FIRE MANAGEMENT OF THE SAN CARLOS APACHE TRIBE: A CASE STUDY IN SOUTHEASTERN ARIZONA

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ABSTRACT

FIRE MANAGEMENT OF THE
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MARVIN VICTOR, JR.

In North America, Native American tribes have been using fire since long before the arrival of Europeans. Their traditional use of fire can be termed Traditional Ecological Knowledge. Traditional Ecological Knowledge is defined as the knowledge, practice, and belief concerning the relationship of living beings with one another with the physical environment. An additional concept known as Traditional Fire Knowledge is often associated with the cultural and traditional use of fire. Traditional Fire Knowledge is fire-related knowledge, beliefs, and practices that have been developed and applied on specific landscapes for specific purposes by long time inhabitants. Few studies exist which attempt to connect past use of fire with the present. The oral history of the San Carlos Apache Tribe of the American Southwest describes fire uses. The reservation system imposed on Native Americans required compliance with federal forest regulations enforced by the Bureau of Indian Affairs that altered the historic fire regime of the ponderosa pine (*Pinus ponderosa*) forest. In recent times, the San Carlos Apache Tribe is striving to return to utilizing fire in a cultural and traditional manner similar to the use of fire before European settlement. Their traditional use of fire coincides with allowing natural processes to occur without extensive human intervention. These types of fire management practices can be expected among tribes where TEK and TFK exists.

I used the Creek Fire which occurred in June of 2013 as a case study to examine the fire management practices by tribal forest and fire management officers of the San Carlos Apache Tribe. As tribal members active in Apache culture and tradition, their decisions to utilize large-

scale, resource-benefit fires on tribal lands may not entirely coincide with traditional Apache uses of fire for small-scale burning as described by Apache elders. However, their utilization of large-scale resource-benefit fires does resemble both past and current Apache culture, tradition, and belief: natural processes such as lightning ignited wildfires should occur without human intervention within the ponderosa pine forest. In addition to the 14,000 acre resource benefit fire utilized on the San Carlos Apache Reservation in 2013, natural resource managers are utilizing similar fires in 2014.

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Introduction

Among Native American tribes in North America, fire has been a part of their culture for many thousands of years. In the American Southwest, the Apache tribes utilized fire as a management tool as documented by a small, but growing number of published studies. Furthermore, written documents and literature about the Apache tribes dating back before pre-European settlement times are difficult to find within this region. The San Carlos Apache Tribe of southeastern Arizona is a unique tribe made up of different Apache bands. The story that I am telling describes how traditional fire use changed from the San Carlos Apache Tribe's usual practices (pre-reservation), how these practices were disrupted and changed from traditional use to federal practices because of the intervention of the Bureau of Indian Affairs, and how this tribe is striving to return to their original practices of pre-settlement times. Their fire management strategies conducted on their own tribal lands are not well known. The objectives of this paper are to:

1. Introduce the concept of San Carlos tribal use of fire as a form of Traditional Ecological Knowledge and Traditional Fire Knowledge,
2. Present a case study of a large-scale resource benefit fire as an example of how TEK and TFK may influence the current fire management practices of the San Carlos Apache Tribe, and
3. Make recommendations towards future studies which attempt to link Traditional Ecological Knowledge and Traditional Fire Knowledge to present day forest/fire management practices on tribal lands.

A History of Native Americans and Fire

Native Americans arrived in North American at least 12,000 years ago (Brose *et al*. 2001) or earlier, and occupied most of the lands. They have always had a relationship with fire. Prior to European colonization, many nomadic North American tribes were heavily dependent upon a hunter-gather subsistence lifestyle and one of the few tools for managing resources was fire (Keeley 2002). Other tribes lived a horticultural lifestyle which included tilling, sowing, irrigating, weeding, pruning, and transplanting (Anderson 1996). In addition, Bean and Sanderson (2008) state that in pre-European forests, Native Americans were believed to have used fire often to manipulate their landscape and that these manipulations may have taken place over broad extents. Native Americans embraced the benefits of burning and were skilled in the application of fire technology (Kimmerer and Lake 2001). Careful use of fire was handed down through cultural traditions.

Fire as a form of Traditional Ecological Knowledge

The application of fire for resource management in the past passed down through generations can be referred to as Traditional Ecological Knowledge (TEK). TEK is the knowledge, practice, and belief concerning the relationship of living beings of one another with the physical environment (Kimmerer 2002). Mauro and Hardison (2000) state that TEK is rational and reliable knowledge that has been developed through generations of intimate contact by native peoples with their lands. "TEK is passed on from one generation to the next building cumulative knowledge specific to particular places and groups of people, but is modified as a result of new experiences and observations," (Fernandez-Gimenez 2000). Furthermore, knowledge of fire use by indigenous tribes could be described as Traditional Fire Knowledge. Huffman (2013) defines Traditional Fire Knowledge (TFK) as fire-related knowledge, beliefs, and practices that have been developed and applied on specific landscapes for specific purposes

by long time inhabitants. Over thousands of years, Native Americans became experts at using fire (Brose et al. 2001). Those entrusted with the ability to utilize fire have to know which conditions are favorable. Severe dry conditions combined with fire can lead to negative impacts, destroying forests, crops, and wildlife. Brose et al. (2001) described the fires used by Native Americans in Appalachia as low-intensity surface fires periodically ignited in the spring or fall.

Fire used for vegetation

"Setting fires to influence vegetation patterns was one of the most important achievements of the human species," (Anderson 2006). In many parts of North America, particularly the United States, Native Americans have used fire for the manipulation of vegetation. Vegetation in this context includes grasses, forbs, brushes, and trees. Fire not only helped return nutrients back into the soils, but also helped clear out old vegetation for new ones.

Keeley (2002) states that it is very likely that through the use of fire, Native Californians markedly altered vegetation patterns over much of the region. Fire ignited by Native Americans have been a major component of the California ecosystems for thousands of years (Stephens *et al*. 2007). The ancestors of the Washoe Indians occupied the Lake Tahoe Basin for approximately 9,000 years and may have used fire to improve plant material quality (Van de Water and North 2010). Improving plant materials was the sole purpose of fire in an effort to improve growth of basketry material (Anderson 2006). They also used fire for manipulating vegetation used for food. Black oak-ponderosa pine forests in the Sierra Nevada of California were managed by the Western Mono, Sierra Miwok/Mono Lake Paiute, and Foothill Yokuts tribes for purposes such as increasing mushroom production and facilitating acorn production (Anderson 2006). They had also used fire for reducing insect pests that inhabit acorns (Anderson 2006).

