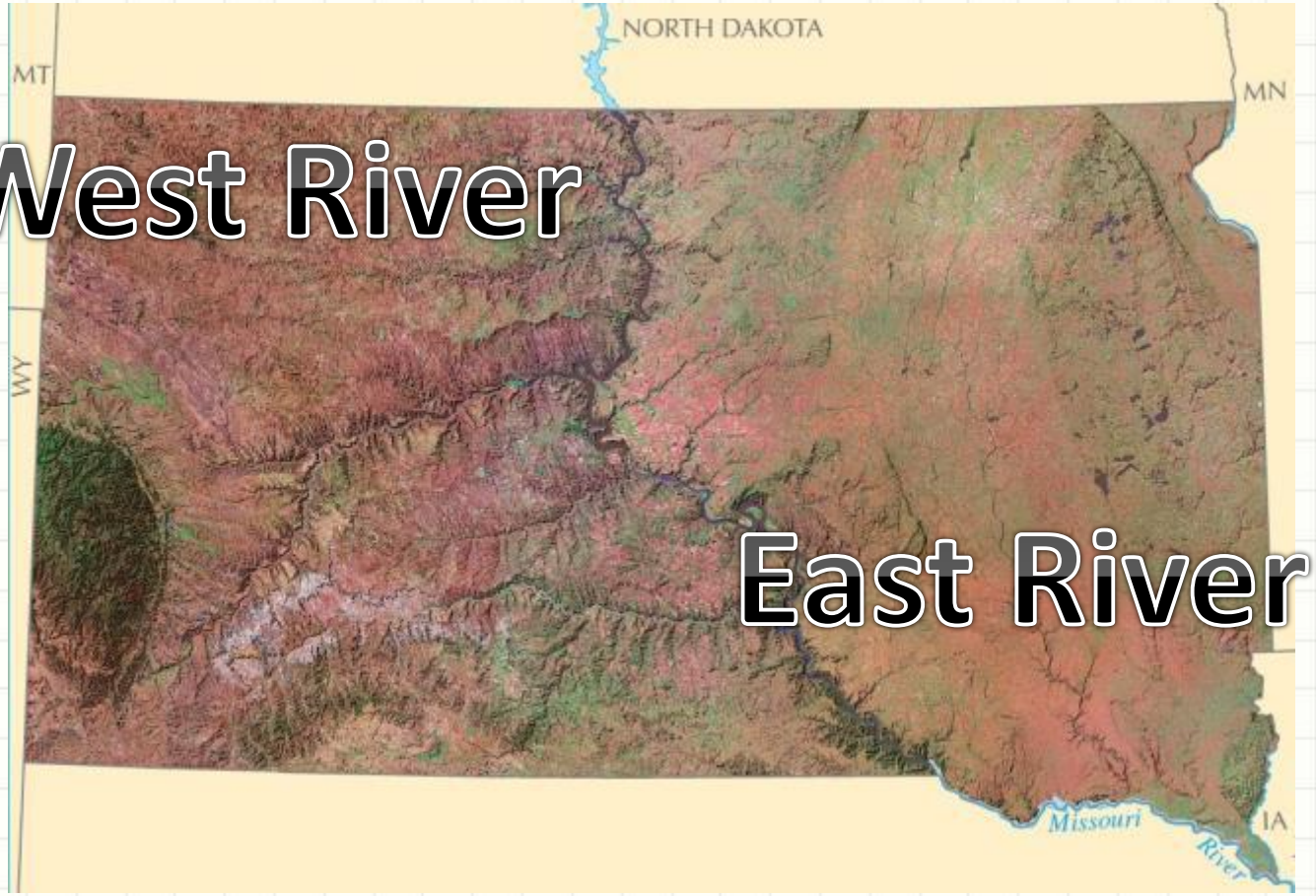
Drought and Wildfire in the Northern Great Plains

Jim Strain, SD Dept. of Agriculture– Wildfire Division

Ken Marchand – Black Hills National Forest

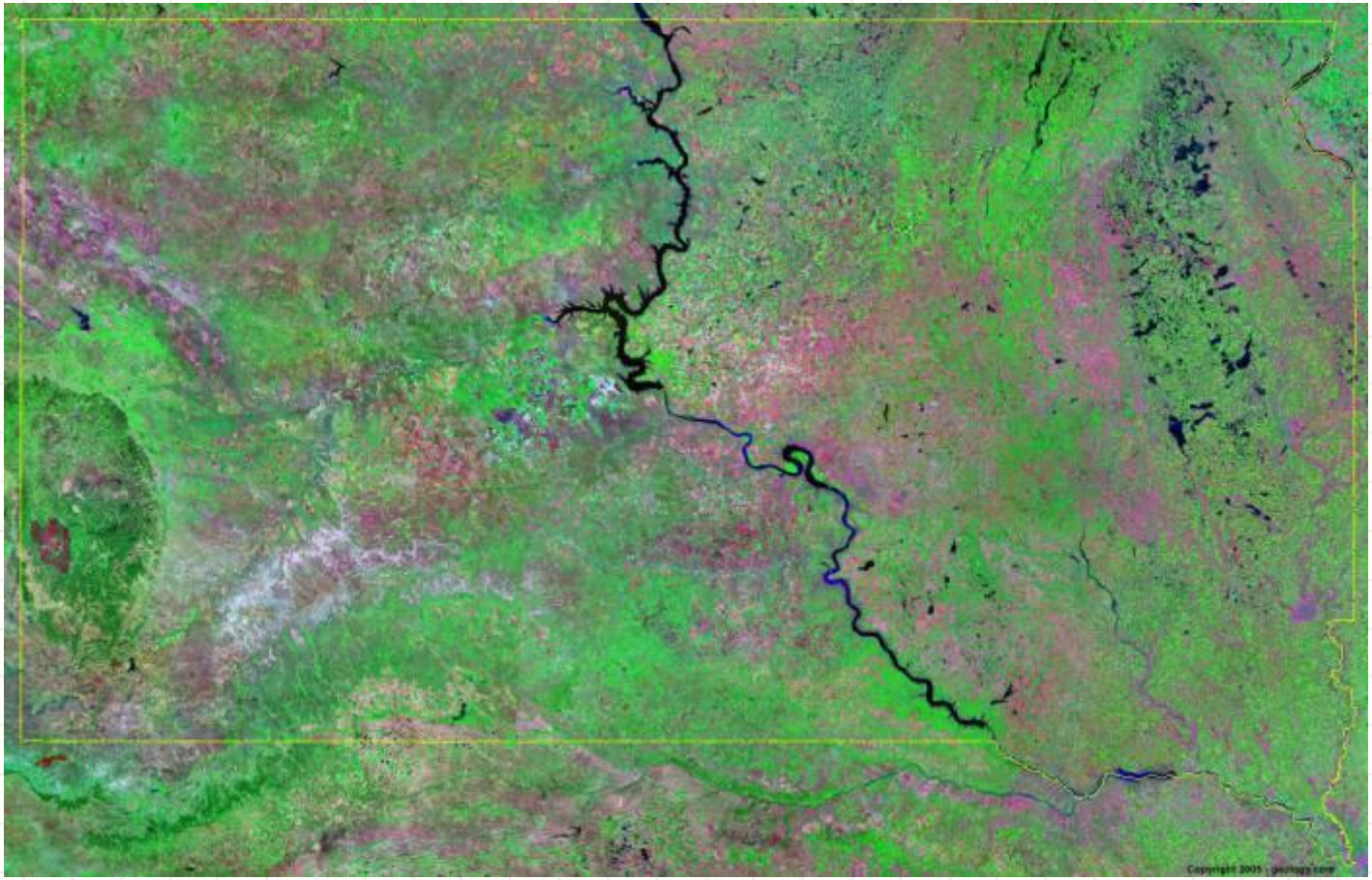
The South Dakota Quiz!

The South Dakota Quiz!



The South Dakota Quiz!

The South Dakota Quiz!



The South Dakota Quiz!

SOUTH DAKOTA STATE NICKNAMES

The “Sunshine State”

SOUTH DAKOTA STATE NICKNAMES

The “Coyote State”

SOUTH DAKOTA STATE NICKNAMES

The “Mount Rushmore State”

SOUTH DAKOTA STATE NICKNAMES

The “Drought State”

“South Dakota leads the nation In the agricultural production of two drought adapted lifeforms”

SOUTH DAKOTA STATE NICKNAMES

The “Drought State”

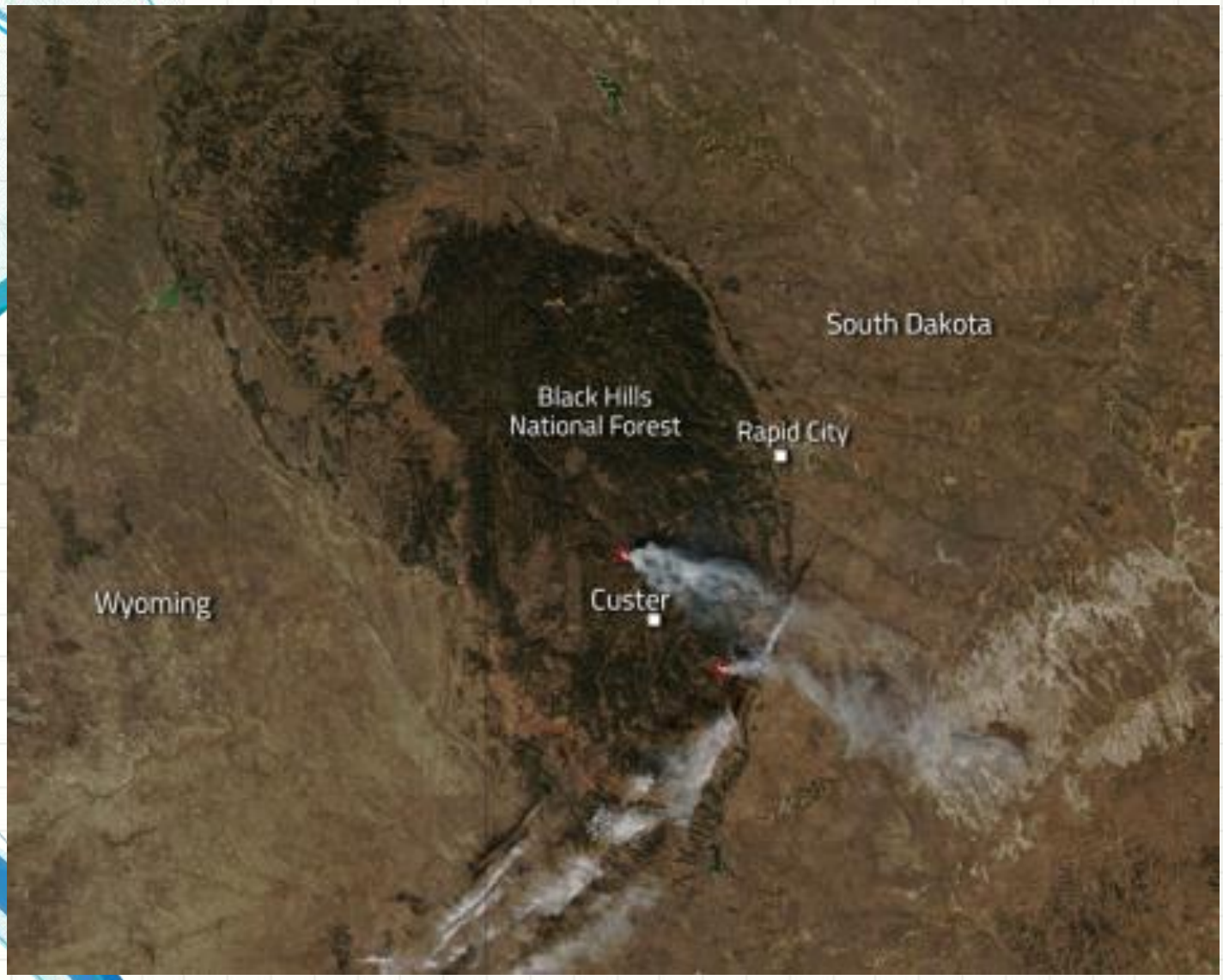
“One lifeform is a plant, the other is an animal”

