

The ecology of summer prescribed fire regimes in the Northern Great Plains

Meet the Researcher

Tallgrass Prairie & Oak Savanna Fire Science Exchange

Devan Allen McGranahan

USDA Agricultural Research Service: Miles City, MT

All data from the paper:

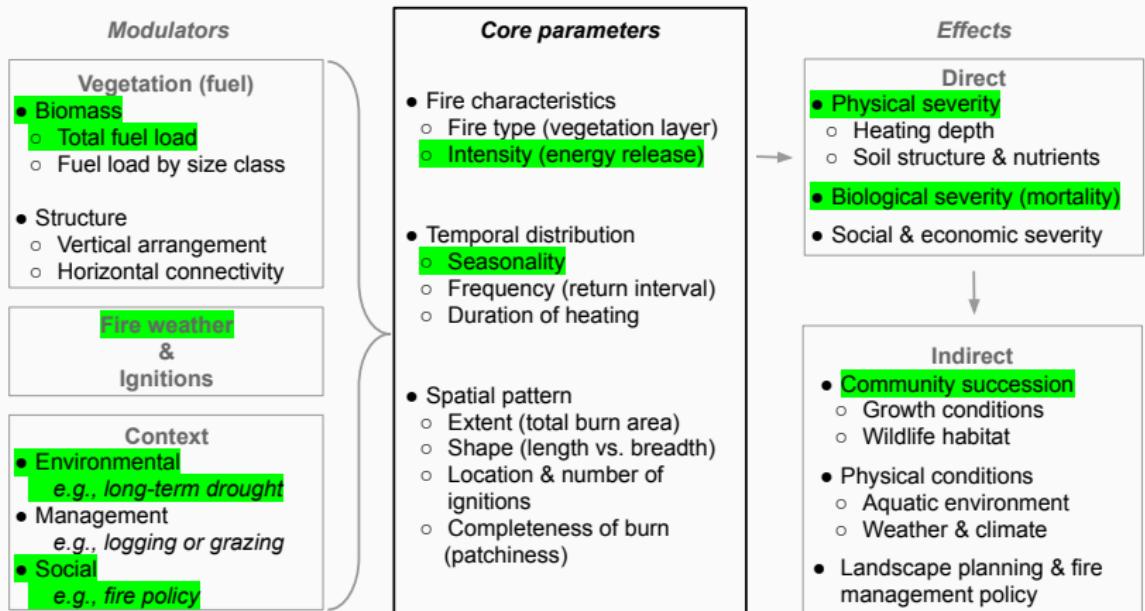
McGranahan & Angerer (2025) *Evaluating an attempt to restore summer fire in the Northern Great Plains*. Environmental Management 75:1656–64

All photo credit to the author

- Fire regimes & R_x
fire management
- Ways to measure,
describe fire
- Feasibility of
summer fires



The Western fire regime concept¹



¹McGranahan & Wonkka (2021) *Ecology of Fire-Dependent Ecosystems*

Measuring wildland fire

Direct measurements of fire behavior

- *Temperature*—Flames, soil heat exposure
- *Rate of spread*—2-D thermocouple array
- *Fireline intensity*—rate of energy release



Describe differences in **fire effects** by understanding
variability in **how it burned**

Satellite imagery informs burn severity

True-color images of a North Dakota wildfire from space



Before (16 August 2022)



During (21 August 2022)



After (31 August 2022)

