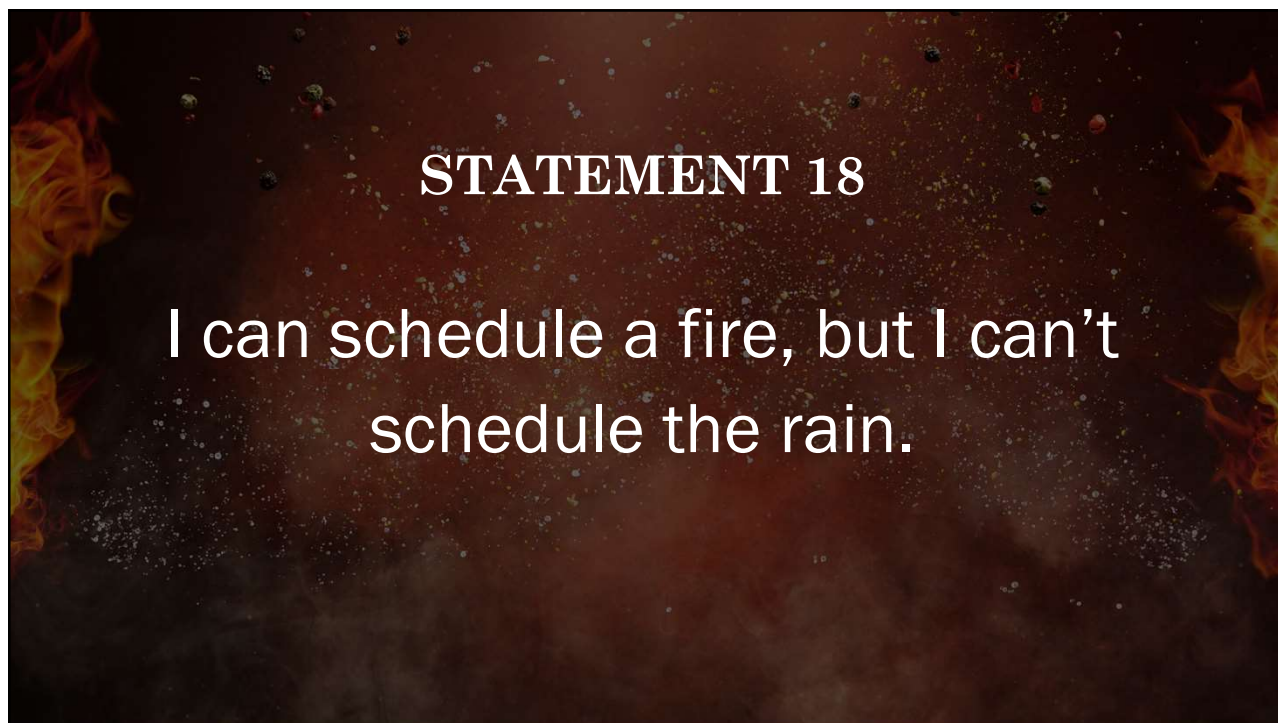
32



STATEMENT 17

I wait to burn until after the first freeze.

33



STATEMENT 18

I can schedule a fire, but I can't schedule the rain.

34

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country

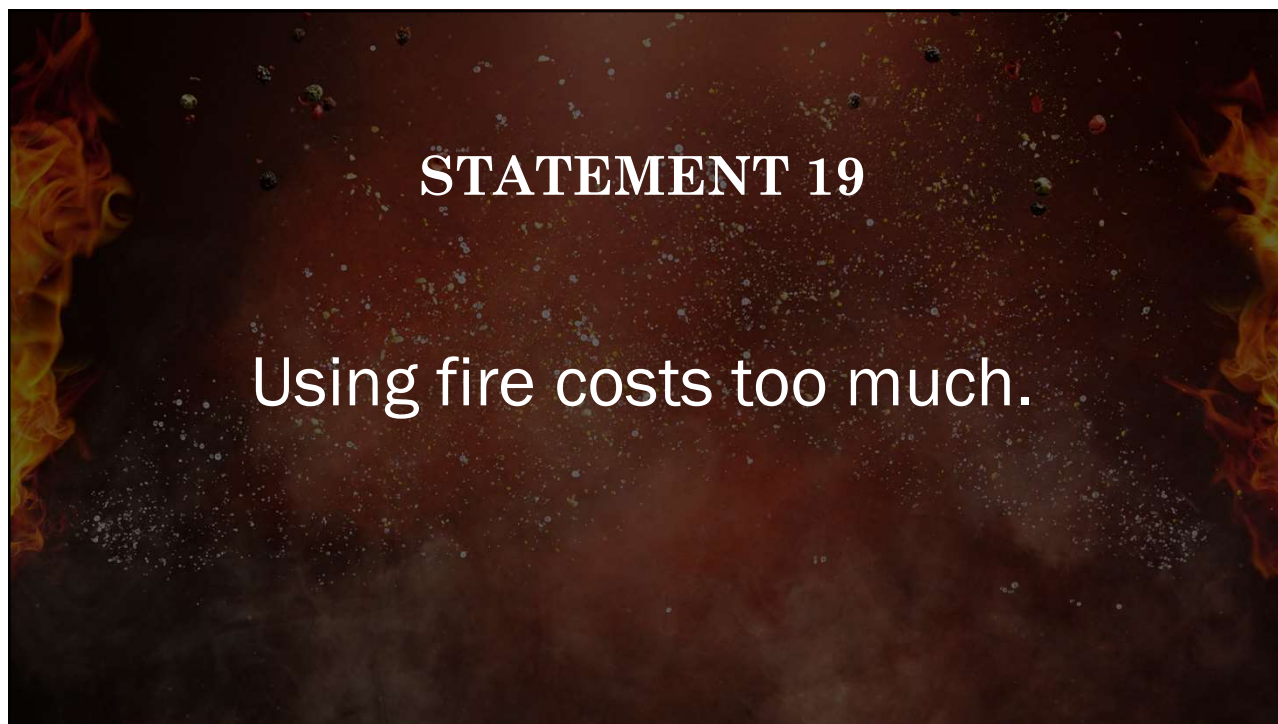


35

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country



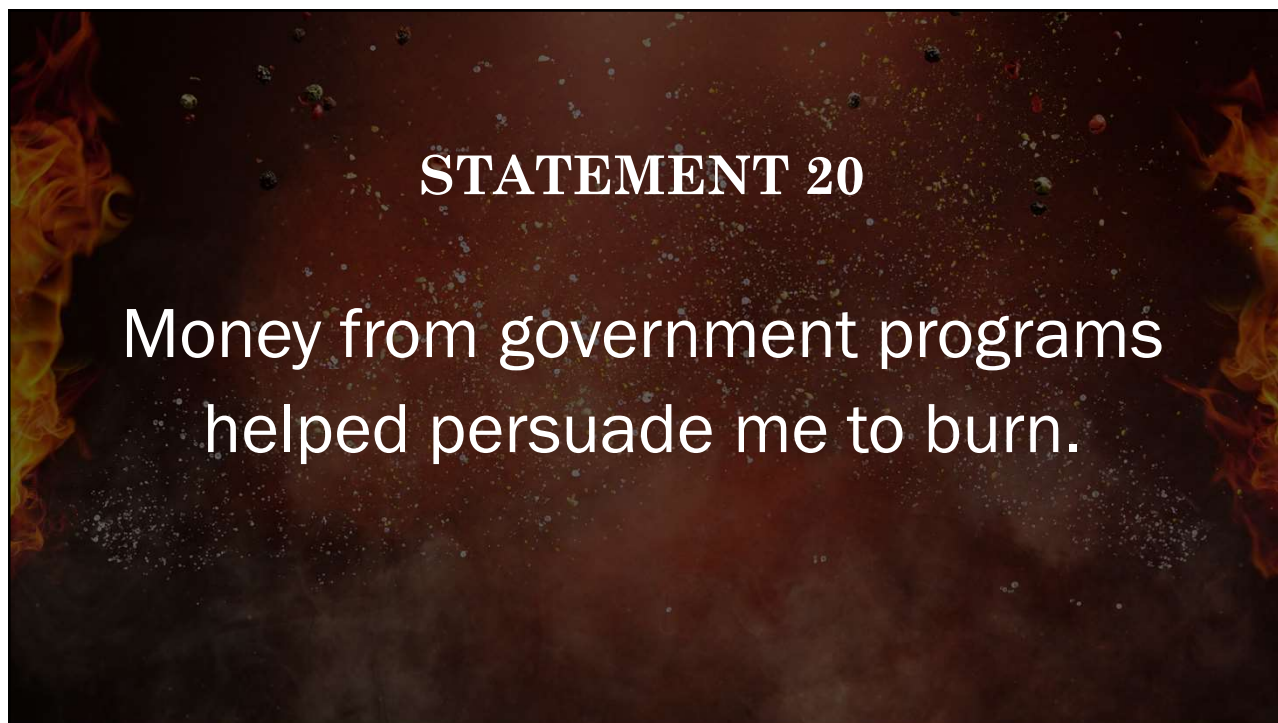
36



STATEMENT 19

Using fire costs too much.

37



STATEMENT 20

Money from government programs
helped persuade me to burn.

38

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country

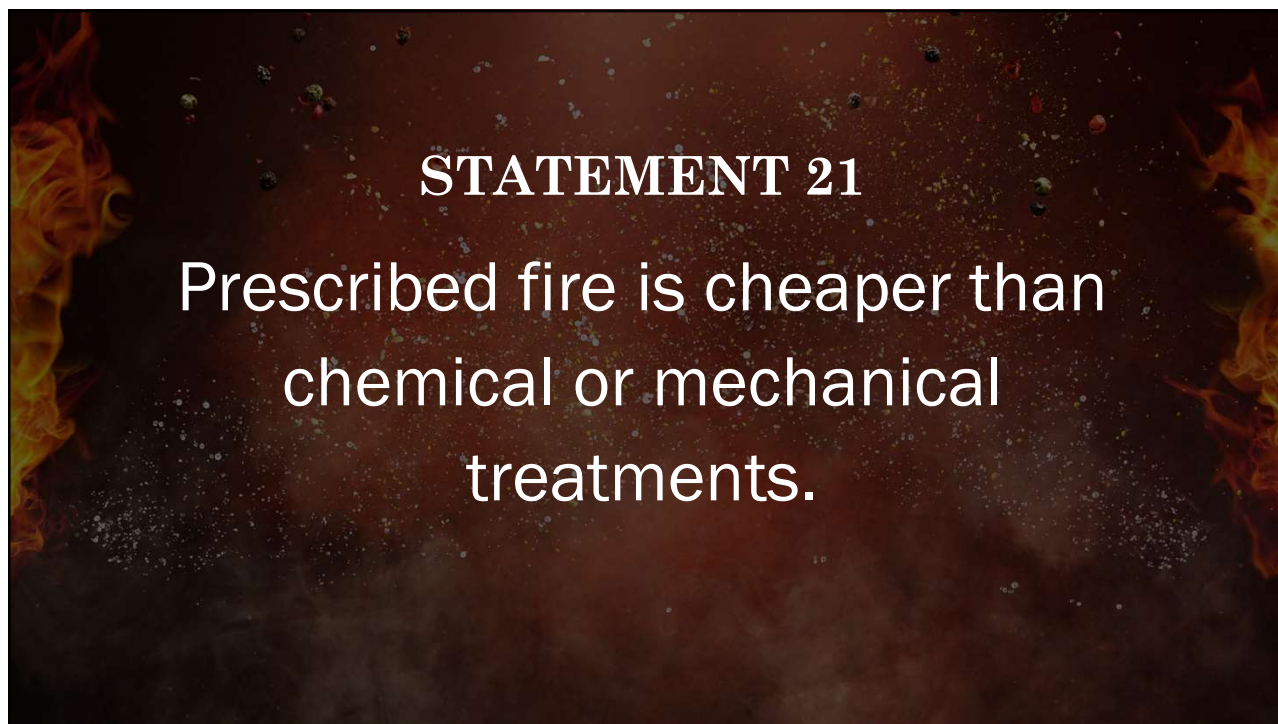


39

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country



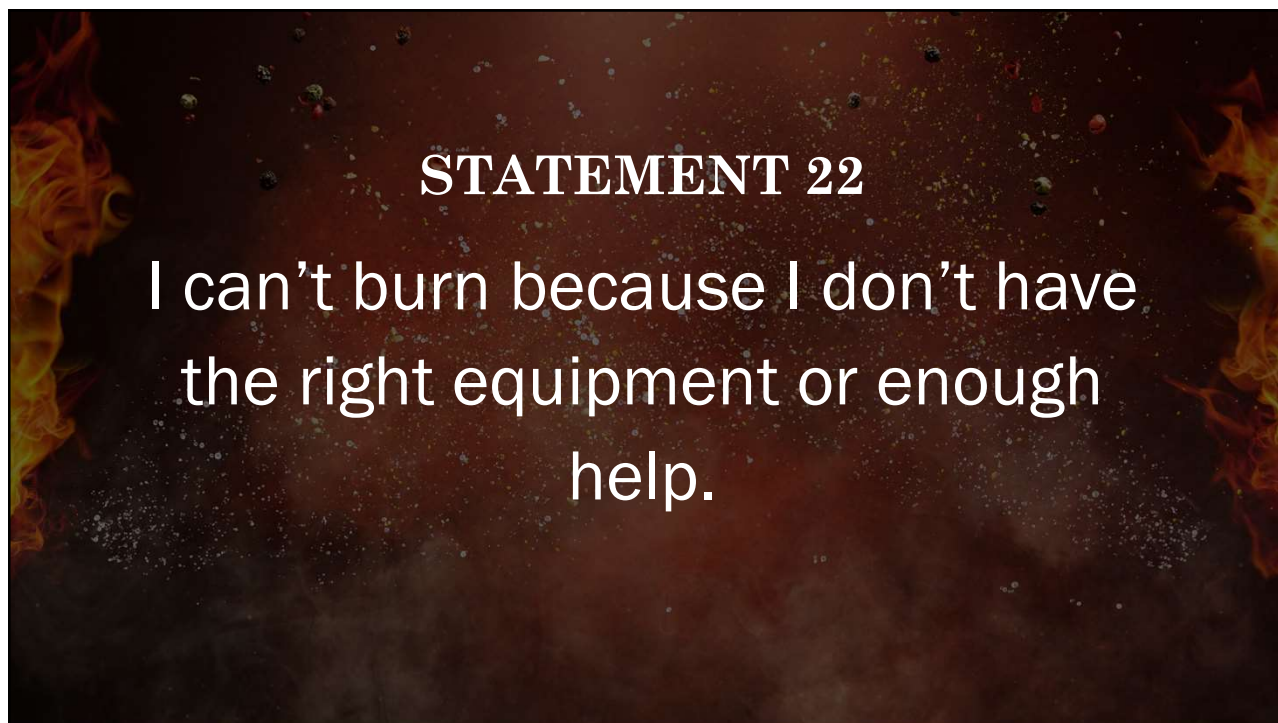
40



STATEMENT 21

Prescribed fire is cheaper than
chemical or mechanical
treatments.

41



STATEMENT 22

I can't burn because I don't have
the right equipment or enough
help.

42

Peers & Pros 360°
Prescribed Fire in the Texas Hill Country

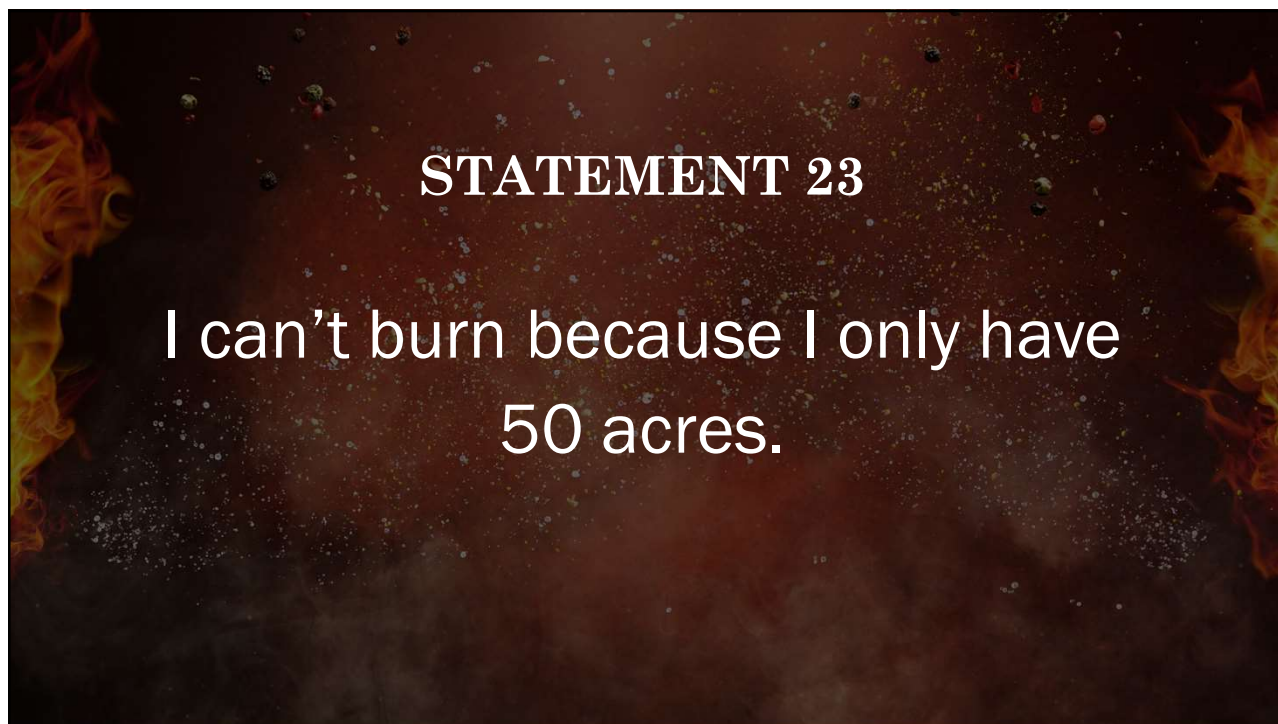


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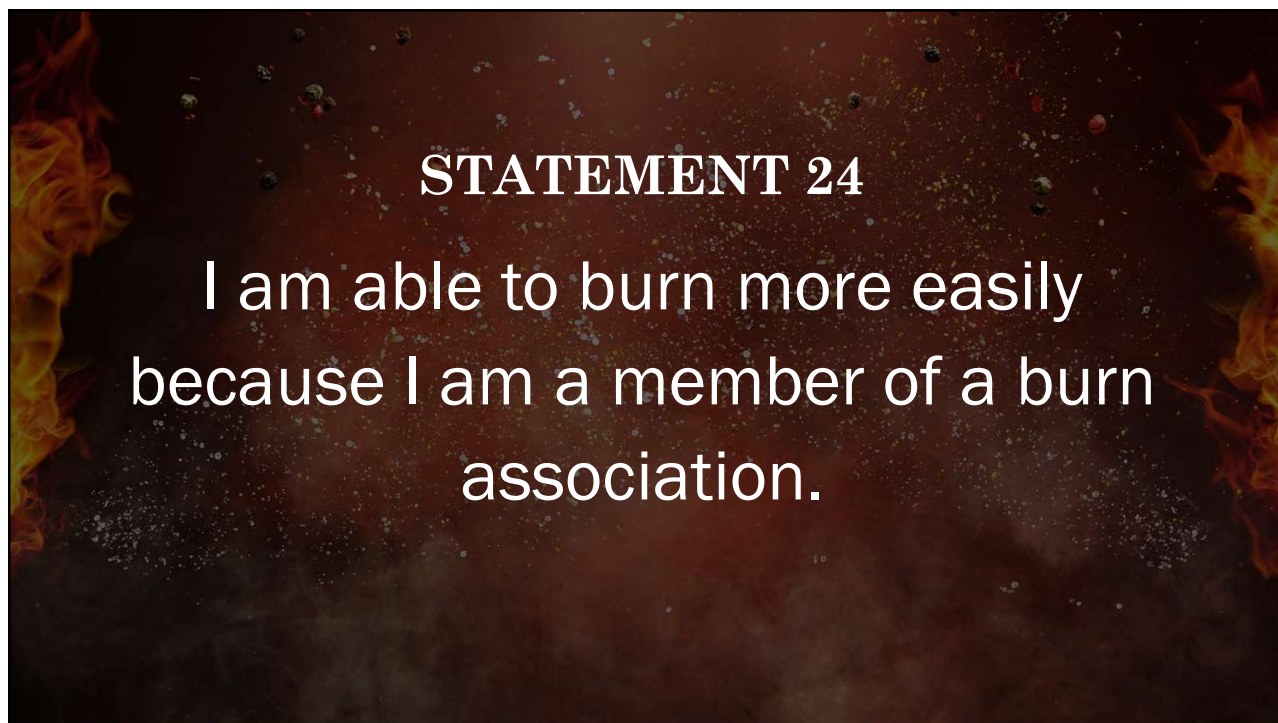
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STATEMENT 23

I can't burn because I only have
50 acres.

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STATEMENT 24

I am able to burn more easily
because I am a member of a burn
association.

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APPENDIX B – TALKING POINTS FOR PROS

Theme 1 - Benefits of Prescribed Fire

Statement 1

I burn to prevent future wildfires.

1. This is a great plan. Properly applied, prescribed fires can be one of the best tools to manage “overgrown” fuel loads that contribute to the risk for wildfires, especially in that “wildland-urban interface”.

Statement 2

My property is more diverse now that I burn.

1. This statement doesn't come as a surprise, especially if a landowner has been burning for a number of years, and if they have combined winter and summer burning into their program. The natural mosaic that results from a fire encountering topography, variations in vegetation, and the timing of precipitation that follows will create a lot of different “islands of opportunity” for plants and animals in the post-fire ecosystem.

Statement 3

Fire is a natural process and it's good for the land.

1. That is a true statement, but it is understandable why some people are opposed to fire or afraid of it. Fire out of control can be a scary thing. Recently burned landscapes are not very pretty. But yes, fire is a natural process, and many ecosystems are fire dependent. They need to burn at some optimum interval to regenerate and stay healthy.

Theme 2 - Wildlife

Statement 4

Ring fires can trap fleeing wildlife.

1. Although a ring-firing technique places fire on all sides of a burn unit, varying degrees of fire behavior exist. Also, our native wildlife (big and small) are very adapted to fire and flame and can escape easily, provided allowable fencing.
2. Ring firing is a very effective technique to generate high temperature, heat duration, and dose of heat for maximum brush management.

Statement 5

Fire leaves wildlife with no place to hide.

1. All fires burn in unique fashions and no two fires are ever the same. Patches of burned and non-burned vegetation exist depending on soil moisture, fuel moisture, fuel loading, and many other factors. Oftentimes, a patchy mosaic is left behind after a fire.
2. There are many components of prescribed burning within our control that can ensure sufficient amounts of wildlife cover are left intact. Also, patch-burning is an effective strategy to optimize habitat and foraging choices.

Statement 6

Prescribed fire creates great natural food plots.

1. New growth following a fire is not only very palatable and tender to eat, but also very high in crude protein. Grazing and browsing animals crave this type of nutrition and actively seek out recently burned areas for this reason!
2. In ecosystems with native vegetation that are adapted to fire, new growth on resprouting plants attracts wildlife to the point that recently burned areas may actually need to be protected from post-fire grazing.

Theme 3 - Livestock

Statement 7

I can't afford to take a pasture out of rotation before a fire to build up fuels.

1. The reasoning behind this statement makes sense, but we have to think about the relative economic value of grass as forage versus what it might be worth as fuel. For instance, the weight gain one would get from old "rank" forage might be less valuable to the bottom line than the work that grass might do in reducing a woody plant or prickly pear stand and producing younger, more nutritious forage in the process.

Statement 8

I have no way to rest my land because the axis will graze it anyways.