Drought Adapted Species

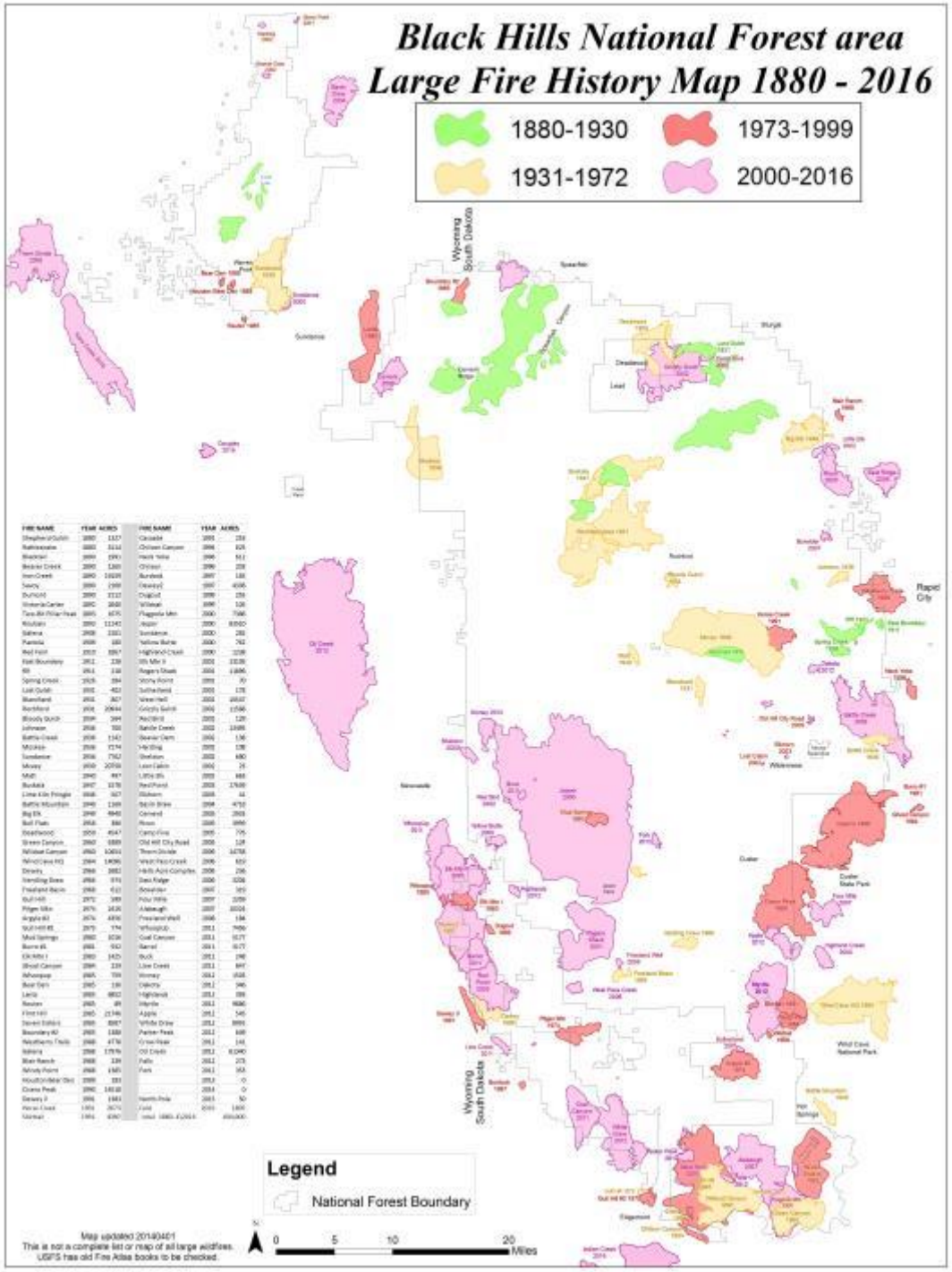
South Dakota
Number #1

THE BLACK HILLS
National Forest
FROM SPACE

RX burns in the Black Hills NF and Custer State Park on November 03, 2016



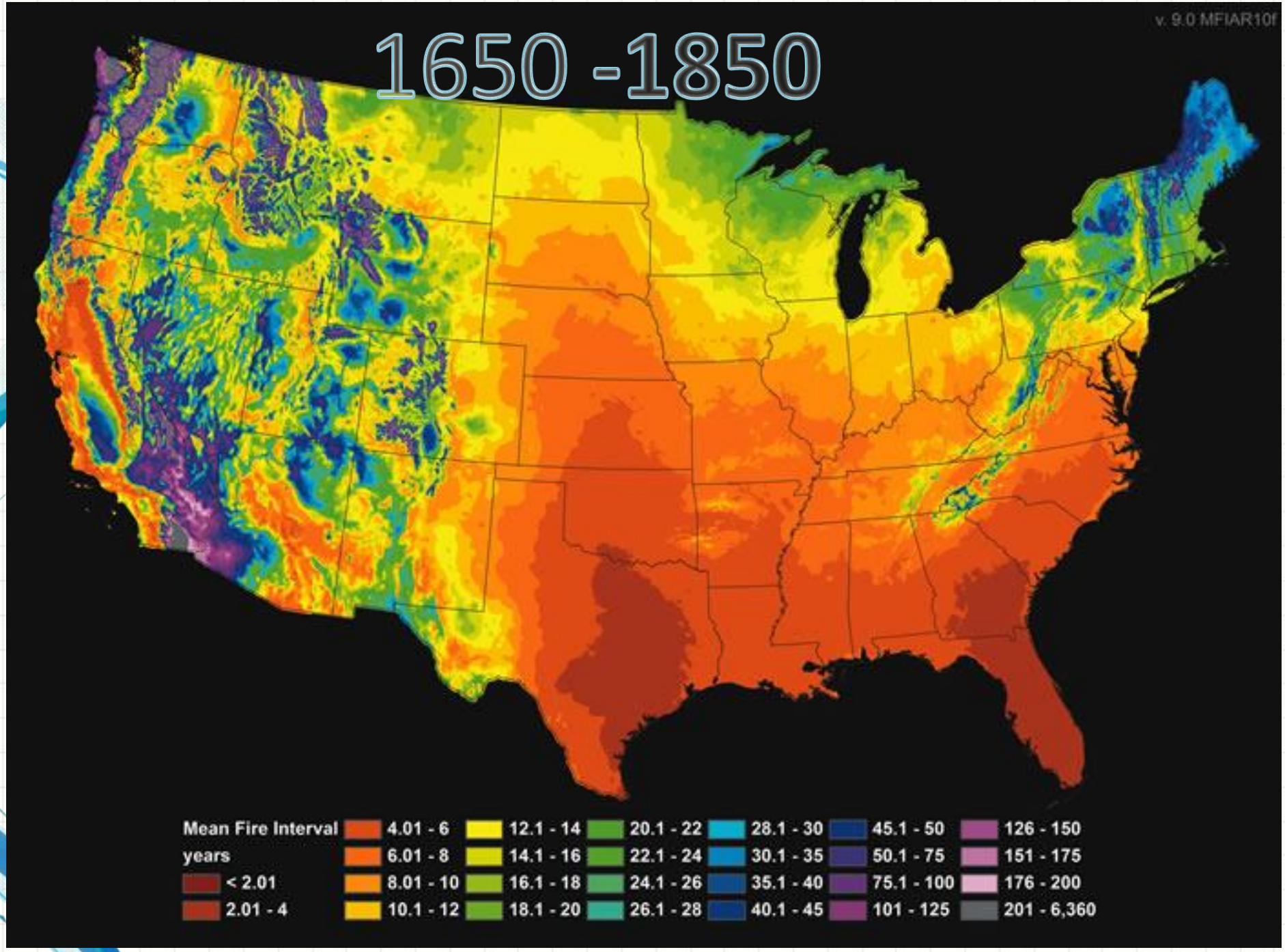
Black Hills National Forest area
Large Fire History Map 1880 - 2016



FIRE NAME	YEAR	ACRES	FIRE NAME	YEAR	ACRES
Shepherd Gulch	1880	1127	Cascade	1991	259
Rattlesnake	1880	3134	Chicken Canyon	1994	625
Blackhawk	1889	1993	Hack Mine	1996	511
Beaver Creek	1890	1300	Chicago	1996	259
Iron Creek	1890	10139	Burdock	1997	138
Savoy	1890	1999	Chicago2	1997	4166
Dumont	1890	2122	Dugout	1998	256
Victoria Carter	1890	2650	Willman	1998	126
Two Bit Friday Peak	1895	6175	Flagpole Mtn	2000	7986
Mountain	1900	11242	Jasper	2000	83502
Sallena	1908	2101	Sundance	2000	288
Pamela	1908	188	Yellow Butte	2000	762
Red Point	1910	1867	Highland Creek	2000	1238
East Boundary	1912	238	Elk Mtn II	2001	23238
80	1914	118	Rogers Shack	2002	11886
Spring Creek	1919	384	Stony Point	2002	70
Lost Gulch	1921	421	Sutherland	2002	178
Blanchard	1921	267	Green Hell	2002	20102
Northfork	1924	20644	Grizzly Gulch	2002	17586
Bloody Gulch	1924	344	Red Bird	2002	129
Johnson	1926	700	Battle Creek	2002	11686
Battle Creek	1928	1142	Beaver Dam	2002	136
McGinnis	1928	7174	Hot Dog	2002	138
Sundance	1936	7162	Shelston	2002	680
Money	1939	20750	Lion Cabin	2002	24
Mott	1940	447	Little Elk	2003	488
Burdock	1947	1178	Red Point	2003	17688
Lime Kiln Fringe	1948	367	Elkhorn	2003	44
Battle Mountain	1948	1169	Battle Brae	2004	4712
Big Elk	1949	4840	Cement	2005	2903
Bull Flats	1950	888	Rocco	2006	1890
Deadwood	1959	4147	Camp Fire	2005	775
Green Canyon	1960	1889	Old Mill City Road	2006	128
Whitetail Canyon	1960	12011	Thorn Divide	2006	14758
Wind Cave NO	1964	1496	West Pine Creek	2006	659
Dinsmore	1964	1882	North Azel Complex	2006	236
Standing Bear	1966	571	Deer Ridge	2006	3226
Freeland Basin	1968	611	Bowman	2007	303
Gulch 40	1972	149	Four Mile	2007	2159
Pilger Mtn	1974	2428	Aldebaran	2007	10024
Angle 40	1974	4816	Freeland Well	2008	184
Gulch 40 II	1975	174	Whoopup	2011	7496
Mud Springs	1980	1036	Gail Canyon	2011	5177
Burro 46	1981	932	Barrel	2011	5177
Elk Mtn I	1983	1425	Buck	2011	198
Wind Canyon	1984	139	Line Creek	2011	897
Whoopup	1985	759	Money	2011	1038
Bear Den	1985	138	Cabin	2011	346
Lentz	1985	8812	Highland	2011	188
Reuter	1985	49	Myrtle	2011	9886
Fine Hill	1985	21746	Apple	2011	145
Seven Sisters	1986	8987	White Drive	2011	8893
Boundary 40	1986	1188	Parker Peak	2011	688
Weatherly Trails	1988	4176	Cross Bear	2011	141
Iowana	1988	17576	Old Creek	2012	61040
Blue Ranch	1988	139	Falls	2012	273
Windy Point	1988	1585	Park	2012	353
Mount Underwood	1989	181		2012	0
Crane Peak	1990	14110		2014	0
Rosary II	1991	1981	North Pole	2015	50
Horse Creek	1991	3575	Cold	2015	1800
Normal	1991	4340	Total 1880-2016		494300

