1148 Complex Fire

Palo Pinto County

April 9, 2009

A case study

TEXAS FOREST SERVICE

The Texas A&M University System

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Abstract

The purpose of this case study is to examine the destruction that occurred Thursday, April 9, 2009, in Palo Pinto County. This publication focuses on the 1148 Complex Fire that occurred off Stringer Lane on the west side of Possum Kingdom Lake. The study reviews effects of ember production, impacts of cedar encroachment and benefits of mitigation.

On April 9, 2009, a dryline pushed eastwardly through much of the Central United States and combined with dry fuel conditions and single-digit relative humidity readings to create a devastating situation. In less than eight hours, the State of Texas experienced a major outbreak of wildfires in 12 North Texas counties.

In several areas, humidity levels dropped from 40 percent to 8 percent in a matter of minutes. The already drought-stressed fuels, exceptionally low humidity levels and high winds gusting to 70 mph, set up what Texas Forest Service (TFS) dreads the most – "perfect storm" conditions for extreme fire.

Through the next eight hours, 205 wildfires raged throughout the North Texas area. The large, fast-moving wildfires exhibited extreme fire behavior and many quickly overwhelmed the capabilities of local fire departments.

In Palo Pinto County, a vulture landed on an overhead powerline and caused an electrical outage that started the fire. The outage ignited the fuels below the lines. The wildfire consumed 14 homes and 1,002 acres of cross timbers post oak forest.

TFS assisted local fire departments and soon had all agency firefighting assets committed to fighting fires. The high winds grounded all aviation assets throughout much of the event and prevented the dropping of much-needed water and retardant on the flames. The need for more assistance quickly became obvious. TIFMAS (Texas Intrastate Fire Mutual Aid System) was activated and fire departments from the Dallas area were called in to help.

After initial massive suppression efforts, local and state firefighting resources continued fire suppression operations in several counties for weeks after the onset of the wildfire event. State mass care agencies joined the fight and worked with local officials to identify unmet needs of individuals and communities.

Based on the examination of the home sites, the team found that narrow roads, overhanging vegetation, winding and unmarked driveways, cedar encroachment, spot fires, and care/maintenance problems inherent with absentee homeowners contributed to home loss.

Definitions

Air tanker – A fixed-wing aircraft that has been certified by Federal Aviation Agency (FAA) to carry and deliver fire retardant.

Combustion – A complex sequence of chemical reactions between a fuel and an oxidant accompanied by the production of heat or both heat and light in the form of either a glow or flames.

Crown fire – A fire that is burning in the treetops.

Engine – A ground vehicle that can provide a specific level of pumping, water and hose capacity.

Firebrands - Any source of heat, natural or human made, capable of igniting wildland fuels. Flaming or glowing fuel particles that can be carried naturally by wind, convection currents, or by gravity into unburned fuels.

Fuel – Any combustible material; includes trees, grass, needles, wood, etc.

Ladder fuels – Provide a vertical link between fuels. They allow the fire to move from the ground to shrubs and trees easily. They also help start crown fires.

Litter – Layer of decaying organic matter on the forest floor composed of twigs, branches, dead sticks and fallen leaves or needles.

Relative humidity (RH) – The ratio of the amount of moisture in the air to the maximum amount of moisture that air would contain if it were saturated.

Spotting – Embers from the main wildfire land in receptive fuel beds ahead of the main fire and start new ignitions.

TFS – Texas Forest Service.

VFD – Volunteer Fire Department.

WUI – The line, area or zone where structures and other human development meet or intermingle with wildland.

Dedication

This report is dedicated to the families who lost not just homes, but memories during this tragic wildfire event and the those courageous men and women who saved countless homes and lives.

Thanks to the responding fire departments

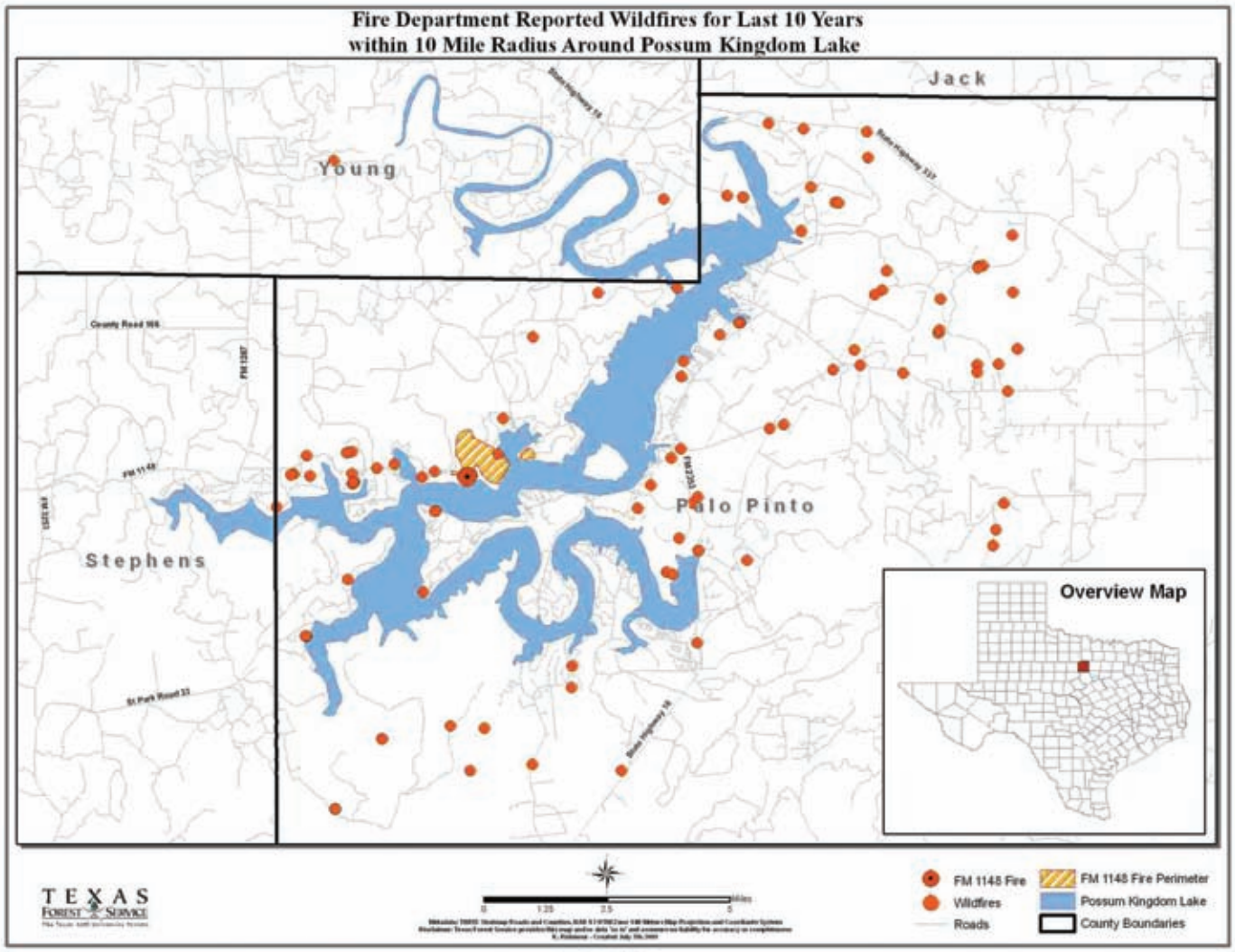
Brazos VFD
Gordon VFD
Graford VFD
Lone Camp VFD
Mineral Wells VFD
Palo Pinto VFD
Peaster Fire and Rescue
Possum Kingdom Lake Eastside VFD
Possum Kingdom Westside VFD
Santo Fire and EMS
Strawn VFD
Two Task Forces from the Dallas/Fort Worth Metroplex