1. Axis deer are another "good news-bad news" situation. On one hand they provide a potential year-round source of income from hunting and they are a unique and attractive species popular with wildlife watchers and photographers. On the other hand, due to their high adaptability, they have been documented as outcompeting native white-tailed deer and they are free-ranging invasive animals so managing their numbers is difficult. So, when Axis deer are present in large numbers, only an aggressive culling strategy will likely be effective in protecting rested forage for livestock or native wildlife.

Statement 9

Freshly burned and rained-on pasture can be as good as grazing wheat.

1. Under the right conditions, largely influenced by a timely rain, fresh young re-growth of native perennial range grasses can be pretty nutritious, maybe not quite as nutritious as wheat, but pretty good.

Theme 4 -Vegetation

Statement 10

Invasive plants will take over after a fire.

1. Invasive plants frequently invade disturbed soil, such as that found following a mechanical treatment. Prescribed fire doesn't disturb the soil and it doesn't kill the roots of herbaceous species that are already present. The rapid recovery of herbaceous species already on site should help reduce the potential for invasion from plants that are not present.
2. Unfortunately, once invasive plants are on a property, they are always going to need management. It's important to know how different invasive species respond to fire. That may help determine fire prescription parameters to reduce the impact to native species and increase the negative impact on invasive species. Some invasive species are capable of recovering after fire and some are not.
3. In some cases, it may be best to use other control methods to reduce or eliminate invasive species before implementing fire as a management practice.

Statement 11

Burning and grazing have helped us control Texas wintergrass.

1. The combination of burning and grazing can be an effective way to shift a plant community from cool-season to warm-season dominated grasses. When grazing and fire are combined, both processes should be implemented carefully with the overall goal in mind.

Statement 12

I'm scared to use fire because I have too many trees/my junipers are mature and dense.

1. Dense mature junipers are important habitat for some species. Additionally, they tend to prevent growth of herbaceous material under them, which reduces the ability for cool-season fires to impact them. During hot, dry periods, junipers can be very volatile and can lead to uncontrollable crown/canopy fires. If you want to protect some stands of junipers, firebreaks can be put in place around them and perform burns when the trees are least likely to be affected.
2. Controlling dense stands of juniper often needs to involve methods of control other than just fire.
3. If there is a concern about protecting other tree species (such as oaks), it's best to reduce the amount of fuel directly under and around the trees. Excessive fuel, especially juniper and other brush, directly under the desired trees can carry flames into the canopy.

Theme 5 - Liability

Statement 13

I can't burn because there is a burn ban in effect.

1. Although county ordinances like burn bans can dictate who burns what, options to implement a safe prescribed burn still exist. For example, Certified and Insured Prescribed Burn Managers from the Texas Department of Agriculture are exempt from burn bans. Also, many county judges exclude prescribed burning from their outdoor burn bans.
2. Communication and planning go a long way. Be as open and transparent as possible and communicate why prescribed fire is your decision as a landowner to manage your property.

Statement 14

I can't burn because my ranch is next to town.

1. Providing information, fostering relationships with local officials, and implementing open communication on a prescribed fire with sensitive smoke receptors, like urban areas, is an absolute must. But it's also a justification for wildfire mitigation fuels reduction practices like prescribed burning. Eliminating accumulated fuels provides a buffer for urbanized areas.
2. Many environmental factors, such as wind, can be taken into account to mitigate impacts to urbanized areas. Communication and planning can go a long way. Starting small and allowing concerned parties time to adjust is advantageous. In fact, invite concerned parties to a prescribed fire in order to build trust and buy-in from all potentially impacted parties.

Statement 15

I'm scared to burn because my neighbor will sue me.

1. In Texas, every landowner has a right to implement a prescribed fire to manage his/her property given all state, county, and local regulations are followed. If you have a sue-happy neighbor, then hire a Commercial and Insured Prescribed Burn Manager (CIPBM) from the Texas Department of Agriculture that shifts all liability on the CIPBM. And/or purchase ranch/farm liability insurance that covers prescribed fire, specifically hostile fire, in the policy.
2. Invite neighbors to pre-fire meetings, morning briefings, and the actual fire! Oftentimes, when concerned neighbors can play an active and engaged role in the prescribed fire, they will understand the process, due diligence, and standards of care being implemented.

Theme 6 - Timing

Statement 16

Summer fire will destroy all my quail nests.

1. Quail and fire have shared the landscape since long before modern humans began interfering with natural processes like fire. Historically, lightning-caused fires would have occurred during the summer months, but these fires were typically accompanied by precipitation and were small in size. To mitigate for lost quail nests during summer fires, there's always the option to burn smaller units. There are also other reasons to consider burning smaller units rather than a whole pasture or property.

Statement 17

I wait to burn until after the first freeze.

1. Waiting to burn until after the first freeze is not always the best option, the timing of a burn really needs to be based off of the objectives of the burn. For example, to promote warm season grasses, typically a winter or early spring burn is the best time to do that. To reduce woody vegetation a summer or growing season burn tends to produce better results.
2. It's important to evaluate fuel loads when deciding when to burn rather than just looking at the calendar.
3. Regardless of the time of year make sure you have a large enough crew, enough safety equipment, and plenty of water for everyone.
4. Regardless of time of year it is important to consider burn prescription parameters. Such as, wind speed and direction, relative humidity, ambient temperature, etc.

Statement 18

I can schedule a fire, but I can't schedule the rain.

1. This is another reason to not burn an entire property or pasture in a given year. By burning portions of a property, you are leaving the remainder of forage available in the event of a drought.
2. Regardless of whether you choose to burn or not, it is important to maintain stocking rates appropriate for your rangeland and climatic conditions.
3. Although fire removes the portion of a plant aboveground, grasses and other plants can remain dormant belowground for long periods between fire and rainfall, and they tend to respond very quickly to precipitation following fire.

Theme 7 - Cost

Statement 19

Using fire costs too much.

1. Prescribed fire is actually one of the least expensive habitat management practices.
2. The cost of a prescribed burn differs for each property, pasture, and time of year. Fireline construction, labor, and equipment are all factors in the overall expense of implementing prescribed fire.
3. Costs can range from less than \$1/acre to more than \$30/acre. Typically, the bigger the burn unit, the less expensive the burn is per acre.

Statement 20

Money from government programs helped persuade me to burn.

1. Depending on property management goals and revenue sources, it may be difficult to defer a pasture from grazing prior to and after a burn. Cost-assistance or cost-share programs are available throughout different counties of the state to help offset the costs of conducting prescribed burns as well as to help incentivize the deferred grazing. These programs/opportunities may vary on requirements and pay-out rates. Contact local conservation professionals (Natural Resource Conservation Service [NRCS], Texas Parks and Wildlife Department [TPWD], Texas A&M AgriLife Ext., Texas A&M Forest Service [TFS], Oaks and Prairies Joint Venture [OPJV], US Fish and Wildlife Service [USFWS], etc.) for more details.
2. Most agencies/organizations have specific goals for their incentive programs. It is important to find a program that best fits the property goals but also know that just because the goals do not appear similar, does not mean that they are not resulting in the same outcomes. For example, programs for wildfire mitigation/prevention and programs for grassland health improvement sound different but ultimately accomplish similar goals.

Statement 21

Prescribed fire is cheaper than chemical or mechanical treatments.

1. Prescribed fire is one of the least expensive habitat management practices. Burn unit size, preparation needs, equipment, and personnel are all factors that dictate overall costs, but this tends to be cheaper than most herbicide applications, and definitely less expensive than mechanical treatments (which can be easily >\$100/ac). Prescribed fire is also a tool that no other tool can replicate the ecological benefits of.

Theme 8 - Resources

Statement 22

I can't burn because I don't have the right equipment or enough help.

1. It is important to have the 'right' equipment at prescribed burns, but that can come in all shapes and forms. At a minimum, the main things needed are effective 2-way communication devices between personnel (e.g., radios, cellphones, etc.), controllable, portable ignition device(s) (e.g., drip torch, pear burner, or something similar), mobile water source(s) (e.g., 'sprayer(s)' of some sort), and clothing that will not easily melt or burn (i.e., cotton products and leather boots and gloves). Other tools can be added to the list, and may be helpful at times, but that all depends on the simplicity/complexity of the burn.
2. It is good to have multiple people assisting with prescribed burns. The more eyes on the fire, the better the observation of fire behavior and response time to any unforeseen incidents. Getting involved with local Prescribed Burn Association not only allows access to equipment, but also other individuals/landowners interested in being involved with fires.
3. Typically, the better (and bigger) the fire breaks are around the perimeter of a burn (i.e., dozer lines, disk strips, shredder lines, etc.; or a combo of sorts), the less likely fire will escape the burn unit, and therefore less equipment or personnel may be needed to carry out the burn safely.

Statement 23

I can't burn because I only have 50 acres.

1. There are no minimum acreage requirements for conducting a prescribed fire. If livestock or other animals graze the property, regardless of property size, it is good practice to burn the property in sections so not all of the resources are out of availability/rotation at the same time.

Statement 24

I am able to burn more easily because I am a member of a burn association.

1. Being involved with a local prescribed burn association allows individuals to network with other locals/landowners that also have an interest in prescribed burning. Depending on how the association is set up, there may be burn equipment available for the members to borrow/rent, or the association may have a network of its members so folks can 'pool' their equipment/resources, as well as help each other, anytime someone is ready to burn.
2. Prescribed burn associations can be a good resource for individuals to gain additional experience and training on prescribed burn planning, burn unit preparation, and implementing safe prescribed burns. Workshops may also be hosted to help keep up with

things such as weather resources and interpretation, equipment use, and conservation cost-assistance or cost-share programs available to help eligible landowners.

3. Multiple active Prescribed Burn Associations (PBAs) exists throughout the Hill Country and state. Contact local conservation professional (Texas A&M AgriLife Ext., Texas A&M Forest Service, Texas Parks and Wildlife Department, Oaks and Prairies Joint Venture, etc.) if you have difficulties locating one, or care to start one in an area that may not currently have an active organization.

APPENDIX C – PROGRAM HANDOUT, KERR WILDLIFE MANAGEMENT AREA &
MASON MOUNTAIN WILDLIFE MANAGEMENT AREA



**Peers & Pros 360°
Additional Resources
on Prescribed Fire**

TEXAS A&M
AGRILIFE
EXTENSION

Conservation Organizations/Professionals (most can directly or indirectly assist with prescribed fire planning or implementation)

- TAMU AgriLife Extension (<https://counties.agrilife.org/>)
- Texas Parks and Wildlife Department (https://tpwd.texas.gov/landwater/land/technical_guidance/biologists/)
- Natural Resource Conservation Service (www.nrcs.usda.gov/wps/portal/nrcs/main/tx/contact/)
- Oaks and Prairies Joint Venture (www.opjv.org/contact)
- US Fish and Wildlife Service (www.fws.gov/southwest/es/Documents/R2ES/AUES_PFW_Handout_2016.pdf)
- Texas Forest Service (<https://tfsweb.tamu.edu/>)
- Prescribed Burn Alliance of Texas (<https://pbatexas.org/Associations.aspx>)
- TX Certified and Insured Prescribed Burn Managers (www.texasagriculture.gov/Portals/0/Reports/PIR/certified_commercial_burn_managers.html)

Grants/programs related to prescribed fire and/or habitat restoration for the Texas Hill Country

- Oaks and Prairies Joint Venture (OPJV)
 - o Grassland Restoration Incentive Program (GRIP): www.opjv.org/grip
 - Contact Ty Higginbotham (thigginbotham@quailforever.org) or Thomas Janke (tjanke@quailforever.org) for more information on GRIP opportunities.
- Texas Forest Service (TFS)
 - o Various prescribed fire and habitat management grants are available to help mitigate wildfires (<https://tfsweb.tamu.edu/cppgrant/>)
 - Contact Jacob Gosschalk (jgosschalk@tfs.tamu.edu) for more details on TFS programs.
- Natural Resource Conservation Service (NRCS)
 - o Environmental Quality Incentives Program (EQIP) www.nrcs.usda.gov/wps/portal/nrcs/main/tx/programs/financial/eqip/
 - o Contact local NRCS office for more information.
- Texas Parks and Wildlife Department (TPWD)
 - o Landowner Incentive Program (LIP) https://tpwd.texas.gov/landwater/land/private/lip/#LIP_Watershed_Funding_Series
 - Multiple areas throughout Edwards Plateau may qualify <https://tpwd.texas.gov/landwater/land/private/lip/images/LIP-Tx-PriorityWatersheds.jpg>
 - o Pastures for Upland Birds (PUB) https://tpwd.texas.gov/landwater/land/habitats/post_oak/upland_game/pub/
 - Though not updated online yet, the PUB program has been extended to include the entire Edwards Plateau.
 - o Contact Arlene Kalmbach (arlene.kalmbach@tpwd.texas.gov) or Tim Siegmund (tim.siegmund@tpwd.texas.gov) for more details on either program.
- US Fish and Wildlife Service (USFWS)
 - o Partners for Fish and Wildlife Program: www.fws.gov/partners/projects/

- Contact Brendan Witt (brendan_witt@fws.gov) for more details.
- Local Soil and Water Conservation Districts (SWCD) occasionally have grant opportunities.
 - Contact local SWCD or local NRCS office about possible opportunities and funds

A good source of information is your local Prescribed Burn Association (PBA). The Edwards Plateau PBA (EPPBA) has multiple (sub)chapters throughout the region. This PBA, like others, consists of landowners interested in using prescribed fire as a management tool. These individuals work with, assist, and learn from each other as they conduct prescribed fires and the necessary trainings and preparations that go along with them. Contact Heath Starns (Heath.Starns@ag.tamu.edu) for more details on individual (sub)chapters of the EPPBA.

Legal Barriers to Prescribed Burning



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The reduction of naturally occurring fires has altered ecosystems worldwide. This alteration of natural fire regimes has had negative impacts in many areas. These include declines in fire-dependent species, the loss of resilience in fire-prone ecosystems, and a dramatic decline in important ecosystem services, such

as surface water infiltration, soil nutrient cycling, and the availability of adequate wildlife habitat. In addition, plant communities that are adapted to specific fire regime's frequency, intensity, and seasonality are more susceptible to invasion by fire-sensitive species such as ashe juniper and eastern redcedar.

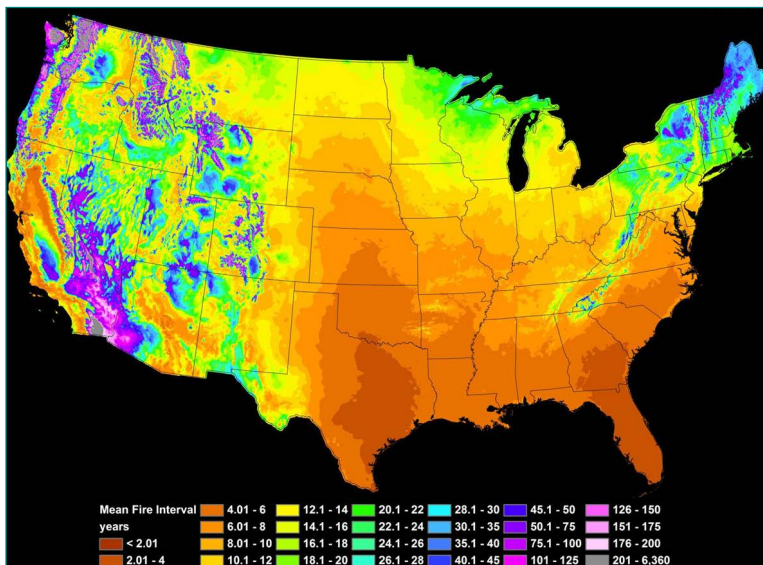


Figure 1. Historic (1650–1850) mean fire return interval estimates for fire in all or part of an average 1.2 km² area. *Graphic courtesy Guyette et al., 2012)*

Recreations of historic fire regimes suggest that the fire return interval for a large portion of the southeastern United States was from 2 to 10 years. Some areas in the Ozarks and Appalachian mountains are thought to have had return intervals of 10 to 45 years (Fig. 1). Fire suppression, which has been the dominant rangeland management response in the southeastern US throughout most of the 20th century, has had many negative impacts on the region's ecosystems. For example, the change from frequent low-intensity fires to infrequent high-intensity fires in forests of east Texas and the southeastern

United States has caused many loblolly pine trees to be replaced by less valuable forest species. This change results in lower forage productivity, decreased diversity of native species, and degraded habitat for grassland birds and mammals—many of which have become threatened or endangered.

Fuel accumulation is inevitable when fire is taken out of the range management scheme. The buildup of flammable plant tissues increases the likelihood of a wildfire that is much more intense than fires in areas where fuels are managed. This increased intensity causes fires that are difficult to control and more likely to destroy property and injure people. In addition, severe fires in systems that are adapted to frequent low-intensity fires can alter the structure and composition of existing plant communities. These changes often reduce overall plant community resilience, which, in turn, decreases ecosystem function. In extreme cases, wildfires resulting from fuel accumulation can increase rangeland degradation and soil erosion as well as injury, loss of life and property, and enormous fire control expenditures.

So what options exist to combat the problems that fire suppression has created? Prescribed burning can mimic historical fire regimes under specific circumstances. It is a cost-effective tool for managing and restoring ranges and forests. Prescribed burning can manage vegetation using a natural process that is integral to native plant communities. Unfortunately, the liability and risks associated with the practice keep prescribed burning from being used extensively. For many landowners, potential lawsuit and litigation costs are important considerations when deciding whether to use fire as an ecosystem management tool.



Figure 2. Map of prescribed fire liability standard in each state. Medium gray states prescribe a gross negligence standard, light gray states prescribe simple negligence for burners, dark gray state have case law or statutory language supporting strict liability for escaped prescribed fires, and white states have a liability standard that is undefined statutorily and usually follow simple negligence rules as established by case law. *Used with permission from John Wiley and Sons.*

Prescribed fire liability

Generally, civil liability standards in the United States for prescribed burning fall into three distinct categories (Fig. 2):

Strict liability

- Holds a burner liable for any property damage caused by an escaped prescribed burn or spot fire from the prescribed burn regardless of the action taken by the burner to prevent fire escape
- This is the highest level of liability for anyone using prescribed burning
- Only 5 states have standards that suggest strict liability, although the statutes do not all explicitly state that strict liability is the standard

Simple negligence

- Requires the burner to practice reasonable care during a prescribed burn
- This is the most common liability standard for prescribed burning; Texas and 42 other states, follow simple negligence standards
- Requires the plaintiff to show the burner acted negligently in order for the burner to be liable for damage caused by a pre-

scribed burn that escapes or is the source of a spot fire

- In Texas, this standard is stated explicitly under Texas Natural Resource Code § 153.081. In many states, such as in New Mexico, this standard is established through case law.

Gross negligence

- If a certified prescribed burner follows codified regulations regarding prescribed burning, a plaintiff must demonstrate the burner showed reckless disregard of the duty of care owed to others
- In states with gross negligence standards, simple negligence typically will apply if regulatory requirements are not fulfilled
- Statutes identifying gross negligence liability standards have been enacted in Florida, Georgia, Michigan, and Nevada
- Gross negligence statutes are also an incentive to follow their requirements and receive prescribed burn training—better trained burners lower the risk of an escape and the cost for the burner and adjacent property owners
- Gross negligence incentivizes creating defensible space and fire-wise construction since the burden of liability is shifted from the burner onto neighbors under a gross negligence standard (this type of fire safety response can also help reduce the spread of wildfire)

In some states, legislators have revised state liability laws to counter concerns of liability by private landowners and to promote the use of prescribed burning to manage fuel loads which mitigates wildfire. For example, in 1990 Florida passed the Prescribed Burning Act, which is nationally recognized as landmark legislation that protects a landowner's right to use fire as a management tool. Under this act, a landowner or burner gains the right to burn. As a result, the burner could not be held civilly liable for damages unless simple negligence in using prescribed fire was found. Following the devas-

tating 1998 wildfire season, the Florida legislature modified its Prescribed Burning Act such that a burner cannot be found civilly liable unless a court finds that the burner exhibited gross negligence. Following Florida's example, other states have changed their laws such that the landowner's right to use prescribed burning is explicit. In addition, new prescribed burning laws clearly state the applicable liability standard, and in some states, lessen the liability burden on landowners using prescribed burning. Although these statutory reforms appear positive for prescribed burning, it is unclear that they are achieving their intended purpose of providing adequate incentive for landowners to manage more acres with prescribed burning.

Examples of statute reform for prescribed burning

- Florida statutes list requirements that should be met to by burners, including a written burn plan and that a Certified Prescribed Burn Manager (CPBM) to be on site during the actual burn, as well as having an adequate crew, equipment, and firebreaks
- Florida changed their liability standard from simple to gross negligence if all requirements are met; however, if regulatory requirements are not met, simple negligence applies
- Georgia followed Florida's example, but does not require an onsite CPBM, adequate crew, equipment, etc., and only requires the burner to obtain a permit from the Division of Forestry before conducting a prescribed burn
- Alabama, South Carolina and North Carolina passed right to burn laws which require a CPBM and written burn plan, but each maintained simple negligence standards
- County or state officials can establish burn bans in most states during dangerous fire weather, but many states' statutes, includ-

ing Alabama, North Carolina, Georgia, and Texas, provide exemptions for CPBMs during burn bans. Georgia extends its exemption to all landowners (even uncertified) burning for pasture and field management

Have reforms to liability laws resulted in more acres being burned?

From 2008-2013, fewer acres were treated with prescribed burning and the annual number of fires was lower in simple negligence states than in gross negligence states (Fig. 3). States with gross negligence liability standards burned 7100 more acres per county per year than states with simple negligence standards. Interestingly, states requiring a written burn plan, a CPBM on site, and adequate equipment, personnel, and firebreaks, burned the same number of acres and had similar annual numbers of fires as states that only required filing a permit. Instead of discouraging landowners from using prescribed burns because the additional requirements seem onerous, they may encourage burning by showing burners did not acted negligently in the case of an escape. In addition, the increased training and safety awareness that come with those requirements, results in better prepared burners. This preparation and lower liability standards incentivize the use of prescribed burns.

The importance of prescribed burn associations

Prescribed burn associations (PBAs) are critical to the effective use of prescribed burning. These associations provide a non-legislative mechanism for limiting liability for prescribed burning by private landowners. PBAs are landowner cooperatives whose goal is to use prescribed burning to manage vegetation on private lands—they are established to share the cost of burning. Typically, each association consists of several county or multi-county chapters that share labor and equipment, facil-

itate knowledge sharing and training opportunities, and spread the costs of liability insurance across their members. In Oklahoma and Texas, PBAs have driven legislation that allows CPBMs to burn during burn bans to meet management objectives that depend on intense fires. PBAs hold regular business meetings, elect officers, and provide hands-on training to members who want to learn more about prescribed burning. The Prescribed Burn Alliance of Texas

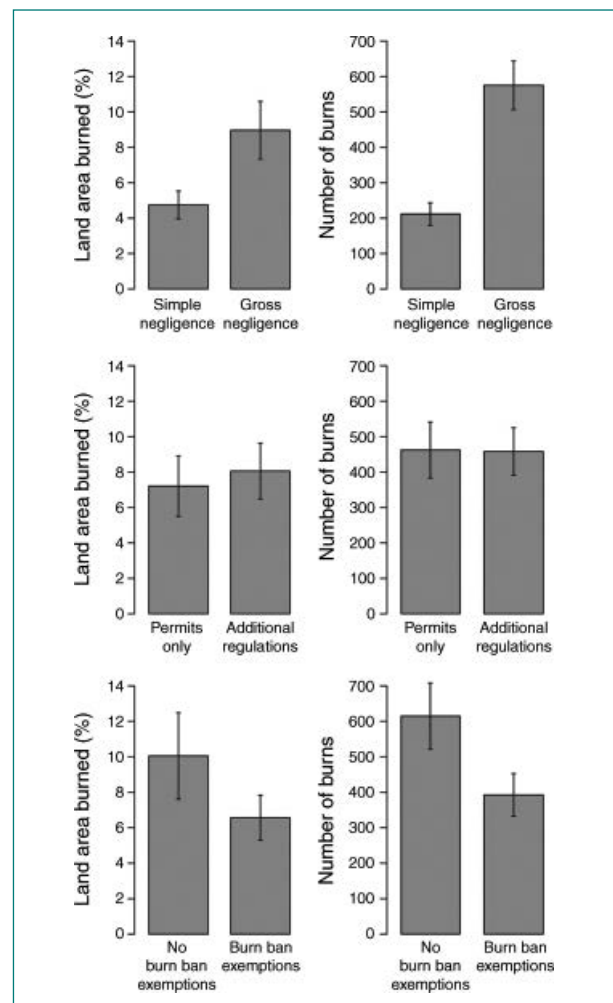


Figure 3. Average annual percentage of land area burned and average annual number of burns between contiguous counties with simple negligence and gross negligence (top row), permit requirements only and additional requirements (middle row), and burn ban exemptions for certified prescribed burn managers (CPBMs) or land management (bottom row). *Used with permission from John Wiley and Sons.*

serves as a portal for the state's 10 PBAs. It provides information and resources on concepts and application of prescribed fire management.