Fire Years or Time periods

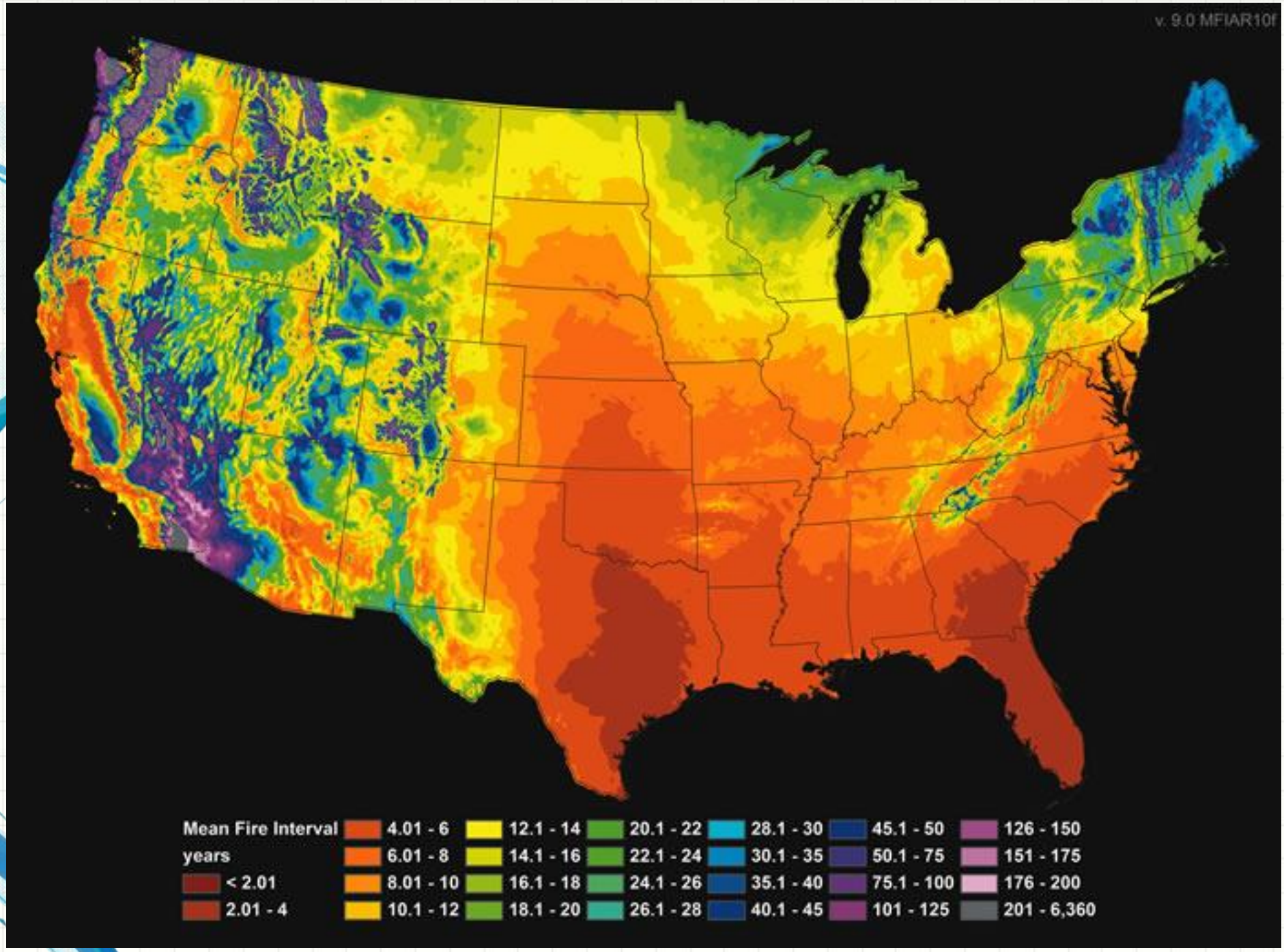
1650 -1850


v. 9.0 MFIAR10f
Mean Fire Interval
years
< 2.01
2.01 - 4
4.01 - 6
6.01 - 8
8.01 - 10
10.1 - 12
12.1 - 14
14.1 - 16
16.1 - 18
18.1 - 20
20.1 - 22
22.1 - 24
24.1 - 26
26.1 - 28
28.1 - 30
30.1 - 35
35.1 - 40
40.1 - 45
45.1 - 50
50.1 - 75
75.1 - 100
101 - 125
126 - 150
151 - 175
176 - 200
201 - 6,360

Future Fire Probability Modeling with Climate Change Data and Physical Chemistry

Richard P. Guyette, Frank R. Thompson, Jodi Whittier, Michael C. Stambaugh, and Daniel C. Dey

For. Sci. 60(5):862–870
http://dx.doi.org/10.5849/forsci.13-108


v. 9.0 MFIAR10f
Mean Fire Interval
years
< 2.01
2.01 - 4
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18.1 - 20
20.1 - 22
22.1 - 24
24.1 - 26
26.1 - 28
28.1 - 30
30.1 - 35
35.1 - 40
40.1 - 45
45.1 - 50
50.1 - 75
75.1 - 100
101 - 125
126 - 150
151 - 175
176 - 200
201 - 6,360

HOME
OPERATIONS
TRAINING
WILDLANDFIRE
ADMINISTRATION
FUELS MITIGATION
FIRE PREVENTION
REVISED CODES
TERRITORY OF DAKOTA
BACK TO TOP

Fire Years

1871

1959-1962

1889

1974

1890-1892

1985-1990

1910-1911

1999-2002

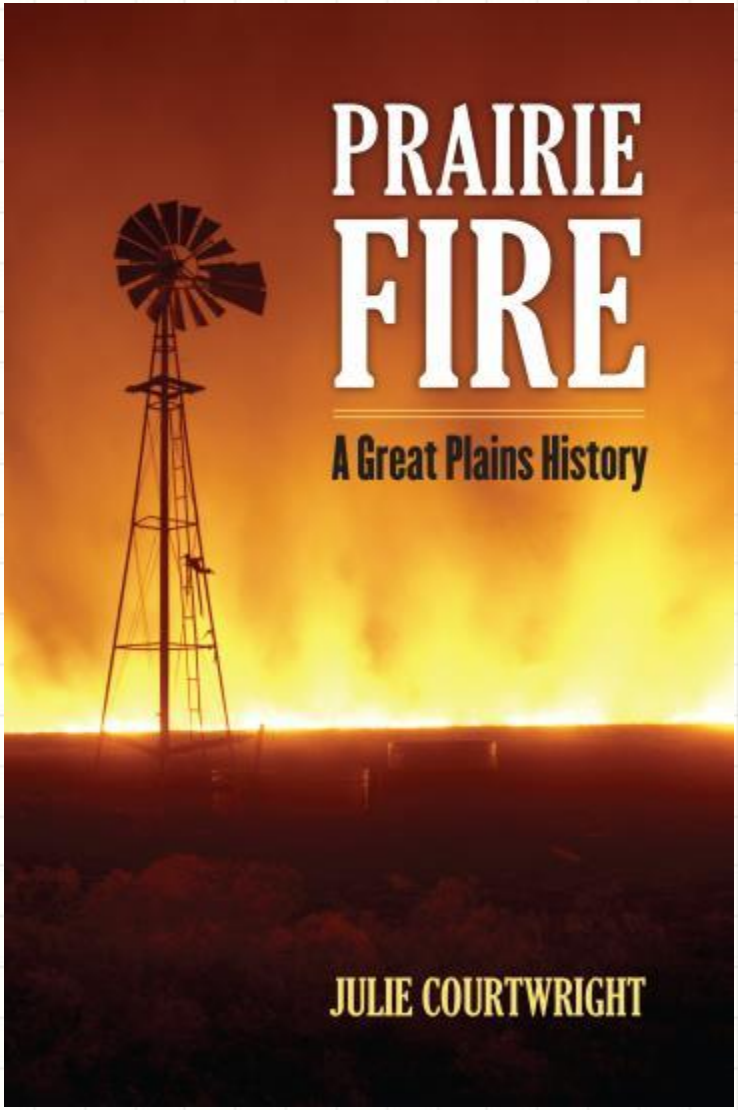
1931-1939

2005-2007

2012

1947-1949

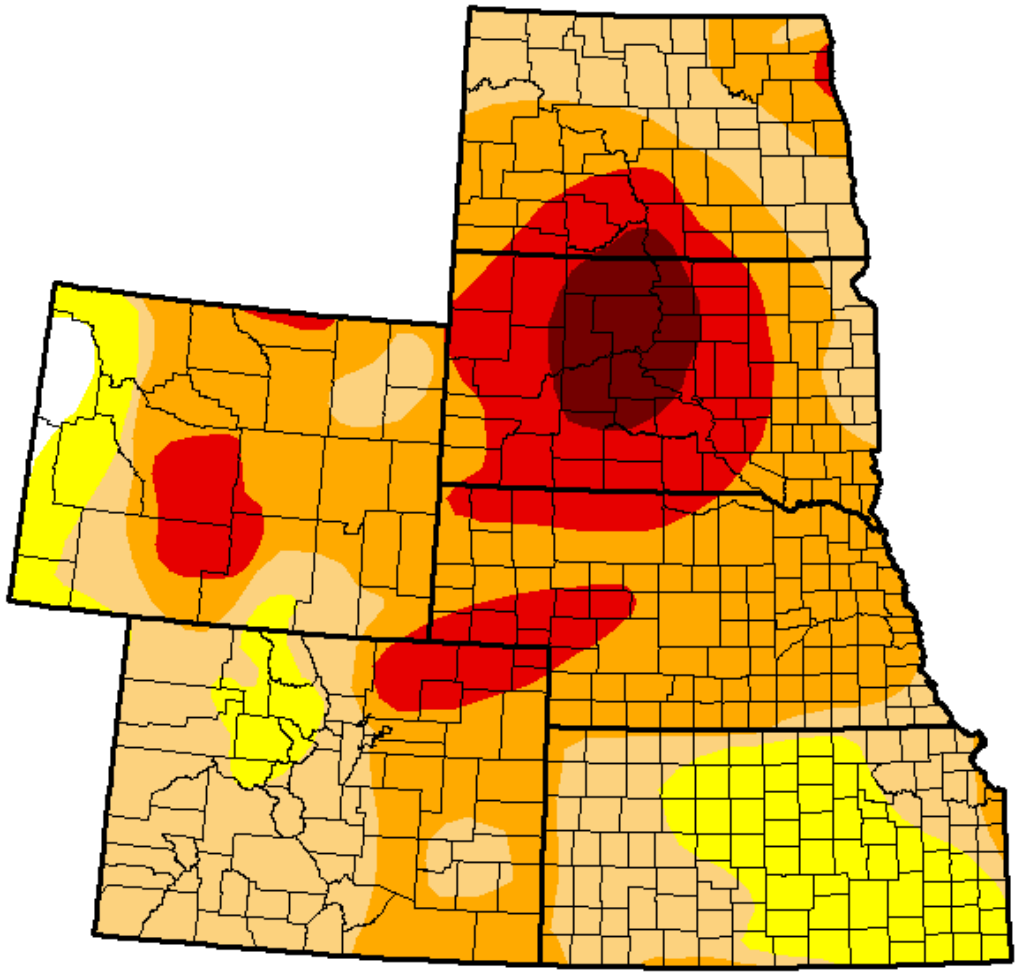
2016-?


PRAIRIE
FIRE
A Great Plains History
JULIE COURTWRIGHT

Some Hits and Misses with the Monitor

U.S. Drought Monitor

High Plains



August 1, 2006

(Released Thursday, Aug. 3, 2006)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.82	99.18	86.83	56.98	18.67	3.50
Last Week *7/25/2006*	0.82	99.18	87.29	49.20	13.69	2.92
3 Months Ago *5/2/2006*	33.14	66.86	38.10	9.43	0.23	0.00
Start of Calendar Year *1/3/2006*	46.85	53.15	20.48	0.20	0.00	0.00
Start of Water Year *9/27/2005*	47.32	52.68	26.28	6.78	0.00	0.00
One Year Ago *8/2/2005*	35.94	64.06	40.91	19.48	8.26	0.00