Appreciations

Mark Engebretson – Lake Country Sun Newspaper
Linda Guerrero – Palo Pinto Tax Appraisal Office
Ken Hyde – Brazos River Authority
Greta Owens – Possum Kingdom Homeowner
James Maddox – Possum Kingdom Homeowner
Greg Patrick - Science and Operations Officer, National Weather Service in Ft. Worth
John Price – Possum Kingdom West VFD
Chief Charles Sims – Lone Camp Volunteer Fire Department

Introduction

Fire is not new to Palo Pinto County and the local volunteer fire departments that protect the area. According to records maintained by Texas Forest Service, volunteer fire departments in the area have responded to more than 681 wildfires within the county since 2000. Local volunteer fire departments within a 10-mile radius of Possum Kingdom Lake have responded to 98 wildfires in the last 10 years.



History of development in Possum Kingdom Lake and Brazos River Authority

According to the Brazos River Valley Authority, the Brazos River and its tributaries begin in the West. The river starts as merely a trickle and grows as the river heads south to the Gulf of Mexico. Each year, the Brazos River provides 6.75 billion gallons of water to cities, agriculture, industry, mining and recreation.

In 1929, the Texas Legislature created the Brazos River Authority — the first state agency in the U.S. created specifically for the purpose of developing and managing the water resources of an entire river basin.

The section of the Brazos River in Palo Pinto County is one of the most scenic that the Brazos has to offer. The river flows through the heart of Palo Pinto Country, an area consisting of beautiful cedar-covered hills and mountains where the Comanche Indians once hunted. This country is rugged, rocky and isolated with very little development. Generally the river is extremely wide and scenic with heavily vegetated banks consisting of elm, willow, oak and cedar, along with spectacular outcroppings of rock, high bluffs and views of the Palo Pinto Mountains.

Possum Kingdom Lake, located on the main stem of the Brazos River northwest of Fort Worth, was the first water supply reservoir constructed in the Brazos River Basin. In the late 1930s, the Brazos River Authority began acquiring land to build Possum Kingdom Lake. Construction of the Morris Sheppard Dam began in 1938 and was completed with the aid of the Works Progress Program in 1941.

During this difficult time we know as the Great Depression, many landowners chose to sell all, rather than part, of their land holdings. These sales left the Authority with much more land than needed to build the lake. Not long after the lake was filled, the Authority began leasing this land for camping and hunting. Over the years, the cabins once built for weekend camping and fishing began to evolve into fulltime home sites. It was the growing development on Possum Kingdom Lake that prompted the Authority's board of directors to set standards for development and construction on properties around the lake (Brazos River Authority).

Since Possum Kingdom Lake is a hydropower-generating reservoir, the Authority is obligated to enforce rules and regulations set by the Federal Energy Regulatory Commission (FERC). The Possum Kingdom Dam and Lake Project are licensed by FERC as Project No. 1490.

Possum Kingdom Lake covers an area of 17,700 acres with 310 miles of shoreline. The river authority is held to guidelines provided by the FERC which requires that no structures or improvements of any kind can occur within 25 feet horizontally of the edge of Possum Kingdom Lake at normal maximum surface elevation. After 1980, the setback guidelines were increased to 50 feet for any newly created lots. If mitigation work is required on older properties grandfathered in before 1980, approval can be granted by the river authority for limited clearing. Why is this management of vegetation along the shoreline important? Imagine the perfect summer day on a lake setting. The sun is shining on clean water and families are playing and swimming along the shore. The picture also includes green vibrant shoreline vegetation blending into the surrounding landscape. The interrelationship between a lake and its shoreline is important because the shoreline produces the buffer to protect the lake from activities that could otherwise destroy a healthy lake. A vegetated shoreline filters runoff generated by surrounding land uses, removing harmful chemicals and nutrients. At the same time, shoreline vegetation protects the lake edges from the onslaught of erosion caused by waves. The shoreline zone also provides critical habitat for aquatic insects, microorganisms, fish and other animals, which help maintain a balance in a sensitive aquatic ecosystems.

Unfortunately, as lake landscapes are developed, natural shorelines often are damaged or destroyed due to the removal of vegetation. This can lead to eroded shorelines, degraded water quality and aquatic habitat, impaired aesthetics, and a reduction in property values. A Shoreline Management Plan and Customer Guide has been approved by the Authority's board of directors to provide a clear understanding of the rules, processes and procedures for activities conducted on Authority land and/or water at Possum Kingdom Lake and is available on their website at www.brazos.org.