In the Southeast, fires were set to maintain an open and productive forest structure where American chestnuts (*Castanea dentata*) could be produced and effectively harvested (Cooley 2002). Native Americans treated their forests impacted by diseases and pathogens efficiently by fires. This use of fire was a form of pest management which was also used to treat mistletoe (Williams 2003). Fires not only got rid of diseases and pathogens over time, but manipulated growth of vegetation for attracting other forms of valuable resources.

Fire use for Animals

In the Northeastern U.S. in deciduous forests, pre-Columbian Native Americans utilized frequent ground fires to maintain their hunting grounds (Delcourt and Delcourt 1997). Frequent fires can create vegetation mosaics which draw in deer and other game species, making hunting easier (Bean and Sanderson 2008). Deer were a major source of food and clothing materials. Their hide provided warmth in cold climates and leather for a number of uses such as making moccasins.

Pyne (1982) states that, "The Native Americans of the Southwest may have used fire for driving game and to increase forage for livestock and large game…." Raish *et al*. (2005) continue to state, the Zuni of New Mexico utilized fire as a way to drive game and use a tactic known as surrounding. Fire was used in a way in that it burned around the animals, corralling them toward individuals for easier hunting.

A study by Higgins (1986) concluded that northern plains Native American tribes conducted small, short duration fires in autumn. Higgins (1986) continues to state that they developed seasonal patterns of burning the prairies in conjunction with bison herd movements because the nomadic tribes of the northern plains was dependent on bison and its ecology. Fire used to capture or herd wildfire was a major form of anthroprogenic use, however, there was another source of ignition.

Lightning strikes

Although Native Americans may have had a hand in influencing the vegetative landscape of the Southwest, Allen (2002) asks the question, "Was the pre-European Southwest a region shaped primarily by natural processes like lightning-ignited fire, or did people mold these lands into regional-scale artifacts through their use of fire?" In the Southwest lightning is frequent among summer thunderstorms (Pyne 1982). Dry lightning is possible between June and August when the monsoon arrives in which lightning fires are abundant but typically small (Pyne 1982). Since high temperatures and various storm events exist every year, fires are likely to occur frequently. Rainfall variability in the Southwest allows available fuels to ignite and burn throughout many seasons of the year (Allen 2002). Lightning strikes could very well be a cause for frequent fires in the Southwest. However, frequent occurrence of fires could have been a combination of lightning and humans.

A study by Walsh *et al*. (2010) concluded that their reconstructions clearly show that prior to Euro-American settlement, fire and vegetation regimes of the Willamette Valley were influenced by a combination of natural and anthropogenic factors. Their conclusions came from studying high-resolution macroscopic charcoal and pollen analysis in northwestern Oregon and southwestern Washington. Pyne (1982) reiterates, ignitions from both lightning and Native Americans were common in many areas before Euro-American settlement in the 19th century. Fire occurrence due to lightning strikes and/or a combination with Native Americans' use of fire is often a common theme especially in semi-arid regions in the United States.

Apache Tribes

The southwestern United States are home to the Apache tribes. They came from the area which is now Canada and are amongst the Athabascan speaking peoples. There are a total of six Apache tribes in the Southwest plus one Kiowa Apache tribe in the central U.S. also known as the Plains Apaches. The Apaches tribes in the Southwest were among the dominant tribes in shaping local history from their approximate time of arrival into southeastern Arizona and southwestern New Mexico until the final surrender of Geronimo in 1886 (Seklecki *et al*. 1996).

In contrast to the Navajo Nation, also in the Southwest, where the tribe organized to form one large population within a large reservation boundary, the Apache tribes are less connected. They are all Apache tribes, but may differ in the utilization of resources and practices. Families may have relatives in other tribes in another area. Presently, the southwestern Apache tribes are made up of the Yavapai-Apache, Tonto, San Carlos, White Mountain, Jicarilla, and the Mescalero Apache Tribes in Arizona and New Mexico.

Apache tribes and fire

The Apaches set fires to clear land of woody species, encourage grass growth, and increase wild seed production (Raish *et al*. 2005). Since most Apache bands were small in size because of limited resource availability (Secklecki *et al*. 1996), careful use of fire was practiced. Separate Apache bands could have put a nearby clan in danger of damaging valuable resources if fire was not practiced carefully (Secklecki et al. 1996). They would use a broadcast type of burning, similar to that of grassland tribes (Pyne 1982).

Hard, scientific evidence describing these traditional practices is limited. However, fire management is evident among the Apache tribes. Much of their traditional knowledge is passed on through oral tradition.

San Carlos Apache Tribe

Here, I introduce the fire history of the San Carlos Apache Tribe as told by tribal members and representatives while introducing their current fire management practices, attempting to connect the past with the present. The San Carlos Apache Tribe was created on December 14, 1872. This reservation totals approximately 1,854,180 acres in east-central Arizona across Gila, Graham, and Pinal counties (San Carlos Forestry 2010). Figure 1 shows the location of the reservation in respects to Phoenix, the capitol of Arizona. The main town, San Carlos, is approximately 110 miles east of Phoenix, AZ. The lowest elevation on the reservation is about 2,050 feet above sea level and the highest point is 8,282 feet above sea level (San Carlos Forestry 2010). A total of 175,000 acres is forested (Inter Tribal Council of Arizona 2014), making up only 9.5% of the total land cover. 665,000 acres are considered wooded (Inter Tribal Council of Arizona 2014), and make about 36% of tribal lands. This reservation borders the southern border of the White Mountain Apache Tribe. The Black and Salt Rivers are the boundaries separating the two reservations.

Tribal Forested lands

Much of the forested areas on the San Carlos Apache tribal lands are dominated by ponderosa pine (*Pinus ponderosa*) with small portions of Douglas-fir (*Pseudotsuga menzeisii*) and various species of oaks (*Quercus spp.*) that make up the rest of the tree species composition. Although various other ecosystems are also found on the reservation, forested lands provide timber and large-game hunting for food. Funding to treat these forests areas come from partnerships between the tribe and the Bureau of Indian Affairs (BIA). Specifically, fire management programs are funded by the BIA, but are managed by tribal employees. Many natural resource programs under the San Carlos Apache Tribe are funded by the BIA, such as range management, watershed programs, forest health, and fuels programs. Tribal personnel

make up the forest and fire management officers including fire staff by Indian Preference. The Indian Preference allows tribes to employ as many of their tribal members as they possibly can. When positions cannot be filled, non-tribal members can assume responsibility of those roles.