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

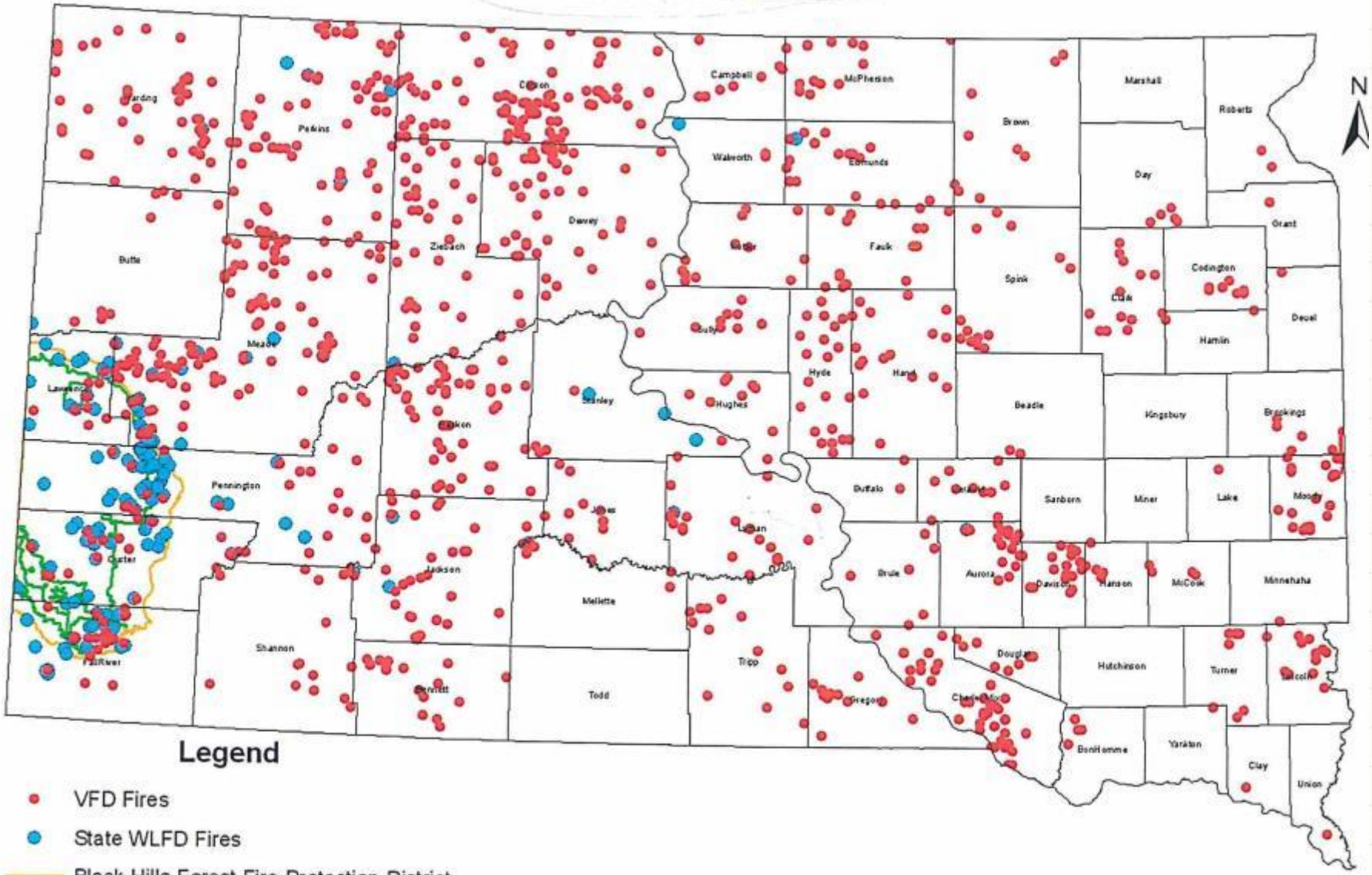
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
David Miskus
NOAA/NWS/NCEP/CPC

http://droughtmonitor.unl.edu/

South Dakota Wildland Fire

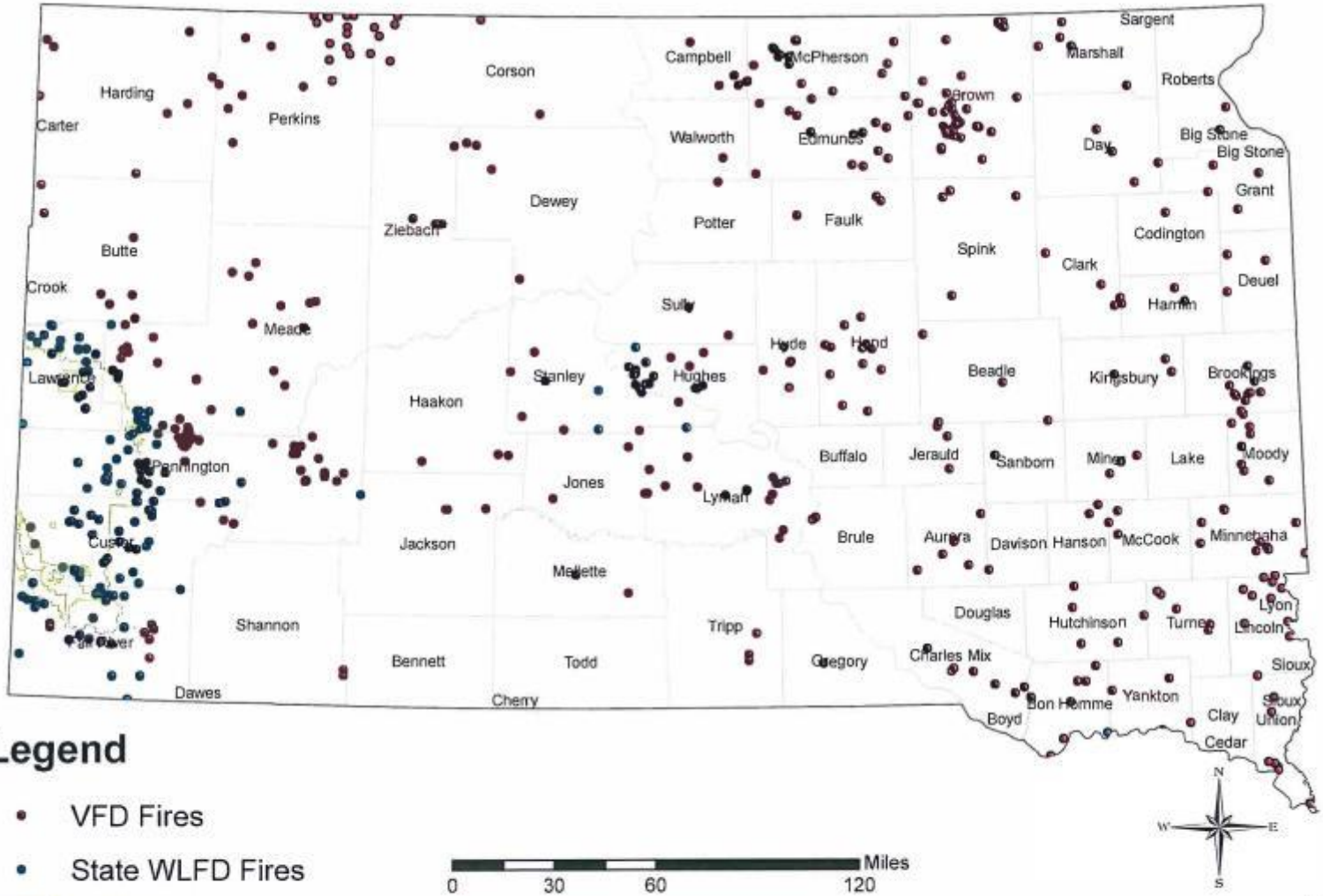
2006 State and VFD Fires



Legend

- VFD Fires
- State WLFD Fires
- Black Hills Forest Fire Protection District
- Black Hills National Forest Boundary
- South Dakota Counties

South Dakota Wildland Fire
2016 State and VFD Fires



Legend

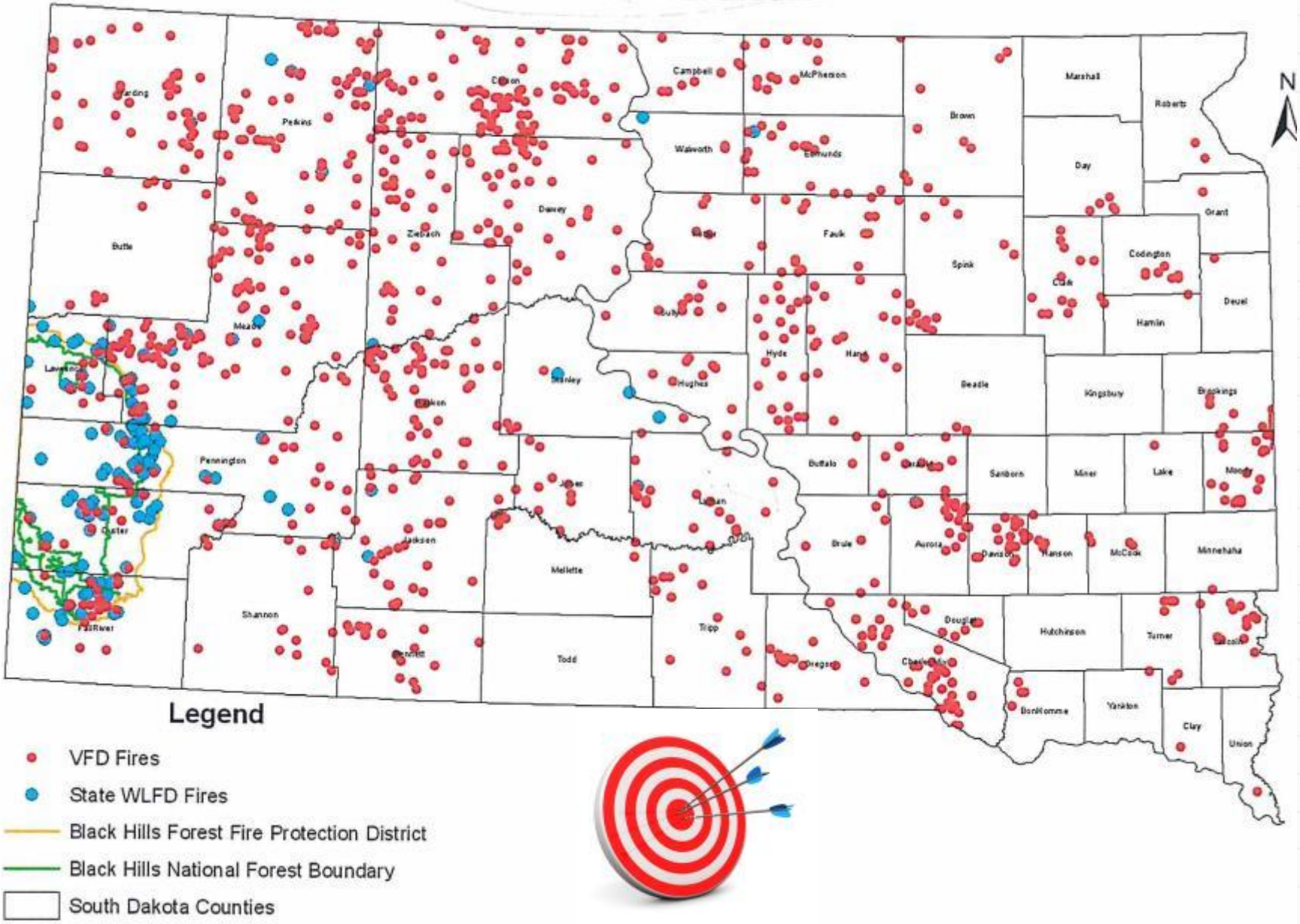
- VFD Fires
- State WLFD Fires
- BHNF Boundary

0 30 60 120 Miles

L. Brown 01/11/2017

South Dakota Wildland Fire

2006 State and VFD Fires

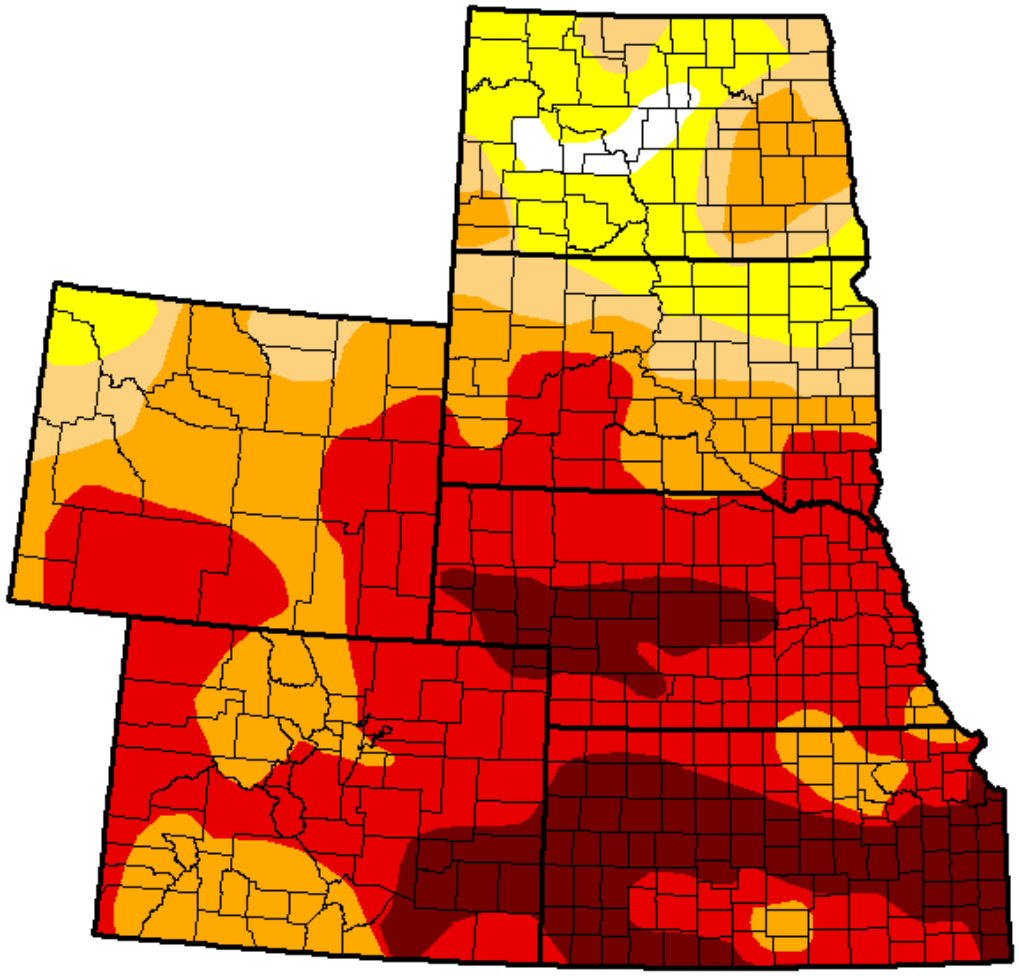


Legend

- VFD Fires
- State WLFD Fires
- Black Hills Forest Fire Protection District
- Black Hills National Forest Boundary
- South Dakota Counties