Shoreline management and cedar encroachment

The cross timbers post oak forests of Palo Pinto County have become susceptible to wildfire with the encroachment of two species of *Juniperus* found in the county, ashe juniper (*Juniperus ashei*) and eastern red cedar (*Juniperus virginiana*). Junipers usually occupy rocky slopes, such as escarpments, ridges or rimrocks. During the last 50 years juniper has become more prevalent on grasslands. The commonly accepted causes are lack of fire, overgrazing and climate changes favoring juniper (Wink and Wright, 1973).

Ashe juniper is a small, native, evergreen tree or shrub. It is usually many-stemmed and rarely grows more than 30-feet tall. Ashe juniper forms dense-to-open communities with oaks (*Quercus spp.*), including live oak (*Q. virginiana*) and Mohr oak (*Q. mohriana*), Texas persimmon (*Diospyros texana*) and mesquite (*Prosopis spp.*) in this area. These communities have invaded many acres of adjacent little bluestem (*Schizachyrium scoparium*) grasslands as a result of overgrazing and fire suppression (Smeins, 1980).

Eastern red cedar (*Juniperus virginiana*) grows where water is near the surface or where soil moisture fluctuates from near saturation in winter to extreme dryness in summer. It has a high drought tolerance, enhanced by the presence of rapidly produced taproots as well as an extensive fibrous root system. The relative drought tolerance of eastern red cedar compared with some herbaceous species (e.g., big bluestem) may contribute to its successful invasion of tallgrass prairies in the absence of fire (Converse, 2003).

The fundamental chemistry of combustion lies at the core of the living world. When it happens within a cell, it is called respiration. When it happens outside organisms, it is called fire (Pyne, 1982). Ashe juniper and eastern red cedar have highly combustible evergreen foliage due to various oils, resins and wax compounds contained within the plants and their foliage that allows them to burn with great intensity.

Dead ashe juniper trees are highly volatile and must be treated with caution. Firebrands can travel up to 400 feet or more, depending on weather conditions during a wildfire, and can ignite spot fires ahead of the main fire front. Low branches near the ground burn and provide a ladder that enables fire to engulf the whole tree. While grasses recovered quickly from the low severity fires that were characteristic of the prairies, growth of the fire intolerant *Juniperus* was controlled. Urbanization has stopped these low severity wildfires, allowing cedar and other volatile trees to invade.

With the increase in cedar infestation within the wildland urban interface, the potential for catastrophic wildfire is greatly increased. The costs of wildfire suppression to fire departments and the state are immense. The safety risk to firefighters is increased when cedars and other junipers are involved. Rural residents may be unaware of the hazard created by surrounding their homes with attractive, yet highly flammable, cedar trees. Similarly, absentee landowners are less likely to manage cedars on their property, allowing them to propagate widely, displacing native vegetation and creating dangerous fuel loads that threaten their neighbors' lives and property in the case of a wildfire. Educating rural and wildland urban interface residents about cedars and their increased risk to wildfire is a big challenge for land stewards.

It is true that evergreens are more flammable than other trees; however, they can be incorporated into the landscape. Homeowners who choose to use evergreens need to take certain steps to reduce the risk of ignition and provide separation between fuels, while still meeting the guidelines of vegetation removal for the Brazos River Authority.

Homeowners living in Possum Kingdom are required to get approval from the Brazos River Authority in order to remove vegetation. Retained evergreen fuels must be reshaped by trimming branches to remove the potential for fire spread into the canopy, surrounding vegetation or structures. Some guidelines include pruning lower branches of trees to a height of six to 15 feet from the top of the vegetation below (or the lower third of branches for small trees). Properties with greater fire potential, such as steeper slopes, will require pruning heights in the upper end of this range.

Volatile fuels such as cedar and yaupon within a 30-foot defensible space zone around the perimeter of the home need to be evaluated for removal and consent provided by Brazos River Authority inspectors prior to removal. Authorization can be provided for limited clearing if the vegetation within a 30-foot defensible space zone around their home occurs within the 25- to 50-foot shoreline setback zone.

Homeowners need to understand that this removal has to be initiated prior to a wildfire, not during the actual event. The area must be maintained throughout the year to keep fuel loads low and reduce risks associated with wildfires. Vegetation is only one of many factors that contribute to the ignitability of homes.

Anderson initially defined flammability in three components: ignitability, sustainability and combustibility (1970). The ignitability component is the time between exposure to a heat source and ignition. Sustainability is the stability of burning rate, or the ability to sustain fire once ignited. Combustibility is defined as the rate of burn after ignition. The definition of flammability has since been expanded to include consumability, the proportion of mass or volume consumed by fire (Martin et al., 1994).

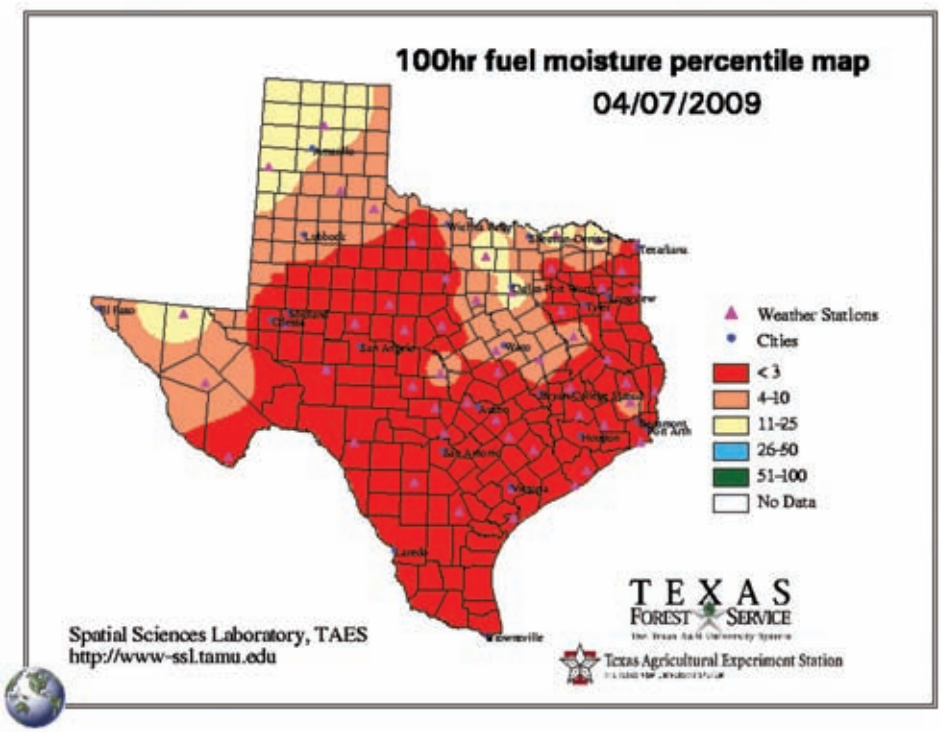
Anderson (1970) related the flammability components of individual plants to fire characteristics at an ecosystem level. Ignitability of individual plants drives the chain of ignition in an ecosystem. Sustainability is related to the rate of fire spread and combustibility to fire intensity. The consumability of individual plants is analogous with the amount of fuel available for fire consumption on the ecosystem level (Martin et al., 1994). In addition, plant flammability can influence wildfire behavior affecting the survivability of human-built structures.