The Coalition of Prescribed Fire Councils is a national body that seeks to enhance public safety, resource management, and environmental quality through appropriate prescribed burning. The Coalition represents twelve million acres of annual prescribed fire use, and serves as a forum for addressing issues of national concern. Its work facilitates communication among those interested in prescribed burning and creates opportunities for prescribed fire collaboration. Currently, 31 states are members of the Coalition of Prescribed Fire Councils.

The Great Plains Fire Science Exchange (GPFSE) also promotes PBAs by assisting land managers and the prescribed burn community with sound decision-making based on the most current scientific research. The GPFSE is supported by the Joint Fire Science Program to strengthen collaboration among prescribed burn managers. It also makes fire science information more readily available to policy makers. Issues of woody plant encroachment, smoke management, prescribed fire techniques, volatile fuel mitigation, and ecosystem health are all issues that the GPFSE works on regularly with PBAs.

Key concepts

- Fire is a necessary component for numerous ecosystems throughout Texas and the southeast. Strict regulations and liability concerns provide disincentives for prescribed burning and have cascading negative effects by discouraging the reintroduced of fire into fire-dependent systems.

- In states that have adopted gross negligence liability standards, landowners are more likely to use fire as a management tool and burn a greater proportion of private land than landowners in states with simple negligence liability standards.
- Regulatory requirements—burn permits, written burn plans, adequate crew, adequate firebreaks and equipment, and CPBMs on site—do not inhibit the incidence of prescribed burning.
- Regulatory requirements along with lower liability standards make prescribed fire more viable for landowners and managers and provide some safety assurances for neighbors.
- In states with gross negligence standards there is no additional damage or increased suppression cost due to escapes or spot fires from prescribed burns.
- Prescribed burn associations provide fire safety training, shared labor, equipment, and (in some cases) liability insurance; they are organizations that effectively help private landowners use prescribed burning.

Additional information on prescribed burning

Great Plains Fire Science Exchange
<http://www.gpfirescience.org/>

Prescribed Burn Alliance of Texas
<http://pbatexas.org/>

Coalition of Prescribed Fire Councils
<http://www.prescribedfire.net/>

Oklahoma Prescribed Burn Association
<http://ok-pba.org/index.html>

The Samuel Roberts Noble Foundation
<http://www.noble.org/fire/>

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The Texas A&M University System, U.S. Department of Agriculture, and the County Commissioners Courts of Texas Cooperating.

New

Effects of Fire on Wildlife



Morgan Russell, Assistant Professor and Extension Range Specialist
John M. Tomeček, Assistant Professor and Extension Wildlife Specialist

The belief that fire on Texas rangelands is detrimental to wildlife is a misconception. In spite of the images that fire prevention programs use to promote their message, rangeland fire has a critical and positive role to play for humans and animals. Native Americans understood that fire enhances the propagation of early successional plants, which attract game such as white-tailed and mule deer, antelope, and bison. Fire plays such a crucial role in our ecosystems, that nearly all native wildlife have adapted to the direct and indirect effects of fire. The absence of fire



Figure 1: 1,000-acre summer prescribed burn in Kimble County (2015). Burn plan objectives included: cedar management, pricklypear management, and increased productivity and vigor of native perennial grasses. *Photo by Dr. Morgan Russell*

on rangelands has consistently been cited as a primary cause of woody encroachment, decreased rangeland condition, and diminished ecological resiliency. Over time, fire suppression actually degrades habitat for many wildlife species—the direct effect of range burning on wildlife is far outweighed by its indirect benefits (Fig. 1).

Many fear that fire is destructive to wildlife. However, even in large fires, animal mortality as a direct result of the fire is rare. When it does occur, it is usually the result of escape routes being blocked by fencing or other obstructions. The beneficial effects of fire typically compensate for any losses, and once vegetation responds, wildlife populations quickly recover, often better than before.

Wildlife habitat is not a static—it changes constantly. Therefore, landowners must manage habitat in order to maintain stable populations of desired wildlife species. Prescribed burning for wildlife must take into account the wildlife species that are present, vegetation types, stages of plant succession, weather patterns, life histories of wildlife, and intensity of burn. Using a series of fires to create a mosaic pattern of vegetation over large areas will create

*Underlined terms are in the glossary on page 7



Figure 2: A 30-acre summer prescribed burn actively burns as part of a patch-burn in a larger 100-acre pasture in San Saba County. Patch-burning allows for enhanced edge effect that provides a variety of fire frequencies and fire effects that enhance wildlife habitat. *Photo by Dr. Morgan Russell*

interspersed habitat types that can support the maximum diversity of plant and wildlife species. In this scheme, burned areas promote edge effects between habitat types that can be used for feeding, escape, loafing coverts*, and sites for ground-nesting birds (Fig. 2).

Below are explanations of the specific effects of fire on various species. These will provide some general rules and context, and to help you develop an understanding of the effects of fire on wildlife.

Small mammals

The direct effect on small mammals (rabbits, squirrels, mice, rats, etc.) is minimal since most escape ahead of the fire front. The indirect effect of fire on small mammals is greater and includes the temporary loss of shelter and food, increased surface exposure, and increased predation. However, research suggests that the numbers and diversity in small mammal populations are maintained for 1 to 3 years or longer after a fire, and that positive food chain effects are present for many years after the fire. Also, some small mammals can tolerate

temperatures of 120 °F for short periods if the relative humidity is above 60 percent. Death typically occurs when fires burn for longer periods at sustained temperatures of 145 °F with a relative humidity below 22 percent. Survival increases when fires involve interspersed low-density fuels and high moisture content.

Birds

The effect of fire on birds depends on the species, the season, and the intensity of a fire. For example, a cool-season dormant burn increases food sources and provides residual nesting sites for ground and brush-foraging birds. A more intense cool-season fire produces the same effect, but creates more openness by reducing the brush canopy. The greatest advantage to varying frequencies of fire is that they create relatively small burns of different ages that are interspersed with areas that have not been burned for several years. Birds may use a recently burned area for foraging within seconds of burning (Fig. 3).

Habitat for endangered bird species such as the golden-cheeked warblers and black-capped vireos can be managed through appropriate burns—these birds evolved in a



Figure 3: A northern bobwhite female in recently burned area foraging for food immediately after a 500-acre prescribed burn in Edwards County. *Photo by Dr. Morgan Russell*

system dominated by fire. The black-capped vireo (listed in 1987) breeds in fire-maintained juniper and scrub-oak habitats. To nest successfully, black-capped Vireos require a patchy structure of mixed shrublands, mature woodlands, and open cover. This diverse habitat type is achieved by varying fire frequencies and seasons to optimize plant diversity and structure.

In some ways, northern bobwhites (*Colinus virginianus*) could be considered a firebird. Quail will take the opportunity to feast on newly available insects and seeds in the edge habitat of burns even before the vegetation stops smoking. A true grassland species, bobwhites thrive in areas characterized by frequent fires that reduce woody cover. In addition, the more efficiently quail feed, the less vulnerable they are to predation—especially following mosaic-type burns that leave residual cover. You can produce quality quail habitat by using a fire regime that intersperses areas burned more frequently than every 2 years with areas burned 2 to 6 years apart. This balance of burn frequencies provides summer fruits and insects that are critical for young birds and laying hens, as well as isolated clumps of grass that are desirable nesting



Figure 4: A covey of northern bobwhite hang out during a summer prescribed burn in McCulloch County. The bobwhite are headed to the recently burned black to forage for new food resources produced from the prescribed burn.
 Photo by Brian Treadwell, Conservation Fire Team



Figure 5: This 100-acre prescribed burn in Tom Green County was conducted to remove decadent litter from perennial grasses. The burn will produce healthier stands of grass and greatly enhance the wildlife habitat of this pasture. Photo by Dr. Morgan Russell

habitat (Fig. 4). These isolated clumps of grass, such as little bluestem [*Schizachyrium scoparium* (Michx.) Nash] typically decrease after 3 years due to litter buildup. This buildup inhibits quail movement, especially for chicks. The problem of vegetation becoming too rank for chicks is most common in high-rainfall grasslands, such as the Texas coastal prairies. Patch burning in these areas, at varied return and season intervals, offers a desirable mosaic habitat effect (Fig. 5).

Lesser prairie chickens (*Tympanuchus pallidicinctus*) are best served by burns every three years. This frequency maintains proper cover conditions and promotes desirable forb species and seed-producing grasses. Further, most desirable food items for this species increase after fire. Frequently- burned areas maintain appropriate grass height for nesting and concealment.

Wild turkeys (*Meleagris gallopavo* spp.) frequently congregate and feed on freshly burned areas. Turkeys require an open understory as well as mature trees. They use

mixed low brush with ample grasses for nesting and the tree canopy for roosting. Therefore, intense burns that kill woody species are not as good for turkey habitat as are cooler, maintenance-type fires conducted during the dormant season. Turkeys benefit from a mosaic of burned and non-burned areas, which provide nesting cover, herbaceous-rich brood-rearing areas, and large roost trees with open understories.

Most adult birds are highly mobile and can easily escape fire. Fires in fine-fuels burn rapidly in a narrow band of flame. These conditions keep the maximum temperature, flame length, and fire intensity low and brief, thereby allowing animals to escape more easily. Early-season fire may cause some direct mortality of young birds, particularly for ground-nesting species, but the ultimate impact on bird populations requires a longer-term view. When nests are lost, many species will re-nest. Bird populations can respond rapidly and will even increase once they are not limited by food availability and negative habitat changes. This provides further evidence of the positive impacts of mosaic-type burns. Less intense burns decrease the short-term impact on food availability or cover following a fire. If you want an intense, hot-season burn, later summer months may be preferable—most ground-nesting birds have hatched out and are near-adult size by that time.

Amphibians and reptiles

In Texas mesquite savanna research, dormant-season fire had no effect on the diversity and abundance of amphibians and reptiles, whereas their diversity and abundance tended to be slightly greater in plots managed with growing-season fires. One species of lizard was 10 times more abundant in plots burned during the growing season than in the unburned control plot. Burning season overall had few short-term effects on the amphibian and reptile community. A fire regime with

burns in varying areas and seasons creates greater mosaic patterns and promotes multiple habitats for wildlife species, including amphibians and reptiles.

Large mammals

One of the most common public concerns regarding fire on Texas rangelands is its effect on white-tailed deer (*Odocoileus virginianus*). This concern arises because deer, especially fawns, need screening cover for protection from predators as well as from harmful heat. For white-tailed deer, woody cover should comprise 40 to 60 percent of the landscape. Leaving irregular-shaped patches of woody cover is best, as this maximizes edge. Most often, fire is underutilized on landscapes managed for deer due to the perceived loss of screening and fawning cover. Historically however, fire in Texas burned $\frac{3}{4}$ of the state every 6 to 10 years. This burning created a habitat in which native populations of white-tailed deer thrived. In the past, much of Texas was covered by prairie, and though deer might not have been as abundant as they are today, healthy populations were maintained due, in part, to the edges fire created between grasslands and woodlands. Again, it is critical that at least 40 percent woody cover remain after a burn to provide for other habitat needs. Within one growing-season after fire, preferred browse plants experience significant resprouting of basal and lateral buds—this makes them more abundant, accessible, and palatable. The young, tender shoots are more succulent and plentiful than older plant material, and can potentially alter populations. Grasses and forbs also typically increase following fire. Though increases in nutrient content also occur, these increased do not generally last beyond 6 months following fire.

Most large mammal species have already produced their young by the peak fire season in late summer to early fall. There has been concern that prescribed fires conducted

outside the summer season, when historical fires were common, might do more harm to wildlife populations—especially concentrated populations. For example, young large mammals may be more vulnerable to early season-fire, because they are still immature and lack mobility. However, many of these species have high reproductive rates and recover rapidly. In the long term, large mammals respond more strongly to habitat conditions, including those created by the fires, than they do to short-term effects created by a single burning season. Isolated populations caught in a wildfire could be destroyed, but a dense volatile habitat that could fuel this lethal kind of fire is already unfavorable to their survival.

White-tailed deer, mule deer (*Odocoileus hermionus*), pronghorn (*Antilocapra americana*), and other native species, instinctively flee from fire. Most native animals evolved in the presence of fire and have adapted behaviors for escaping fire. These adaptations along with suitable habitat enable population persistence—many species benefit directly from the habitat modifications that result from fire. However, wildlife’s ability to survive fires (prescribed burning and wildfires) can be compromised by human interference, such as high fences that limit escape (Fig. 6). During an extreme wildfire season, unmanaged fuel loads accumulate and hot, dry conditions persist. Furthermore, if a manager chooses to leave a pasture ungrazed to provide wildlife with cover, the very cover that was intended to protect wildlife could actually fuel a devastating fire. These conditions enable erratic wildfires, where flames are 15 to 50 feet long and can loft firebrands that result in fire spotting. Wildlife mortality increases because of these fire’s severity, intensity, and speed—they are very different from the fire conditions under which native wildlife species evolved. Unmanaged fuel loads promote hot, intense wildfires that all animals struggle against, whether by burrowing or escaping.

Bears, which are native to Texas, are



Figure 6: Two white-tailed bucks on a 1,500-acre summer burn in Mason County. The two bucks wandered the fire lines on the east side of the active burn unit. The Burn Boss met prescribed burn objectives with ignition techniques that allowed wildlife access and escape routes. *Photo by Dr. Morgan Russell*

expanding back into their historic range, though large-scale fires influence their population by reducing their food supplies in the short term. However, bears will wander across mountain ranges in search of food, and then re-establish in new areas once they find new food sources. This foraging behavior has been a key factor in bear expansion for thousands of years.

Historically, fires were so frequent that fuel buildup seldom occurred and fires burned in cooler mosaic patterns with short flame lengths and head fire behavior almost consistent with today’s back-fires. In environments where fire was common, there is little evidence that fires, within historical intensities, cause any direct mortality of wildlife.

Resource management includes promoting diversity of both fauna and flora. Fire will happen on landscapes and it is up to us to decide what kind will occur and how they will impact wildlife populations. Prescribed burns can be controlled and they reduce potential wildfire severity and intensity, thus reducing potential for animal mortality.

Summary of fire effects on wildlife types

- Small mammals (rabbits, squirrels, mice, rats, etc.)
 - Direct fire effects on small mammals are minimal.
 - Greater fire effects occur indirectly due to the temporary loss of shelter, food, increased surface exposure, and increased predation.
 - Survival increases when fires are conducted with low fuel-density, variable fuel continuity and high moisture content.
- Birds
 - Birds easily escape the fire front and congregate to recently burned areas within seconds.
 - Adult birds are more mobile and can easily escape fire more easily than younger birds.
- Northern Bobwhite love to occupy the edges of burns before they stop smoking and feast on newly available insects and seeds.
- Lesser prairie chickens prefer sites burned every 3 years to maintain—this return period provides appropriate grass height for nesting and concealment.
- Turkeys require a mosaic of burned and non-burned areas to provide for spring nesting and feeding, and winter mast and roosts.
- Amphibians and reptiles
 - Dormant-season fire had no effect on their diversity and abundance.

- Diversity and abundance are slightly greater in plots managed with growing-season fires.
- Variable fire frequencies and seasons promote greater mosaic patterns ideal for amphibian and reptile species.
- Large mammals
 - White-tailed deer require at least 40 percent of landscape to be screening cover.
 - Deer populations increase dramatically following fire, provided 40 percent or more cover remains after the burn.
 - Increases in nutrient content occur; however, these increases do not last for more than 6 months following fire.
 - Large mammal species, such as white-tailed deer, mule deer, and pronghorn flee from fire instinctively.
 - Deer also benefit from increased acorn production and other foods, such as succulents.
 - Fire suppression and landscape fragmentation through high-fencing have created conditions in which large mammal wildlife mortality is more frequent.

For more information

AgriLife Extension

Agrilife.org

naturalresourcewebinars.tamu.edu

texnat.tamu.edu

wildlife.tamu.edu

Texas Parks and Wildlife Department

tpwd.texas.gov

Natural Resources Conservation Service

nrcs.usda.gov

Related publications

ERM-020, "Wildfire Impacts on Surface Waters," Texas A&M AgriLife Extension.

EWf-034, "Managing Heat for Wildlife on Texas Rangelands," Texas A&M AgriLife Extension.

SP-248, “Fire as a Tool for Managing Wildlife Habitat,” Texas A&M AgriLife Extension.

SP-379, “Proceedings of the Trans-Pecos Prescribed Fire Symposium,” Texas A&M AgriLife Extension.

SP-492, “Conducting Prescribed Fires – A Comprehensive Manual,” Oklahoma State University.

SP-491, “Brush Management Past, Present, Future,” Texas A&M AgriLife Extension.

Glossary

Cover – any structure that provides screening, protection, or insulation against weather events, sunlight, predators, etc.

Diversity – consisting of different elements and variety

Edge habitat – areas in the transition between two habitat types (i.e. woodland and grassland)

Fine fuels – typically 1-hr fuels such as grass and grass like plants

Firebrands – flaming or glowing fuel particles that are carried by wind, convective currents, or by gravity into non-burned fuels

Interspersed – mixing of components, in this case, of habitat components

Loafing coverts – cover that provides protection from sun and predation risk in sufficient structure that animals can move freely, or loaf, underneath it

Suppression – the act of extinguishing any open flame

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New



ON-SITE BRUSH PILE BURNING IN TEXAS

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ABSTRACT

Burning on-site brush and debris piles is an effective and efficient method to rapidly break down unwanted or dead plant material generated from land management activities such as brush chaining, grubbing, or shearing that allow for agricultural, forestry, and livestock use. However, these types of burns can be risky and volatile when conducted improperly, potentially causing unexpected wildfires with rapid rates of spread. In order to effectively manage cut and piled brush and conduct a safe brush pile burn, there are several straightforward steps that can be taken. Following regulatory guidelines, building piles that are safe to burn, actively monitoring burning brush piles, and having the right resources on hand will allow burning plant debris to continue to be an integral and safe part of rangeland and property management.

MANAGEMENT SUMMARY

Burning brush piles is very similar to conducting a prescribed burn. The same requirements, due diligence, and standards of care apply to brush piles. Adequate fire lines or firebreaks, personnel, firefighting equipment, appropriate notification requirements, safe weather forecast, and prior planning and preparation are all considerations that should be carefully thought out.

Before Burning

- ▶ Determine if the proposed burn is allowable per Texas Commission on Environmental Quality (TCEQ) regulations.
- ▶ Become familiar with TCEQ burn requirements related to disposal fires, such as designated nonattainment areas.
- ▶ Become familiar with county or other local outdoor burning rules and regulations.

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- ▶ Inquire whether a burn ban is issued for the burn day and proceed accordingly, notifying local fire departments and fire dispatch. If a burn ban exemption exists, notify the requisite authorities of the intention to burn and provide all necessary information.
- ▶ Ensure the burn does not create a smoke nuisance or potential traffic hazard.
- ▶ Ensure the weather forecast will permit safe burning, adequate smoke dispersion, and will not change in a manner that creates a wildfire risk.
- ▶ Prepare a safe area to burn by establishing a clear line free of any fuel; ensure there is no fuel above or around the pile and construct piles to a manageable size (i.e., larger than a small car, but smaller than a greyhound bus).

During and After Brush Pile Burning

- ▶ Keep suppression water resources and tools handy in case the pile needs to be extinguished.
- ▶ Never leave a brush pile actively burning without appropriate supervision.
- ▶ Continuous weather monitoring during the burn is equally as important as weather monitoring before and after lighting.
- ▶ After the pile is no longer actively burning, ensure that all brush or debris is either burned completely or cold to the touch before leaving the area.
- ▶ Large logs and tree trunks may continue to smolder for weeks after the fire's flaming phase is complete. These larger fuels may still emit embers under volatile weather conditions and ignite wildfires. Be sure to look at the weather forecast before, during, and after igniting brush piles.
- ▶ Remember, safety is a priority at all times. Communicate with participating help and with suppression resources both on and off the fire. Support resources should be

prioritized (charged cell phones, radios, wireless walkie-talkie devices, etc.). Keeping participants hydrated and alert, having a first-aid kit handy, appropriate clothing to deal with heat and smoke, etc. are important considerations that should not go overlooked.

INTRODUCTION

Burning brush and plant material is a long-standing and effective way of breaking down unwanted plant growth from Texas rangeland pastures. However, a majority of Texas wildfires are caused by the unsafe burning of brush and plant materials (Texas A&M Forest Service, 2019). This document is designed to aid landowners and property managers before, during, and after the decision-making processes of safely preparing, building, igniting, supervising, and extinguishing burning vegetative brush and debris piles.

OUTDOOR BURNING REGULATIONS

Across the state, there are generally three levels of regulations and ordinances potentially applicable to the burning of brush and plant material. First, at the state level, the TCEQ regulates all outdoor burning in Texas. Their regulations apply statewide and should be thoroughly reviewed and understood before conducting any burn in Texas. Second, there may be regulations at the county level. These primarily are in the form of a burn ban instituted by the county judge or commissioners. Finally, local municipalities commonly have restrictions or guidance on when or how to burn brush and plant debris within their city limits. Every county will vary in their outdoor burning rules and regulations; therefore, extreme regard and standards of care for county and city rules must be satisfied before igniting any brush pile.

Texas Outdoor Burning Exemptions

The TCEQ is the state regulatory agency regulating outdoor burning, including brush and debris piles. TCEQ regulations prohibit all outdoor burning in Texas, subject to certain exceptions (30 Texas Administrative Code § 111.201). The only scenario in which outdoor burning is allowed is if the proposed burn fits within one of the exceptions to the general prohibition on outdoor burning.

The following types of burns are allowable exceptions to the general prohibition on outdoor burning:

- ▶ Fire training;
- ▶ Fires for recreation, ceremony, cooking, and warmth;
- ▶ Disposal fires (including domestic waste, diseased animal carcasses, veterinarian disposal of animal remains, on-site burning of plant growth, at a site designated for consolidated burning of waste generated from specific residential properties, crop residue burning for agricultural management purposes when no practical

alternative exists, and plant growth detrimental to public health and safety conditions that is burned by a county or municipal government at a government-owned site upon receiving site and burn approval from the executive director);

- ▶ Prescribed burning;
- ▶ Hydrocarbon burning (methane, butane, propane, hexane, natural gas, and other fuels); and
- ▶ Executive director approval of otherwise prohibited outdoor burning.

See 30 Texas Administrative Code (TAC) §§ 111.205–111.215.

Disposal Fires

Typically, on-site burning of trees, brush, grass, leaves, branch trimmings, or other plant growth by the owner of the property or any other authorized person when the plant material is generated only from that property is considered an exemption for outdoor burning as a disposal fire—not a prescribed burn. Therefore, this publication will only focus on the rules related to the exemption provided for disposal fires and, in particular, on-site burning of plant growth. The owner or person authorized by the owner must follow and meet all of the prescribed burning requirements found in 30 TAC Sections 111.209(4) and 111.219(3, 4, 6, and 7).