U.S. Drought Monitor

High Plains



August 28, 2012

(Released Thursday, Aug. 30, 2012)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	1.25	98.75	88.07	79.12	54.19	14.97
Last Week *8/21/2012*	4.31	95.69	87.49	76.96	51.72	16.20
3 Months Ago *5/29/2012*	34.45	65.55	31.55	7.60	2.03	0.00
Start of Calendar Year *1/3/2012*	57.62	42.38	18.12	6.33	2.07	0.04
Start of Water Year *9/27/2011*	70.09	29.91	17.44	11.97	6.22	2.96
One Year Ago *8/30/2011*	52.33	47.67	18.10	4.84	0.00	0.00

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

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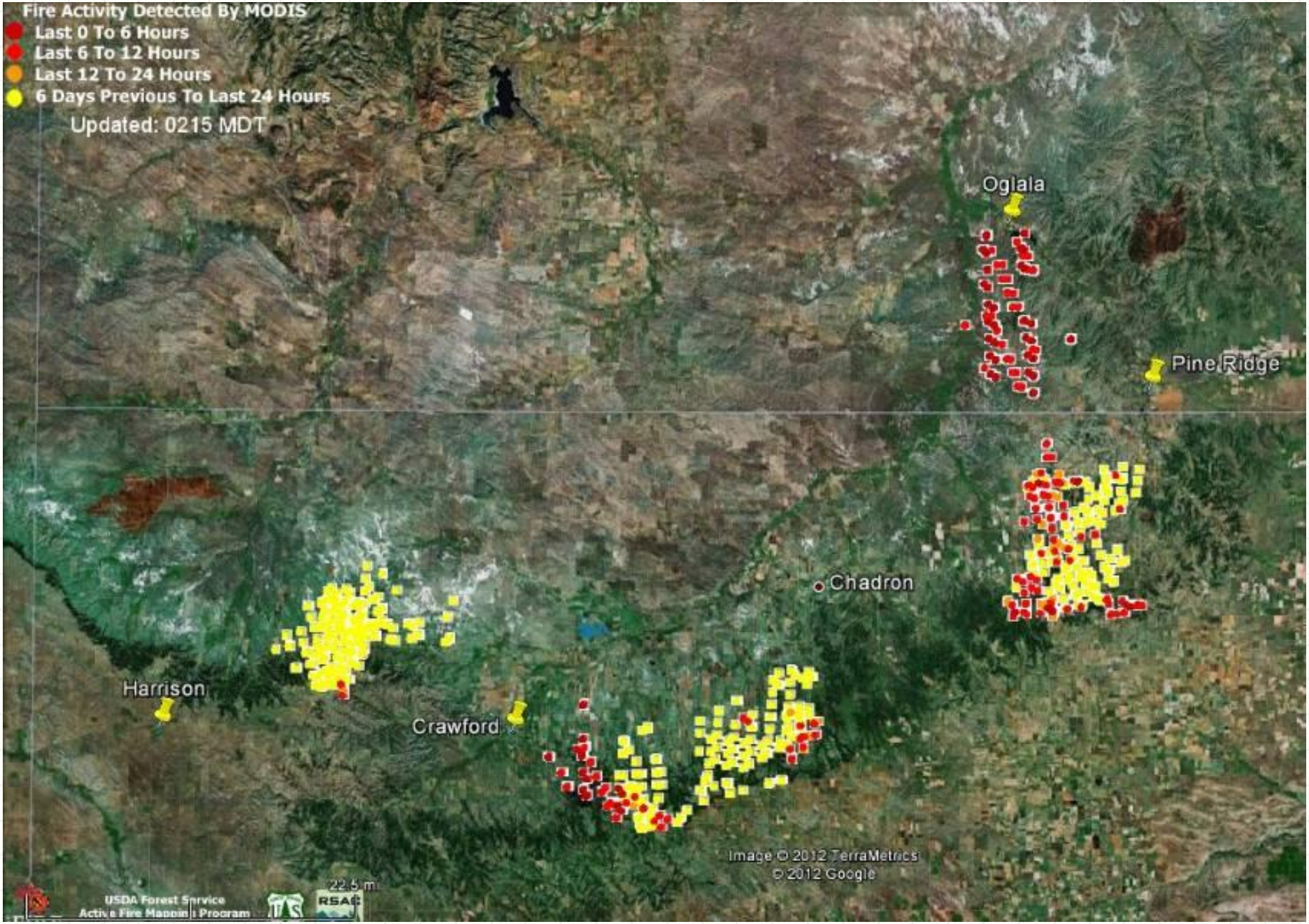
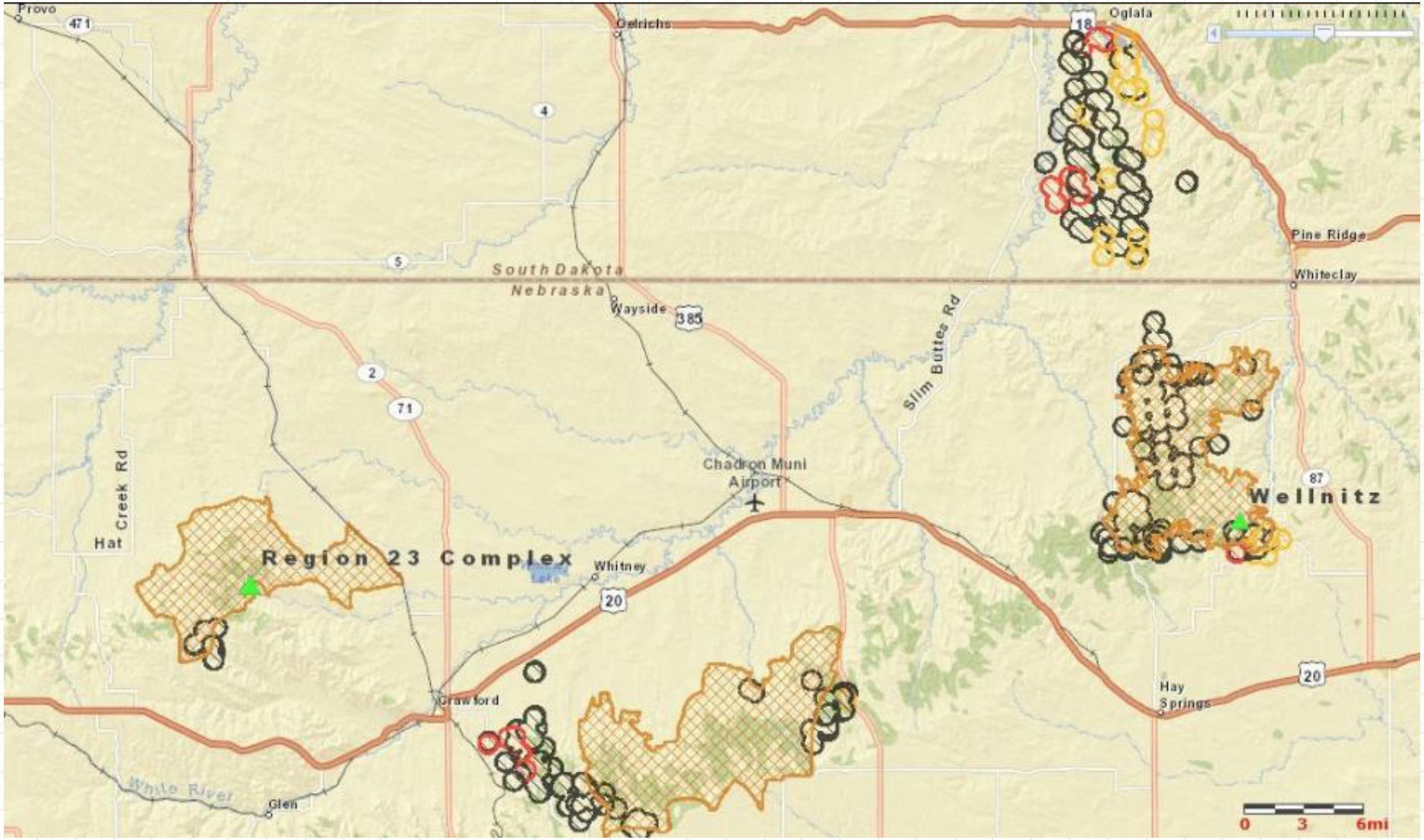
Author:
Brian Fuchs
National Drought Mitigation Center

http://droughtmonitor.unl.edu/

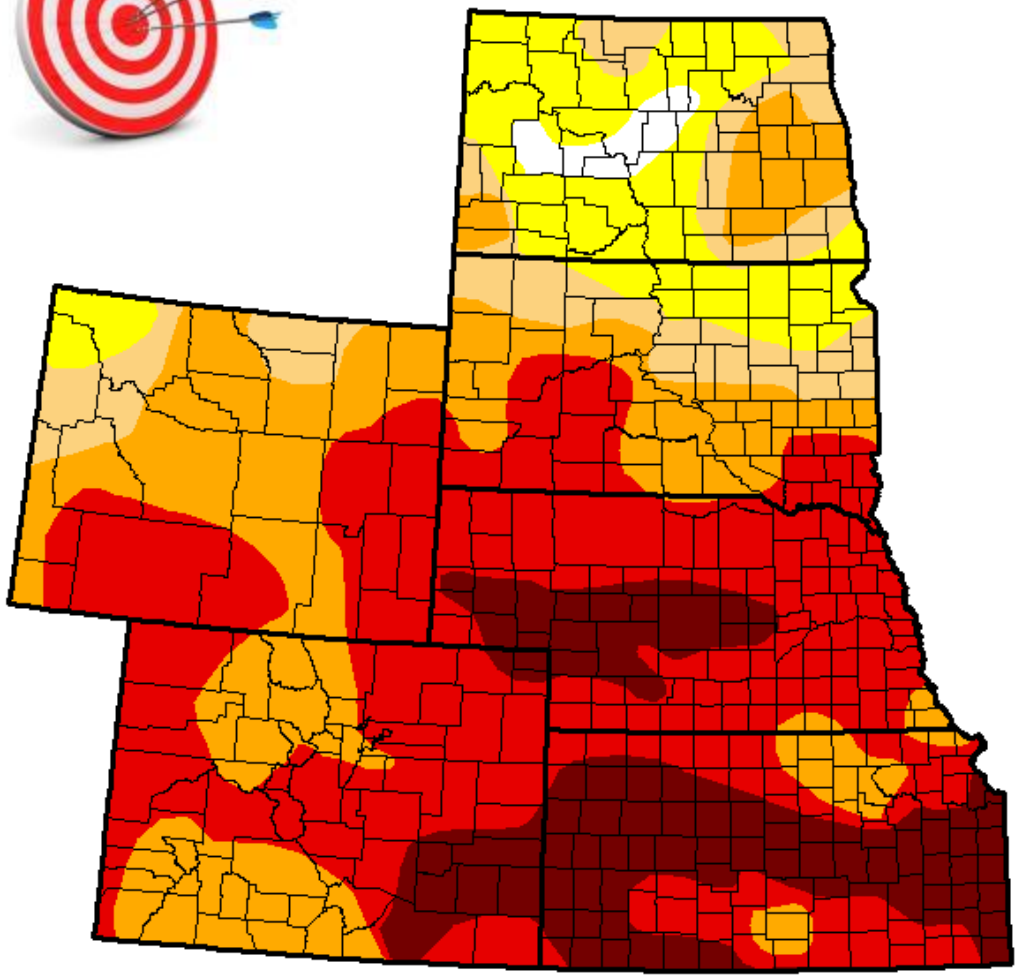

Fire Activity Detected By MODIS
Last 0 To 6 Hours
Last 6 To 12 Hours
Last 12 To 24 Hours
6 Days Previous To Last 24 Hours
Updated: 0215 MDT
Oglala
Pine Ridge
Chadron
Harrison
Crawford
Image © 2012 TerraMetrics
© 2012 Google
22.5 m
USDA Forest Service
Active Fire Mapping Program
RSAC