Weather and Fuels

The lack of rainfall during the first half of the year led to severe drought in Texas. Richard Heim, a meteorologist at the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center, said that the 2.69-inch average rainfall across the U.S. in January and February was the least amount of moisture nationwide in those months since NOAA began keeping records in 1895.

Prior to the wildfires on April 9, federal officials reported there had already been almost twice as many wildfires this year than during the same period last year in Texas. They also predicted more fires to happen through the middle of the year. According to the Texas Interagency Coordination Center, as of Friday, April 10, 2009, there had been 6,929 open forest and grassland blazes this year in Texas, involving more than 324,000 acres. With the driest winter on record, rainfall was still a foot below normal in many parts of the state, including those in North Texas hit hard by wildfires the week of April 5. More than 90 percent of the state was under some degree of drought condition. Drought conditions lower live and dead fuel moistures, making the fuels more available for combustibility, not just in fine fuels, but in the heavier 10-hour and 100-hour fuels as well.

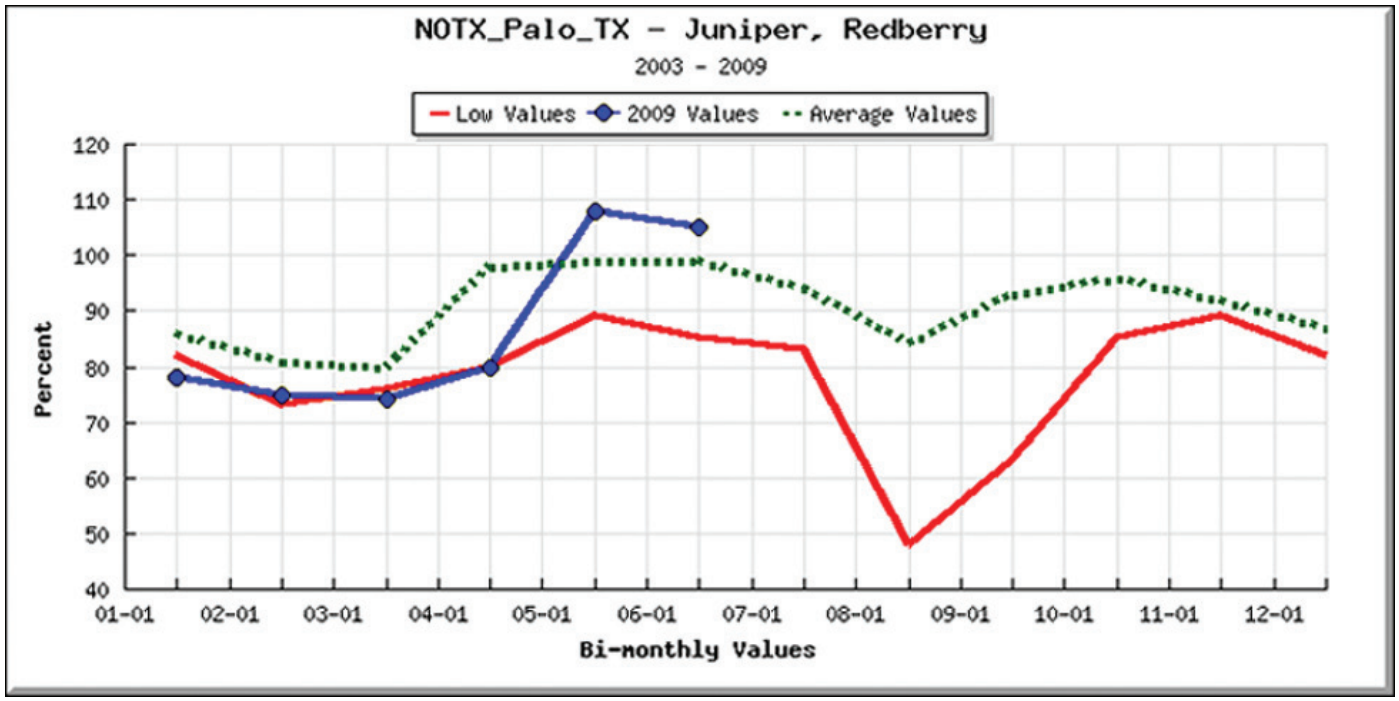
Dead fuels are those fuels whose moisture contents are controlled exclusively by changing environmental conditions, such as temperature, relative humidity and rainfall. Examples include dead, rotten wood on the ground, fallen leaves and needles, dead leaves and twigs on shrubs, and the litter on the forest floor. For purposes of fire danger modeling, dead fuels are divided into four "timelag" categories: 1-hour, 10-hour, 100-hour, and 1000-hour. One-hour fuels are fuels that are less than one-fourth of an inch in diameter and respond very quickly to changes in their environment. These fuels will only take about an hour to lose or gain two-thirds of their equilibrium moisture content of their environment. This size fuel, if dead, is referred to as "fine dead fuel" and is the most critical size fuel in starting fires. Moving up in size, a fuel will lose or gain moisture less rapidly through time. Ten-hour fuels range in diameter from one-fourth of an inch to one inch, 100-hour fuels from one inch to three inches, and 1,000-hour fuels from three inches to eight inches in diameter.