Melting Pot of Apache Tribes

The San Carlos Apache reservation is unique because of the various types of Apache bands placed in a non-traditional area. This mix of families, clans, and bands of Apaches was a product of the U.S. Government's attempt to gather multiple bands of Apaches on one reservation so that they could be displaced from their traditional locations (Palmer 2013). They were displaced onto another reservation set aside in Florida for a time period before being allowed to return to their home reservations in Arizona and New Mexico. The San Carlos Reservation in Arizona was placed in an area where conditions were not favorable for creating a long-term lifestyle for the Apache tribes placed here. Non-productive soils and high temperatures gave this reservation a bad name at the time of creation. Through time, the people now called the San Carlos Apaches have learned to become self-sufficient with some aid of federal government programs. While becoming self-sufficient, being able to maintain their traditional and cultural practices and maintaining a relationship with the earth has been top priority for the Apache peoples (Kelly *et al*. 2013, Randall 2014).

Apache Ecological Knowledge

The San Carlos Apaches residing within this reservation have a relationship with nature in-general. Seth Pilsk, a botanist of 25 years for the San Carlos Apache Tribe, has taken in much knowledge after years of first-hand experience with speaking, learning, and hearing the oral tradition being passed on from elders to the younger generations. "Apaches, in general, have a respect for natural processes to occur without intervention and see themselves at the same level as the world, not above it," Seth Pilsk (2014). The clans made up of families and relatives who

utilized the lands before the establishment of the San Carlos Reservation used only what they could within this region. They never put anything to waste. For medicinal plants, they never took more than four plants (Pilsk 2014).

The number four is sacred to the Apache people. They are representative of the four elements: fire, water, earth, and plants. The four elements are also represented by four colors: white (water), black (earth), yellow (fire), and green (plants). With fire being one of the elements, they have always a deep respect for fire. Fire is utilized during ceremonies such as the "Changing of Woman" puberty right of females, for cooking, and manipulating vegetation. Small scale fire was set around skunkbush (*Rhus trilobata*) so that the shoots would become straight for burden baskets (Pilsk 2014). Native tobacco plants responded well to small, low intensity fires. Other plants such as devil's claw (*Harpagophytum procumbrens*) also responded to small fires, as these plants were used for medicines and cradleboards. The Apache also favored wild weedy grasses and used fire to encourage growth (Pilsk 2014).

The San Carlos Apaches, knew about lightning caused fires in the upper elevations of the ponderosa pine forest. Fires burning in forests, to the Apache, were seen as part of a natural process sent from the Apache god "Ulsen". Ulsen is translated as the Giver of Life (Palmer 2013). Fire in the upper elevations were often associated with Mountain Spirits or "gaans" (Palmer2013). Palmer (2013) adds, "Mountain Spirits are powerful spirits living in the mountains who possess attributes of humans." Their intentions are often good, but in some cases can be bad if angered. However fire was symbolized by the San Carlos Apaches in the past, the respect and use of fire is evident in the present day.

Present Day San Carlos Apache Tribe

Current Fire Management

The current fire management policy on the San Carlos Reservation is to conduct full fire suppression management where valuable resources are threatened. These valuable resources can range from cattle pastures, wildlife habitat, archaeological sites, and the wildland urban-interface. However, the fire management activities are variable across the landscape of the tribe's land. The forest and fire managers divide the reservation into management zones, called Fire Management Units (San Carlos Fire Management Plan 2003). The tribe has a total of 8 fire management units as seen in Table 1.

An objective of the fire management plan is to treat fuels on forested lands over at least 20,000 acres annually with prescribed burning and wildfires (SCFMP 2003). While treating fuels to reduce catastrophic wildfires from occurring, the tribe is looking to restore the natural fire regime of the ponderosa pine forest of frequent, low-severity fires prior to European settlement (Kaib 2001, SCFMP 2003). Pre-reservation tree ring studies conducted on four sites on the San Carlos Apache Reservation found broad-scale fire events recorded on fire scarred trees at a return interval of three to eleven years (Kelly *et al*. 2013).

Case Study of the Creek Fire, Summer 2013

With the notion that fire is respected and should remain a part of the natural world, the San Carlos Apache Tribe has utilized large-scale naturally ignited fires where appropriate. I present a large-scale managed wildfire utilized during the summer months of 2013 which took place entirely on tribal lands.

On June 16, 2013 at 0956 hours, a lightning caused fire was reported at about twenty-five acres within the forested portion of the San Carlos Reservation (Figure 3). By 1049 hours, initial attack on the fire had begun. The Incident Commander Type IV had assessed the fire upon

discovery. An Incident Commander is the person who is responsible for the incident and has the qualifications to take on the task. Upon locating the fire, he or she is responsible for identifying any valued resources being threatened by the fire, the location of the fire, and identification of additional resources needed to control the fire in an aggressive, but safe strategy. As the complexity levels of an incident increases, the type of the incident decreases in numerical order. A very complex incident is a Type I incident while a basic, non-complex incident will be a Type 5 Incident. The IC then talked with the fire management officer back at the main offices of the tribal forestry department in the town of San Carlos, AZ. The IC reported that the fire had previously received some precipitation the night before, but dried out when the day started. Readings from a Remote Automated Weather Station on the Dry Lake Look-Out indicated that the area had received less than 0.01 inch of rain the day before. The main carrier of the fire was a combination of pine litter, bunch grass, and dense-clumpy ponderosa pine timber (Phillips 2014). At the time of report the fire remained a surface fire and slowly transitioned to a passive crown fire. A passive crown fire burns/torches single trees or a group of trees (Van Wagner 1977).

A majority of the overstory vegetation within the burned area consisted of ponderosa pine, Gambel's oak (*Quercus gambellii*), alligator juniper (*Juniperus deppeana*), one-seed juniper (*Juniperus monosperma*), and pińon-pine (*Pinus edulis*). Much of the understory was composed of litter, native forbs and grasses with some non-native species such as common mullein (*Verbascum thapsus*). Figure 2 shows the vegetation types found within the Creek Fire boundary.

The maximum temperatures on that day were expected to be around 82º Fahrenheit with the lows around 57 º F. The expected humidity ranges were to be in the seventies as a high and in the twenties for the low. The temperatures were expected to increase throughout the week while the relative humidity percentage were predicted to decrease in the single digits. Winds were blowing out of the south/southwest at 5-10 mph. The chances of precipitation within the next

couple of weeks were minimal. The surrounding area had been in drought-like conditions for several years: high average temperatures and minimum annual precipitation rates.