Accepted Plant Material

A landowner of the property or any other person authorized by the owner of the property may conduct on-site burning of plant material generated only from that property if the plant material being burned consists strictly of:

- ▶ Trees;
- ▶ Brush;
- ▶ Grass;
- ▶ Leaves;
- ▶ Branch trimmings; or
- ▶ Other plant growth.

See 30 TAC § 111.209(4).

Importantly, only material generated on the property may legally be burned on-site. Note that this exemption to the general burning prohibition is applied only to a limited class of vegetation.

Identify Certain Categories of Vegetation

Although trees, brush, grass, leaves, branch trimmings, or other plant growth may be burned on-site if generated from the property, there are additional limitations on burning that may exist for certain areas if the vegetation was generated as a result of right-of-way maintenance, land-clearing operations, and maintenance along water canals; see 30 TAC § 111.209(4)(A)–(B) for more information. Thus, prior

to burning plant material, a person must determine if the material was generated as a result of one of these categories.

A “land-clearing operation” is defined as “the uprooting, cutting, or clearing of vegetation in connection with conversion for the construction of buildings, rights-of-way, residential, commercial, or industrial development, or the clearing of vegetation to enhance property value, access, or production. It does not include the maintenance burning of on-site property wastes such as fallen limbs, branches, or leaves, or other wastes from routine property clean-up activities, nor does it include prescribed burning or burning following clearing for ecological restoration” (30 TAC § 111.203[3]).

Given the breadth of this definition, many agricultural-related burns of brush piles will likely fall within the definition of land clearing and, therefore, be subject to additional requirements. Burns of accepted plant materials not falling within these three categories are not subject to the requirements related to attainment status.

For example, consider the burning of a brush pile consisting of tree limbs. If a landowner cut the limbs to enable easier access to the property, that would likely constitute as land clearing, and the additional attainment status requirements would apply. If, however, the pile was created by a landowner who gathered up fallen tree limbs after a storm, it would not be considered land clearing, and the additional requirements related to attainment status would be inapplicable. Of course, in either scenario, TCEQ’s general requirements for allowable outdoor burning (30 TAC § 111.219), as well as any county or local rules, would apply.

Determine Attainment Status

If the brush or debris pile is generated as a result of the categories discussed above—right-of-way maintenance, land-clearing operations, or maintenance along water canals—then county attainment status must be determined, and additional restrictions may apply.

An area’s status will either be designated as “attainment” or “nonattainment.” This distinction is based upon the concentration of criteria pollutants in an area and whether they exceed the regulated levels of established National Ambient Air Quality Standards. If any of the criteria pollutants are over the regulated allowable amount, the area is deemed nonattainment. Alternatively, an area where all criteria pollutants are below the regulated allowable level would be considered attainment.

Landowners may determine current attainment status for a respective county by visiting <https://www.tceq.texas.gov/airquality/sip>, which provides an interactive map of Texas counties and current information on attainment status. Clicking on a specific county or area will generate attainment status information for that specific county or area and will



Brush piles should be contained with a bladed line down to bare mineral soil in order to prevent any escapes through adjacent fine fuel, such as dormant grass. (Image courtesy of Morgan Treadwell)

include a summary table of the federal criteria pollutants for nonattainment status. Landowners should look at the “Designation” column of the report. A listing of attainment/unclassifiable, unclassifiable, or attainment (maintenance) would be considered an attainment status. A designation for any listed pollutant as nonattainment would deem the area a designated nonattainment area for the purposes of this regulation. Attainment status can also be determined by calling any TCEQ regional office.

Additionally, TCEQ regulations provide that if a burn is conducted in a county that contains any part of a municipality that extends into a designated nonattainment area, the burn will be considered to occur in an attainment area (30 TAC § 111.209[4][A]–[B]).

Result of Attainment or Nonattainment Status

If a landowner conducts a burn of vegetation that falls into one of the three categories listed above—right-of-way maintenance, land-clearing operations, or maintenance along water canals—the following additional regulations apply.

For burns falling in these three categories in a nonattainment area: burns are allowed only “when no practical alternative exists” (30 TAC § 111.209[4][A]). TCEQ regulations define “practical alternative” as an “economically, technologically, ecologically, and logistically viable option” (30 TAC § 111.203[5]). Thus, a landowner in a nonattainment area may burn only if there is not a practical alternative to dispose of the vegetation. Any such burns must be conducted in accordance with the TCEQ General Requirements for Outdoor Burning (30 TAC § 111.219) discussed below. Commission notification or approval is not required for such burns (30 TAC § 111.209[4][A]).

For an attainment area: burns falling within these three categories are allowed without having to prove the lack of a practical alternative. Such burns in an attainment area are subject to local ordinances that prohibit burning inside

the corporate limits of a city or town and are consistent with the Texas Clean Air Act, Subchapter E, Authority of Local Governments. Additionally, these burns are subject to the General Requirements for Allowable Outdoor Burning Sections 111.219(3, 4, 6, 7), discussed below. See 30 TAC § 111.209(4)(B).

Requirements for Certified and Insured Prescribed Burn Managers

Please note that if the landowner or landowner's representative igniting the brush pile is a Certified and Insured Prescribed Burn Manager from the Texas Department of Agriculture, the "Requirements for Certified and Insured Prescribed Burn Managers" found in 30 TAC Section 111.217 apply.

General Requirements for Allowable Outdoor Burning

The TCEQ regulations list several requirements applicable to all outdoor burns. These requirements are as follows:

1. Prior to prescribed or controlled burning for forest management purposes, the Texas Forest Service shall be notified.
2. Burning must be outside the corporate limits of a city or town except where the incorporated city or town has enacted ordinances which permit burning consistent with the Texas Clean Air Act, Subchapter E, Authority of Local Governments.
3. Burning shall be commenced and conducted only when wind direction and other meteorological conditions are such that smoke and other pollutants will not cause adverse effects to any public road, landing strip, navigable water, or off-site structure containing sensitive receptor(s).
4. If at any time the burning causes or may tend to cause smoke to blow onto or across a road or highway, it is the responsibility of the person initiating the burn to post flag-persons on affected roads.
5. Burning must be conducted downwind of or at least 300 feet (90 meters) from any structure containing sensitive receptors located on adjacent properties unless prior written approval is obtained from the adjacent occupant with possessory control.
6. Burning shall be conducted in compliance with the following meteorological and timing considerations:
 - a. The initiation of burning shall commence no earlier than one hour after sunrise. Burning shall be completed on the same day not later than one hour before sunset and shall be attended by a responsible party at all times during the active burn phase when the fire is progressing. In cases where residual fires and/or smoldering objects continue to emit smoke after this time, such areas shall be extinguished if the smoke from these areas has the potential to create a

nuisance or traffic hazard condition. In no case shall the extent of the burn area be allowed to increase after this time.

- b. Burning shall not be commenced when surface wind speed is predicted to be less than six miles per hour (mph) (five knots) or greater than 23 mph (20 knots) during the burn period.
 - c. Burning shall not be conducted during periods of actual or predicted persistent low-level atmospheric temperature inversions.
7. Electrical insulation, treated lumber, plastics, non-wood construction/demolition materials, heavy oils, asphaltic materials, potentially explosive materials, chemical wastes, and items containing natural or synthetic rubber must not be burned.

See 30 TAC § 111.219.

Allowable Burn Locations

Burning that is otherwise allowed based on the regulations discussed above may generally be conducted only outside of the corporate limits of a city or town; see 30 TAC § 111.219(2). Burning will be allowed within the corporate limits of a city or town if the city or town has enacted an ordinance allowing burning consistent with the Texas Clean Air Act, Subchapter E, Authority of Local Governments; see 30 TAC § 111.219(2).

Potential Liability

Finally, TCEQ regulations make it clear that compliance with these regulations does not excuse a person conducting a burn from any consequences, damages, or injuries resulting from the burn; see 30 TAC § 111.221. In other words, these regulations do not offer limited liability for landowners who can prove compliance. Landowners should take care to ensure they do not act negligently when conducting a burn and should confirm liability insurance coverage before undertaking a burn.

TIME OF YEAR

Whether growing or dormant season, the time of year is a crucial factor in brush pile burning. Growing-season months—April to June—are generally the best times of the year to burn brush piles to minimize the risk of escape. Early to late spring is best, as the surrounding vegetation—both cool- and warm-season plants—is usually actively growing with high moisture content. Burning brush piles during early to late spring significantly reduces potential ignition or fire spread. If a brush pile does expand beyond the designated area, fire behavior, flame length, and intensity are manageable due to high amounts of fuel moisture from actively growing vegetation. These types of fires are much easier to suppress due to slower rates of spread and shorter flames. However, if the current year's growth is green, residual fuel accumulation from the previous year's growth

is likely, and a fire will still carry and burn. This is the primary reason and justification for constant monitoring of actively burning piles and ensuring adequate and appropriate suppression equipment is on-site to successfully extinguish a burning pile if need be. In Texas, it is not recommended to burn piles during the winter following a recent rain or snow due to the dormant and cured-out surrounding vegetation, even with high soil moisture. Dry and dormant fine fuels will rapidly lose moisture, even during the winter after a snow event. Fine fuels, such as grasses, are considered 1-hour time lag fuels. One-hour fuels represent a fuel lag category of one hour for fine fuels to equalize to the same moisture content as the surrounding atmospheric conditions. This is important, as the dry weather during winter and changing wind conditions may result in the spread of a previously contained fire since brush piles can smolder and are at risk to become open flames for up to several days or even weeks once ignited (Oklahoma Cooperative Extension Service, 2017).



Brush piles may smolder for several days after ignition due to heavy fuel loads of 100-hour or 1,000-hour fuel loads. Brush piles should be monitored after being consumed by the fire due to lingering heat effects from heavy fuel loads. (Image courtesy of Morgan Treadwell)

SMOKE MANAGEMENT

Burning must only occur when smoke does not present a hazard to a public road, waterway, landing strip, or any sensitive receptors, such as residences, hospitals, schools, etc. The landowner or landowner representative who ignited the brush pile is solely responsible for wherever the brush pile smoke disperses (6 Texas Natural Resources Code § 153). Wind direction is an important weather factor to continuously monitor due to ember wash and potential ignition downwind of the burning brush pile. Atmospheric dispersal should be taken into consideration when managing smoke. Cloudy, rainy, high-humidity days provide stable atmospheric conditions, which are poor days for smoke dispersal. Avoid burning during inversions that will trap smoke close to the surface—typically early morning or early evening conditions, or near surface water areas. Igniting a very small test fire to ensure the smoke is dispersing is

a good test to determine wind direction and lift. These negative smoke effects can be minimized by burning dry brush, burning under appropriate smoke dispersal weather conditions, and by sizing piles to appropriately manage smoke plumes. Brush piles should be built to a realistic, manageable size. For example, if a brush pile is too tall, it could potentially collapse and send an ember wash into adjacent fuels.

WEATHER CONDITIONS

Current weather conditions are the top concern when burning brush piles. When contemplating and planning for brush pile burns, wind speed should be the first weather condition checked prior to burning. According to Texas A&M Forest Service (2019), burning brush piles during gusty and high-wind days is the major contributor to wildfires and rapid rates of spread, especially during the dormant or winter season. Additionally, piles should not be ignited when the wind speed is over 15 miles per hour and winds are steady in the days following ignition. A general rule-of-thumb is to target burn days that are 40 percent or greater in relative humidity in order to mitigate ember wash, spotting, and potential fire escapes. Verifying that any steady winds are below 15 mph and from a consistent direction while the relative humidity is 40 percent or greater will ensure a safe burn with brush piles that contain tree limbs and trunks, as these are considered 100-hour or 1,000-hour time lag fuels. These time lag fuel categories will require 100 or 1,000 hours to become as dry as the surrounding atmospheric conditions (Oklahoma Cooperative Extension Service, 2017). Therefore, burning brush piles on high-humidity days or even during a light rain can be accomplished due to the fuel lag for larger fuel types, taking into consideration smoke management, especially if the larger fuels have been dry for an extended period of time. It is critical to recognize the positive relationship between relative humidity and fuel moisture to successfully conduct a brush pile fire while minimizing the threat of a potential wildfire. Keep in mind that outdoor burning is prohibited prior to or during a low-pressure atmospheric inversion, often occurring overnight or during cold fronts.

Once a day is selected, frequently check the weather forecast in the days leading up to the burn. Keep in mind that many brush piles may take several days to burn completely. Piles that contain large amounts of soil will cause slower and less complete fuel combustion (Oklahoma Cooperative Extension Service, 2017). Due to the potential time to burn down 100-hour or 1,000-hour fuel types and soil in the brush pile, piles can potentially burn and smolder for several days or even weeks. In order to mitigate any fire spotting or escape, weather conditions must be appropriate for safe conditions while the piles burn. If winds become unfavorable or relative humidity drops for an extended period of time, brush pile burning should be delayed until the forecast improves for the duration of the burn.

BUILDING ON-SITE BRUSH AND PLANT DEBRIS PILES

When chaining or grubbing standing brush, it is often convenient to make large windrows of piled plant debris. While this may be an easy solution on the tractor or bulldozer, it can be a major safety and liability issue when it comes time to burn it. Brush piles are best built small and dense—picture a small car versus a greyhound bus—which allows fire to quickly spread throughout the pile, increasing its intensity. As a result, this reduces the time it takes to burn and shortens the time that the pile is emitting and lofting firebrands and embers into the air. Small and compact brush piles will reduce the overall intensity of the burn, the size of the flame, and the amount of smoke produced, making the pile much more manageable on burn days. Even though building many small brush piles adds more piles to burn, it makes the process more manageable while minimizing the risk of a wildfire and allowing for better smoke management, which should be a priority (Oklahoma Cooperative Extension Service, 2017). Therefore, when building brush piles, be sure to plan ahead for potential ignition. Look up, look down, and look around for potential hazards and flammable material. Burning beneath a tree canopy has a high risk of igniting the canopy and causing the fire to escape the managed brush pile area.

Make sure to avoid building brush piles under tree canopies, power or transmission lines, on buried or exposed gas lines, or within close proximity to hydrogen sulfide (H₂S) gas. Gas lines are susceptible to leaking and may potentially overheat, and smoke from the burning pile can cause electricity to arc on powerlines.

Always consider the capacity to safely and effectively burn brush when building piles. Maintain a general idea of the water and equipment available to completely extinguish the

burning pile. Wind and weather can change rapidly, sending smoke and embers in undesirable directions. Unforeseen weather shifts are always a possibility and may rapidly increase fire behavior, flame length, and rate-of-spread of the burning pile. Maintaining control and capacity to safely extinguish the burning brush pile is critically important.

After building the brush pile, it is also important to take the time to clear the area around the brush pile of dormant fine fuel or other materials that may ignite—this includes the proximity to adjacent brush piles. Mowing or disking a ring around the pile can greatly reduce the chance of fire creeping away from the main brush pile. Prior to igniting piles, a wet line can be applied around the brush pile to decrease the chances of a creeping fire.

IGNITING BRUSH PILES

The safe ignition of brush piles should be treated with considerable care. Several different types of equipment exist for ignition, although the primary tool is a drip torch. Other tools that can be used safely include a fusee, or a road flare, a propane torch, or placing flammable fine fuel, such as lighting hay or paper, in the brush pile. Igniting piles soaked with flammable liquids with a match should be avoided. However, liquids such as kerosene, an equal mixture of diesel and gasoline, or charcoal lighter fluid can be effective if they are safely used due to their less-flammable nature (Oklahoma Cooperative Extension Service, 2017). If flammable liquids are necessary, only use them sparingly on smaller sections of the brush pile before igniting (Oklahoma Cooperative Extension Service, 2017). If the brush pile does not ignite due to high moisture conditions or large fuel categories, ensure all flames are extinguished before adding more drip torch fuel or flammable liquid. A good practice is to drip the fluid out away from the pile, giving the burner adequate space and time to distance themselves from the brush pile.

Gasoline is highly flammable, has a low flash point, and releases a vapor that is denser than air; therefore, it should not be used to ignite brush piles (Oklahoma Cooperative Extension Service, 2017). Gasoline can easily cause serious burns and injury to the person igniting it or nearby bystanders.

In addition to the equipment or liquid used to ignite brush piles, the ignition method and location also play a critical role. Igniting a brush pile with a goal to reduce the intensity of the fire and length of the flame should be prioritized, minimizing any chance of escape or wildfire. Therefore, when igniting a brush pile, start with ignitions on the downwind side. This will create a backfire—a fire moving or burning into the wind—causing slower consumption of the brush pile with minimized fire behavior, flame length, and fire intensity. This ignition method may take longer for the brush pile to be consumed, but it is a safe and reliable method to ensure containment.



Burning smaller brush piles reduces the risk of fire escapes while still burning faster than large piles. (Image courtesy of Chase T. Brooke)

If a significant number of brush piles exist, have a plan before ignition as to how many brush piles can be effectively and safely managed at one time or over the course of a single day. The span of control is crucial, even when it comes to lighting brush piles. Do not spread resources too thin.

AFTER THE FIRE

After the pile is consumed, there are still several considerations landowners must keep in mind. The main post-fire issue is that large logs and tree trunks may continue to smolder for weeks after the flaming phase of the fire is complete. These larger fuels may still emit embers under volatile weather conditions and ignite wildfires. Be sure to look at the weather forecast before, during, and after igniting brush piles. Do not burn if a red flag warning is issued or other volatile or unpredictable weather conditions are forecasted within 24 hours of burning. Once most of the brush pile is consumed, use water or a tool, such as a shovel, to wet or scrape any embers until smoldering ceases, and the residual brush pile is cool to the touch.

Once the fire is extinguished, there may be a residual fire scar left on the ground. While potentially unsightly, these scars will naturally be reclaimed by grasses and forbs in upcoming years with adequate rainfall and rest. Brush pile scars on the soil's surface can be mitigated by the season of burn, such as during periods of high fuel moisture content or relative humidity. Keep in mind the need for smoke management and dispersion, as well as increased time for



Once the fire is extinguished, there may be a residual fire scar left on the ground. While potentially unsightly, these scars will naturally be reclaimed by grasses and forbs in upcoming years with adequate rainfall and rest. (Image courtesy of Morgan Treadwell)

complete combustion of the brush pile. Brush pile scars or more areas with bare ground following the brush pile burn are temporary and will create an opportunity for different plants to become established, such as forbs and secondary-succession plant species. Plant succession will eventually attract certain species of wildlife, livestock, or pollinators back to their native plant community (Oklahoma Cooperative Extension Service, 2017). Larger piles will leave burn scars that last longer, but reclamation can be enhanced by re-seeding the area with desirable grass and forb species. Small-acreage properties may necessitate permanent burning locations to reduce the loss of grazeable area from brush pile burn sites.

CONCLUSION

Burning on-site brush piles can benefit landowners when conducted carefully and in accordance with all legal requirements. Before burning plant material, landowners should review and understand all applicable TCEQ regulations and determine if any county or local ordinances are applicable.

Finally, there is no substitute for common sense and an abundance of caution. Anyone conducting a brush pile burn should use best management practices such as having and executing a well-thought-out burn plan, checking weather conditions, being aware of any forecast changes, and being in contact with neighbors and local fire departments.

RESOURCES

TCEQ Attainment Status Website: <https://www.tceq.texas.gov/airquality/sip>

Outdoor Burning in Texas (2015). Texas Commission on Environmental Quality. Publication RG-049

National Ambient Air Quality Standards: <https://www.epa.gov/criteria-air-pollutants/naaqs-table>

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Oklahoma Cooperative Extension Service. (2017). *NREM-2894: Managing Brush Piles* [Fact sheet]. Retrieved from <http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-9405/NREM-2894web.pdf>

Texas A&M Forest Service. (2019). *Preparing for Wildfires*. Retrieved from <https://tfsweb.tamu.edu/PreventWildfire/>

30 Texas Administrative Code Chapter 111, Subchapter B (Sections 111.201–111.221). Retrieved from [https://texreg.sos.state.tx.us/public/readtac\\$ext.ViewTAC?tac_view=5&ti=30&pt=1&ch=111&sch=B&rl=Y](https://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=5&ti=30&pt=1&ch=111&sch=B&rl=Y)

6 Texas Natural Resources Code Chapter 153. Retrieved from <https://statutes.capitol.texas.gov/Docs/NR/htm/NR.153.htm>

Highlights

- ▶ Review and comply with all applicable state, county, and local regulations or ordinances.
- ▶ The best time to burn brush and debris piles is April through June, when the surrounding vegetation is green.
- ▶ Have adequate suppression equipment available.
- ▶ Be certain participants are healthy and vigilant. Have communication devices, adequate hydration, and first-aid supplies readily accessible.
- ▶ Watch the extended weather forecast and ensure that the winds will be less than 15 miles per hour and that the relative humidity is greater than 40 percent.
- ▶ Notify local volunteer fire departments, neighbors, required regulatory state agencies, and sensitive smoke areas or receptors.

Acknowledgment

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Disclaimer

This manuscript is specific to Texas Laws and Regulations for Outdoor Burning. However, it is potentially applicable to other states or regions, particularly regarding methodology and safety. Burn managers should confer with their various state regulators for specific regulations and restrictions that may vary.

APPENDIX D – PROGRAM HANDOUT, SPICEWOOD RANCH



**Peers & Pros 360°
Additional Resources
on Prescribed Fire**

TEXAS A&M
AGRILIFE
EXTENSION

Conservation Organizations/Professionals (most can directly or indirectly assist with prescribed fire planning or implementation)

- TAMU AgriLife Extension (<https://counties.agrilife.org/>)
- Texas Parks and Wildlife Department (https://tpwd.texas.gov/landwater/land/technical_guidance/biologists/)
- Natural Resource Conservation Service (www.nrcs.usda.gov/wps/portal/nrcs/main/tx/contact/)
- Oaks and Prairies Joint Venture (www.opjv.org/contact)
- US Fish and Wildlife Service (www.fws.gov/southwest/es/Documents/R2ES/AUES_PFW_Handout_2016.pdf)
- Texas Forest Service (<https://tfsweb.tamu.edu/>)
- Prescribed Burn Alliance of Texas (<https://pbatexas.org/Associations.aspx>)
- TX Certified and Insured Prescribed Burn Managers (www.texasagriculture.gov/Portals/0/Reports/PIR/certified_commercial_burn_managers.html)

Grants/programs related to prescribed fire and/or habitat restoration for the Texas Hill Country

- Oaks and Prairies Joint Venture (OPJV)
 - o Grassland Restoration Incentive Program (GRIP): www.opjv.org/grip
 - Contact Taylor Daily (tdaily@quailforever.org) or Thomas Janke (tjanke@quailforever.org) for more information on GRIP opportunities.
- Texas Forest Service (TFS)
 - o Various prescribed fire and habitat management grants are available to help mitigate wildfires (<https://tfsweb.tamu.edu/cppgrant/>)
 - Contact Jacob Gosschalk (jgosschalk@tfs.tamu.edu) for more details on TFS programs.
- Natural Resource Conservation Service (NRCS)
 - o Environmental Quality Incentives Program (EQIP) www.nrcs.usda.gov/wps/portal/nrcs/main/tx/programs/financial/eqip/
 - o Contact local NRCS office for more information.
- Texas Parks and Wildlife Department (TPWD)
 - o Landowner Incentive Program (LIP) https://tpwd.texas.gov/landwater/land/private/lip/#LIP_Watershed_Funding_Series
 - Multiple areas throughout Edwards Plateau may qualify <https://tpwd.texas.gov/landwater/land/private/lip/images/LIP-Tx-PriorityWatersheds.jpg>
 - o Pastures for Upland Birds (PUB) https://tpwd.texas.gov/landwater/land/habitats/post_oak/upland_game/pub/
 - Though not updated online yet, the PUB program has been extended to include the entire Edwards Plateau.
 - o Contact Arlene Kalmbach (arlene.kalmbach@tpwd.texas.gov) or Tim Siegmund (tim.siegmund@tpwd.texas.gov) for more details on either program.
- US Fish and Wildlife Service (USFWS)
 - o Partners for Fish and Wildlife Program: www.fws.gov/partners/projects/

- Contact Brendan Witt (brendan_witt@fws.gov) for more details.
- Local Soil and Water Conservation Districts (SWCD) occasionally have grant opportunities.
 - Contact local SWCD or local NRCS office about possible opportunities and funds

A good source of information is your local Prescribed Burn Association (PBA). The Edwards Plateau PBA (EPPBA) has multiple (sub)chapters throughout the region. This PBA, like others, consists of landowners interested in using prescribed fire as a management tool. These individuals work with, assist, and learn from each other as they conduct prescribed fires and the necessary trainings and preparations that go along with them. Contact Heath Starns (Heath.Starns@ag.tamu.edu) for more details on individual (sub)chapters of the EPPBA.