In addition to dried dead fuels coming into the April 9 fire event, live fuel (foliage) moisture content (percentage) in juniper was at critically low levels. The basis of live fuel moisture causes some confusion among fire practitioners (i.e., is it possible for live fuel to have more than 100 percent moisture?). Moisture content of wildland fuels is expressed in relation to dry weight, not just the proportion of water in the fuel. The dry material provides the heat to evaporate water so that the fuel will burn. The definition of moisture content used here is the ratio of the weight of the water contained to the dry weight of the material, expressed as a percentage. The simple formula for percent moisture content is:

$$\frac{\text{Weight of water in sample (100)}}{\text{Dry weight of sample}} = \text{percent moisture content}$$

Live plants can either suppress combustion or contribute to it, depending on their moisture content and flammability of chemical compounds contained in the plants. Successive years of drought may be sufficient to cause mortality in juniper. The North Texas Predictive Service Area (PSA) is an area where the weather reporting stations, or a group of Remote Automated Weather Stations (RAWS), tend to react similarly to daily weather regimes and exhibit similar fluctuations in the fire danger and climate. During the first three months of 2009, reports from the North Texas PSA showed juniper levels in the 70s. This level put juniper live fuel moisture levels in the 97 percent percentile for critical fire behavior.



	15-Jan	15-Feb	15-Mar	15-Apr	15-May	15-Jun	15-Jul	15-Aug	15-Sept	15-Oct	15-Nov	15-Dec
2009	78	75	74	80	108	105	-	-	-	-	-	-
Avg	86	81	80	98	99	99	94	84	93	96	92	87
Low	82	73	76	80	89	85	83	48	63	85	89	82

Along with dry dead and live fuels, an anomalously strong weather system contributed to the extreme fire behavior on April 9. Typically, the boundary between two air masses with differing temperatures defines a front. During springtime in the U.S. Southern Plains, another phenomenon separates the dry air blowing from the Mexican Plateau into West Texas from the moist air carried north from the Gulf of Mexico into Central and East Texas. This boundary is called the dryline. The dryline exists most commonly in West and Central Texas during the spring. This boundary separates the moist air mass with higher relative humidity to the east and the dry air mass with lower relative humidity to the west. The difference in relative humidity values across the dry line can be astounding. Dew point temperatures can be as low as the single digits west of the dryline and as high as the 70s east of the feature. Air temperatures ahead of a dryline are typically in the 70s and 80s while behind the dryline, temperatures can range from the mid-80s to mid-90s.

Greg Patrick with the National Weather Service in Fort Worth said, "On the day of the FM 1148 wildfire, a strong weather system resulted in a deep surface low pressure center across northern Oklahoma. Very strong west and southwesterly surface winds to the south of the low pressure center allowed the dryline to be pushed east through much of North Texas.

"So even though the pattern observed was somewhat typical of an April weather system, this system was associated with anomalously strong winds near and west of the dryline as it crossed the fire event area. The energetic weather system allowed for deep mixing of higher level (6,000 – 10,000 feet Above Ground Level) winds creating strong and gusty winds at the surface. As the dryline passed the fire event area, very strong south winds switched to the west and temperatures rose quickly under sunny skies. With hot temperatures and very low dew points behind the dryline, relative humidity values plummeted," Patrick said.

These extreme weather conditions, in conjunction with prolonged drought conditions, set the stage for the perfect fire weather event – extremely dry fine fuels allowed for easier ignitions and strong winds led to increased rates of spread, spotting and ignition potentials.

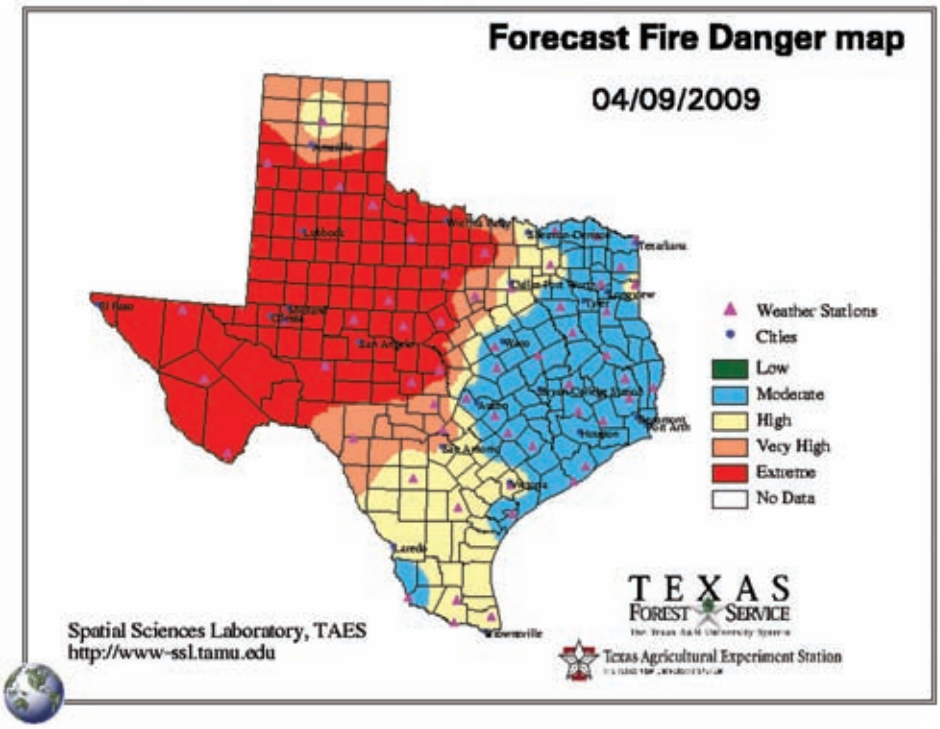
The National Weather Service Forecast Office in Fort Worth is responsible for weather forecasts in Palo Pinto County. The forecast office issued a Red Flag Warning for much of North Texas, including Palo Pinto County, the day before the event. Below is an excerpt from that Red Flag Warning, issued at 2:53 p.m. Central Daylight Time (CDT) on April 8.