The conditions were set for a high severity fire covering a large area to occur. However, with an understanding that there had been several treatments within a close vicinity of this fire and many years of fire experience and knowledge, the forest and fire manager decided to utilize this fire for resource benefits, also known as a managed wildfire. Tribal natural resource managers making the decision to utilize resource benefit fires are rather different than some federal agencies which can have extensive wildland-urban interface zones. Some of these agencies typically engage in full fire suppression efforts, unless conditions fall within predefined parameters favoring the use of resource benefit fires. However, tribal agencies decide how they can best utilize naturally occurring wildfires with the approval of the tribe's council. These types of decisions are culturally and traditionally influenced to a certain degree, but years of previous treatments (i.e. prescribed burning, thinning, previous wildfires) occurring within the vicinity of the fire also has an influence to utilize resource benefit fires.

To keep the fire from increasing in rate of spread as well as intensity near the perimeter, strategic areas were prepped by handcrews. When conditions were favorable and resources were in place, burnouts were conducted to keep the fire from racing towards the perimeter. Much of the burn effects were similar to those of many fires utilized for resource benefit: a low severity fire with low rates of spread. However, isolated pockets within the ponderosa pine timber exhibited high burn severity. The mix in burn severity was what the managers was a major objective they were hoping to achieve. A mixed-burn severity across a landscape creates a fire mosaic, which is highly favored by many tribes. Another objective was to maintain the fire within the designated roads which serve as a fuel break. The third objective was to use this fire as a prevention measure to reduce the chances of a catastrophic wildfire to occur in the future.

The fire was declared controlled on July 1, 2013 at 1700 hours. Controlled is a term used to identify that a handline or fuel break has been constructed around the entire perimeter of the fire and the fire was held within that perimeter without further growth. Not more than a week later, on July 8, 2013 the Creek Fire was declared out and approximately 18,055 acres in size. Figure 2 shows the total acreage burned at 18,055 acres during the Creek Fire in the summer months of June. Usually, the summer months of May and June exhibit high rates of high-severity wildfires in the Southwest. More fires such as the Creek Fire could reduce impacts to the ecosystem as well as the local economy. No precipitation was recorded throughout the duration of the fire, except the night before it was declared out and received only 0.06 inches of rain.

An important piece of information related to the Creek Fire is that on June 7, 2013, nine days before this fire had started, another lightning-caused fire was also utilized as a resource benefit fire. This fire was called the 4-Mile Fire, totaled approximately 14,000+ acres, lower in elevation by about 1,000 feet, and was not more than 15 miles from the location of the Creek Fire. In addition, the Maggie 4,522 ac. (2011), Trail 2,512 ac. (2012), and Shorten 7,096 ac. (2012) fires were also utilized as resource benefit fires. These fires burned approximately 2-6 miles from the Creek Fire.

The decision to carry out the managed wildfire was brought about through the change of fire management on tribal lands by forest and fire managers throughout the years. In the past, the tribe had a full wildfire suppression management just as the Forest Service did. This policy was at the start of fire management of tribes in partnerships with the BIA. During recent years, both forest and fire managers are striving to bring back fire into the ponderosa pine ecosystem as it was before the reservation system was imposed. The notion of letting naturally ignited (lightning) fires take place with limited intervention as a practice of the past, is resurging among the San Carlos people. A respect for lightning-caused fire has always been amongst the San

Carlos tribe. Utilizing the lightning-caused Creek Fire was a potentially risky decision, especially in the summer months of 2013. High temperatures, low relative humidity, and winds were conditions which could have caused the fire to escape from its designated perimeter. An escaped resource benefit fire burning out of control can be the cause for this type of a fire to transition over to a wildfire where suppression is the main objective. However, the decision came carefully knowing the area has had a past history of timber sales, thinning, and relatively small wildfires. Ultimately, it was the tribal members' respect for natural processes to take place and their goal to return to traditional and cultural use of fire that led them to make the decision to utilize this fire as a resource benefit fire.

The Creek Fire exhibited different levels of fire severity along the burn area (Figure 3). The Burned Area Reflectance Classification Map of the Creek Fire (McKinley and Hetzler 2013) in Figure 3 shows that almost half of the burn was a low severity at 45%. Approximately 1% of the burn area had high severity. Other areas had no burn severity recorded because of the presence of clouds which were not recorded or because they simply did not burn at all. Although terrain has an influence in fire severity, vegetation (Figure 3**)** may also indicate why the burn severity across this landscape varied greatly.

The boundary within the Creek Fire had plenty of treatments conducted since the 1960's. Timber treatments have occurred on the reservation. Although many treatments are implemented across the reservation, the ponderosa pine forest was still quite dense. Because of active wildfire suppression starting in the early 1900's to the 1930's, the first known forest and fire management under the BIA in San Carlos, fire could not be reintroduced without thinning of the forests.

Besides objectives for the fire, it is relevant to mention the tribe's objectives within the ponderosa pine forest. The first objective is to create uneven-aged stands. Uneven-aged stands

have the benefit of having several stratus within the vertical structure of the forest. The tribe's goal is to transform these stands into an uneven-aged forest (San Carlos Forest Management Plan 2008). An uneven-aged prescription allows for crop trees of every diameter class to remain in the stand (SCFMP 2003). The second objective was to create a forest where the natural fire regime of ponderosa pine can function as it did during pre-European settlement. There are many more objectives, but these two objectives are highly relevant to this study.

Assessment of Fire Impacts

Fires within the Creek Fire boundary are not uncommon. Many fires have taken place over the existence of the reservation and before. Only until recent times have managers been able to keep inventory of fire occurrence on tribal lands. Figure 5 shows the fire occurrence within the Creek Fire boundary from 1982 to 2012, with a total of 84 fires prior to the Creek Fire. With most of the vegetation being ponderosa pine, the average fire occurrence in the ponderosa pine forest is 40 fires annually and the average size is 13 acres across the tribe's ponderosa pine forest (SCFMP 2003). Most of these fires were reported to be wildfires. The Shorten Fire in 2012 overlapped the southern-most boundary of the Creek Fire, but at a very small acreage. This area was useful for identifying actual areas which did burn in previous years. It also helped in serving as an anchor point for burnouts, securing this portion of the fire.

A number of treatments were carried out within the burn area before the fire had occurred. Figure 6 shows the thinning blocks identified and thinned out from 1978 to 2010. These thinning operations targeted smaller diameter trees. A thinning from below type of silviculture application was put into action in the areas shown in Figure 6. This type of silvicultural application was used to promote stand structure for creating uneven-aged characteristics (SCFMP 2003).

Although the thinning blocks (Table 2) were conducted at certain years, all thinning operations including the Creek Fire burn boundary (Figure 7) fall within a larger boundary identified for the purpose of timber sales. Table 2 is an example of the inventory gathered before the fire had occurred and the targeted stand characteristics the tribe was hoping to achieve during the Shoe Timber Sale 2008 Operations. Also shown in Figure 7 are the areas within the Creek Fire perimeter identified as timber sales during 1962, 1965, and 2008. These areas designated for timber sales exhibited characteristics of even-aged stands within the ponderosa pine forest before the fire had occurred. Once the stand and surrounding areas were designated for thinning and timber sales operations to be implemented, burning could be reintroduced to the stands.