Credit: Bill Gabbert, *Wildfire Today,* permission granted

U.S. Drought Monitor

High Plains



August 28, 2012

(Released Thursday, Aug. 30, 2012)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	1.25	98.75	88.07	79.12	54.19	14.97
Last Week *8/21/2012*	4.31	95.69	87.49	76.96	51.72	16.20
3 Months Ago *5/29/2012*	34.45	65.55	31.55	7.60	2.03	0.00
Start of Calendar Year *1/3/2012*	57.62	42.38	18.12	6.33	2.07	0.04
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Intensity:

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Author:

Brian Fuchs

National Drought Mitigation Center

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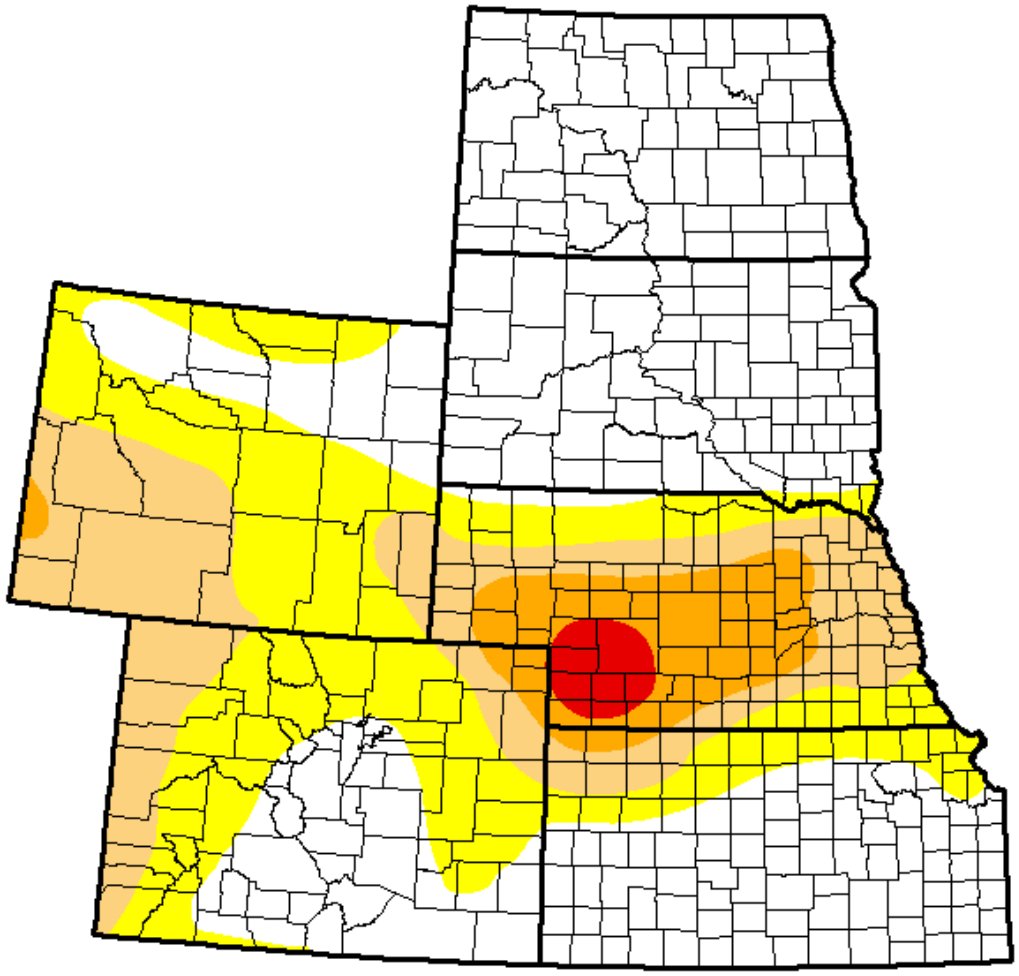
U.S. Drought Monitor

High Plains



August 22, 2000

(Released Thursday, Aug. 24, 2000)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	53.21	46.79	23.19	7.32	1.32	0.00
Last Week *8/15/2000*	46.07	53.93	23.30	7.67	1.32	0.00
3 Months Ago *5/23/2000*	73.65	26.35	10.60	7.24	1.11	0.00
Start of Calendar Year *1/4/2000*	47.23	52.77	12.04	6.01	0.00	0.00
Start of Water Year	-	-	-	-	-	-
One Year Ago	-	-	-	-	-	-

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

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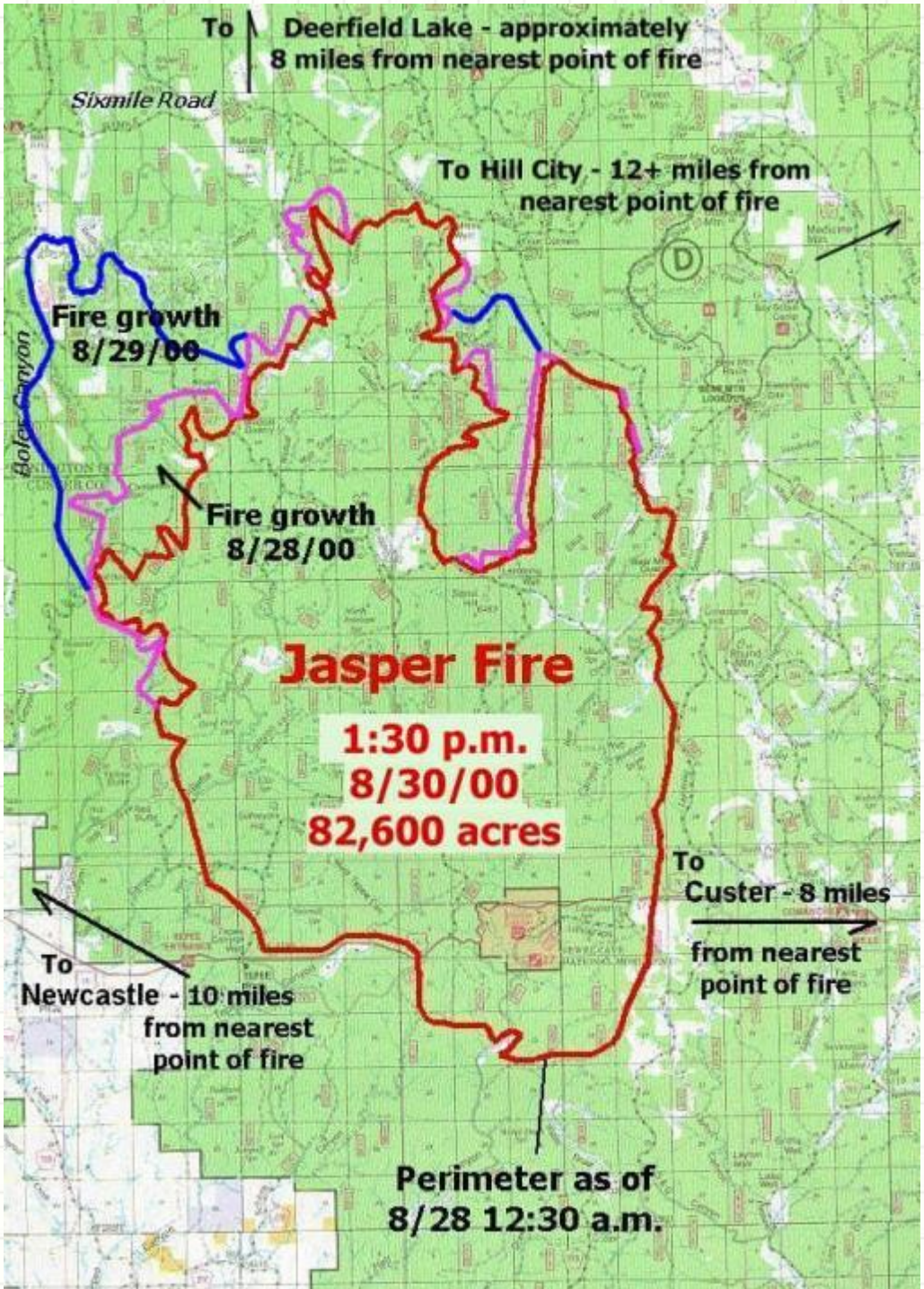
Author:
Staff
National Drought Mitigation Center

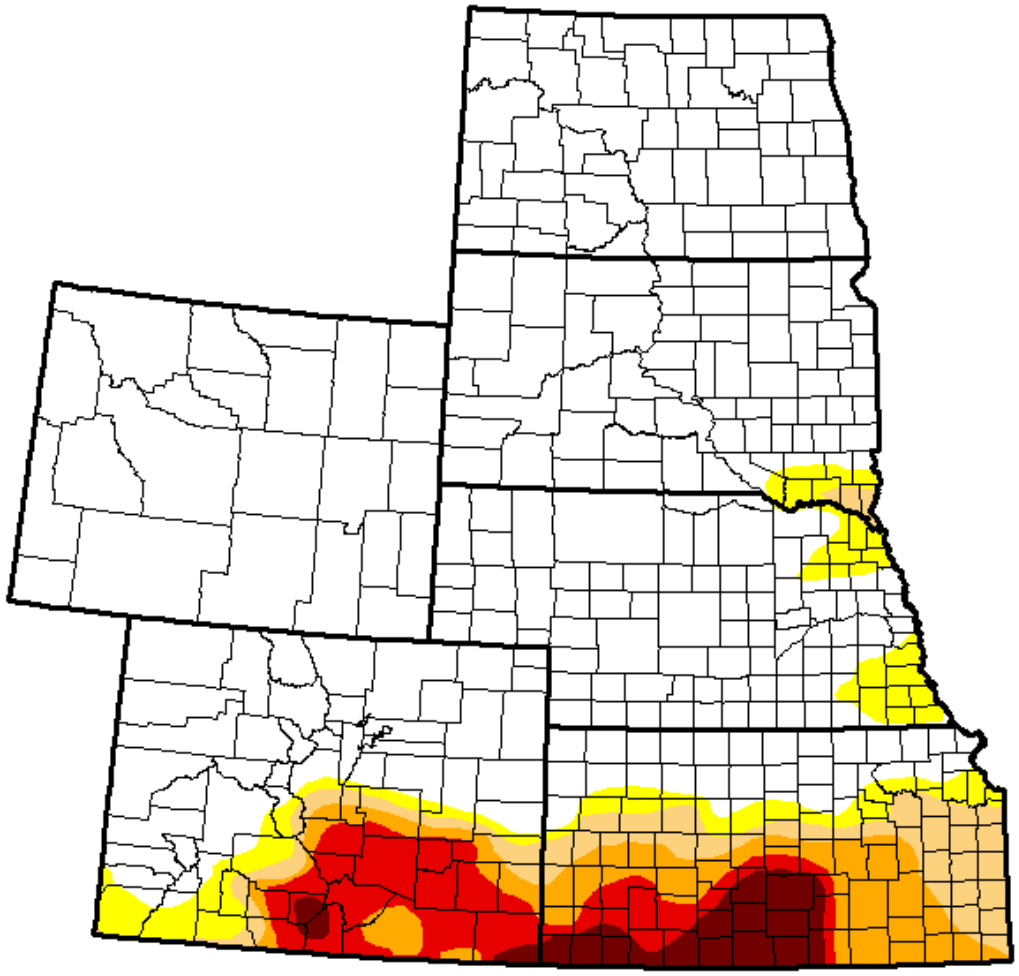
http://droughtmonitor.unl.edu/

Jasper Fire


To
Deerfield Lake - approximately
8 miles from nearest point of fire
Sixmile Road
To Hill City - 12+ miles from
nearest point of fire
Fire growth
8/29/00
Boles Canyon
Fire growth
8/28/00
Jasper Fire
1:30 p.m.
8/30/00
82,600 acres
To
Custer - 8 miles
from nearest
point of fire
To
Newcastle - 10 miles
from nearest
point of fire
Perimeter as of
8/28 12:30 a.m.