Legal Barriers to Prescribed Burning



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The reduction of naturally occurring fires has altered ecosystems worldwide. This alteration of natural fire regimes has had negative impacts in many areas. These include declines in fire-dependent species, the loss of resilience in fire-prone ecosystems, and a dramatic decline in important ecosystem services, such

as surface water infiltration, soil nutrient cycling, and the availability of adequate wildlife habitat. In addition, plant communities that are adapted to specific fire regime's frequency, intensity, and seasonality are more susceptible to invasion by fire-sensitive species such as ashe juniper and eastern redcedar.

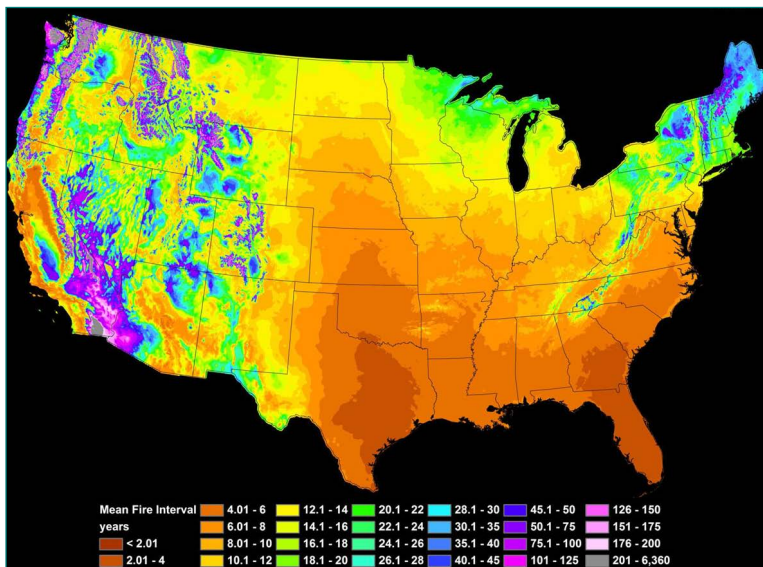


Figure 1. Historic (1650–1850) mean fire return interval estimates for fire in all or part of an average 1.2 km² area. *Graphic courtesy Guyette et al., 2012)*

Recreations of historic fire regimes suggest that the fire return interval for a large portion of the southeastern United States was from 2 to 10 years. Some areas in the Ozarks and Appalachian mountains are thought to have had return intervals of 10 to 45 years (Fig. 1). Fire suppression, which has been the dominant rangeland management response in the southeastern US throughout most of the 20th century, has had many negative impacts on the region's ecosystems. For example, the change from frequent low-intensity fires to infrequent high-intensity fires in forests of east Texas and the southeastern

United States has caused many loblolly pine trees to be replaced by less valuable forest species. This change results in lower forage productivity, decreased diversity of native species, and degraded habitat for grassland birds and mammals—many of which have become threatened or endangered.

Fuel accumulation is inevitable when fire is taken out of the range management scheme. The buildup of flammable plant tissues increases the likelihood of a wildfire that is much more intense than fires in areas where fuels are managed. This increased intensity causes fires that are difficult to control and more likely to destroy property and injure people. In addition, severe fires in systems that are adapted to frequent low-intensity fires can alter the structure and composition of existing plant communities. These changes often reduce overall plant community resilience, which, in turn, decreases ecosystem function. In extreme cases, wildfires resulting from fuel accumulation can increase rangeland degradation and soil erosion as well as injury, loss of life and property, and enormous fire control expenditures.

So what options exist to combat the problems that fire suppression has created? Prescribed burning can mimic historical fire regimes under specific circumstances. It is a cost-effective tool for managing and restoring ranges and forests. Prescribed burning can manage vegetation using a natural process that is integral to native plant communities. Unfortunately, the liability and risks associated with the practice keep prescribed burning from being used extensively. For many landowners, potential lawsuit and litigation costs are important considerations when deciding whether to use fire as an ecosystem management tool.



Figure 2. Map of prescribed fire liability standard in each state. Medium gray states prescribe a gross negligence standard, light gray states prescribe simple negligence for burners, dark gray state have case law or statutory language supporting strict liability for escaped prescribed fires, and white states have a liability standard that is undefined statutorily and usually follow simple negligence rules as established by case law. *Used with permission from John Wiley and Sons.*

Prescribed fire liability

Generally, civil liability standards in the United States for prescribed burning fall into three distinct categories (Fig. 2):

Strict liability

- Holds a burner liable for any property damage caused by an escaped prescribed burn or spot fire from the prescribed burn regardless of the action taken by the burner to prevent fire escape
- This is the highest level of liability for anyone using prescribed burning
- Only 5 states have standards that suggest strict liability, although the statutes do not all explicitly state that strict liability is the standard

Simple negligence

- Requires the burner to practice reasonable care during a prescribed burn
- This is the most common liability standard for prescribed burning; Texas and 42 other states, follow simple negligence standards
- Requires the plaintiff to show the burner acted negligently in order for the burner to be liable for damage caused by a pre-

scribed burn that escapes or is the source of a spot fire

- In Texas, this standard is stated explicitly under Texas Natural Resource Code § 153.081. In many states, such as in New Mexico, this standard is established through case law.

Gross negligence

- If a certified prescribed burner follows codified regulations regarding prescribed burning, a plaintiff must demonstrate the burner showed reckless disregard of the duty of care owed to others
- In states with gross negligence standards, simple negligence typically will apply if regulatory requirements are not fulfilled
- Statutes identifying gross negligence liability standards have been enacted in Florida, Georgia, Michigan, and Nevada
- Gross negligence statutes are also an incentive to follow their requirements and receive prescribed burn training—better trained burners lower the risk of an escape and the cost for the burner and adjacent property owners
- Gross negligence incentivizes creating defensible space and fire-wise construction since the burden of liability is shifted from the burner onto neighbors under a gross negligence standard (this type of fire safety response can also help reduce the spread of wildfire)

In some states, legislators have revised state liability laws to counter concerns of liability by private landowners and to promote the use of prescribed burning to manage fuel loads which mitigates wildfire. For example, in 1990 Florida passed the Prescribed Burning Act, which is nationally recognized as landmark legislation that protects a landowner's right to use fire as a management tool. Under this act, a landowner or burner gains the right to burn. As a result, the burner could not be held civilly liable for damages unless simple negligence in using prescribed fire was found. Following the devas-

tating 1998 wildfire season, the Florida legislature modified its Prescribed Burning Act such that a burner cannot be found civilly liable unless a court finds that the burner exhibited gross negligence. Following Florida's example, other states have changed their laws such that the landowner's right to use prescribed burning is explicit. In addition, new prescribed burning laws clearly state the applicable liability standard, and in some states, lessen the liability burden on landowners using prescribed burning. Although these statutory reforms appear positive for prescribed burning, it is unclear that they are achieving their intended purpose of providing adequate incentive for landowners to manage more acres with prescribed burning.

Examples of statute reform for prescribed burning

- Florida statutes list requirements that should be met to by burners, including a written burn plan and that a Certified Prescribed Burn Manager (CPBM) to be on site during the actual burn, as well as having an adequate crew, equipment, and firebreaks
- Florida changed their liability standard from simple to gross negligence if all requirements are met; however, if regulatory requirements are not met, simple negligence applies
- Georgia followed Florida's example, but does not require an onsite CPBM, adequate crew, equipment, etc., and only requires the burner to obtain a permit from the Division of Forestry before conducting a prescribed burn
- Alabama, South Carolina and North Carolina passed right to burn laws which require a CPBM and written burn plan, but each maintained simple negligence standards
- County or state officials can establish burn bans in most states during dangerous fire weather, but many states' statutes, includ-

ing Alabama, North Carolina, Georgia, and Texas, provide exemptions for CPBMs during burn bans. Georgia extends its exemption to all landowners (even uncertified) burning for pasture and field management

Have reforms to liability laws resulted in more acres being burned?

From 2008-2013, fewer acres were treated with prescribed burning and the annual number of fires was lower in simple negligence states than in gross negligence states (Fig. 3). States with gross negligence liability standards burned 7100 more acres per county per year than states with simple negligence standards. Interestingly, states requiring a written burn plan, a CPBM on site, and adequate equipment, personnel, and firebreaks, burned the same number of acres and had similar annual numbers of fires as states that only required filing a permit. Instead of discouraging landowners from using prescribed burns because the additional requirements seem onerous, they may encourage burning by showing burners did not act negligently in the case of an escape. In addition, the increased training and safety awareness that come with those requirements, results in better prepared burners. This preparation and lower liability standards incentivize the use of prescribed burns.

The importance of prescribed burn associations

Prescribed burn associations (PBAs) are critical to the effective use of prescribed burning. These associations provide a non-legislative mechanism for limiting liability for prescribed burning by private landowners. PBAs are landowner cooperatives whose goal is to use prescribed burning to manage vegetation on private lands—they are established to share the cost of burning. Typically, each association consists of several county or multi-county chapters that share labor and equipment, facil-

itate knowledge sharing and training opportunities, and spread the costs of liability insurance across their members. In Oklahoma and Texas, PBAs have driven legislation that allows CPBMs to burn during burn bans to meet management objectives that depend on intense fires. PBAs hold regular business meetings, elect officers, and provide hands-on training to members who want to learn more about prescribed burning. The Prescribed Burn Alliance of Texas

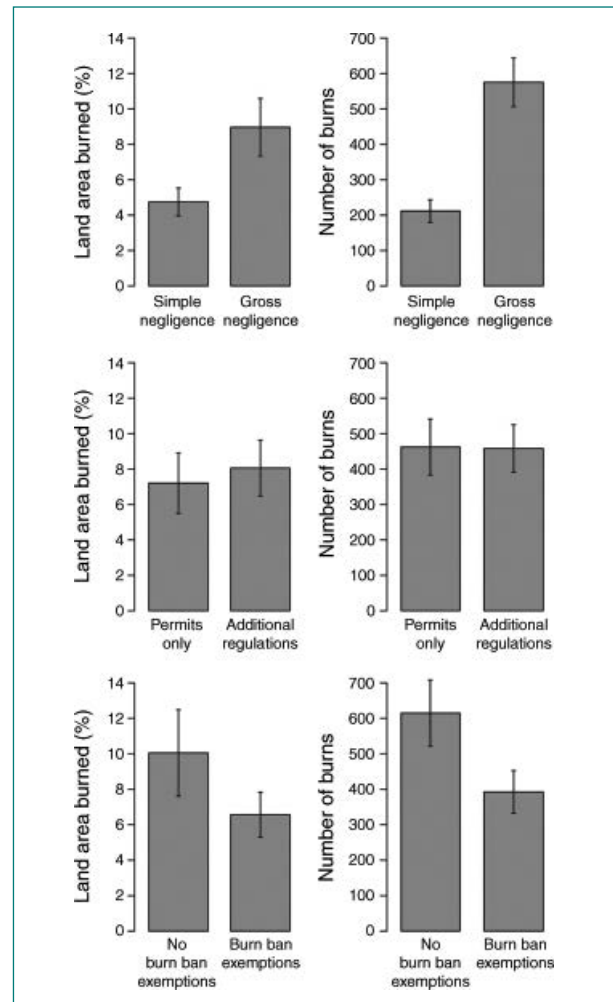


Figure 3. Average annual percentage of land area burned and average annual number of burns between contiguous counties with simple negligence and gross negligence (top row), permit requirements only and additional requirements (middle row), and burn ban exemptions for certified prescribed burn managers (CPBMs) or land management (bottom row). *Used with permission from John Wiley and Sons.*

serves as a portal for the state's 10 PBAs. It provides information and resources on concepts and application of prescribed fire management.

The Coalition of Prescribed Fire Councils is a national body that seeks to enhance public safety, resource management, and environmental quality through appropriate prescribed burning. The Coalition represents twelve million acres of annual prescribed fire use, and serves as a forum for addressing issues of national concern. Its work facilitates communication among those interested in prescribed burning and creates opportunities for prescribed fire collaboration. Currently, 31 states are members of the Coalition of Prescribed Fire Councils.

The Great Plains Fire Science Exchange (GPFSE) also promotes PBAs by assisting land managers and the prescribed burn community with sound decision-making based on the most current scientific research. The GPFSE is supported by the Joint Fire Science Program to strengthen collaboration among prescribed burn managers. It also makes fire science information more readily available to policy makers. Issues of woody plant encroachment, smoke management, prescribed fire techniques, volatile fuel mitigation, and ecosystem health are all issues that the GPFSE works on regularly with PBAs.

Key concepts

- Fire is a necessary component for numerous ecosystems throughout Texas and the southeast. Strict regulations and liability concerns provide disincentives for prescribed burning and have cascading negative effects by discouraging the reintroduced of fire into fire-dependent systems.

- In states that have adopted gross negligence liability standards, landowners are more likely to use fire as a management tool and burn a greater proportion of private land than landowners in states with simple negligence liability standards.
- Regulatory requirements—burn permits, written burn plans, adequate crew, adequate firebreaks and equipment, and CPBMs on site—do not inhibit the incidence of prescribed burning.
- Regulatory requirements along with lower liability standards make prescribed fire more viable for landowners and managers and provide some safety assurances for neighbors.
- In states with gross negligence standards there is no additional damage or increased suppression cost due to escapes or spot fires from prescribed burns.
- Prescribed burn associations provide fire safety training, shared labor, equipment, and (in some cases) liability insurance; they are organizations that effectively help private landowners use prescribed burning.

Additional information on prescribed burning

Great Plains Fire Science Exchange
<http://www.gpfirescience.org/>

Prescribed Burn Alliance of Texas
<http://pbatexas.org/>

Coalition of Prescribed Fire Councils
<http://www.prescribedfire.net/>

Oklahoma Prescribed Burn Association
<http://ok-pba.org/index.html>

The Samuel Roberts Noble Foundation
<http://www.noble.org/fire/>

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The Texas A&M University System, U.S. Department of Agriculture, and the County Commissioners Courts of Texas Cooperating.

New

Effects of Fire on Wildlife



Morgan Russell, Assistant Professor and Extension Range Specialist
John M. Tomeček, Assistant Professor and Extension Wildlife Specialist

The belief that fire on Texas rangelands is detrimental to wildlife is a misconception. In spite of the images that fire prevention programs use to promote their message, rangeland fire has a critical and positive role to play for humans and animals. Native Americans understood that fire enhances the propagation of early successional plants, which attract game such as white-tailed and mule deer, antelope, and bison. Fire plays such a crucial role in our ecosystems, that nearly all native wildlife have adapted to the direct and indirect effects of fire. The absence of fire



Figure 1: 1,000-acre summer prescribed burn in Kimble County (2015). Burn plan objectives included: cedar management, pricklypear management, and increased productivity and vigor of native perennial grasses. *Photo by Dr. Morgan Russell*

on rangelands has consistently been cited as a primary cause of woody encroachment, decreased rangeland condition, and diminished ecological resiliency. Over time, fire suppression actually degrades habitat for many wildlife species—the direct effect of range burning on wildlife is far outweighed by its indirect benefits (Fig. 1).

Many fear that fire is destructive to wildlife. However, even in large fires, animal mortality as a direct result of the fire is rare. When it does occur, it is usually the result of escape routes being blocked by fencing or other obstructions. The beneficial effects of fire typically compensate for any losses, and once vegetation responds, wildlife populations quickly recover, often better than before.

Wildlife habitat is not a static—it changes constantly. Therefore, landowners must manage habitat in order to maintain stable populations of desired wildlife species. Prescribed burning for wildlife must take into account the wildlife species that are present, vegetation types, stages of plant succession, weather patterns, life histories of wildlife, and intensity of burn. Using a series of fires to create a mosaic pattern of vegetation over large areas will create

*Underlined terms are in the glossary on page 7



Figure 2: A 30-acre summer prescribed burn actively burns as part of a patch-burn in a larger 100-acre pasture in San Saba County. Patch-burning allows for enhanced edge effect that provides a variety of fire frequencies and fire effects that enhance wildlife habitat. *Photo by Dr. Morgan Russell*

interspersed habitat types that can support the maximum diversity of plant and wildlife species. In this scheme, burned areas promote edge effects between habitat types that can be used for feeding, escape, loafing coverts*, and sites for ground-nesting birds (Fig. 2).

Below are explanations of the specific effects of fire on various species. These will provide some general rules and context, and to help you develop an understanding of the effects of fire on wildlife.

Small mammals

The direct effect on small mammals (rabbits, squirrels, mice, rats, etc.) is minimal since most escape ahead of the fire front. The indirect effect of fire on small mammals is greater and includes the temporary loss of shelter and food, increased surface exposure, and increased predation. However, research suggests that the numbers and diversity in small mammal populations are maintained for 1 to 3 years or longer after a fire, and that positive food chain effects are present for many years after the fire. Also, some small mammals can tolerate

temperatures of 120 °F for short periods if the relative humidity is above 60 percent. Death typically occurs when fires burn for longer periods at sustained temperatures of 145 °F with a relative humidity below 22 percent. Survival increases when fires involve interspersed low-density fuels and high moisture content.

Birds

The effect of fire on birds depends on the species, the season, and the intensity of a fire. For example, a cool-season dormant burn increases food sources and provides residual nesting sites for ground and brush-foraging birds. A more intense cool-season fire produces the same effect, but creates more openness by reducing the brush canopy. The greatest advantage to varying frequencies of fire is that they create relatively small burns of different ages that are interspersed with areas that have not been burned for several years. Birds may use a recently burned area for foraging within seconds of burning (Fig. 3).

Habitat for endangered bird species such as the golden-cheeked warblers and black-capped vireos can be managed through appropriate burns—these birds evolved in a



Figure 3: A northern bobwhite female in recently burned area foraging for food immediately after a 500-acre prescribed burn in Edwards County. *Photo by Dr. Morgan Russell*

system dominated by fire. The black-capped vireo (listed in 1987) breeds in fire-maintained juniper and scrub-oak habitats. To nest successfully, black-capped Vireos require a patchy structure of mixed shrublands, mature woodlands, and open cover. This diverse habitat type is achieved by varying fire frequencies and seasons to optimize plant diversity and structure.

In some ways, northern bobwhites (*Colinus virginianus*) could be considered a firebird. Quail will take the opportunity to feast on newly available insects and seeds in the edge habitat of burns even before the vegetation stops smoking. A true grassland species, bobwhites thrive in areas characterized by frequent fires that reduce woody cover. In addition, the more efficiently quail feed, the less vulnerable they are to predation—especially following mosaic-type burns that leave residual cover. You can produce quality quail habitat by using a fire regime that intersperses areas burned more frequently than every 2 years with areas burned 2 to 6 years apart. This balance of burn frequencies provides summer fruits and insects that are critical for young birds and laying hens, as well as isolated clumps of grass that are desirable nesting



Figure 4: A covey of northern bobwhite hang out during a summer prescribed burn in McCulloch County. The bobwhite are headed to the recently burned black to forage for new food resources produced from the prescribed burn.
Photo by Brian Treadwell, Conservation Fire Team



Figure 5: This 100-acre prescribed burn in Tom Green County was conducted to remove decadent litter from perennial grasses. The burn will produce healthier stands of grass and greatly enhance the wildlife habitat of this pasture. Photo by Dr. Morgan Russell

habitat (Fig. 4). These isolated clumps of grass, such as little bluestem [*Schizachyrium scoparium* (Michx.) Nash] typically decrease after 3 years due to litter buildup. This buildup inhibits quail movement, especially for chicks. The problem of vegetation becoming too rank for chicks is most common in high-rainfall grasslands, such as the Texas coastal prairies. Patch burning in these areas, at varied return and season intervals, offers a desirable mosaic habitat effect (Fig. 5).

Lesser prairie chickens (*Tympanuchus pallidicinctus*) are best served by burns every three years. This frequency maintains proper cover conditions and promotes desirable forb species and seed-producing grasses. Further, most desirable food items for this species increase after fire. Frequently- burned areas maintain appropriate grass height for nesting and concealment.

Wild turkeys (*Meleagris gallopavo* spp.) frequently congregate and feed on freshly burned areas. Turkeys require an open understory as well as mature trees. They use

mixed low brush with ample grasses for nesting and the tree canopy for roosting. Therefore, intense burns that kill woody species are not as good for turkey habitat as are cooler, maintenance-type fires conducted during the dormant season. Turkeys benefit from a mosaic of burned and non-burned areas, which provide nesting cover, herbaceous-rich brood-rearing areas, and large roost trees with open understories.

Most adult birds are highly mobile and can easily escape fire. Fires in fine-fuels burn rapidly in a narrow band of flame. These conditions keep the maximum temperature, flame length, and fire intensity low and brief, thereby allowing animals to escape more easily. Early-season fire may cause some direct mortality of young birds, particularly for ground-nesting species, but the ultimate impact on bird populations requires a longer-term view. When nests are lost, many species will re-nest. Bird populations can respond rapidly and will even increase once they are not limited by food availability and negative habitat changes. This provides further evidence of the positive impacts of mosaic-type burns. Less intense burns decrease the short-term impact on food availability or cover following a fire. If you want an intense, hot-season burn, later summer months may be preferable—most ground-nesting birds have hatched out and are near-adult size by that time.

Amphibians and reptiles

In Texas mesquite savanna research, dormant-season fire had no effect on the diversity and abundance of amphibians and reptiles, whereas their diversity and abundance tended to be slightly greater in plots managed with growing-season fires. One species of lizard was 10 times more abundant in plots burned during the growing season than in the unburned control plot. Burning season overall had few short-term effects on the amphibian and reptile community. A fire regime with

burns in varying areas and seasons creates greater mosaic patterns and promotes multiple habitats for wildlife species, including amphibians and reptiles.

Large mammals

One of the most common public concerns regarding fire on Texas rangelands is its effect on white-tailed deer (*Odocoileus virginianus*). This concern arises because deer, especially fawns, need screening cover for protection from predators as well as from harmful heat. For white-tailed deer, woody cover should comprise 40 to 60 percent of the landscape. Leaving irregular-shaped patches of woody cover is best, as this maximizes edge. Most often, fire is underutilized on landscapes managed for deer due to the perceived loss of screening and fawning cover. Historically however, fire in Texas burned $\frac{3}{4}$ of the state every 6 to 10 years. This burning created a habitat in which native populations of white-tailed deer thrived. In the past, much of Texas was covered by prairie, and though deer might not have been as abundant as they are today, healthy populations were maintained due, in part, to the edges fire created between grasslands and woodlands. Again, it is critical that at least 40 percent woody cover remain after a burn to provide for other habitat needs. Within one growing-season after fire, preferred browse plants experience significant resprouting of basal and lateral buds—this makes them more abundant, accessible, and palatable. The young, tender shoots are more succulent and plentiful than older plant material, and can potentially alter populations. Grasses and forbs also typically increase following fire. Though increases in nutrient content also occur, these increased do not generally last beyond 6 months following fire.

Most large mammal species have already produced their young by the peak fire season in late summer to early fall. There has been concern that prescribed fires conducted

outside the summer season, when historical fires were common, might do more harm to wildlife populations—especially concentrated populations. For example, young large mammals may be more vulnerable to early season-fire, because they are still immature and lack mobility. However, many of these species have high reproductive rates and recover rapidly. In the long term, large mammals respond more strongly to habitat conditions, including those created by the fires, than they do to short-term effects created by a single burning season. Isolated populations caught in a wildfire could be destroyed, but a dense volatile habitat that could fuel this lethal kind of fire is already unfavorable to their survival.