As Figure 5 demonstrated, there have been a considerable amount of fire occurrence within the Creek Fire over of the previous 22 years. The use of resource benefit fires and prescribed burning has been limited within the boundary as seen in Figure 8, prior to the Creek Fire. It is speculated that because of frequent small fires, surface fuel loading within the fire boundary was minimal. However, the uneven aged management and the opened structure as indicated by Table 2 are good indications as to why small amounts of prescribed burning activities had been implemented. Only 2 prescribed burns had been implemented in 2003 and 2011 with Figure 8 showing only 2 prescribed burns large enough to be shown on the map. There has never been a definite need to use prescribed burning on this location in past years.

Discussion

Paraphrasing the words of the tribal biologist, Seth Pilsk, fire has been a part of the San Carlos Apache culture and tradition for a long time. The Creek Fire burned a total of 18,055 acres completely on tribal lands, roughly 1% of tribal lands, but burned an estimated 10% of forested lands. However, with another naturally-caused fire utilized for resource benefit just before the Creek Fire occurred, the total amount of tribal lands burned was 2% and forested lands were about 18%.

Fire utilization among the San Carlos Apache tribe is evident, to some degree, through culture and tradition passed on orally. Their past use of fire, burning in small acreages and targeting plant species which thrive when fire is added to its ecosystem is a concept that has been practiced and is currently managed for. Because of the disruption of low intensity, frequent fires exhibited within the ponderosa pine forest, inventory and careful thinning needed to be carried out before fire could be reintroduced. Aggressive wildfire suppression excluded fire from this landscape from the early 1900's to the 1930's (Kelly *et al*. 2013). Up to the early 1940's the assigned forester began to understand the tribe's use of fire. His understanding came from including the general community as well as the tribal elders and council in the fire management decision making processes. In 1943, the use of resource benefits fires got acknowledged and became a regular practice on the reservation (Kelly *et al*. 2013). Although recognized, the use of resource-benefit fires was not a practice associated with success because of their reliance on cattle. Heavy grazing was a major form of fire exclusion not long after the creation of the reservation in 1897 up to the 1940's. This time period is also associated with the loss of practicing their traditional and cultural use of fire. The tribe did engage in ceremonial and social gatherings which allowed use of fire, but not in the surrounding forests of the reservation. After an extensive period of fire exclusion due to heavy grazing (Kelly *et al*. 2013) and regulations for

active fire suppression management set forth in conjunction with the Bureau of Indian Affairs, does the San Carlos Apaches now have a chance to decide on their own to utilize fire in a cultural and traditional way.

The tradition and cultural beliefs of the San Carlos Apache Tribe combined with western technology are consistent with the objectives of achieving a low to moderate severity burn across a large area within the Creek Fire. The fire also created pockets of high severity burn which would favor the understory grasses and forbs. A diversity in grasses and forbs are favored by the Apache elders because a group of native grasses and forbs in the forest were signs of a healthy ecosystem (Pilsk 2014). A healthy forest was created by not suppressing the fires and having a deep respect for fire and its role in the natural world.

Apache people favored natural processes to occur without intervention. This idea is analogous to today's wilderness fire management: let naturally ignited fires take place as it once did. Another type of management this is similar to in today's current fire management practice is the idea of allowing naturally ignited fires to burn in a vicinity where the process will benefit multi-resources. Although Traditional Ecological Knowledge may have had an influence on how the San Carlos Apache Tribe conduct their forest and fire management programs to a certain degree, other factors can have a greater influence on management. An example is the decline in threatened and endangered species such as the Mexican Spotted Owl (*Strix occidentalis lucida*). If their populations were to decline substantially, strict management of MSO habitat could decrease the number of resource benefit fires on the San Carlos Apache reservation. A change in natural resource management could also affect how tribal forest and fire management programs are carried out. Forest and fire managers should continue to conduct traditional and cultural practices combined with updated forest health techniques in an effort to restore the ponderosa pine forest on tribal lands.

The future of Fire Management on the San Carlos Apache Tribe

There are several factors which may dictate how the San Carlos Apache Tribe will manage its fire program: funding and personnel availability, policies, land ownership, climate change, and even a change in management. Climate change will have the most adverse effect on fire management practices. How long fire knowledge and practice will continue is confronted by a serious threat when climate change forces a disruption in fire activity that will be problematic to Native American tribes (Huffman 2013) as well as non-tribal agencies. However, the payoffs for being proactive in harnessing resource benefit fires could play a major role in reducing these effects. A study by Azpeleta *et al*. (in press) state, "Non-fire treatments under moderate climate change were forecast to become dense and susceptible to severe wildfire." Additionally, changes in federal fire restrictions could potentially halt the use of resource benefit fires on San Carlos' tribal forests. Futhermore, a combination of resource benefit fires utilized now in combination with prescribed burning across the tribe's landscape could reduce the potential effects of increasing wildfire threats in the future. The fire management officer for the San Carlos Apache Tribal Forestry, Duane Chapman (2013) states "…the return of fire to the landscape–that has been excluded for many decades–-is now providing positive effects, including plant diversity, improving wildlife habitat, and improving rangelands." There is no question that fire has been beneficial to indigenous peoples. The question is now, "How will Apache Ecological Knowledge stand against the factors limiting fire management on tribal lands?"

Learning from past knowledge as well as carrying those practices on with adaptive management can be a valuable learning tool to give to younger tribal members who will take on the responsibilities of being a forest and fire manager. TEK being passed onto the next generation is very important, as well as having educational programs, if traditional ecological practices are to be connected with today's restoration applications (Alcoze 2003). Land manages

are helping to create the relationships that the younger generations will have with utilizing fire on the San Carlos Apache tribal lands (Kelly *et al.* 2013). This evolving practice to new challenges and environments is similar to what tribal elders, clans, and families have been doing since time immemorial. There is a difficult task of connecting traditional ecological knowledge and its effects with today's management on all Native American tribal lands. With the help of tribal elders and members, ecologists and forest practitioners can help connect and solidify the idea that fire use among the Apache people can be a form of traditional ecological knowledge as well as traditional fire knowledge.