URGENT - FIRE WEATHER MESSAGE
NATIONAL WEATHER SERVICE FORT WORTH TX
253 PM CDT WED APR 8 2009

...A RED FLAG WARNING IS IN EFFECT THURSDAY AFTERNOON FOR THE NORTHWEST TWO THIRDS OF NORTH TEXAS DUE TO GUSTY SOUTHWEST WINDS...VERY LOW HUMIDITIES...AND VERY WARM TEMPERATURES.

.A DEEP SURFACE LOW PRESSURE SYSTEM WILL MOVE EAST ACROSS OKLAHOMA ON THURSDAY AND RESULT IN THE PASSAGE OF A DRYLINE ACROSS NORTH TEXAS DURING THE AFTERNOON. VERY WARM...WINDY...AND DRY CONDITIONS WILL OCCUR BEHIND THE DRYLINE RESULTING IN CRITICAL FIRE CONDITIONS THROUGH SUNSET THURSDAY EVENING.

The most commonly accepted definition of fire danger is "the resultant descriptor of the combination of both constant and variable factors which affect the initiation, spread and difficulty of control of wildfires on an area." The various factors of fuels, weather, topography and risk are combined to assess the daily fire potential on an area. Fire danger is usually expressed in numeric or adjective terms. Most of us are familiar with the adjective terms "low," "moderate," "high," "very high" and "extreme." The fire danger rating of an area gives the fire manager a tool to help with the day-to-day "fire business" decisions.



Extreme fire danger was forecast for Palo Pinto County. This designation meant that fires would start quickly, spread furiously and burn intensely. All fires throughout the region would be potentially serious. Fires that develop in conifer stands could be unmanageable while the extreme burning conditions last. The fire behavior on April 9 exhibited all the expected definitions and ratings.

Photo credit: Mark Engebretson – Lake County Sun Paper

The weather station in Possum Kingdom (PKLT2), located at N 32.8500° and W -98.5500°, is four miles southwest of the 1148 Fire's origin. The weather station showed winds out of the south, starting to shift to a southwesterly direction as the dryline passed through the area. The relative humidity ranged from 21 to 34 percent prior to the wind shift and dryline passage. The relative humidity was down to 13 percent by noon. The 1148 Fire started at 12:29 p.m. By 1:05 p.m., sustained winds were recorded at 22 mph with gusts to 39 mph.

Weather Observation for April 9th 2009, from Possum Kingdom RAWS					
Time	**Temp °F**	**RH %**	**Wind mph**	**Gust mph**	**Direction**
0:05	75	27	10	19	181
1:05	74	26	9	17	190
2:05	73	27	11	19	182
3:05	72	29	10	19	189
4:05	72	32	12	22	194
5:05	73	30	10	20	202
6:05	75	26	11	21	208
7:05	74	27	11	23	202
8:05	74	30	11	22	206
9:05	74	24	9	18	194
10:05	79	33	9	18	199
11:05	86	21	13	24	229
12:05	89	13	15	32	247
13:05	86	9	22	29	252
14:05	86	6	15	33	254
15:05	83	6	17	31	250
16:05	83	6	19	33	276
17:05	83	6	13	34	272
18:05	82	5	15	30	267
19:05	80	6	9	31	264
20:05	77	8	7	21	263
21:05	71	12	2	12	267
22:05	66	18	2	5	338
23:05	75	31	8	15	172

The 1148 Fire

The 1148 Fire was reported at 12:29 p.m. near Stringer Camp Road on the west side of Possum Kingdom Lake. The fire started when a vulture landing on a powerline caused an electrical outrage which ignited fuels below.

As the fire raged toward homes in the area, county officials called for an evacuation of 35 to 40 residents. The Brazos River Authority personnel helped with the evacuation. Reports of people being rescued off docks by lake patrol abounded. Frantic calls from fire departments trying to get assistance could be heard over radios throughout the area. Barry Gill, Palo Pinto Fire Marshal, requested Texas Forest Service (TFS) assistance with both ground and air resources, but all TFS resources were committed to other fires.

Gill said, "When I got over to the fire they were so under-manned. I called Jack County and they had two fires. Parker County had fires. Young County had fires. The closest mutual aid was the Metroplex."

With wildfires raging across North Texas and all resources stretched to the limit, the Texas Division of Emergency Management enacted Texas Intrastate Fire Mutual Aid System (TIFMAS) to bring in ground resources from the Metroplex. Many of those units arrived at the 1148 Fire around midnight.

Nick Harrison, public information officer for TFS, said, "The locals were running ragged and all of our resources were out on fires. To exacerbate the situation, the winds were too high for our aviation assets to fly."

The fire burned in heavy cedar and brush. Extreme fire behavior was observed with canopy runs in cedar and flame lengths of more than 11 feet in understory vegetation. High wind gusts of 30 to 40 mph were evident in the formation of 5-plus foot swells in the cove waters.

The first ember production traveled more than 500 feet from the origin to ignite a picnic table across the first cove. The fire from the table moved to the ground and then ignited several cedars, which forced an evacuation due to increased fire behavior. Two homes were lost. Later embers would travel one-fourth of a mile over a second cove.

Photo Credit: Mark Engebretson – Lake Country Sun Paper

According to eyewitness reports, embers traveled across the cove to the Willingham Ranch property and lit trees in the water on fire. Kay Lynn Bridges, a homeowner, said she first heard that some residents lost their homes on the west side of the lake. By 5 p.m., Bridges said she witnessed a new fire start on the north end of the lake near the intersection of State Highways 337 and 16 from her window. Although the fire was about two ridges over and on the other side of the lake, Bridges could see flames and kept an eye on the fire throughout the night. By the time the 1148 Fire was over, it had jumped two coves and traveled more than two miles.