White-tailed deer, mule deer (*Odocoileus hermionus*), pronghorn (*Antilocapra americana*), and other native species, instinctively flee from fire. Most native animals evolved in the presence of fire and have adapted behaviors for escaping fire. These adaptations along with suitable habitat enable population persistence—many species benefit directly from the habitat modifications that result from fire. However, wildlife’s ability to survive fires (prescribed burning and wildfires) can be compromised by human interference, such as high fences that limit escape (Fig. 6). During an extreme wildfire season, unmanaged fuel loads accumulate and hot, dry conditions persist. Furthermore, if a manager chooses to leave a pasture ungrazed to provide wildlife with cover, the very cover that was intended to protect wildlife could actually fuel a devastating fire. These conditions enable erratic wildfires, where flames are 15 to 50 feet long and can loft firebrands that result in fire spotting. Wildlife mortality increases because of these fire’s severity, intensity, and speed—they are very different from the fire conditions under which native wildlife species evolved. Unmanaged fuel loads promote hot, intense wildfires that all animals struggle against, whether by burrowing or escaping.

Bears, which are native to Texas, are



Figure 6: Two white-tailed bucks on a 1,500-acre summer burn in Mason County. The two bucks wandered the fire lines on the east side of the active burn unit. The Burn Boss met prescribed burn objectives with ignition techniques that allowed wildlife access and escape routes. *Photo by Dr. Morgan Russell*

expanding back into their historic range, though large-scale fires influence their population by reducing their food supplies in the short term. However, bears will wander across mountain ranges in search of food, and then re-establish in new areas once they find new food sources. This foraging behavior has been a key factor in bear expansion for thousands of years.

Historically, fires were so frequent that fuel buildup seldom occurred and fires burned in cooler mosaic patterns with short flame lengths and head fire behavior almost consistent with today’s back-fires. In environments where fire was common, there is little evidence that fires, within historical intensities, cause any direct mortality of wildlife.

Resource management includes promoting diversity of both fauna and flora. Fire will happen on landscapes and it is up to us to decide what kind will occur and how they will impact wildlife populations. Prescribed burns can be controlled and they reduce potential wildfire severity and intensity, thus reducing potential for animal mortality.

Summary of fire effects on wildlife types

- Small mammals (rabbits, squirrels, mice, rats, etc.)
 - Direct fire effects on small mammals are minimal.
 - Greater fire effects occur indirectly due to the temporary loss of shelter, food, increased surface exposure, and increased predation.
 - Survival increases when fires are conducted with low fuel-density, variable fuel continuity and high moisture content.
- Birds
 - Birds easily escape the fire front and congregate to recently burned areas within seconds.
 - Adult birds are more mobile and can easily escape fire more easily than younger birds.
- Northern Bobwhite love to occupy the edges of burns before they stop smoking and feast on newly available insects and seeds.
- Lesser prairie chickens prefer sites burned every 3 years to maintain—this return period provides appropriate grass height for nesting and concealment.
- Turkeys require a mosaic of burned and non-burned areas to provide for spring nesting and feeding, and winter mast and roosts.
- Amphibians and reptiles
 - Dormant-season fire had no effect on their diversity and abundance.

- Diversity and abundance are slightly greater in plots managed with growing-season fires.
- Variable fire frequencies and seasons promote greater mosaic patterns ideal for amphibian and reptile species.
- Large mammals
 - White-tailed deer require at least 40 percent of landscape to be screening cover.
 - Deer populations increase dramatically following fire, provided 40 percent or more cover remains after the burn.
 - Increases in nutrient content occur; however, these increases do not last for more than 6 months following fire.
 - Large mammal species, such as white-tailed deer, mule deer, and pronghorn flee from fire instinctively.
 - Deer also benefit from increased acorn production and other foods, such as succulents.
 - Fire suppression and landscape fragmentation through high-fencing have created conditions in which large mammal wildlife mortality is more frequent.

For more information

AgriLife Extension

Agrilife.org

naturalresourcewebinars.tamu.edu

texnat.tamu.edu

wildlife.tamu.edu

Texas Parks and Wildlife Department

tpwd.texas.gov

Natural Resources Conservation Service

nrcs.usda.gov

Related publications

ERM-020, “Wildfire Impacts on Surface Waters,” Texas A&M AgriLife Extension.

EWf-034, “Managing Heat for Wildlife on Texas Rangelands,” Texas A&M AgriLife Extension.

SP-248, “Fire as a Tool for Managing Wildlife Habitat,” Texas A&M AgriLife Extension.

SP-379, “Proceedings of the Trans-Pecos Prescribed Fire Symposium,” Texas A&M AgriLife Extension.

SP-492, “Conducting Prescribed Fires – A Comprehensive Manual,” Oklahoma State University.

SP-491, “Brush Management Past, Present, Future,” Texas A&M AgriLife Extension.

Glossary

Cover – any structure that provides screening, protection, or insulation against weather events, sunlight, predators, etc.

Diversity – consisting of different elements and variety

Edge habitat – areas in the transition between two habitat types (i.e. woodland and grassland)

Fine fuels – typically 1-hr fuels such as grass and grass like plants

Firebrands – flaming or glowing fuel particles that are carried by wind, convective currents, or by gravity into non-burned fuels

Interspersed – mixing of components, in this case, of habitat components

Loafing coverts – cover that provides protection from sun and predation risk in sufficient structure that animals can move freely, or loaf, underneath it

Suppression – the act of extinguishing any open flame

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ON-SITE BRUSH PILE BURNING IN TEXAS

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ABSTRACT

Burning on-site brush and debris piles is an effective and efficient method to rapidly break down unwanted or dead plant material generated from land management activities such as brush chaining, grubbing, or shearing that allow for agricultural, forestry, and livestock use. However, these types of burns can be risky and volatile when conducted improperly, potentially causing unexpected wildfires with rapid rates of spread. In order to effectively manage cut and piled brush and conduct a safe brush pile burn, there are several straightforward steps that can be taken. Following regulatory guidelines, building piles that are safe to burn, actively monitoring burning brush piles, and having the right resources on hand will allow burning plant debris to continue to be an integral and safe part of rangeland and property management.

MANAGEMENT SUMMARY

Burning brush piles is very similar to conducting a prescribed burn. The same requirements, due diligence, and standards of care apply to brush piles. Adequate fire lines or firebreaks, personnel, firefighting equipment, appropriate notification requirements, safe weather forecast, and prior planning and preparation are all considerations that should be carefully thought out.

Before Burning

- ▶ Determine if the proposed burn is allowable per Texas Commission on Environmental Quality (TCEQ) regulations.
- ▶ Become familiar with TCEQ burn requirements related to disposal fires, such as designated nonattainment areas.
- ▶ Become familiar with county or other local outdoor burning rules and regulations.

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- ▶ Inquire whether a burn ban is issued for the burn day and proceed accordingly, notifying local fire departments and fire dispatch. If a burn ban exemption exists, notify the requisite authorities of the intention to burn and provide all necessary information.
- ▶ Ensure the burn does not create a smoke nuisance or potential traffic hazard.
- ▶ Ensure the weather forecast will permit safe burning, adequate smoke dispersion, and will not change in a manner that creates a wildfire risk.
- ▶ Prepare a safe area to burn by establishing a clear line free of any fuel; ensure there is no fuel above or around the pile and construct piles to a manageable size (i.e., larger than a small car, but smaller than a greyhound bus).

During and After Brush Pile Burning

- ▶ Keep suppression water resources and tools handy in case the pile needs to be extinguished.
- ▶ Never leave a brush pile actively burning without appropriate supervision.
- ▶ Continuous weather monitoring during the burn is equally as important as weather monitoring before and after lighting.
- ▶ After the pile is no longer actively burning, ensure that all brush or debris is either burned completely or cold to the touch before leaving the area.
- ▶ Large logs and tree trunks may continue to smolder for weeks after the fire's flaming phase is complete. These larger fuels may still emit embers under volatile weather conditions and ignite wildfires. Be sure to look at the weather forecast before, during, and after igniting brush piles.
- ▶ Remember, safety is a priority at all times. Communicate with participating help and with suppression resources both on and off the fire. Support resources should be

prioritized (charged cell phones, radios, wireless walkie-talkie devices, etc.). Keeping participants hydrated and alert, having a first-aid kit handy, appropriate clothing to deal with heat and smoke, etc. are important considerations that should not go overlooked.

INTRODUCTION

Burning brush and plant material is a long-standing and effective way of breaking down unwanted plant growth from Texas rangeland pastures. However, a majority of Texas wildfires are caused by the unsafe burning of brush and plant materials (Texas A&M Forest Service, 2019). This document is designed to aid landowners and property managers before, during, and after the decision-making processes of safely preparing, building, igniting, supervising, and extinguishing burning vegetative brush and debris piles.

OUTDOOR BURNING REGULATIONS

Across the state, there are generally three levels of regulations and ordinances potentially applicable to the burning of brush and plant material. First, at the state level, the TCEQ regulates all outdoor burning in Texas. Their regulations apply statewide and should be thoroughly reviewed and understood before conducting any burn in Texas. Second, there may be regulations at the county level. These primarily are in the form of a burn ban instituted by the county judge or commissioners. Finally, local municipalities commonly have restrictions or guidance on when or how to burn brush and plant debris within their city limits. Every county will vary in their outdoor burning rules and regulations; therefore, extreme regard and standards of care for county and city rules must be satisfied before igniting any brush pile.

Texas Outdoor Burning Exemptions

The TCEQ is the state regulatory agency regulating outdoor burning, including brush and debris piles. TCEQ regulations prohibit all outdoor burning in Texas, subject to certain exceptions (30 Texas Administrative Code § 111.201). The only scenario in which outdoor burning is allowed is if the proposed burn fits within one of the exceptions to the general prohibition on outdoor burning.

The following types of burns are allowable exceptions to the general prohibition on outdoor burning:

- ▶ Fire training;
- ▶ Fires for recreation, ceremony, cooking, and warmth;
- ▶ Disposal fires (including domestic waste, diseased animal carcasses, veterinarian disposal of animal remains, on-site burning of plant growth, at a site designated for consolidated burning of waste generated from specific residential properties, crop residue burning for agricultural management purposes when no practical

alternative exists, and plant growth detrimental to public health and safety conditions that is burned by a county or municipal government at a government-owned site upon receiving site and burn approval from the executive director);

- ▶ Prescribed burning;
- ▶ Hydrocarbon burning (methane, butane, propane, hexane, natural gas, and other fuels); and
- ▶ Executive director approval of otherwise prohibited outdoor burning.

See 30 Texas Administrative Code (TAC) §§ 111.205–111.215.

Disposal Fires

Typically, on-site burning of trees, brush, grass, leaves, branch trimmings, or other plant growth by the owner of the property or any other authorized person when the plant material is generated only from that property is considered an exemption for outdoor burning as a disposal fire—not a prescribed burn. Therefore, this publication will only focus on the rules related to the exemption provided for disposal fires and, in particular, on-site burning of plant growth. The owner or person authorized by the owner must follow and meet all of the prescribed burning requirements found in 30 TAC Sections 111.209(4) and 111.219(3, 4, 6, and 7).

Accepted Plant Material

A landowner of the property or any other person authorized by the owner of the property may conduct on-site burning of plant material generated only from that property if the plant material being burned consists strictly of:

- ▶ Trees;
- ▶ Brush;
- ▶ Grass;
- ▶ Leaves;
- ▶ Branch trimmings; or
- ▶ Other plant growth.

See 30 TAC § 111.209(4).

Importantly, only material generated on the property may legally be burned on-site. Note that this exemption to the general burning prohibition is applied only to a limited class of vegetation.

Identify Certain Categories of Vegetation

Although trees, brush, grass, leaves, branch trimmings, or other plant growth may be burned on-site if generated from the property, there are additional limitations on burning that may exist for certain areas if the vegetation was generated as a result of right-of-way maintenance, land-clearing operations, and maintenance along water canals; see 30 TAC § 111.209(4)(A)–(B) for more information. Thus, prior

to burning plant material, a person must determine if the material was generated as a result of one of these categories.

A “land-clearing operation” is defined as “the uprooting, cutting, or clearing of vegetation in connection with conversion for the construction of buildings, rights-of-way, residential, commercial, or industrial development, or the clearing of vegetation to enhance property value, access, or production. It does not include the maintenance burning of on-site property wastes such as fallen limbs, branches, or leaves, or other wastes from routine property clean-up activities, nor does it include prescribed burning or burning following clearing for ecological restoration” (30 TAC § 111.203[3]).

Given the breadth of this definition, many agricultural-related burns of brush piles will likely fall within the definition of land clearing and, therefore, be subject to additional requirements. Burns of accepted plant materials not falling within these three categories are not subject to the requirements related to attainment status.

For example, consider the burning of a brush pile consisting of tree limbs. If a landowner cut the limbs to enable easier access to the property, that would likely constitute as land clearing, and the additional attainment status requirements would apply. If, however, the pile was created by a landowner who gathered up fallen tree limbs after a storm, it would not be considered land clearing, and the additional requirements related to attainment status would be inapplicable. Of course, in either scenario, TCEQ’s general requirements for allowable outdoor burning (30 TAC § 111.219), as well as any county or local rules, would apply.

Determine Attainment Status

If the brush or debris pile is generated as a result of the categories discussed above—right-of-way maintenance, land-clearing operations, or maintenance along water canals—then county attainment status must be determined, and additional restrictions may apply.

An area’s status will either be designated as “attainment” or “nonattainment.” This distinction is based upon the concentration of criteria pollutants in an area and whether they exceed the regulated levels of established National Ambient Air Quality Standards. If any of the criteria pollutants are over the regulated allowable amount, the area is deemed nonattainment. Alternatively, an area where all criteria pollutants are below the regulated allowable level would be considered attainment.

Landowners may determine current attainment status for a respective county by visiting <https://www.tceq.texas.gov/airquality/sip>, which provides an interactive map of Texas counties and current information on attainment status. Clicking on a specific county or area will generate attainment status information for that specific county or area and will



Brush piles should be contained with a bladed line down to bare mineral soil in order to prevent any escapes through adjacent fine fuel, such as dormant grass. (Image courtesy of Morgan Treadwell)

include a summary table of the federal criteria pollutants for nonattainment status. Landowners should look at the “Designation” column of the report. A listing of attainment/unclassifiable, unclassifiable, or attainment (maintenance) would be considered an attainment status. A designation for any listed pollutant as nonattainment would deem the area a designated nonattainment area for the purposes of this regulation. Attainment status can also be determined by calling any TCEQ regional office.

Additionally, TCEQ regulations provide that if a burn is conducted in a county that contains any part of a municipality that extends into a designated nonattainment area, the burn will be considered to occur in an attainment area (30 TAC § 111.209[4][A]–[B]).

Result of Attainment or Nonattainment Status

If a landowner conducts a burn of vegetation that falls into one of the three categories listed above—right-of-way maintenance, land-clearing operations, or maintenance along water canals—the following additional regulations apply.

For burns falling in these three categories in a nonattainment area: burns are allowed only “when no practical alternative exists” (30 TAC § 111.209[4][A]). TCEQ regulations define “practical alternative” as an “economically, technologically, ecologically, and logistically viable option” (30 TAC § 111.203[5]). Thus, a landowner in a nonattainment area may burn only if there is not a practical alternative to dispose of the vegetation. Any such burns must be conducted in accordance with the TCEQ General Requirements for Outdoor Burning (30 TAC § 111.219) discussed below. Commission notification or approval is not required for such burns (30 TAC § 111.209[4][A]).

For an attainment area: burns falling within these three categories are allowed without having to prove the lack of a practical alternative. Such burns in an attainment area are subject to local ordinances that prohibit burning inside

the corporate limits of a city or town and are consistent with the Texas Clean Air Act, Subchapter E, Authority of Local Governments. Additionally, these burns are subject to the General Requirements for Allowable Outdoor Burning Sections 111.219(3, 4, 6, 7), discussed below. See 30 TAC § 111.209(4)(B).

Requirements for Certified and Insured Prescribed Burn Managers

Please note that if the landowner or landowner's representative igniting the brush pile is a Certified and Insured Prescribed Burn Manager from the Texas Department of Agriculture, the "Requirements for Certified and Insured Prescribed Burn Managers" found in 30 TAC Section 111.217 apply.

General Requirements for Allowable Outdoor Burning

The TCEQ regulations list several requirements applicable to all outdoor burns. These requirements are as follows:

1. Prior to prescribed or controlled burning for forest management purposes, the Texas Forest Service shall be notified.
2. Burning must be outside the corporate limits of a city or town except where the incorporated city or town has enacted ordinances which permit burning consistent with the Texas Clean Air Act, Subchapter E, Authority of Local Governments.
3. Burning shall be commenced and conducted only when wind direction and other meteorological conditions are such that smoke and other pollutants will not cause adverse effects to any public road, landing strip, navigable water, or off-site structure containing sensitive receptor(s).
4. If at any time the burning causes or may tend to cause smoke to blow onto or across a road or highway, it is the responsibility of the person initiating the burn to post flag-persons on affected roads.
5. Burning must be conducted downwind of or at least 300 feet (90 meters) from any structure containing sensitive receptors located on adjacent properties unless prior written approval is obtained from the adjacent occupant with possessory control.
6. Burning shall be conducted in compliance with the following meteorological and timing considerations:
 - a. The initiation of burning shall commence no earlier than one hour after sunrise. Burning shall be completed on the same day not later than one hour before sunset and shall be attended by a responsible party at all times during the active burn phase when the fire is progressing. In cases where residual fires and/or smoldering objects continue to emit smoke after this time, such areas shall be extinguished if the smoke from these areas has the potential to create a

nuisance or traffic hazard condition. In no case shall the extent of the burn area be allowed to increase after this time.

- b. Burning shall not be commenced when surface wind speed is predicted to be less than six miles per hour (mph) (five knots) or greater than 23 mph (20 knots) during the burn period.
 - c. Burning shall not be conducted during periods of actual or predicted persistent low-level atmospheric temperature inversions.
7. Electrical insulation, treated lumber, plastics, non-wood construction/demolition materials, heavy oils, asphaltic materials, potentially explosive materials, chemical wastes, and items containing natural or synthetic rubber must not be burned.

See 30 TAC § 111.219.

Allowable Burn Locations

Burning that is otherwise allowed based on the regulations discussed above may generally be conducted only outside of the corporate limits of a city or town; see 30 TAC § 111.219(2). Burning will be allowed within the corporate limits of a city or town if the city or town has enacted an ordinance allowing burning consistent with the Texas Clean Air Act, Subchapter E, Authority of Local Governments; see 30 TAC § 111.219(2).

Potential Liability

Finally, TCEQ regulations make it clear that compliance with these regulations does not excuse a person conducting a burn from any consequences, damages, or injuries resulting from the burn; see 30 TAC § 111.221. In other words, these regulations do not offer limited liability for landowners who can prove compliance. Landowners should take care to ensure they do not act negligently when conducting a burn and should confirm liability insurance coverage before undertaking a burn.

TIME OF YEAR

Whether growing or dormant season, the time of year is a crucial factor in brush pile burning. Growing-season months—April to June—are generally the best times of the year to burn brush piles to minimize the risk of escape. Early to late spring is best, as the surrounding vegetation—both cool- and warm-season plants—is usually actively growing with high moisture content. Burning brush piles during early to late spring significantly reduces potential ignition or fire spread. If a brush pile does expand beyond the designated area, fire behavior, flame length, and intensity are manageable due to high amounts of fuel moisture from actively growing vegetation. These types of fires are much easier to suppress due to slower rates of spread and shorter flames. However, if the current year's growth is green, residual fuel accumulation from the previous year's growth

is likely, and a fire will still carry and burn. This is the primary reason and justification for constant monitoring of actively burning piles and ensuring adequate and appropriate suppression equipment is on-site to successfully extinguish a burning pile if need be. In Texas, it is not recommended to burn piles during the winter following a recent rain or snow due to the dormant and cured-out surrounding vegetation, even with high soil moisture. Dry and dormant fine fuels will rapidly lose moisture, even during the winter after a snow event. Fine fuels, such as grasses, are considered 1-hour time lag fuels. One-hour fuels represent a fuel lag category of one hour for fine fuels to equalize to the same moisture content as the surrounding atmospheric conditions. This is important, as the dry weather during winter and changing wind conditions may result in the spread of a previously contained fire since brush piles can smolder and are at risk to become open flames for up to several days or even weeks once ignited (Oklahoma Cooperative Extension Service, 2017).



Brush piles may smolder for several days after ignition due to heavy fuel loads of 100-hour or 1,000-hour fuel loads. Brush piles should be monitored after being consumed by the fire due to lingering heat effects from heavy fuel loads. (Image courtesy of Morgan Treadwell)

SMOKE MANAGEMENT

Burning must only occur when smoke does not present a hazard to a public road, waterway, landing strip, or any sensitive receptors, such as residences, hospitals, schools, etc. The landowner or landowner representative who ignited the brush pile is solely responsible for wherever the brush pile smoke disperses (6 Texas Natural Resources Code § 153). Wind direction is an important weather factor to continuously monitor due to ember wash and potential ignition downwind of the burning brush pile. Atmospheric dispersal should be taken into consideration when managing smoke. Cloudy, rainy, high-humidity days provide stable atmospheric conditions, which are poor days for smoke dispersal. Avoid burning during inversions that will trap smoke close to the surface—typically early morning or early evening conditions, or near surface water areas. Igniting a very small test fire to ensure the smoke is dispersing is

a good test to determine wind direction and lift. These negative smoke effects can be minimized by burning dry brush, burning under appropriate smoke dispersal weather conditions, and by sizing piles to appropriately manage smoke plumes. Brush piles should be built to a realistic, manageable size. For example, if a brush pile is too tall, it could potentially collapse and send an ember wash into adjacent fuels.

WEATHER CONDITIONS

Current weather conditions are the top concern when burning brush piles. When contemplating and planning for brush pile burns, wind speed should be the first weather condition checked prior to burning. According to Texas A&M Forest Service (2019), burning brush piles during gusty and high-wind days is the major contributor to wildfires and rapid rates of spread, especially during the dormant or winter season. Additionally, piles should not be ignited when the wind speed is over 15 miles per hour and winds are steady in the days following ignition. A general rule-of-thumb is to target burn days that are 40 percent or greater in relative humidity in order to mitigate ember wash, spotting, and potential fire escapes. Verifying that any steady winds are below 15 mph and from a consistent direction while the relative humidity is 40 percent or greater will ensure a safe burn with brush piles that contain tree limbs and trunks, as these are considered 100-hour or 1,000-hour time lag fuels. These time lag fuel categories will require 100 or 1,000 hours to become as dry as the surrounding atmospheric conditions (Oklahoma Cooperative Extension Service, 2017). Therefore, burning brush piles on high-humidity days or even during a light rain can be accomplished due to the fuel lag for larger fuel types, taking into consideration smoke management, especially if the larger fuels have been dry for an extended period of time. It is critical to recognize the positive relationship between relative humidity and fuel moisture to successfully conduct a brush pile fire while minimizing the threat of a potential wildfire. Keep in mind that outdoor burning is prohibited prior to or during a low-pressure atmospheric inversion, often occurring overnight or during cold fronts.

Once a day is selected, frequently check the weather forecast in the days leading up to the burn. Keep in mind that many brush piles may take several days to burn completely. Piles that contain large amounts of soil will cause slower and less complete fuel combustion (Oklahoma Cooperative Extension Service, 2017). Due to the potential time to burn down 100-hour or 1,000-hour fuel types and soil in the brush pile, piles can potentially burn and smolder for several days or even weeks. In order to mitigate any fire spotting or escape, weather conditions must be appropriate for safe conditions while the piles burn. If winds become unfavorable or relative humidity drops for an extended period of time, brush pile burning should be delayed until the forecast improves for the duration of the burn.