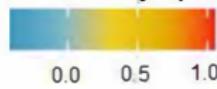
Satellite imagery informs burn severity

Comparing multispectral imagery = Burn Severity

Normalized Burn Ratio

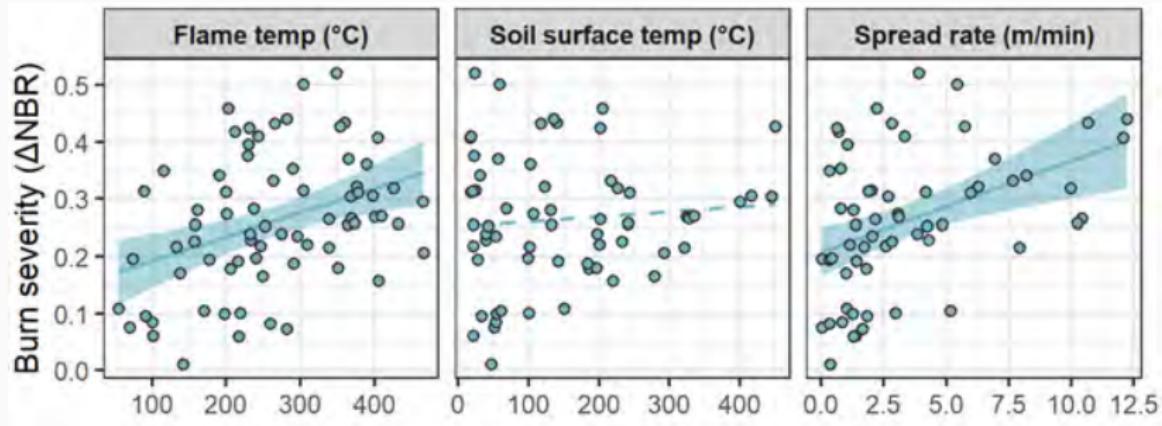


Burn severity (dNBR)



“Burn severity” and “fire behavior” correlate pretty well

If burn severity works as proxy for fire behavior ...



... managers might better understand variability in fire effects
without collecting (much) data

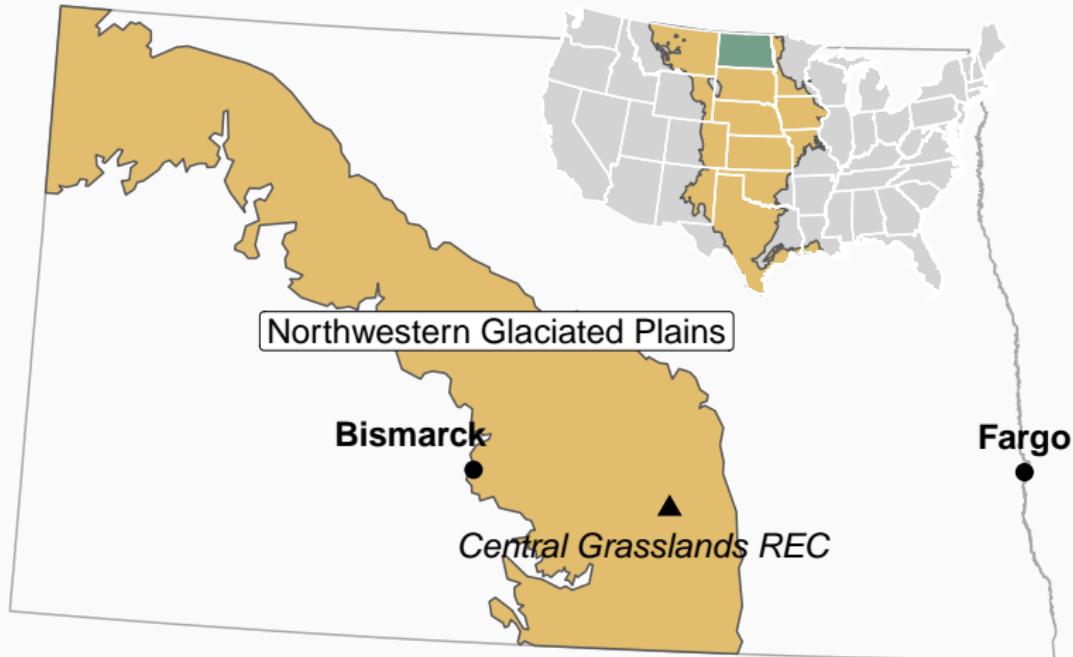
Seasonality & management

For every season: Burn, burn, burn...