Photo Credit: Mark Engebretson – Lake Country Sun Paper

Crews worked through the night and all day Friday to contain the fire. They saved 119 houses and 70 outbuildings. Unfortunately, 14 homes and 11 outbuildings were lost. More than 1,000 acres of cedar and post oak stands, along with shoreline vegetation, burned.

Map ID	Foundation	Roof	Siding	Deck	Value of structure lost	Additional X-factors for ignition	Number of outbuildings	Number of vehicles
1	Slab	Metal	Masonry	Yes	$462,710	Wooden deck areas built around oak trees	1	0
2	Cinder block	Composite	Aluminum	Yes	$13,520	Ember spotting on wooden dock	1	1
3	Cinder block	Composite	Aluminum	Yes	$10,940	Ember spotting on wooden dock	0	0
4	Slab	Composite	Brick	Yes	$72,310	Wooden addition with metal roof, overhanging vegetation	1	0
5	Slab	Composite	Brick	Yes	$319,320	Open wooden deck with cedar siding and glass. Plastic eave material	1	1
6	Slab	Metal	Masonry	Yes	$131,830	Wooden deck, picnic table and lawn furniture against house	1	1
7	Slab	Composite	Brick	Yes	$357,530	Wooden porch	1	0
8	Cinder Block	Metal	Aluminum	Yes	$73,050	Wood frame addition, open car port with paint cans and water pump	-	-
9	Slab	Metal	Wood and masonry	Yes	$441,380	Open balcony, railroad ties along walkways to house	0	0
10	Cinder Block	Metal	Vinyl	Yes	$27,430	RR ties for landscaping, lawnmower and metal deck furniture against home	1	2
11	Cinder Block	Composite	Wood and masonry	Yes	$21,460	Gas grill and wicker seat table against house, cedars	2	1
12	Cinder Block	Metal	Vinyl	Yes	$167,670	Open wooden deck and carport attached	1	0
13	Cinder Block	Composite	Wood	Yes	$5,420	Wooden deck on house front	1	0
14	Cinder Block	Wood shingle	Wood	Yes	-	Roofing material and wooden deck	0	0
	Total Losses				$2,104,570		11	6

FM1148 Wildfire - Palo Pinto County, Texas
Home Losses and Fire Perimeter

TEXAS FOREST SERVICE
The Texas A&M University System

0 0.25 0.5 1 Miles

Metadata: TNRIS 2008 NAIP Imagery, NAD 83 UTM Zone 14N Meters Map Projection and Coordinate System
Disclaimer: Texas Forest Service provides this map and/or data 'as is' and assumes no liability for accuracy or completeness
K. Ridenour - Created July 7th 2009

Lost Homes
Fire Origin
Fire Perimeter

The first home lost was on Stringer Lane, near the ignition point of the fire. The fire progressed eastwardly through thick cedar and oak closed canopy with heavy dormant greenbrier (*Smilax bona-nox*) understory to the large rock and wood siding home. A large wooden deck with large oaks incorporated in the construction, ignited and exposed the home to intense heat. The fire burned down the slope to the shoreline. Cedar fence posts and wooden decking furniture served as additional fuel sources for embers and eventually the fire itself.

As the fire continued to burn northwardly through undeveloped areas, embers traveled across the 500-foot cove and ignited two mobile homes located on the adjacent side, 150 feet apart. Heavy ember production was seen raining down on the two-foot wide wooden docks, vegetation and homes. Wooden decks and vegetation proximity were documented as ignition sources around many homes.

Another mobile home, this one located 300 feet south of the two neighboring mobile homes, was lost as the fire traveled eastward toward the opposite side of the inlet. The home was located at the bottom of the slope near the shoreline. Oaks with a heavy cedar understory surrounded the north, east and west sides of the home. Proximity to vegetation and leaf litter were contributing factors to the home ignition. Melted plastic lawn furniture sitting on a concrete pad next to the driveway provided more evidence of ember production.

Next, the fire traveled half-a-mile to the opposite side of the inlet through a mixed evergreen-deciduous closed tree canopy of juniper and oak where eight homes located along the shoreline were lost. Four homes on Edgewater Lane were the first impacted by the approaching fire. A single-wide mobile home located at the top of a plateau surrounded by oaks and heavy cedar was the first to be destroyed. A cinder block foundation allowed for blowing embers to move under the foundation. Most mobile homes are up on block foundations, some with decks, and the majority of them are hooked up to gas, electricity and other utilities. As officials examine the need for building regulations for traditional, single-family homes, stronger mobile home regulations should be addressed as well in regard to Firewise construction.

The next three structures — two masonry homes and one mobile home — were spaced 50 feet apart from one another. Spotting was evident by the unburned grass around the burned riding mower and unburned areas between burned homes. The wooden pier down to the dock was completely gone except for metal support poles. The proximity of cedar and oak along the slope down to the water edge was credited with enabling the heat to impact the structures.

Another four homes lost were lost farther down the shoreline. Three of the homes were of brick construction and one was a mobile home. James Maddox, one of the residents, shared pictures of his home prior to the fire. He said that his family was out of town during the wildfire. Points of ignition on their home were: 1) cedar siding on the sun room on the east side of the home and 2) plastic eave material designed to reduce the need for painting and maintenance on the west side of the home that had melted off exposing the support beams. The short distance between cedars and the open carport contributed to the ignition of a boat and lawn equipment.

The fire spotted over the one-fourth of a mile-wide cove and ignited vegetation on the opposite side of the cove. This spotting resulted in the destruction of two more homes. The fire burned 296 acres where the Lone Camp Volunteer Fire Department spent 168 man-hours of suppression work saving multiple structures on the inlet where the fire was finally contained.

Embers

The largest impact to homes during this wildfire was the thousands of embers raining down on receptive volatile cedar fuels and roofs and pelting the sides of homes like hail during a storm. Embers, or firebrands, range in size from miniscule pieces of burning branches to flaming chunks as thick as two-by-fours. Embers are also a threat when they drift in from a distance. Depending on the fire intensity, wind speed and the size of the materials burning, embers can be carried more than a mile ahead of the fire. Consequently, homes located ahead of the actual fire front are vulnerable to ignition and complete loss. Evidence of this occurrence was seen in lost homes on the shoreline opposite the fire.