BUILDING ON-SITE BRUSH AND PLANT DEBRIS PILES

When chaining or grubbing standing brush, it is often convenient to make large windrows of piled plant debris. While this may be an easy solution on the tractor or bulldozer, it can be a major safety and liability issue when it comes time to burn it. Brush piles are best built small and dense—picture a small car versus a greyhound bus—which allows fire to quickly spread throughout the pile, increasing its intensity. As a result, this reduces the time it takes to burn and shortens the time that the pile is emitting and lofting firebrands and embers into the air. Small and compact brush piles will reduce the overall intensity of the burn, the size of the flame, and the amount of smoke produced, making the pile much more manageable on burn days. Even though building many small brush piles adds more piles to burn, it makes the process more manageable while minimizing the risk of a wildfire and allowing for better smoke management, which should be a priority (Oklahoma Cooperative Extension Service, 2017). Therefore, when building brush piles, be sure to plan ahead for potential ignition. Look up, look down, and look around for potential hazards and flammable material. Burning beneath a tree canopy has a high risk of igniting the canopy and causing the fire to escape the managed brush pile area.

Make sure to avoid building brush piles under tree canopies, power or transmission lines, on buried or exposed gas lines, or within close proximity to hydrogen sulfide (H₂S) gas. Gas lines are susceptible to leaking and may potentially overheat, and smoke from the burning pile can cause electricity to arc on powerlines.

Always consider the capacity to safely and effectively burn brush when building piles. Maintain a general idea of the water and equipment available to completely extinguish the

burning pile. Wind and weather can change rapidly, sending smoke and embers in undesirable directions. Unforeseen weather shifts are always a possibility and may rapidly increase fire behavior, flame length, and rate-of-spread of the burning pile. Maintaining control and capacity to safely extinguish the burning brush pile is critically important.

After building the brush pile, it is also important to take the time to clear the area around the brush pile of dormant fine fuel or other materials that may ignite—this includes the proximity to adjacent brush piles. Mowing or disking a ring around the pile can greatly reduce the chance of fire creeping away from the main brush pile. Prior to igniting piles, a wet line can be applied around the brush pile to decrease the chances of a creeping fire.

IGNITING BRUSH PILES

The safe ignition of brush piles should be treated with considerable care. Several different types of equipment exist for ignition, although the primary tool is a drip torch. Other tools that can be used safely include a fusee, or a road flare, a propane torch, or placing flammable fine fuel, such as lighting hay or paper, in the brush pile. Igniting piles soaked with flammable liquids with a match should be avoided. However, liquids such as kerosene, an equal mixture of diesel and gasoline, or charcoal lighter fluid can be effective if they are safely used due to their less-flammable nature (Oklahoma Cooperative Extension Service, 2017). If flammable liquids are necessary, only use them sparingly on smaller sections of the brush pile before igniting (Oklahoma Cooperative Extension Service, 2017). If the brush pile does not ignite due to high moisture conditions or large fuel categories, ensure all flames are extinguished before adding more drip torch fuel or flammable liquid. A good practice is to drip the fluid out away from the pile, giving the burner adequate space and time to distance themselves from the brush pile.

Gasoline is highly flammable, has a low flash point, and releases a vapor that is denser than air; therefore, it should not be used to ignite brush piles (Oklahoma Cooperative Extension Service, 2017). Gasoline can easily cause serious burns and injury to the person igniting it or nearby bystanders.

In addition to the equipment or liquid used to ignite brush piles, the ignition method and location also play a critical role. Igniting a brush pile with a goal to reduce the intensity of the fire and length of the flame should be prioritized, minimizing any chance of escape or wildfire. Therefore, when igniting a brush pile, start with ignitions on the downwind side. This will create a backfire—a fire moving or burning into the wind—causing slower consumption of the brush pile with minimized fire behavior, flame length, and fire intensity. This ignition method may take longer for the brush pile to be consumed, but it is a safe and reliable method to ensure containment.



Burning smaller brush piles reduces the risk of fire escapes while still burning faster than large piles. (Image courtesy of Chase T. Brooke)

If a significant number of brush piles exist, have a plan before ignition as to how many brush piles can be effectively and safely managed at one time or over the course of a single day. The span of control is crucial, even when it comes to lighting brush piles. Do not spread resources too thin.

AFTER THE FIRE

After the pile is consumed, there are still several considerations landowners must keep in mind. The main post-fire issue is that large logs and tree trunks may continue to smolder for weeks after the flaming phase of the fire is complete. These larger fuels may still emit embers under volatile weather conditions and ignite wildfires. Be sure to look at the weather forecast before, during, and after igniting brush piles. Do not burn if a red flag warning is issued or other volatile or unpredictable weather conditions are forecasted within 24 hours of burning. Once most of the brush pile is consumed, use water or a tool, such as a shovel, to wet or scrape any embers until smoldering ceases, and the residual brush pile is cool to the touch.

Once the fire is extinguished, there may be a residual fire scar left on the ground. While potentially unsightly, these scars will naturally be reclaimed by grasses and forbs in upcoming years with adequate rainfall and rest. Brush pile scars on the soil's surface can be mitigated by the season of burn, such as during periods of high fuel moisture content or relative humidity. Keep in mind the need for smoke management and dispersion, as well as increased time for



Once the fire is extinguished, there may be a residual fire scar left on the ground. While potentially unsightly, these scars will naturally be reclaimed by grasses and forbs in upcoming years with adequate rainfall and rest. (Image courtesy of Morgan Treadwell)

complete combustion of the brush pile. Brush pile scars or more areas with bare ground following the brush pile burn are temporary and will create an opportunity for different plants to become established, such as forbs and secondary-succession plant species. Plant succession will eventually attract certain species of wildlife, livestock, or pollinators back to their native plant community (Oklahoma Cooperative Extension Service, 2017). Larger piles will leave burn scars that last longer, but reclamation can be enhanced by re-seeding the area with desirable grass and forb species. Small-acreage properties may necessitate permanent burning locations to reduce the loss of grazeable area from brush pile burn sites.

CONCLUSION

Burning on-site brush piles can benefit landowners when conducted carefully and in accordance with all legal requirements. Before burning plant material, landowners should review and understand all applicable TCEQ regulations and determine if any county or local ordinances are applicable.

Finally, there is no substitute for common sense and an abundance of caution. Anyone conducting a brush pile burn should use best management practices such as having and executing a well-thought-out burn plan, checking weather conditions, being aware of any forecast changes, and being in contact with neighbors and local fire departments.

RESOURCES

TCEQ Attainment Status Website: <https://www.tceq.texas.gov/airquality/sip>

Outdoor Burning in Texas (2015). Texas Commission on Environmental Quality. Publication RG-049

National Ambient Air Quality Standards: <https://www.epa.gov/criteria-air-pollutants/naaqs-table>

REFERENCES

Oklahoma Cooperative Extension Service. (2017). *NREM-2894: Managing Brush Piles* [Fact sheet]. Retrieved from <http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-9405/NREM-2894web.pdf>

Texas A&M Forest Service. (2019). *Preparing for Wildfires*. Retrieved from <https://tfsweb.tamu.edu/PreventWildfire/>

30 Texas Administrative Code Chapter 111, Subchapter B (Sections 111.201–111.221). Retrieved from [https://texreg.sos.state.tx.us/public/readtac\\$ext.ViewTAC?tac_view=5&ti=30&pt=1&ch=111&sch=B&rl=Y](https://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=5&ti=30&pt=1&ch=111&sch=B&rl=Y)

6 Texas Natural Resources Code Chapter 153. Retrieved from <https://statutes.capitol.texas.gov/Docs/NR/htm/NR.153.htm>

Highlights

- ▶ Review and comply with all applicable state, county, and local regulations or ordinances.
- ▶ The best time to burn brush and debris piles is April through June, when the surrounding vegetation is green.
- ▶ Have adequate suppression equipment available.
- ▶ Be certain participants are healthy and vigilant. Have communication devices, adequate hydration, and first-aid supplies readily accessible.
- ▶ Watch the extended weather forecast and ensure that the winds will be less than 15 miles per hour and that the relative humidity is greater than 40 percent.
- ▶ Notify local volunteer fire departments, neighbors, required regulatory state agencies, and sensitive smoke areas or receptors.

Acknowledgment

The authors express heartfelt appreciation to Drs. Bill Rogers, Doug Tolleson, and Joe Veldman for their time, enthusiasm, and efforts in reviewing this manuscript.

Disclaimer

This manuscript is specific to Texas Laws and Regulations for Outdoor Burning. However, it is potentially applicable to other states or regions, particularly regarding methodology and safety. Burn managers should confer with their various state regulators for specific regulations and restrictions that may vary.

APPENDIX E – POST-SURVEY

Thank you for joining us at a Peers and Pros 360° Prescribed Fire Workshop!

We thank you for choosing to help us in our research!

All participants in our workshop have been asked to complete this survey, which has been designed to help Texas A&M AgriLife Extension Service better understand how we can best teach concepts to landowners and land managers who steward Texas' natural resources.

Please review the following information sheet before proceeding to the survey. Return the completed survey to the registration table.

If you have any problems with or questions about the survey, please contact Kaitlyn Restivo at the program or by email at kcargol96@tamu.edu.

Your responses are important to us and we appreciate your time and participation!

Maureen G. Frank

Maureen G. Frank, Ph.D.

Principal Investigator

Assistant Professor &

Extension Wildlife Specialist

Kaitlyn N. Restivo

Kaitlyn N. Restivo

Graduate Research Assistant



IRB NUMBER: IRB2021-0548M
IRB APPROVAL DATE: 10/21/2021

Texas A&M University Human Research Protection Program
Information Sheet

Title of Research Study: An Evaluation of the Effectiveness of Moderated Peer-to-peer Learning for Extension Outreach to Landowners

Investigator: Dr. Maureen Frank

Why am I being asked to take part in this research study?

You are invited to participate in this study because we are trying to learn more about different teaching methods for extension programs for landowners and land managers.

You were selected as a possible participant in this study because you have participated in a Peers and Pros 360° Prescribed Fire Workshop. You must be 18 years of age or older to participate in this survey.

Why is this research being done?

The study is designed to allow researchers to better understand the effectiveness of teaching methods for Extension programs for landowners and land managers.

How long will the research last?

The survey is expected to take approximately 15 minutes to complete. There will be a follow-up survey conducted 6 months after the date of the workshop. This survey is expected to take approximately 10 minutes to complete.

What will I be asked to do in this study?

In this survey, you will be asked to answer a series of questions about your thoughts on the workshop in which you participated. In the follow-up survey, you will be asked to answer a series of questions about management practices that you may have chosen to adopt since the workshop.

What happens if I do not want to be in this research?

Your participation in this study is voluntary. You can decide not to participate in this research and it will not be held against you. You can leave the study at any time.



IRB NUMBER: IRB2021-0548M
IRB APPROVAL DATE: 10/21/2021

Are there any risks to me?

No risks are expected to participants in the study. There are not sensitive questions in this survey that should cause discomfort. However, you can skip any question you do not wish to answer, or exit the survey at any point.

Are there any benefits to me?

No benefits are expected to participants in the study.

What happens to the information collected for the research?

Efforts will be made to limit the use and disclosure of your personal information, including research study and other records, to people who have a need to review this information. We cannot promise complete privacy. Organizations that may inspect and copy your information include the Texas A&M University Human Research Protection Program (TAMU HRPP) and other representatives of this institution. No identifiers linking you to this study will be included in any sort of report that might be published.

Who can I talk to?

Please feel free to ask questions regarding this study. There will be staff on site while you complete this survey, or you can contact the Principal Investigator, Maureen Frank, by phone at 830-261-0539 or by email at mgfrank@tamu.edu. For questions about your rights as a research participant, or if you have questions, complaints, or concerns about the project, you may call the TAMU HRPP (a group who review the research to protect your rights) by phone at 979-458-4067, toll-free at 1-855-795-8636, or by email at irb@tamu.edu.



Section 1: Knowledge Change

1. Prior to attending this program, how familiar were you with prescribed fire?
Please mark one.

Very familiar	Moderately familiar	Slightly familiar	Not at all familiar	Unsure

2. What resources have you used previously to learn about prescribed fire?
Please mark all that apply.

- Face-to-face AgriLife seminar
- Virtual AgriLife seminar
- Seminar hosted by another agency or organization
- AgriLife fact sheets or publications
- Publications from another agency or organization
- County Extension Agent
- TPWD Wildlife Biologist
- NRCS Conservationist/Specialist/Biologist
- Oaks and Prairies Joint Venture Biologist
- Private consulting biologist
- Other (please specify)

3. For each topic, mark the category that best reflects your level of understanding **before** the workshop.

	None	Poor	Fair	Good	Excellent
Overall benefits of prescribed fire					
Prescribed fire and food plots					
Livestock and prescribed fire					
Invasive species control					
Liability					
Best time to implement prescribed fire					
How to offset prescribed fire costs					
Resources for implementing prescribed fire					



4. For each topic, mark the category that best reflects your level of understanding **after** the workshop.

	None	Poor	Fair	Good	Excellent
Overall benefits of prescribed fire					
Prescribed fire and food plots					
Livestock and prescribed fire					
Invasive species control					
Liability					
Best time to implement prescribed fire					
How to offset prescribed fire costs					
Resources for implementing prescribed fire					

5. Please indicate your level of agreement with the following statements.

My perception of risk involved with prescribed fire has decreased.

Strongly agree	Agree	Somewhat agree	Neither agree nor disagree	Disagree	Somewhat disagree	Strongly disagree

My comfort level with the application of prescribed fire on my property has increased.

Strongly agree	Agree	Somewhat agree	Neither agree nor disagree	Disagree	Somewhat disagree	Strongly disagree

I have an increased understanding of the advantages and disadvantages involved with prescribed fire in general.

Strongly agree	Agree	Somewhat agree	Neither agree nor disagree	Disagree	Somewhat disagree	Strongly disagree



The knowledge I gained from this program is applicable to my future use of prescribed fire.

Strongly agree	Agree	Somewhat agree	Neither agree nor disagree	Disagree	Somewhat disagree	Strongly disagree

Section 2: Intent to Adopt New Practices

1. Please indicate how likely you are to adopt the following practices.

1 = extremely unlikely, 2 = unlikely, 3 = neutral, 4 = likely, 5 = extremely likely

How likely are you to:	1	2	3	4	5	Unsure	Already do this	N/A
...use prescribed fire to create food plots for wildlife?								
...use prescribed fire to create heterogeneous vegetation?								
...to change stocking rates or rotation patterns to build up fuel?								
...use prescribed fire to manage encroaching brush?								
...work with your local Prescribed Burn Association (PBA) to conduct a burn?								
...apply for cost assistance through a cost-share program?								
...contact Texas A&M AgriLife, Oaks and Prairies Joint Venture, or TPWD for information on prescribed fire?								

Section 3: Peers and Pros 360°

1. For a future workshop about prescribed fire, I would prefer (please circle one):
 - a. A traditional workshop, where one or more speakers give a presentation to participants
 - b. A Peers and Pros 360° workshop



2. Would you be interested in attending a Peers and Pros 360° workshop on another topic? Please circle one.
 - a. Yes, such as: _____
 - b. No

3. Please indicate what you think are some benefits of this type of program. Please mark all that apply.
 - I enjoyed learning from my peers.
 - I enjoyed getting to know my fellow landowners and land managers.
 - I enjoyed being able to discuss freely and participate in the program.
 - I enjoyed not having a professional lecture.
 - Other: _____

4. Please indicate what you think are some of the disadvantages of this type of program. Please mark all that apply.
 - The professionals were not able to share enough information.
 - I did not learn enough from my peers.
 - I prefer to learn from professionals.
 - I did not like having to participate in the program.
 - Other: _____

5. Based on the information presented, would you recommend Texas A&M AgriLife Extension Service to your family, friends, and colleagues as a contact information on prescribed fire? Circle one number below.

1	2	3	4	5	6	7	8	9	10
Not									Very
likely									likely

Section 4: Participant Land Information

1. Do you own or manage land in the Edwards Plateau ecoregion (Hill Country)? Please circle one. If no, please skip to the next section.
 - a. Yes
 - b. No



For the following questions, please answer in regards to the property/properties that you own or manage in the Edwards Plateau ecoregion (Hill Country) only.

2. What are the uses of the land you own or manage? Please mark all that apply.

- Private residence
- Farming or crop production
- Ranching - Domestic livestock
- Ranching - Native wildlife (deer, quail, etc.)
- Ranching – Exotic wildlife
- Personal recreation (hunting, fishing, leisure, etc.)
- Lease hunting (includes guide services, outfitting, etc.)
- Natural gas or oil extraction
- Timber production
- Other, please specify: _____

3. What size is the property that you own or manage? Please mark one.

0-50 acres	50-100 acres	100-200 acres	200-500 acres	500+ acres

4. Do you currently utilize prescribed fire on your property? Please circle one. If the answer is no, please skip to the next section.

- a. Yes
- b. No

5. How many acres do you typically burn on your property in a given year?

_____ acres

6. How often do you burn on your property?

7. What time of year do you typically burn? Please mark all that apply.

- Spring
- Summer
- Fall
- Winter



8. How do you get the equipment you need to burn? Please mark all that apply.
- Own my own equipment
 - Rent equipment
 - Borrow equipment from a friend/family/neighbor
 - Use equipment from my local Prescribed Burn Association (PBA)
9. Are you a member of a local PBA? Please circle one.
- a. Yes – name of PBA: _____
 - b. No

Section 5: Participant Demographic Information

1. What is the ZIP code of your primary residence?
- _____
2. In what year were you born?
- _____
3. What is your sex?
- a. Male
 - b. Female
4. What is the highest level of education you have obtained? Please mark one.
- Did not graduate high school or receive GED
 - High school graduate, diploma, or GED
 - Some college, no degree
 - Associate degree
 - Trade/technical/vocational training
 - Bachelor's degree
 - Master's degree
 - Doctoral degree
5. Please specify your ethnicity. Please circle your answer.
- White
 - Black or African American
 - American Indian or Alaska Native
 - Spanish, Hispanic, or Latino



Section 7: Follow-up Survey

1. Please indicate your preferred contact method for the follow-up survey.

Choose one and write your information.

a. Email: _____

b. Mailing address: _____



APPENDIX F – PROGRAM DEVELOPMENT, MEETING 1 NOTES

Peers and Pros 360° Program Development (Meeting 1) Notes

In attendance:

Kaitlyn Restivo, kcargol96@tamu.edu

Maureen Frank, mgfrank@tamu.edu

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Sandy Smith, sss5@psu.edu

Agenda

1. Define the Peer Group
2. Brainstorm Statements
3. Organize Themes
4. Write the Talking Points for One Statement
5. Homework: Assign Themes to Create Talking Points

1. Who are the peers you normally reach when teaching about prescribed fire in the Edwards Plateau ecoregion?

- Landowners
- Adults, in a range of ages but a lot of returning to land (younger generations)
- Youth (high school) who received education on fire through a camp/summer education program/4-H. We will not be focusing on this group for this specific program, but it is one we can develop in the future.
- Knowledge levels
 - Basic: effects of fire on brush – using fire as a tool to manage junipers and mesquite.
 - More experienced folks: season of fire, firing technique, how to be an ambassador for fire to their neighbors.

2. Statement Cards

The statement cards will consist of things you hear often from this peer group. These statements can be correct, half true, or not true at all. To get the statements we will all brainstorm and come up with 20-30 common things you hear from people who call in, attend classes, etc. We need to keep the statements more conversational and less like an Extension fact sheet.

Brainstorming Statements:

- **Example 1)** from another program with the topic “Vegetable Gardening”: “Using lime every year is a good practice.”
- **Example 2)** from another program with the topic “We Own the Land”: “Timbering destroys forests!”

1. I fear using fire because I don't know when the next rain event will be.
2. Using fire costs too much.
3. I'm scared to use fire because I have too many trees/my juniper are mature and dense.
4. Fire causes erosion.
5. Invasive plants will take over after a fire.
6. I have nowhere to graze my animals after a fire; I can't afford to take that pasture out of rotation.
7. I can't afford to take a pasture out of rotation before a fire to build up fuels.
8. Fire is a natural and necessary part of most Texas ecosystems.
9. I can't burn because I don't have a drip torch.
10. It is difficult to schedule help to conduct a burn when the conditions are right.
11. I'm scared to burn because I fear it will get on to my neighbor.
12. Fire can destroy cover for white-tailed deer.
13. Prescribed fire can create food plots.
14. Wildlife will flee from an area being burned.
15. Fire can kill all my quail.
16. The best time to burn is winter.
17. Fire kills all plants.
18. My landscape is more diverse now that I burn.
19. Ring fires can trap all the wildlife.
20. I'm scared to burn because my neighbor has horses.
21. I would burn but my neighbor will sue me if I do.
22. I can't burn because I only have 50 acres.
23. I can't burn because I live near a school.
24. I can't burn because there is a burn ban in effect.
25. I am able to burn more easily because I am a member of a burn association.
26. Burning and grazing have helped us control Texas wintergrass.
27. I wait to burn until after the first freeze.
28. The summer is too dry to burn.
29. Freshly burned and rained-on pasture can be as good as grazing wheat.
30. Prescribed fire is cheaper than chemical or mechanical treatments.
31. I burn to prevent future wildfires.
32. Money from government programs helped persuade me to burn even though I wasn't able to graze that area.

3. Themes

After we create our list of statements, we will then organize them into themes. Each theme should have at least three statements. On average, 3-5 themes can be used per an hour-long session.

Wildlife (██████)

Ring fires can trap fleeing wildlife.

Fire leaves wildlife with no place to hide.

Prescribed fire creates great natural food plots.

Livestock (██████)

I can't afford to take a pasture out of rotation before a fire to build up fuels.

I have no way to rest my land because the axis will graze it anyways.

Freshly burned and rained-on pasture can be as good as grazing wheat.

Timing (██████)

Summer fire will destroy all my quail nests.

I wait to burn until after the first freeze.

I can schedule a fire, but I can't schedule the rain.

Vegetation (██████)

Invasive plants will take over after a fire.

Burning and grazing have helped us control Texas wintergrass.

I'm scared to use fire because I have too many trees/my junipers are mature and dense.

Cost (██████)

Using fire costs too much.

Money from government programs helped persuade me to burn.

Prescribed fire is cheaper than chemical or mechanical treatments.

Liability ([REDACTED])

I can't burn because there is a burn ban in effect.

I can't burn because my ranch is next to town.

I'm scared to burn because my neighbor will sue me.

Resources ([REDACTED])

I can't burn because I don't have the right equipment or enough help.

I can't burn because I only have 50 acres.

I am able to burn more easily because I am a member of a burn association.

Benefits of Prescribed Fire ([REDACTED])

I burn to prevent future wildfires.

My property is more diverse now that I burn.

Fire is a natural process and it's good for the land.

4. Talking Points

We will add 2-3 talking points for each statement. These need to be written out in a conversational way, like the pro would talk to the peers.

Example 1) "Using lime every year is a good practice."

- Lime raises pH so a soil test should be done every 3 years in the fall.
- Follow the recommendations from the lab results. It may take 2 applications to apply the correct amount.
- The type of lime formulation is important (pellitized vs powder).

Example 2) "Timbering destroys forests!"

- This is not an uncommon statement. Even the best managed timber harvest can look quite dramatic right after the trees have been cut. The good news is that forests are "renewable" – that means they can grow back in a person's lifetime. Our forests

regenerate (regrow) from stump sprouts, seeds and roots. If proper safeguards are taken before, during and after the harvest (such as assuring there is deer protection for the seedlings, or that invasive plants are not competing for light and space on the harvest site), regeneration will quickly grow on the site within 1-3 years.

- Some people think “planting trees in the forest helps save the planet,” but in fact, since our Pennsylvania hardwood trees grow back naturally, this is just not practical or advantageous. Conifer trees are planted in the western and southern states to reestablish forests, and of course trees are planted in urban areas for many good reasons. It’s debatable if these will “save the planet.”
- Beauty is in the eye of the beholder. Some harvested sites can look attractive and can “grow” on you after you get used to the change, especially when you see a healthy young forest starting to grow back.