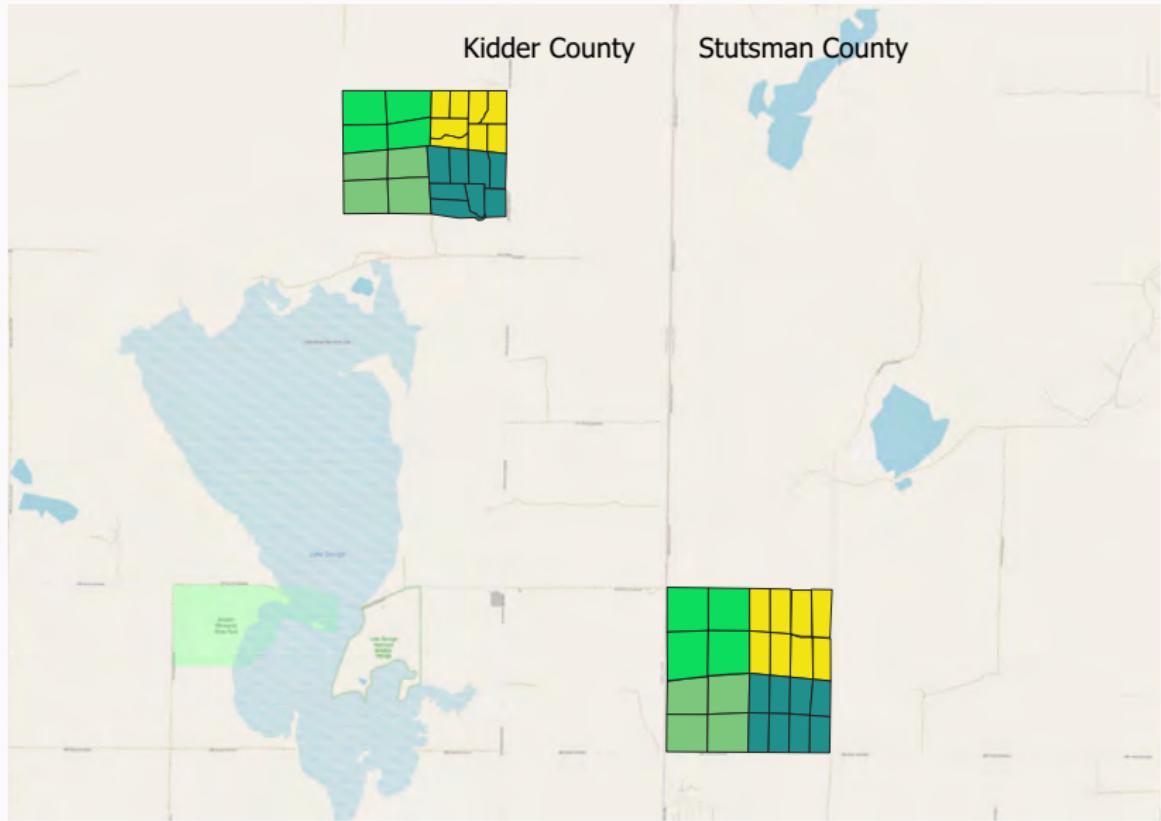
- Conventionally: R_x fire conducted primarily during dormant season
- Increased interest in burning during non-dormant season
 - Awareness of pre-colonial fire regimes
 - Diversify management



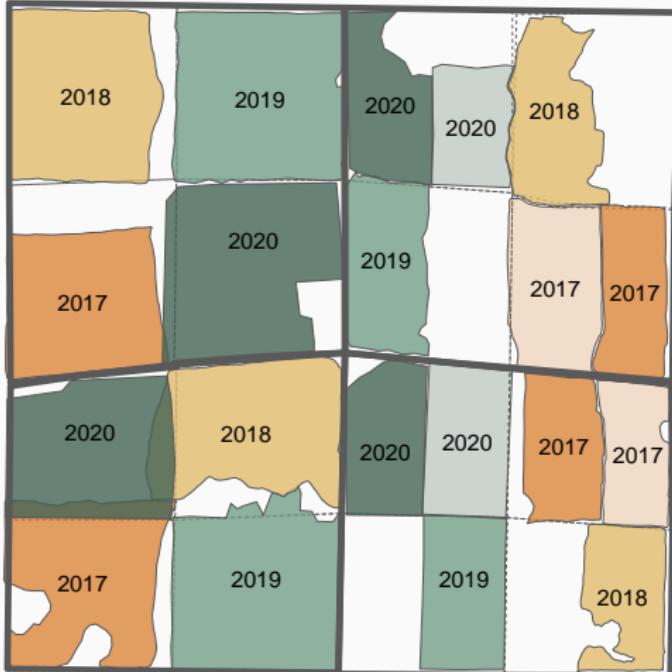
Case study: Rx fire in the Northern Great Plains