Tribal Practices, TEK, and TFK

The Creek Fire case study and other natural resource benefit fires mentioned are an example of how tribes can integrate the past use of fire on current tribal lands. This type of natural resource management is expected among tribes where TEK and TFK exist. The tribes share a belief that how they treat the earth is exactly how "Mother Earth" is going to treat them. Not only does treating the earth with respect play a strong role in their beliefs, but having a close relationship and understanding on natural processes is important among Native Americans. Whether it is an understanding of ecosystem processes or the application of fire, the oral tradition will keep these concepts continuing into the future.

Recommendations towards Future Studies of TEK and TFK

For future studies which attempt to connect Traditional Ecological Knowledge or Traditional Fire Knowledge with current forest and fire management practices, there are several recommendations which would help achieve this objective. I identified these recommendations in the process of writing this paper and they should be acknowledged when determining if TEK or TFK has an influence on present-day natural resource management.

To begin with, extensive research should be done on the tribe of interest. Knowing just what type of question you are asking is important. Having the question in mind, gives you a better understanding of how you will obtain your answer, or attempt to answer. Your questions could be derived from talking with the resource managers and find if there are any they have in particular? Is there a question they are curious about and would like to know more? You also may want to speak with representatives at the Bureau of Indian Affairs regional offices about research gaps or practices associated with TEK or TFK. These offices are placed throughout different regions in the U.S. These regional offices coordinate with tribes within a specific region. For example, the San Carlos Apache Tribe is in the Southwest Region and the regional office is located in Phoenix, Arizona. Once you have your question, you will need to obtain tribal acceptance for your study. Tribal lands require a permit for non-tribal members to gain access onto tribal lands. The same is required for research projects to take place on tribal lands. The tribal council has final approval or disapproval of the project. Writing a letter of interest for pursing a project and how it will benefit the tribe is important to create support from the tribal council. Researching the background of the tribe in the form of a literature review is useful, including tribal websites if available.

Once the pre-research items have been completed and accepted, it is very important to visit the tribe's lands and tribal members. Having a presence at the tribal reservation is helpful in creating trust with the tribal members and resource managers. Once trust is gained, usually, tribal documents will be made available for your project. Many of these original documents will not be published. You will have to search for them because inventory data and methods are fairly new compared to some other agencies. Lastly, the most important of unpublished resources are the tribal elders. To get full participation of the tribal elders, you will need to spend time with them and participate in traditional and cultural events. This helps built trust among the elders and they

will become more accepting to answering questions pertaining to your project. You may be able to use a translator, but in general you will not be able to film the elders because of traditional and cultural beliefs. The success of your project depends on how much effort and planning you put into your project. There is a critical need for various studies to be conducted on all tribal lands in North America to help create bridges between tribal members and non-native peoples in the long run.

Tables and Figures

Table 1. The 8 Fire Management Zones, Riparian Wetlands, their descriptions, sizes in acres, and percentage of tribal lands (SCFMP 2003).

Fire Management Zones		Acres	% of Tribal Lands
FMU 1	Ponderosa pine forest	247,694	13
FMU2	Madrean evergreen woodlands	150,832	8
FMU3	Juniper woodlands	282,149	15
FMU4	Interior chaparral	219,028	12
FMU5	Upper-elevation grasslands	184,365	10
FMU6	Semi-desert grasslands	273,108	15
FMU7	Sonoran-desert scrub	377,811	20
FMU8	Wildand/Urban Interface/Intermix (WUI)	119,193	6
N/A	Riparian Wetlands	Unknown	~1
N/A	Total	1,854,180	100

Table 2. Inventory gathered from the Shoe Stand within the Creek Fire boundary prior to the fire.

Shoe Timber Sale 2008 Operations

Stand	Basal Area	Residual BA	Acres	Cutting Cycle
452	81.33	40	70	20 Yrs
455	61.54	40	113	20 Yrs
460	82.4	40	256	20 Yrs
462	78.18	40	190	20 Yrs
506	96.36	40	121	20 Yrs
514	74.58	40	121	20 Yrs
541	90	40	71	20 Yrs
550	110	40	90	20 Yrs
558	86.36	40	309	20 Yrs
560	79.62	40	296	20 Yrs
597	64.55	40	95	20 Yrs
681	90	40	359	20 Yrs
699	60	40	99	20 Yrs
718	84.29	40	207	20 Yrs
719	75.71	40	207	20 Yrs
785	72.73	40	N/A	20 Yrs
898	97.27	40	278	20 Yrs

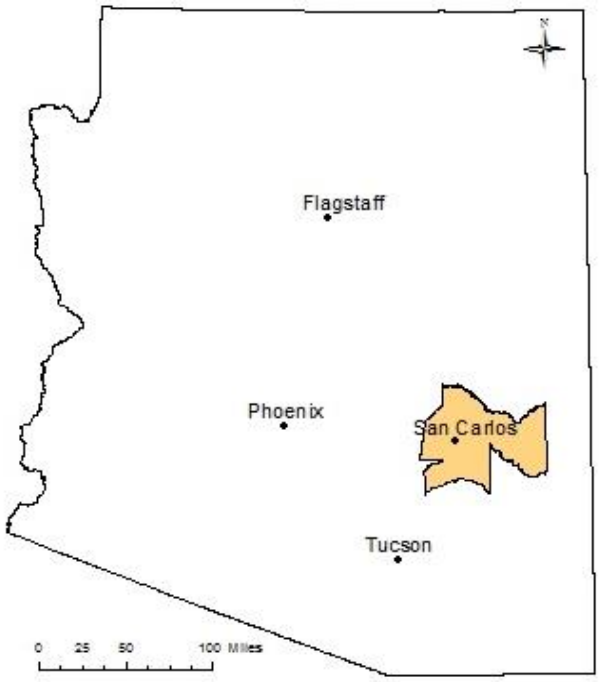

Figure 1. Location of the town of San Carlos, Arizona, and the San Carlos Apache Reservation.

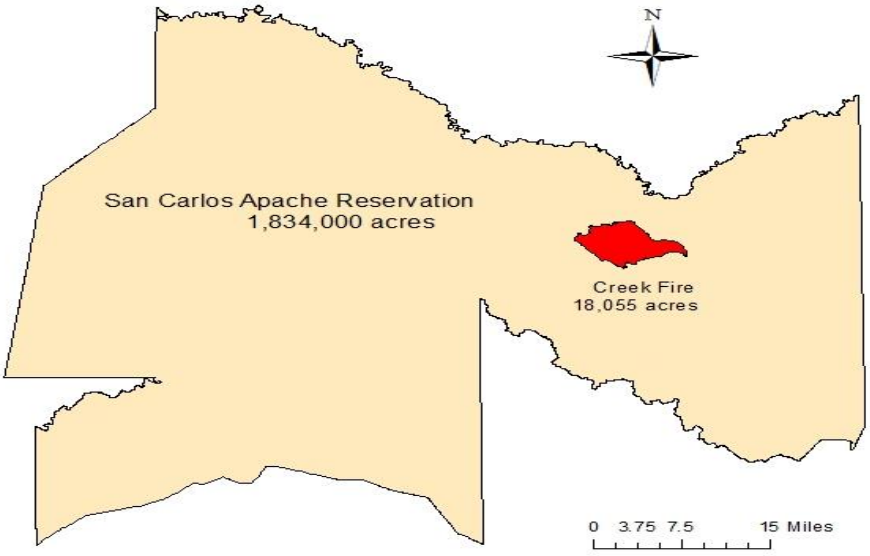

Figure 2 Map of the Creek Fire within the San Carlos Apache Reservation boundary.