Our Example) I wait to burn until after the first freeze.

- Waiting to burn until after the first freeze is not always the best option, the timing of a burn really needs to be based off of the objectives of the burn. For example, if you want to promote your warm season grasses, typically a winter or early spring burn is the best time to do that. To reduce woody vegetation a summer or growing season burn tends to produce better results.
- It’s important to evaluate your fuel loads when deciding when to burn rather than just looking at the calendar.
- Regardless of the time of year make sure you have a large enough crew, enough safety equipment, and plenty of water for everyone.
- Regardless of time of year it is important to consider your burn prescription parameters. Such as, wind speed and direction, relative humidity, ambient temperature, etc.

5. Homework

Add 3 talking points under each statement for your assigned theme by March 19th. If possible, have your points reviewed by a colleague or peer to finalize your draft talking points and send them to [REDACTED] before the second meeting. The second meeting will be held the week of March 22nd.

APPENDIX G – PROGRAM DEVELOPMENT, MEETING 2 NOTES

Peers and Pros 360° Program Development (Meeting 2) Notes

In attendance:

Kaitlyn Restivo, kcargol96@tamu.edu

Doug Tolleson, douglas.tolleson@ag.tamu.edu

Thomas Janke, tjanke@pheasantsforever.org

Heath Starns, heath.starns@ag.tamu.edu

Program Dates

1. Friday, May 7th – Kerr Wildlife Management Area, 8:30-11:00
2. Thursday, May 13th – Mason Mountain Wildlife Management Area, 8:30-11:00
3. Thursday, May 20th – Sonora Research Station, 8:30-11:00

Agenda

1. Review All Themes, Statements, & Talking Points

Theme 1 - Benefits of Prescribed Fire

Statement 1

I burn to prevent future wildfires.

1. This is a great plan. Properly applied, prescribed fires can be one of the best tools to manage “overgrown” fuel loads that contribute to the risk for wildfires, especially in that “wildland-urban interface”.

Statement 2

My property is more diverse now that I burn.

1. This statement doesn't come as a surprise, especially if a landowner has been burning for a number of years, and if they have combined winter and summer burning into their program. The natural mosaic that results from a fire encountering topography, variations in vegetation, and the timing of precipitation that follows will create a lot of different “islands of opportunity” for plants and animals in the post-fire ecosystem.

Statement 3

Fire is a natural process and it's good for the land.

1. That is a true statement, but it is understandable why some people are opposed to fire or afraid of it. Fire out of control can be a scary thing. Recently burned landscapes are not very pretty. But yes, fire is a natural process, and many ecosystems are fire dependent. They need to burn at some optimum interval to regenerate and stay healthy.

Theme 2 - Wildlife

Statement 4

Ring fires can trap fleeing wildlife.

1. Although a ring-firing technique places fire on all sides of a burn unit, varying degrees of fire behavior exist. Also, our native wildlife (big and small) are very adapted to fire and flame and can escape easily, provided allowable fencing.
2. Ring firing is a very effective technique to generate high temperature, heat duration, and dose of heat for maximum brush management.

Statement 5

Fire leaves wildlife with no place to hide.

1. All fires burn in unique fashions and no two fires are ever the same. Patches of burned and non-burned vegetation exist depending on soil moisture, fuel moisture, fuel loading, and many other factors. Oftentimes, a patchy mosaic is left behind after a fire.
2. There are many components of prescribed burning within our control that can ensure sufficient amounts of wildlife cover are left intact. Also, patch-burning is an effective strategy to optimize habitat and foraging choices.

Statement 6

Prescribed fire creates great natural food plots.

1. New growth following a fire is not only very palatable and tender to eat, but also very high in crude protein. Grazing and browsing animals crave this type of nutrition and actively seek out recently burned areas for this reason!
2. In ecosystems with native vegetation that are adapted to fire, new growth on resprouting plants attracts wildlife to the point that recently burned areas may actually need to be protected from post-fire grazing.

Theme 3 - Livestock

Statement 7

I can't afford to take a pasture out of rotation before a fire to build up fuels.

1. The reasoning behind this statement makes sense, but we have to think about the relative economic value of grass as forage versus what it might be worth as fuel. For instance, the weight gain one would get from old "rank" forage might be less valuable to the bottom line than the work that grass might do in reducing a woody plant or prickly pear stand and producing younger, more nutritious forage in the process.

Statement 8

I have no way to rest my land because the axis will graze it anyways.

1. Axis deer are another “good news-bad news” situation. On one hand they provide a potential year-round source of income from hunting and they are a unique and attractive species popular with wildlife watchers and photographers. On the other hand, due to their high adaptability, they have been documented as outcompeting native white-tailed deer and they are free-ranging invasive animals so managing their numbers is difficult. So, when Axis deer are present in large numbers, only an aggressive culling strategy will likely be effective in protecting rested forage for livestock or native wildlife.

Statement 9

Freshly burned and rained-on pasture can be as good as grazing wheat.

1. Under the right conditions, largely influenced by a timely rain, fresh young re-growth of native perennial range grasses can be pretty nutritious, maybe not quite as nutritious as wheat, but pretty good.

Theme 4 -Vegetation

Statement 10

Invasive plants will take over after a fire.

1. Invasive plants frequently invade disturbed soil, such as that found following a mechanical treatment. Prescribed fire doesn't disturb the soil and it doesn't kill the roots of herbaceous species that are already present. The rapid recovery of herbaceous species already on site should help reduce the potential for invasion from plants that are not present.
2. Unfortunately, once invasive plants are on a property, they are always going to need management. It's important to know how different invasive species respond to fire. That may help determine fire prescription parameters to reduce the impact to native species and increase the negative impact on invasive species. Some invasive species are capable of recovering after fire and some are not.
3. In some cases, it may be best to use other control methods to reduce or eliminate invasive species before implementing fire as a management practice.

Statement 11

Burning and grazing have helped us control Texas wintergrass.

1. The combination of burning and grazing can be an effective way to shift a plant community from cool-season to warm-season dominated grasses. When grazing and fire are combined, both processes should be implemented carefully with the overall goal in mind.

Statement 12

I'm scared to use fire because I have too many trees/my junipers are mature and dense.

1. Dense mature junipers are important habitat for some species. Additionally, they tend to prevent growth of herbaceous material under them, which reduces the ability for cool-season fires to impact them. During hot, dry periods, junipers can be very volatile and can lead to uncontrollable crown/canopy fires. If you want to protect some stands of junipers, firebreaks can be put in place around them and perform burns when the trees are least likely to be affected.
2. Controlling dense stands of juniper often needs to involve methods of control other than just fire.
3. If there is a concern about protecting other tree species (such as oaks), it's best to reduce the amount of fuel directly under and around the trees. Excessive fuel, especially juniper and other brush, directly under the desired trees can carry flames into the canopy.

Theme 5 - Liability

Statement 13

I can't burn because there is a burn ban in effect.

1. Although county ordinances like burn bans can dictate who burns what, options to implement a safe prescribed burn still exist. For example, Certified and Insured Prescribed Burn Managers from the Texas Department of Agriculture are exempt from burn bans. Also, many county judges exclude prescribed burning from their outdoor burn bans.
2. Communication and planning go a long way. Be as open and transparent as possible and communicate why prescribed fire is your decision as a landowner to manage your property.

Statement 14

I can't burn because my ranch is next to town.

1. Providing information, fostering relationships with local officials, and implementing open communication on a prescribed fire with sensitive smoke receptors, like urban areas, is an absolute must. But it's also a justification for wildfire mitigation fuels reduction practices like prescribed burning. Eliminating accumulated fuels provides a buffer for urbanized areas.
2. Many environmental factors, such as wind, can be taken into account to mitigate impacts to urbanized areas. Communication and planning can go a long way. Starting small and allowing concerned parties time to adjust is advantageous. In fact, invite concerned parties to a prescribed fire in order to build trust and buy-in from all potentially impacted parties.

Statement 15

I'm scared to burn because my neighbor will sue me.

1. In Texas, every landowner has a right to implement a prescribed fire to manage his/her property given all state, county, and local regulations are followed. If you have a sue-happy neighbor, then hire a Commercial and Insured Prescribed Burn Manager (CIPBM) from the Texas Department of Agriculture that shifts all liability on the CIPBM. And/or purchase ranch/farm liability insurance that covers prescribed fire, specifically hostile fire, in the policy.
2. Invite neighbors to pre-fire meetings, morning briefings, and the actual fire! Oftentimes, when concerned neighbors can play an active and engaged role in the prescribed fire, they will understand the process, due diligence, and standards of care being implemented.

Theme 6 - Timing

Statement 16

Summer fire will destroy all my quail nests.

1. Quail and fire have shared the landscape since long before modern humans began interfering with natural processes like fire. Historically, lightning-caused fires would have occurred during the summer months, but these fires were typically accompanied by precipitation and were small in size. To mitigate for lost quail nests during summer fires, there's always the option to burn smaller units. There are also other reasons to consider burning smaller units rather than a whole pasture or property.

Statement 17

I wait to burn until after the first freeze.

1. Waiting to burn until after the first freeze is not always the best option, the timing of a burn really needs to be based off of the objectives of the burn. For example, to promote warm season grasses, typically a winter or early spring burn is the best time to do that. To reduce woody vegetation a summer or growing season burn tends to produce better results.
2. It's important to evaluate fuel loads when deciding when to burn rather than just looking at the calendar.
3. Regardless of the time of year make sure you have a large enough crew, enough safety equipment, and plenty of water for everyone.
4. Regardless of time of year it is important to consider burn prescription parameters. Such as, wind speed and direction, relative humidity, ambient temperature, etc.

Statement 18

I can schedule a fire, but I can't schedule the rain.

1. This is another reason to not burn an entire property or pasture in a given year. By burning portions of a property, you are leaving the remainder of forage available in the event of a drought.
2. Regardless of whether you choose to burn or not, it is important to maintain stocking rates appropriate for your rangeland and climatic conditions.
3. Although fire removes the portion of a plant aboveground, grasses and other plants can remain dormant belowground for long periods between fire and rainfall, and they tend to respond very quickly to precipitation following fire.

Theme 7 - Cost

Statement 19

Using fire costs too much.

1. Prescribed fire is actually one of the least expensive habitat management practices.
2. The cost of a prescribed burn differs for each property, pasture, and time of year. Fireline construction, labor, and equipment are all factors in the overall expense of implementing prescribed fire.
3. Costs can range from less than \$1/acre to more than \$30/acre. Typically, the bigger the burn unit, the less expensive the burn is per acre.

Statement 20

Money from government programs helped persuade me to burn.

1. Depending on property management goals and revenue sources, it may be difficult to defer a pasture from grazing prior to and after a burn. Cost-assistance or cost-share programs are available throughout different counties of the state to help offset the costs of conducting prescribed burns as well as to help incentivize the deferred grazing. These programs/opportunities may vary on requirements and pay-out rates. Contact local conservation professionals (Natural Resource Conservation Service [NRCS], Texas Parks and Wildlife Department [TPWD], Texas A&M AgriLife Ext., Texas A&M Forest Service [TFS], Oaks and Prairies Joint Venture [OPJV], US Fish and Wildlife Service [USFWS], etc.) for more details.
2. Most agencies/organizations have specific goals for their incentive programs. It is important to find a program that best fits the property goals but also know that just because the goals do not appear similar, does not mean that they are not resulting in the same outcomes. For example, programs for wildfire mitigation/prevention and programs for grassland health improvement sound different but ultimately accomplish similar goals.

Statement 21

Prescribed fire is cheaper than chemical or mechanical treatments.

1. Prescribed fire is one of the least expensive habitat management practices. Burn unit size, preparation needs, equipment, and personnel are all factors that dictate overall costs, but this tends to be cheaper than most herbicide applications, and definitely less expensive than mechanical treatments (which can be easily >\$100/ac). Prescribed fire is also a tool that no other tool can replicate the ecological benefits of.

Theme 8 - Resources

Statement 22

I can't burn because I don't have the right equipment or enough help.

1. It is important to have the 'right' equipment at prescribed burns, but that can come in all shapes and forms. At a minimum, the main things needed are effective 2-way communication devices between personnel (e.g., radios, cellphones, etc.), controllable, portable ignition device(s) (e.g., drip torch, pear burner, or something similar), mobile water source(s) (e.g., 'sprayer(s)' of some sort), and clothing that will not easily melt or burn (i.e., cotton products and leather boots and gloves). Other tools can be added to the list, and may be helpful at times, but that all depends on the simplicity/complexity of the burn.
2. It is good to have multiple people assisting with prescribed burns. The more eyes on the fire, the better the observation of fire behavior and response time to any unforeseen incidents. Getting involved with local Prescribed Burn Association not only allows access to equipment, but also other individuals/landowners interested in being involved with fires.
3. Typically, the better (and bigger) the fire breaks are around the perimeter of a burn (i.e., dozer lines, disk strips, shredder lines, etc.; or a combo of sorts), the less likely fire will escape the burn unit, and therefore less equipment or personnel may be needed to carry out the burn safely.

Statement 23

I can't burn because I only have 50 acres.

1. There are no minimum acreage requirements for conducting a prescribed fire. If livestock or other animals graze the property, regardless of property size, it is good practice to burn the property in sections so not all of the resources are out of availability/rotation at the same time.

Statement 24

I am able to burn more easily because I am a member of a burn association.

1. Being involved with a local prescribed burn association allows individuals to network with other locals/landowners that also have an interest in prescribed burning. Depending on how the association is set up, there may be burn equipment available for the members

to borrow/rent, or the association may have a network of its members so folks can ‘pool’ their equipment/resources, as well as help each other, anytime someone is ready to burn.

2. Prescribed burn associations can be a good resource for individuals to gain additional experience and training on prescribed burn planning, burn unit preparation, and implementing safe prescribed burns. Workshops may also be hosted to help keep up with things such as weather resources and interpretation, equipment use, and conservation cost-assistance or cost-share programs available to help eligible landowners.
3. Multiple active Prescribed Burn Associations (PBAs) exists throughout the Hill Country and state. Contact local conservation professional (Texas A&M AgriLife Ext., Texas A&M Forest Service, Texas Parks and Wildlife Department, Oaks and Prairies Joint Venture, etc.) if you have difficulties locating one, or care to start one in an area that may not currently have an active organization.

APPENDIX H – SURVEY RESPONSE COMMENTS

Free Response Prompts:

What is one take-home message from this workshop you would convey to your neighbor?

- “Control” burn can be safely conducted to increase native vegetation.
- Do it!! Lots of good info from folks who are experiencing it.
- Prescription burns are good.
- Benefits of prescribed fire.
- Promoting fire culture.
- The benefits of fire are hard to quantify.
- Let’s work together to make it friendly.
- Burning helps ecosystems.
- Well worth it.
- Prescribed burns are not as intimidating as they look.
- Higher comfort level of control burn.
- Wonderful environment to learn and get answers to various questions.
- Take a workshop if you can!
- Burn and join the association.
- Attend, if possible.
- Local burn association appears to be knowledgeable, beneficial, and helpful.
- Burn smaller and more often.
- The best and most effective way to improve conditions on your range for wildlife and ranch operation.
- Very beneficial for landowners and cheaper than chemical/mechanical.
- Go to next workshop!
- Before you start have a burn plan developed with assistance of local burn association and help/observe other burns first.
- Get to know folks in the community managing land.
- Get involved in burn association and use them for your burn.
- Advantageous of prescribed burning, organized and professional approach, less risk than thought.
- Small acreage burns are equally important.
- Many resources available and some in-depth expertise provided a great learning experience.
- Join a burn association.
- Go help someone else burn.
- Prescribed fire works, join a PBA.
- Educate yourself of the resources available to you.
- Fire is a good tool.
- Join burn association.
- Burning is good, but do it right/get involved with PBA.
- Let’s all do prescribed burns.
- There are resources eager to help us.

- Learn more.
- Let them know when to burn.
- Better communication.
- There are experts available.
- Come and learn.

What is one misconception you may have had about fire on rangelands (wild or prescribed) that changed as a result of this workshop?

- You have to spend a lot.
- I thought they were just to clear brush.
- Autumn burns work too.
- Resources can be easy to find when one educates themselves on the topic.
- How dangerous it is and how necessary it really is.
- Funding availability.
- Risk of fire escaping planned boundaries.
- Wildlife punishing/oak tree punishing.
- Prescribed burn is something you have to figure out on your own.
- Only large plots can benefit.
- I thought you had to hire a professional burn boss for all prescribed burns.
- Risk and liability
- Misconception: summer burns are very dangerous/ not an option. Now I know this is not true.
- An individual can conduct a burn.
- Fire is manageable.
- I need to step up my safety measures every year.
- They are too risky.
- Wildlife comes back.
- Cons outweigh pros

What is one question you have about fire that was not answered?

- None.
- Do you dig ditches?
- Cost of liability insurance for a private burn manager.
- I would've liked to hear about the science behind prescribed fire.
- Land recovery after the burn and what to expect.
- Info regarding burn plan.
- Still not real clear on best conditions and the cool/warm season choice.
- Specific species affected as per timing year burned.
- How to plan a burn.
- Not sure yet how to assess which parts of property should be burned.
- How long to root before and after. How long to keep cattle off.
- Cannot think of any.
- Burn techniques.

- Smoke models online for writing burn plans.
- Smoke models.
- What is going to happen specifically to a fire burned pasture.
- Mechanics of options.

Please provide any other comments you would like to share.

- PP360 great for auditory learners. Consider sound quality and demographics (>65 years have decreased hearing/comprehensiveness). Supplement with concise visuals. Name tags for Pros- title/institution.
- Great job!
- Great presentation.
- These people are so professional, energetic, and knowledgeable.
- I loved the outdoor style!
- County judges and commissioners need to attend so they are not afraid.
- Great time and great attitudes from all the presenters and program information.
- Thank you!
- Good program, helpful to hear from peers.
- Thank you! Keep up the good work! Fighting Aggies!
- Great Job!
- Thank you! I learned so much! It was especially helpful to meet fold already doing burns as well as local agency reps.
- Great!
- Really enjoyed this style of workshop. Look forward to more.
- Enjoyed it and learned a lot.
- Great event, thank you!
- The workshop was very informative and helpful. The site at the Mason Mountain WMA is very beautiful and a good outdoor classroom.
- You need a balance between experts and novices. Discuss small burns vs large burns.
- I found the format very relaxing and extremely productive.
- Great innovative learning experience, no pressure from coordinators. Excellent knowledge base to answer questions.
- Do this course again!
- The networking opportunities are fabulous, moving around kept it engaging, very helpful/informative in small group share opportunity.
- More shade.
- It was good.
- Excellent workshop!
- Excellent workshop.

APPENDIX I – BENEFITS AND DISADVANTAGES

Additional benefits of the Peers and Pros 360° teaching method:

Outdoors is great.

Very stimulating.

Interaction was great.

As a novice, I did not feel intimidated.

Loved the program and how it was set up, good balance of landowner and professional input.

Great program, I liked it.

Enjoyed being out and seeing results.

Networking with peers and professionals.

Multiple sites and change of scenery.

No issues, everything was helpful!

Additional disadvantages of the Peers and Pros 360° teaching method:

I came to get concise, relevant best practices. Would like that presented.

Shyness with sharing at first.

Weather.

Didn't get the details on how to implement a burn.

If false or unfounded information is shared, professionals should refute it.

APPENDIX J – FOLLOW-UP SURVEY

Howdy,

You are receiving this email because you attended the Peers & Pros 360 Prescribed Fire Workshop at Kerr Wildlife Management Area. We hope you are doing well!

As mentioned after the workshop, there is a brief follow-up survey that we would like to ask you to complete. We hope to learn about the usefulness of the workshop to you in the last 6 months. You can find the survey at this link:

https://agrilife.az1.qualtrics.com/jfe/form/SV_cD30tB6NOkmohMi. If you prefer a paper copy, please let us know and we will mail one to you.

Please contact us if you have any questions. You can reach the Principal Investigator, Maureen Frank, by phone at 830-261-0539 or by email at mgfrank@tamu.edu. For questions about your rights as a research participant, or if you have questions, complaints, or concerns about the project, you may call the TAMU HRPP (a group who review the research to protect your rights) by phone at 979-458-4067, toll-free at 1-855-795-8636, or by email at irb@tamu.edu.

Thank you so much for your support of our programs!

Best,

Dr. Maureen Frank and Kaitlyn Restivo

In the past six months, did you utilize prescribed fire on your property?

- Yes, because I had plans to do so before I attended the program.
- Yes, because of what I learned at the program I implemented prescribed fire on my property or the property I manage.
- No

In the next six months, do you plan to utilize prescribed fire on your property?

- Yes, I had plans to do so before I attended the program.
- Yes, because of what I learned at the program I am planning to implement prescribed fire on my property or the property I manage.
- No

Please indicate if you have adopted or are planning to adopt the following practices.

	I did this before the program	I have started doing this since program	I haven't done this yet, but plan to in the next 6 months	No
Use prescribed fire to create food plots for wildlife	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use prescribed fire to create heterogeneous vegetation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Change stocking rates and/or rotation patterns to build up fuel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use prescribed fire to manage encroaching brush	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Work with local Prescribed Burn Association to conduct a burn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Apply for cost assistance through a cost-share program	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	I did this before the program	I have started doing this since program	I haven't done this yet, but plan to in the next 6 months	No
Contact Texas A&M AgriLife, Oaks and Prairies Joint Venture, or TPWD for information on prescribed fire.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Contact or hire a Commercial and Insured Prescribed Burn Manager from the Texas Department of Agriculture.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Are you a member of your local PBA?

- Yes, I was a member before the program – name of PBA:
- Yes, I became a member after the program – name of PBA:
- No

What resources have you used since the program to learn more about prescribed fire? Please mark all that apply.

- Face-to-face AgriLife seminar
- Virtual AgriLife seminar
- Seminar hosted by another agency or organization
- AgriLife fact sheets or publications
- Publications from another agency or organization
- County Extension Agent
- TPWD Wildlife Biologist
- NRCS Conservationist/Specialist/Biologist
- Oaks and Prairies Joint Venture Biologist
- Private consulting biologist
- Other (please specify)
- None

For the following questions, please answer in regards to the property/properties that you own or manage in the Edwards Plateau ecoregion (Hill Country) only.

What are the uses of the land you own or manage? Please mark all that apply.

- I do not own or manage land in the Edwards Plateau ecoregion (Hill Country)
- Private residence
- Farming or crop production
- Ranching – Domestic livestock
- Ranching – Native wildlife (deer, quail, etc.)
- Ranching – Exotic wildlife (wild pigs, axis, etc.)
- Personal recreation (hunting, fishing, leisure, etc.)
- Lease hunting (includes guide services, outfitting, etc.)
- Natural gas or oil extraction
- Timber production
- Other, please specify:

What size is the property that you own or manage?

- 0-50 acres
- 50-100 acres
- 100-200 acres
- 200-500 acres
- 500+ acres

How many years have you owned or managed your current property? If less than 1 year you may answer with a decimal (e.g. 0.5).

Please fill out the following demographic questions. The program survey you previously filled out is not linked to this post-survey; therefore, we do not know your demographic information.

What is the ZIP code of your primary residence?

In what year were you born?

What is your sex?

- Male
- Female

What is the highest level of education you have obtained?

- Did not graduate high school or receive GED
- High school graduate, diploma, or GED
- Some college, no degree
- Associate degree or trade/technical/vocational training
- Bachelor's degree
- Master's degree
- Doctoral degree

Please specify your ethnicity.

- White
- Black or African American

- American Indian or Alaska Native
- Spanish, Hispanic, or Latino
- Asian
- Native Hawaiian or Pacific Islander
- Other/prefer not to answer

Please indicate your average household income.

- Less than \$20,000
- \$20,000 to \$34,999
- \$35,000 to \$49,999
- \$50,000 to \$74,999
- \$75,000 to \$99,999
- Over \$100,000
- Prefer not to answer