R_x fire in the Northern Great Plains



Two-for-four in completing summer burns



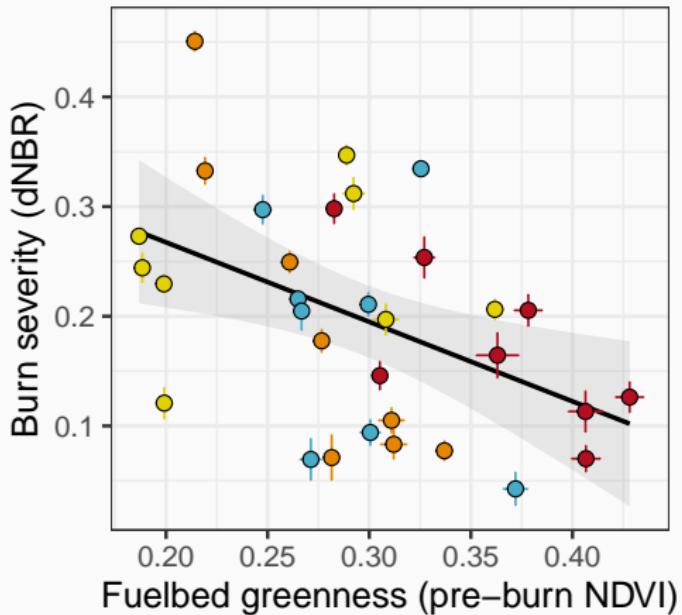
Final burn map for southern study block

Spring fire: What a difference a few days make!

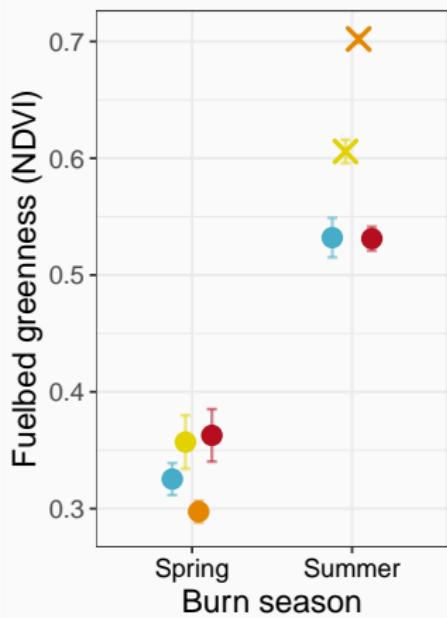
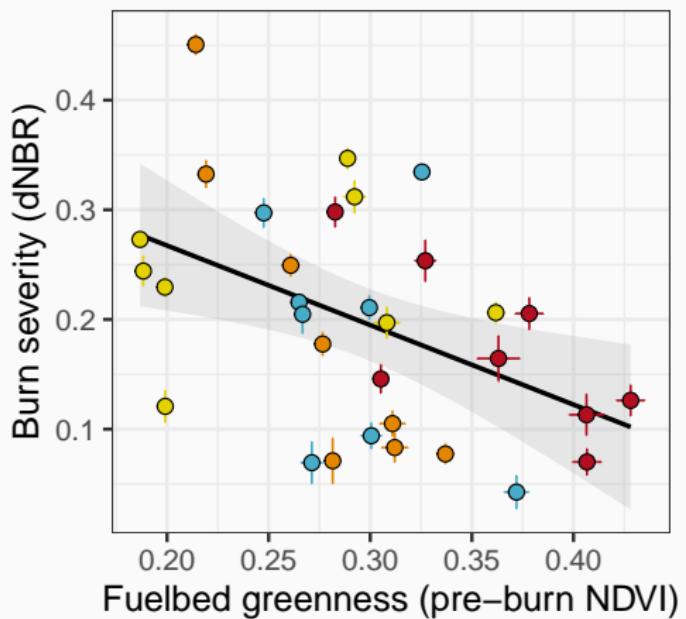