Even if you do not live right next to the wildland, you may still be at risk from firebrands. If these embers become lodged in something easily ignited on or near your house, such as dry leaves on the roof or patio cushions on a deck, your home could be in jeopardy of burning. An ember coming into contact with flammable material is one of the major reasons why homes are destroyed during wildfires. Points of ember ignition are often roofs, roof debris, skylights, windows, vents, rain gutters, siding, woodpiles, patio furniture, decks, deck debris, deck accessories, debris under the deck, eaves, flowerbeds, vehicles, garbage cans and wooden fences.

Embers start a fire on the roof while there is still unburned leaf litter on the ground around the home.

When falling embers land, they can start a new spot fire. This explains why some homes burned to the ground, while ones next door are left untouched. When a solid object catches on fire, it is heated to its combustion temperature. What actually burns are flammable vapors that are emitted during that warm-up, which mix with oxygen. You see a flame at the end of what is usually a bluish, hot vapor trail. So it is not the solid wood, but rather a vaporized portion of the wood, that burns. The non-vaporized ashes are left behind. Wood begins to give off flammable vapors at about 400° F, and reaches a combustion temperature at about 900° F. Various species of wood have lower ignition points lowering their point of combustibility. In addition, as vegetation is preheated by the sun for prolonged periods of high temperature and low relative humidity, fuel temperatures increase, thus lowering the ignition point.

It is important to determine whether a building will trap embers, and if so, whether those trapped will be in sufficient quantity and location to cause ignition of the building. Furthermore, it is important to know whether those ignitions will lead to continued burning and the destruction of the building. Homeowners need to examine their homes and locate possible ember collection points then reduce or eliminate those risk points on their home prior to a wildfire. In the event of a wildfire, predetermined ember collection points need to be monitored and mitigated prior to evacuation, if possible.

One concern for homeowners in the wildland urban interface is roof vents as an entry point into the attic for embers and flames. Research conducted at the University of California Fire Research Laboratory has shown that all forms of vents on the underside of the eaves in both boxed and open-eave construction are almost immediately penetrated under flame impingement exposures, confirming the vulnerability of vents to a least one kind of wildfire exposure. Another mechanism for embers to lead to the loss of structures is through entry into crawlspace vents, with subsequent ignition of combustible materials in those spaces. Crawlspace vents are used to control excess moisture build up, generated by either moisture evaporating from the soil or surface/subsurface water entry into the crawlspace from the exterior (Quarles and TenWolde, 2004).

In addition to embers, exterior walls are susceptible to a wildfire's radiant and convective heat. A fire on an exterior wall provides the fire with a direct path inside the home through areas such as eaves, soffits, and vents. Recent wildfires throughout Texas have provided images that reinforce this concept of embers entering through both attic and foundation vents on homes.

Grass embers entered through the gable vent on this house and ignited attic materials which resulted in the loss of the roof despite mitigation efforts by local volunteer fire departments.

The homeowner witnessed embers blowing under the eaves and flames climbing the side of the house. Hours were spent putting out spot fires in the attic in order to save the house.

Despite the masonry construction, foundation vents allowed the entry of embers and flames into the home.

Recommendations

Eaves, fascias and soffits are vulnerable to both firebrands and convective exposures. They should be "boxed" or enclosed with noncombustible materials to reduce the size of the vents. Materials that melt or burn in relatively low temperatures, such as polyvinyl chloride (PVC) and vinyl siding should not be used, since they do not provide adequate protection and can melt in the heat of the wildfire. Non-combustible screening should be used in the vents. The current Texas building codes require a one-fourth inch mesh on vents which is the baseline regulation issued by the International Building Code (IBC) a model building code developed by the International Code Council (ICC). It has been adopted throughout most of the United States.

Wind and/or direct contact with a fire's convective heat can push firebrands through the vents into a home's basement or crawlspace. Vent openings should be screened to prevent firebrands or other objects larger than one-fourth inch from entering the home. Both vents and screens should be constructed of materials that will not burn or melt when exposed to radiate or convective heat or firebrands. Also, these vents should be corrosion-resistant to help minimize maintenance.

Research needs to be done on alternative roof and eave designs that would reduce collection of embers and on the use of ignition–resistant materials that would prevent embers from igniting if contact occurred. The importance of vents in wildfire resistance is leading to such innovations as the development of vents specially designed to limit ember intrusion while still allowing sufficient air flow for ventilation and construction designs and procedures that circumvent moisture-related problems in unvented attics. California's Office of the State Fire Marshal (SFM) has building codes including venting regulations related to homes in the wildland urban interface. The California SFM has a compliance program and has issued several vent products and an acceptance policy for use in the urban interface. Texas builders need to utilize these tested resources and consider their application in future home building.

A video is available from the Texas A&M University System at (http://tamus.edu/video/dimensions/wildfire) that shows heavy ember production from cedar and pine vegetation during a wildfire in Texas. The video also provides information about how current conditions in Texas are going to affect future wildfires in the state.

Future Forecast for Possum Kingdom

As development continues around the lake, obstacles for fighting wildfires in the community will continue. Many of the roads are narrow, with vegetation overhanging long, winding and unmarked driveways. All these things make initial attacks on fire and emergency evacuations in the area difficult. Although the overall home density around the lake is relatively low, this actually makes fire protection problems worse. A scattering of seasonal homes and absentee homeowners between permanent residents allow for the accumulation of unmanaged brush and timberland fuels around and between these structures and, many times, mitigation efforts are not maintained.

Firefighters will have difficulties protecting homes due to the large number of spot fires, the potential for crown runs and the intense heat output that could occur in these heavily accumulated fuels. Emergency managers must also deal with evacuation strategies of residents from hazard areas around the lake when notification needs to occur in a rapid and extensive manner.

The issue of cedar removal around homes and the need to stay compliant with the regulations set forth by the Brazos River Authority will need to be evaluated to allow homeowners the opportunity to remove cedars from within 30 feet of their home and limb up cedars outside of the 30-feet zone around their homes. Educational material in regards to cedar flammability, defensible space and Firewise landscaping concepts should be provided to homeowners, builders, schools and local community leaders.

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