U.S. Drought Monitor

High Plains



August 9, 2011

(Released Thursday, Aug. 11, 2011)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	78.06	21.94	16.71	12.32	7.42	2.65
Last Week *8/2/2011*	77.36	22.64	17.27	12.62	7.49	2.80
3 Months Ago *5/10/2011*	66.62	33.38	23.52	14.94	0.90	0.03
Start of Calendar Year *1/4/2011*	60.48	39.52	16.49	2.63	0.00	0.00
Start of Water Year *9/28/2010*	65.06	34.94	3.73	0.00	0.00	0.00
One Year Ago *8/10/2010*	85.97	14.03	6.81	1.67	0.00	0.00

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

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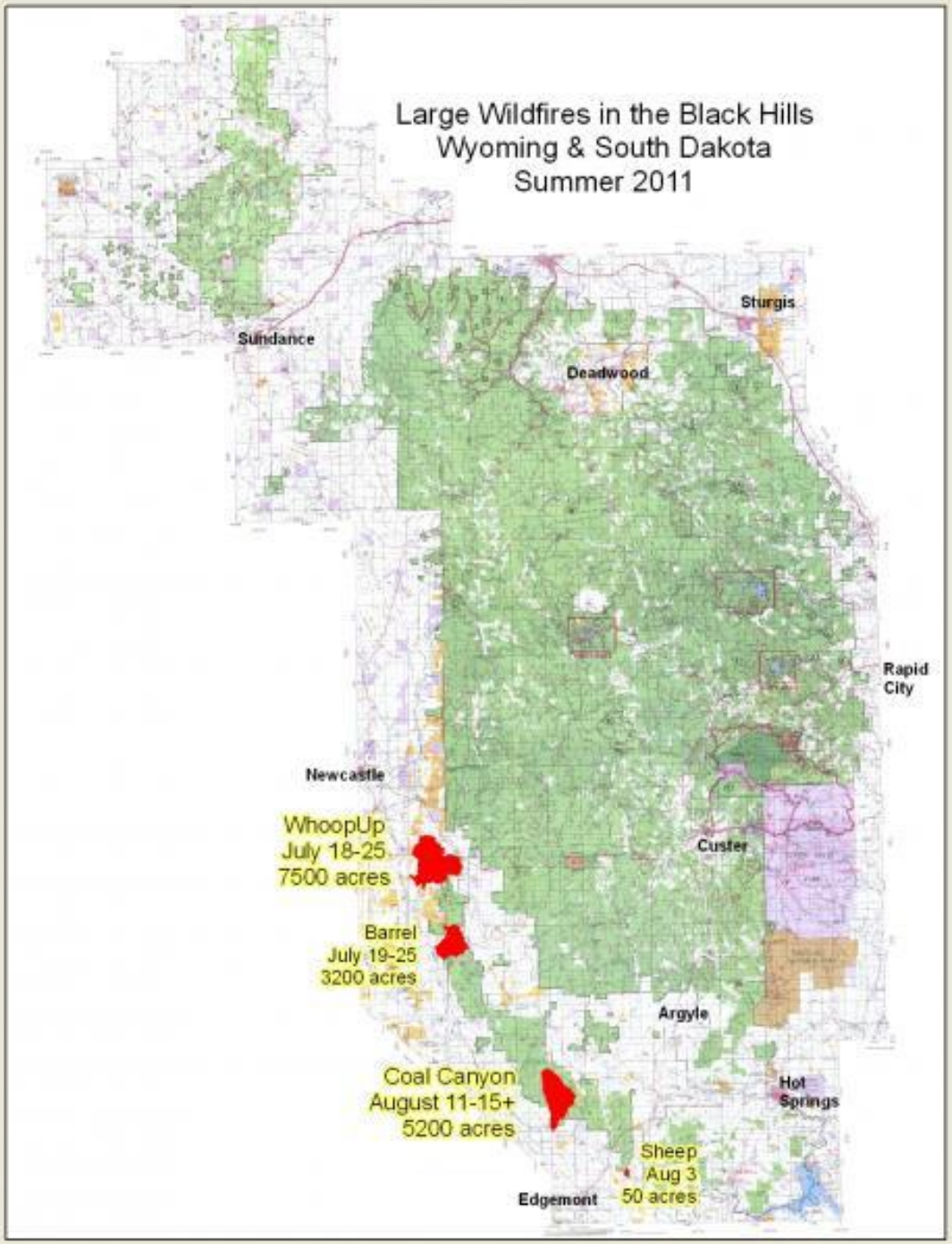
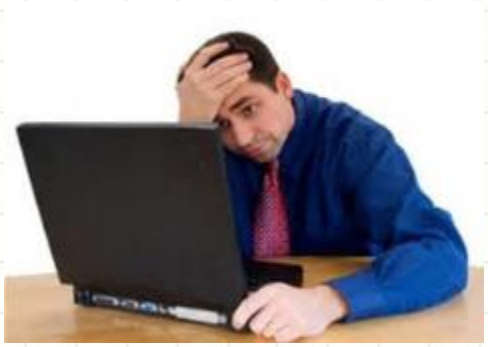
Author:
Laura Edwards
Western Regional Climate Center

http://droughtmonitor.unl.edu/


Large Wildfires in the Black Hills
Wyoming & South Dakota
Summer 2011
Sundance
Sturgis
Deadwood
Rapid City
Newcastle
WhoopUp
July 18-25
7500 acres
Custer
Barrel
July 19-25
3200 acres
Argyle
Coal Canyon
August 11-15+
5200 acres
Hot Springs
Sheep
Aug 3
50 acres
Edgemont

Should Drought Monitors Authors be concerned?



http://wfas.net/

The Wildland Fire Assesme...

USFS - WFAS

Wildland Fire Assessment System

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- Lightning Efficiency
- NDFD Fire Danger Forecasts

Weather

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- Map Data
- Google Earth Map Data

Moisture / Drought

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- Growing Season Index
- AVHRR NDVI
- Keetch-Byram Index
- Palmer Index
- National Fuel Moisture Database

Experimental Products

New Severe Fire Weather Potential Interface

Open the mobile friendly version here: http://m.wfas.net

WFAS - Severe Fire Weather Potential Mapping System

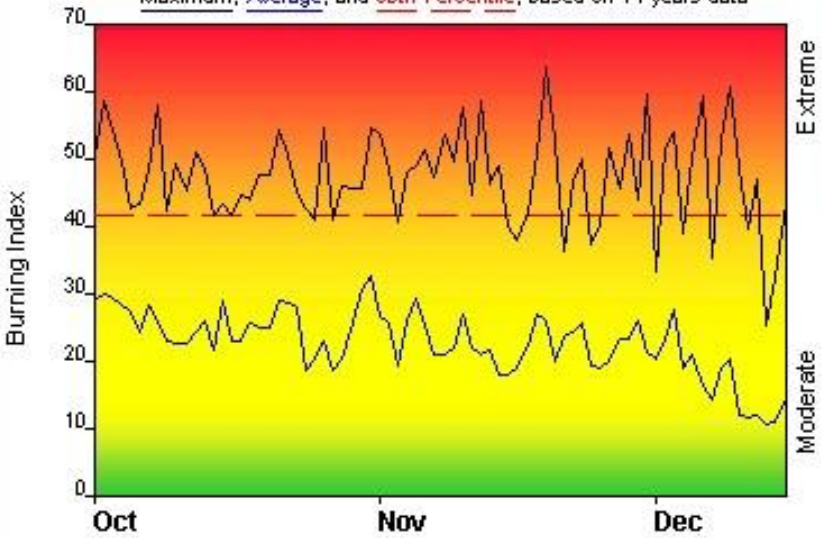
10:57 AM
04/02/2017

SMOKEY
SMOKEY

TODAY'S FIRE DANGER
LOW
MODERATE
HIGH
VERY HIGH
EXTREME
PREVENT WILDFIRES!

FIRE DANGER -- Daniel Boone National Forest

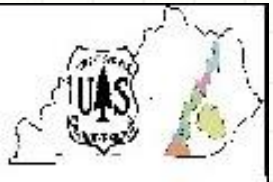
Maximum, Average, and 90th Percentile, based on 14 years data



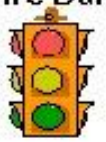
Fire Danger Area:

- Daniel Boone NF Spring
- CMB, LON, STE, RED
- Forest SIG

  * Meets NWCG Wx Station Standards



Fire Danger Interpretation:



EXTREME -- Use extreme caution

(Caution) -- Watch for change

Moderate -- Lower Potential, but always be aware

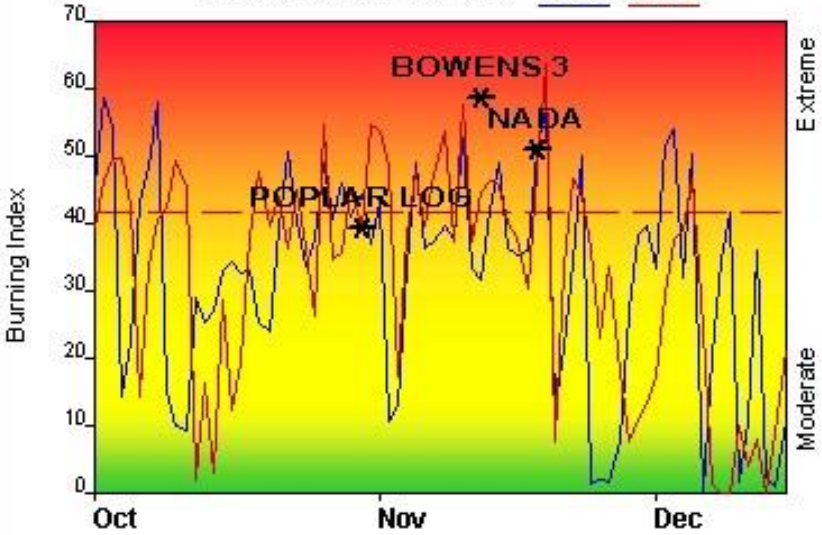
Maximum -- Highest Burning Index by day for 1995 - 2008

Average -- shows peak fire season over 14 years (1030 observations)

90th Percentile -- Only 10% of the 1030 days from 1995 - 2008 had an Burning Index above 42

Local Thresholds - Watch out: Combinations of any of these factors can greatly increase fire behavior: 20' Wind Speed over 15 mph, RH less than 25%, Temperature over 90, 10-Hour Fuel Moisture less than 10

Years to Remember: 1999 2001



Fuel Model: E - Hardwood Litter (Winter)

Remember what Fire Danger tells you:

- ✓ Burning Index gives day-to-day fluctuations calculated from 2 pm temperature, humidity, wind, daily temperature & rh ranges, and precip duration.
- ✓ Wind is part of BI calculation.
- ✓ Watch local conditions and variations across the landscape -- Fuel, Weather, Topography.
- ✓ Listen to weather forecasts -- especially WIND.

Past Experience:

Ice storm and Southern Pine Beetle damaged timber is prevalent across the forest. Heads up for snags! Arson is the leading cause for all fires on the DBNF.

Poplar Log Fire 10/30/2001 80 acres
A snag fell striking a firefighter, leaving him paralyzed.
Bowens 3 Fire 11/12/2005 155 acres
Nada Fire 11/18/199 540 acres developed into a Type II complex involving over 2000 acres in the Red River Gorge.