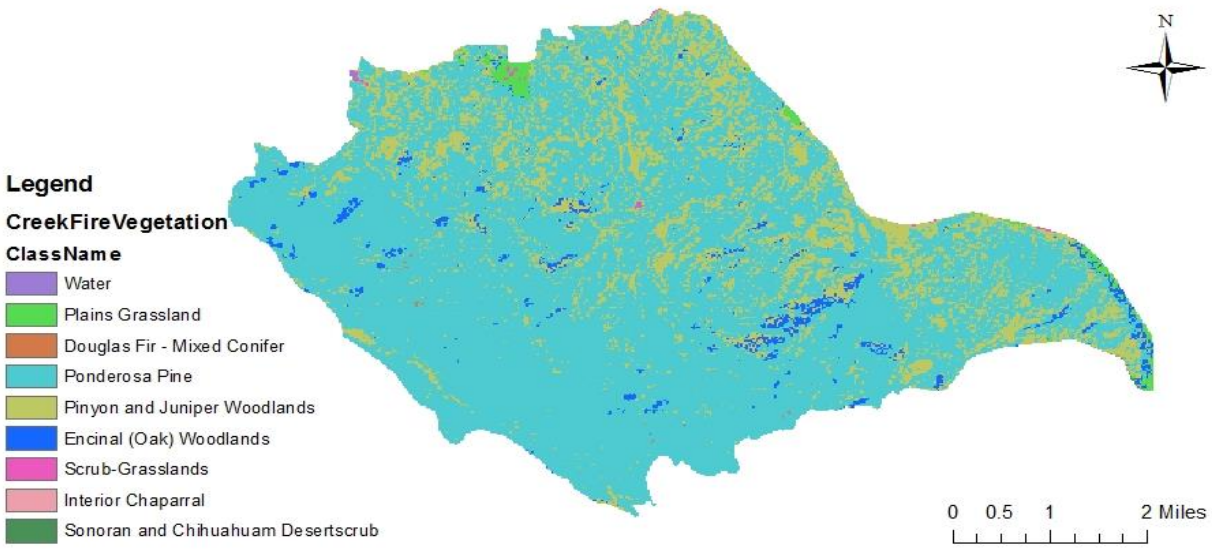

Figure 3 Vegetation map of the Creek Fire.

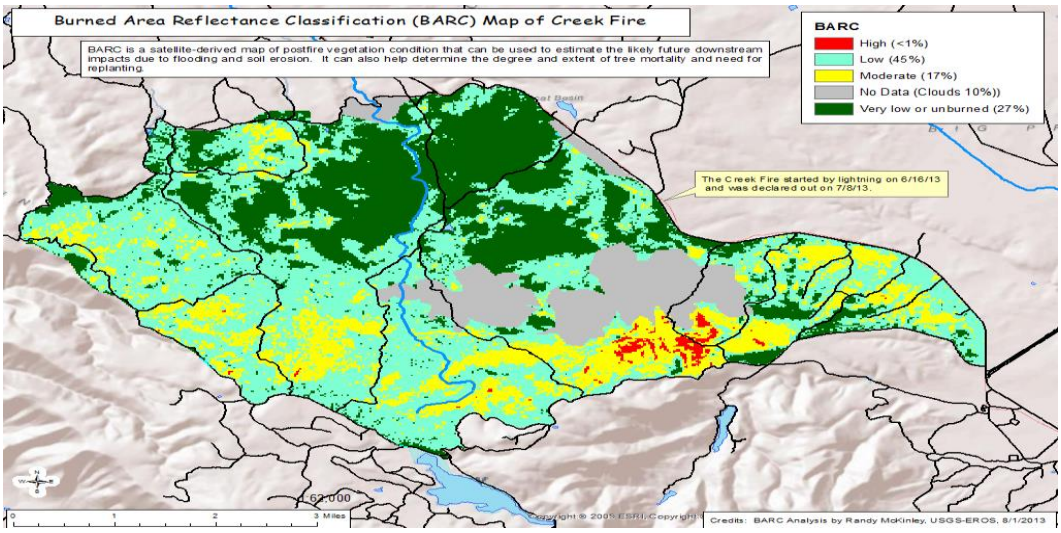

Figure 4 Different categories of burn severity of the Creek Fire. (McKinley and Hetzler 2013).

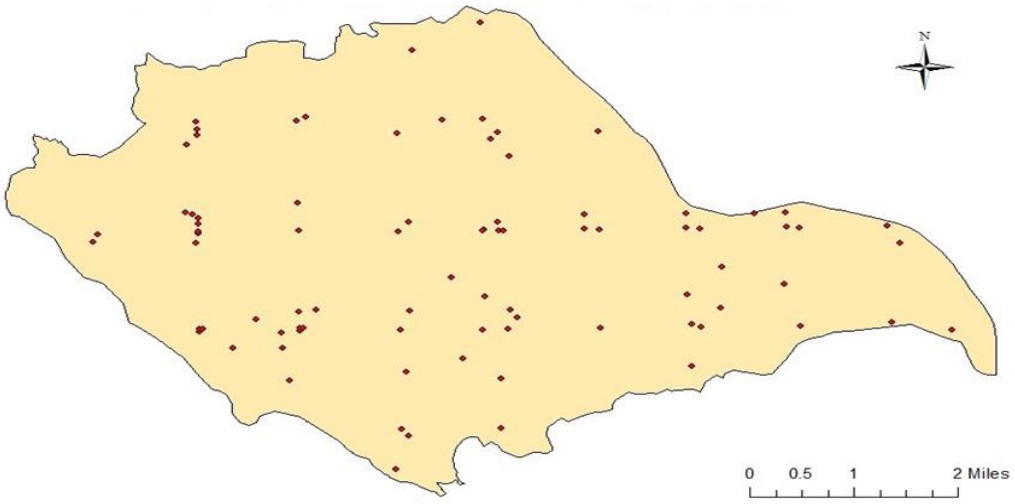

Figure 5 Fire occurrences (84 fires) within the Creek Fire burn perimeter from 1980 to 2012.

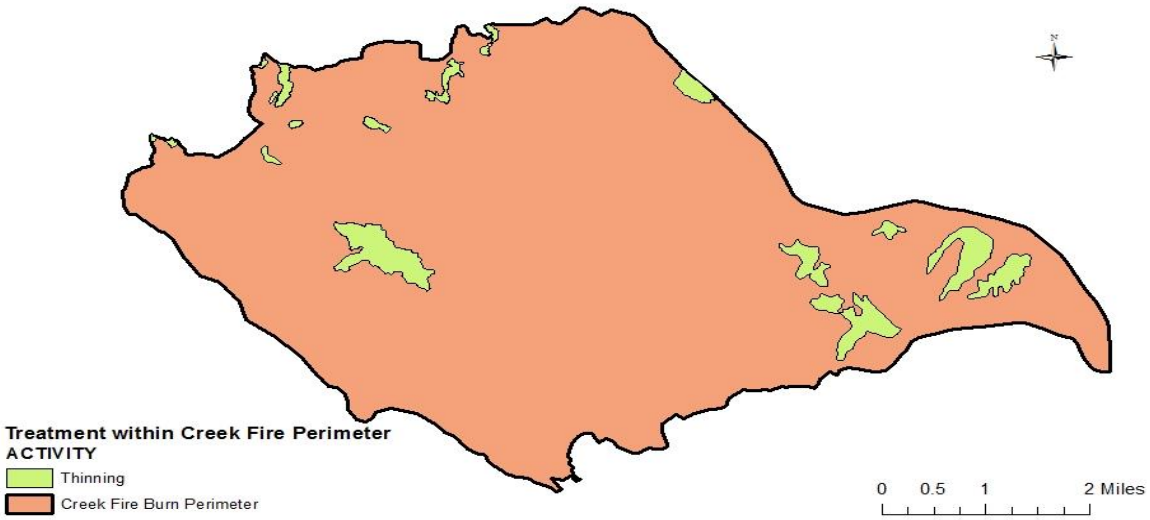

Figure 6 Thinning blocks within the Creek Fire boundary.

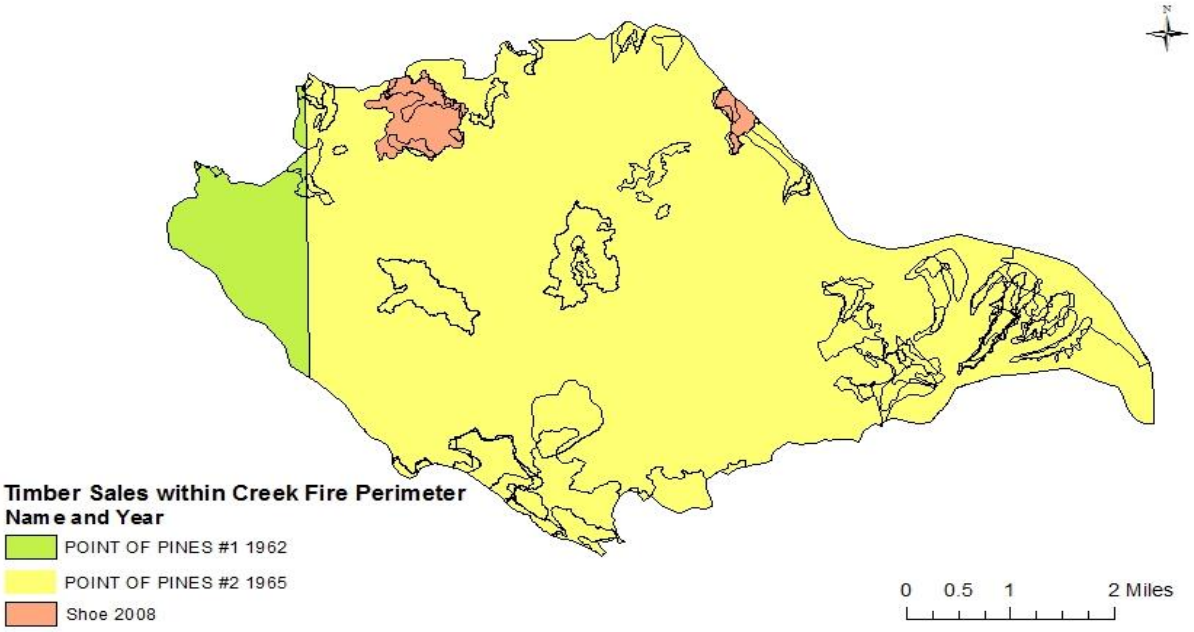

Figure 7. Large timber sales locations and year within the Creek Fire boundary prior to the burn.

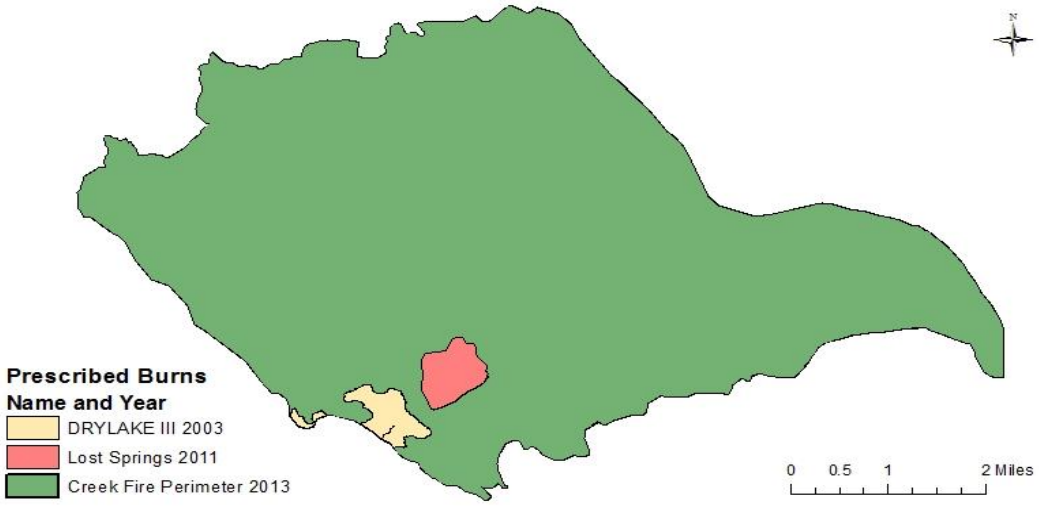

Figure 8 Treated areas using prescribed burning within the Creek Fire boundary prior to the burn.

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