Responsible Agency: Daniel Boone National Forest

FF+4.0.2 08/31/2009-14:27 (C:\Documents and Settings\ejbunzendahl\...\DBNF_Spring_09a)

Design by NWCG Fire Danger Working Team

Local NWS Products

Routine Fire Wx Fcst (With/Without 6-10 Day Outlook)
Issued by NWS Rapid City, SD

Product Version: 2017-04-03 08:28:48 Select

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040
FNO853 KUNR 030828
FWFUNR

Fire Weather Planning Forecast for NE Wyoming and NRW South Dakota
National Weather Service Rapid City SD
228 AM MDT Mon Apr 3 2017

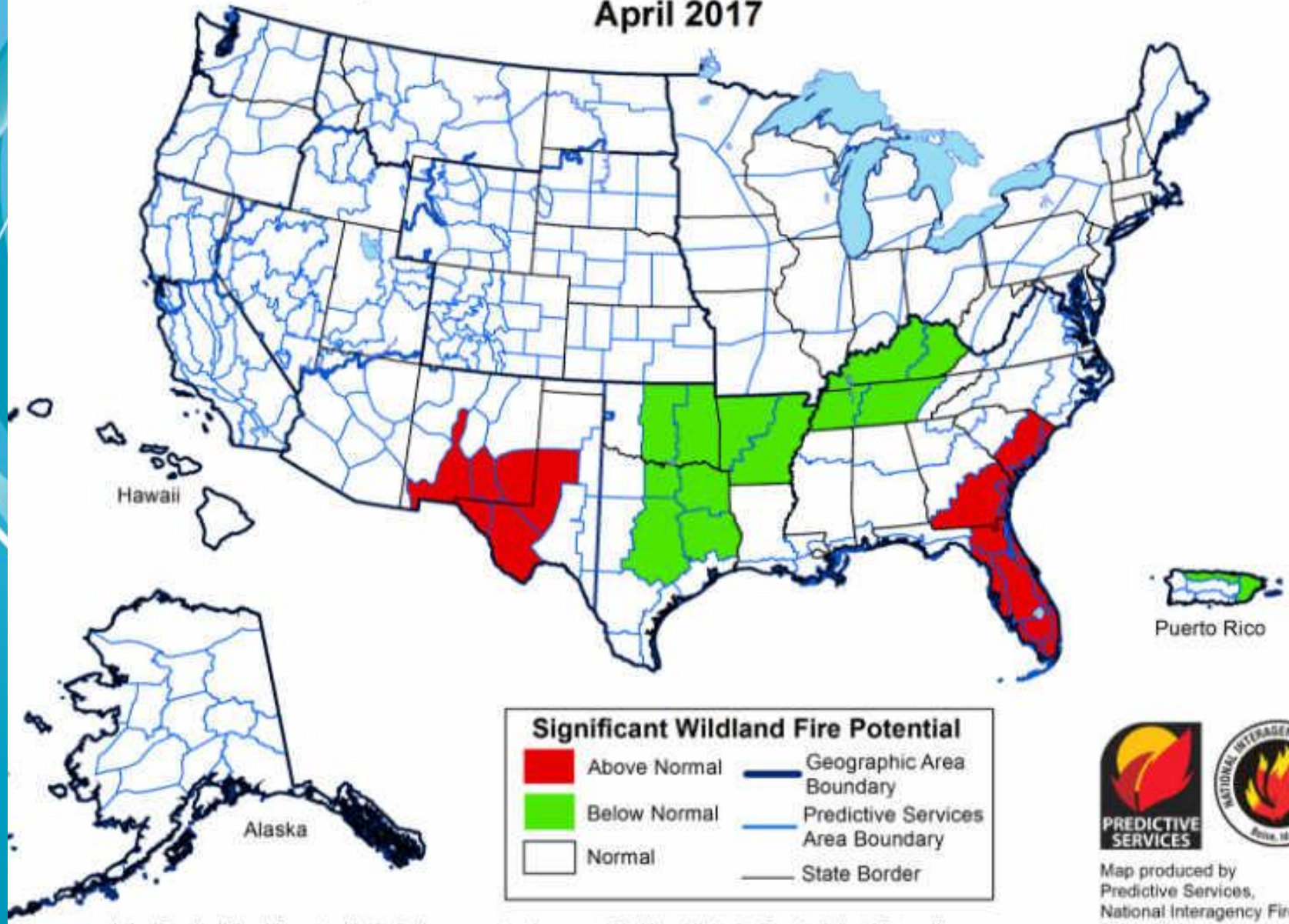
.DISCUSSION...Precipitation will continue today, gradually diminishing
this afternoon and evening. Conditions begin to dry out Tuesday, with
some slight chances of light rain showers. Drier and warmer weather
is then expected for the second half of the week.


SDZ262-032215-
Southern Black Hills-
Including the cities of Rapid City, Hill City, Custer,
Hot Springs, and Edgemont
228 AM MDT Mon Apr 3 2017

.TODAY...
Sky/weather.........Cloudy. Rain and snow until 1200, then chance
                     of rain showers and snow showers likely.
Chc of wetting rain.70 percent.
LAL.................1.
Max temperature.....38-46.
Min humidity........56-70 percent.
20-foot winds.......North 5 to 10 mph.
Haines Index........4 or low potential for large plume dominated
                    fire growth.
Transport winds.....North 10 to 15 mph.
Smoke dispersal.....Good.
Mixing height.......5200 to 6500 ft agl.

.TONIGHT...
Sky/weather.........Mostly cloudy. Chance of rain showers and snow
                    showers until 2400, then slight chance of snow
                    showers.
Chc of wetting rain.20 percent.
LAL.................1.
Min temperature.....23-29.
Max humidity........94-100 percent.
20-foot winds.......Northwest up to 10 mph.
Haines Index........2 or very low potential for large plume
                    dominated fire growth.
Transport winds.....Northwest 10 to 15 mph.
Smoke dispersal.....Poor.
Mixing height.......400 to 500 ft agl.
```

Significant Wildland Fire Potential Outlook
April 2017



Above normal significant wildland fire potential indicates a greater than usual likelihood that significant wildland fires will occur. Significant wildland fires should be expected at typical times and intervals during normal significant wildland fire potential conditions. Significant wildland fires are still possible but less likely than usual during forecasted below normal periods.

Map produced by
Predictive Services,
National Interagency Fire Center
Boise, Idaho
Issued April 1, 2017
Next issuance May 1, 2017

Global Change Biology

Global Change Biology (2016), doi: 10.1111/gcb.13275

RESEARCH REVIEW

A review of the relationships between drought and forest fire in the United States

JEREMY S. LITTELL[1], DAVID L. PETERSON[2], KARIN L. RILEY[3], YONGQUIANG LIU[4] and CHARLES H. LUCE[5]

[1]*DOI Alaska Climate Science Center, 4210 University Drive, Anchorage, AK 99508, USA,* [2]*USDA Forest Service Pacific Northwest Research Station, 400 N. 34th Street, Suite 201, Seattle, WA 98103, USA,* [3]*USDA Forest Service Rocky Mountain Research Station, 800 East Beckwith, Missoula, MT 59801, USA,* [4]*USDA Forest Service Southern Research Station, 320 Green Street, Athens, GA 30602, USA,* [5]*USDA Forest Service Rocky Mountain Research Station, 322 East Front Street, Suite 401, Boise, ID 83702, USA*

Abstract

The historical and presettlement relationships between drought and wildfire are well documented in North America, with forest fire occurrence and area clearly increasing in response to drought. There is also evidence that drought interacts with other controls (forest productivity, topography, fire weather, management activities) to affect fire intensity, severity, extent, and frequency. Fire regime characteristics arise across many individual fires at a variety of spatial and temporal scales, so both weather and climate – including short- and long-term droughts – are important and influence several, but not all, aspects of fire regimes. We review relationships between drought and fire regimes in United States forests, fire-related drought metrics and expected changes in fire risk, and implications for fire management under climate change. Collectively, this points to a conceptual model of fire on real landscapes: fire regimes, and how they change through time, are products of fuels and how other factors affect their availability (abundance, arrangement, continuity) and flammability (moisture, chemical composition). Climate, management, and land use all affect availability, flammability, and probability of ignition differently in different parts of North America. From a fire ecology perspective, the concept of drought varies with scale, application, scientific or management objective, and ecosystem.

Keywords: climate change, climate variability, drought, ecological drought, fire, water balance

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Introduction: drought and fire

The paleoecological record indicates that on time scales of centuries to millennia, climatic controls on fuel availability and fuel flammability influence aspects of the fire regime, with fire responding to the limits of available fuels (vegetation) and vegetation responding to frequency of fire (e.g., Prichard *et al.*, 2009; Whitlock *et al.*, 2010). Historical and pre-European settlement relationships between drought and wildfire have been well-documented in much of North America: forest fire occurrence and area burned clearly increase in response to drought. Drought interacts with other controls (forest productivity, topography, and fire weather) to affect fire intensity and severity. Fire regime characteristics (including area, frequency, and severity) arise across many individual fires, so both weather and climate – including short- and long-term droughts – are important.

Correspondence: Jeremy S. Littell, tel. +1 907 360 9416, e-mail: jlittell@usgs.gov

Fire history evidence from diverse climates and forest ecosystems suggests that components of North American forest fire regimes were moderately to strongly controlled by climate prior to Euro-American settlement and subsequent fire exclusion (Swetnam 1993; Swetnam & Betancourt, 1998; Heyerdahl *et al.*, 2002; Hessl *et al.*, 2004; Guyette *et al.*, 2006; Heyerdahl *et al.*, 2008; Flatley *et al.*, 2013). These presettlement fire histories indicate a relationship between low precipitation anomalies and widespread fire activity, especially in forests of the western United States. This is consistent with a regional depletion of soil and atmospheric moisture, leading to low moisture in foliage and surface fuels, and ultimately the potential for widespread fire (Swetnam & Betancourt, 1998). Some fire histories derived from fire-scarred trees in the American Southwest demonstrate a lagged relationship with above-average antecedent precipitation (Swetnam & Betancourt, 1998) and/or cooler temperatures (Veblen *et al.*, 2000) in the year(s) prior to years of widespread fire. Most of these records are derived from fire-scarred trees that survived fire events in low- or mixed-severity

Published 2016.
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https://www.fs.fed.us/sites/default/files/DROUGHT_book-web-1-11-16.pdf

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USDA

United States Department of Agriculture

Effects of Drought on Forests and Rangelands in the United States:

A Comprehensive Science Synthesis

(1 of 302)

12:25 PM
04/02/2017

Characterizing Drought: Metrics of Fire Risk

- **Which Drought Metrics Relate to Fire Risk? Drought is not a <u>necessary</u> or <u>sufficient</u> condition for fire, because fires burn during conditions of normal seasonal aridity (e.g., dry summers that occur annually in California), and drought occurs without wildfires in the absence of ignitions**. *However, when drought occurs, both live and dead fuels can dry out and become more flammable, and probability of ignition increases along with rate of fire spread (Andrews and others 2003, Scott and Burgan 2005).*

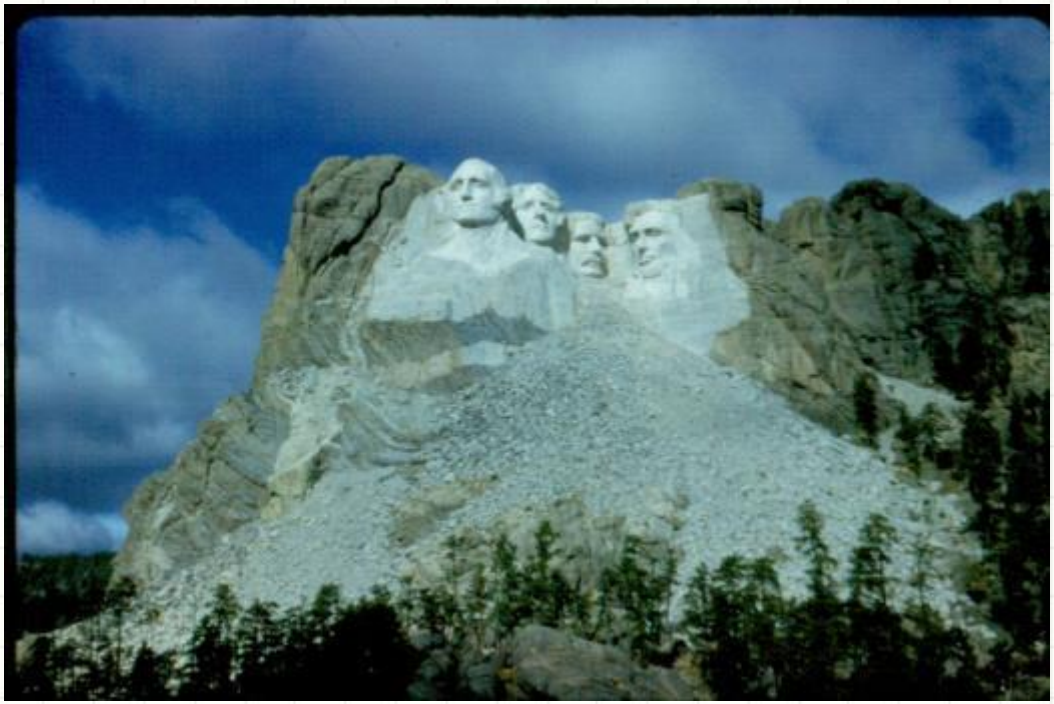
Phil 101 refresher

- <u>Necessary Condition</u>:
- “X is necessary condition for Y” means if we do not have x we will not have y.
- <u>Sufficient Condition</u>:
- “X is a sufficient condition for Y” if we have x, y must follow

Characterizing Drought: Metrics of Fire Risk

- **Which Drought Metrics Relate to Fire Risk? Drought is not a <u>necessary</u> or <u>sufficient</u> condition for fire, because fires burn during conditions of normal seasonal aridity (e.g., dry summers that occur annually in California), and drought occurs without wildfires in the absence of ignitions**. *However, when drought occurs, both live and dead fuels can dry out and become more flammable, and probability of ignition increases along with rate of fire spread (Andrews and others 2003, Scott and Burgan 2005).*

Summary

- Through the Black Hills National Forest Large Fire Mapping Project
- And with more historical research, (digital archives – easier access)
- We can better understand the important relationship between drought and wildland fire in the Great Plains
- Your work as Drought Monitors is very important to Wildland Firefighters

Any Questions?