5 May 2018	Date	16 May 2018
79	Air temp (F)	82
5.9	Wind (m s ⁻¹)	2.4
22	min RH (%)	24
37	Dew Point (F)	46

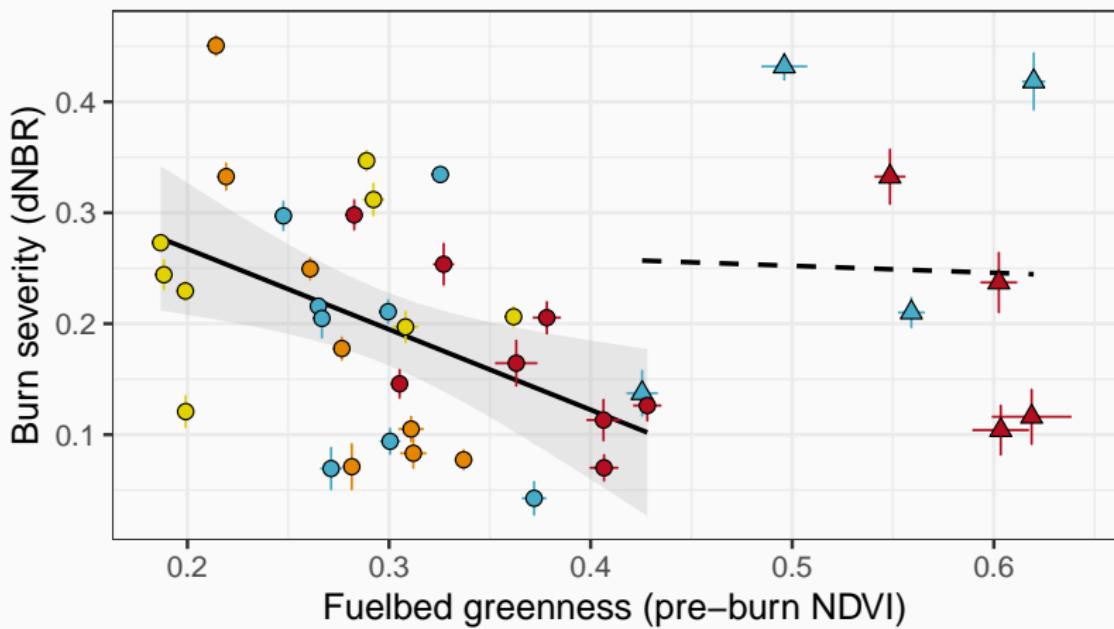
Spring fire: Green fuels reduce burn severity



Summer fire: Fuels are much greener!



Summer fire: High severity possible even with green fuels



Summer fire: Role of fire weather

The terrible, humid, green, no-good day

13 August 2018

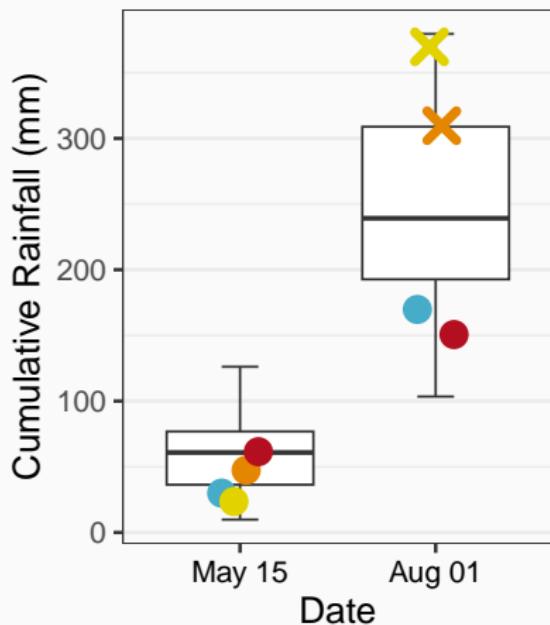
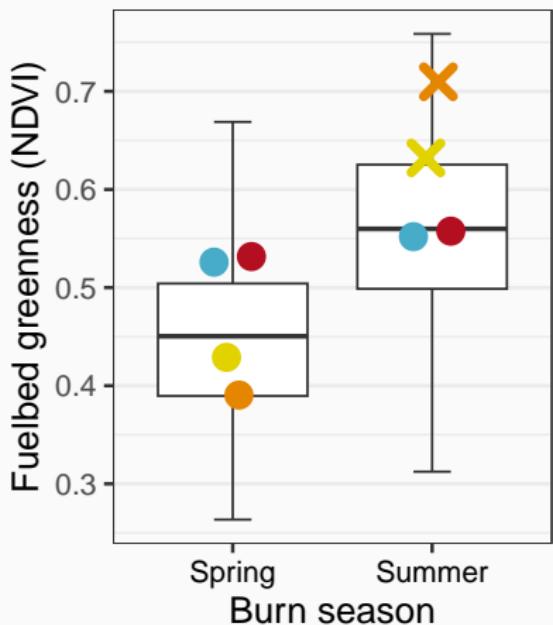
- Forecast called for < 40% RH by noon, but...
 - 54% at 1200
 - 50% at 1500
- Moisture constraints on ignition and spread
 - Transpiration by green plants
 - Humid air resists heating, lift



What *normal* can managers expect?

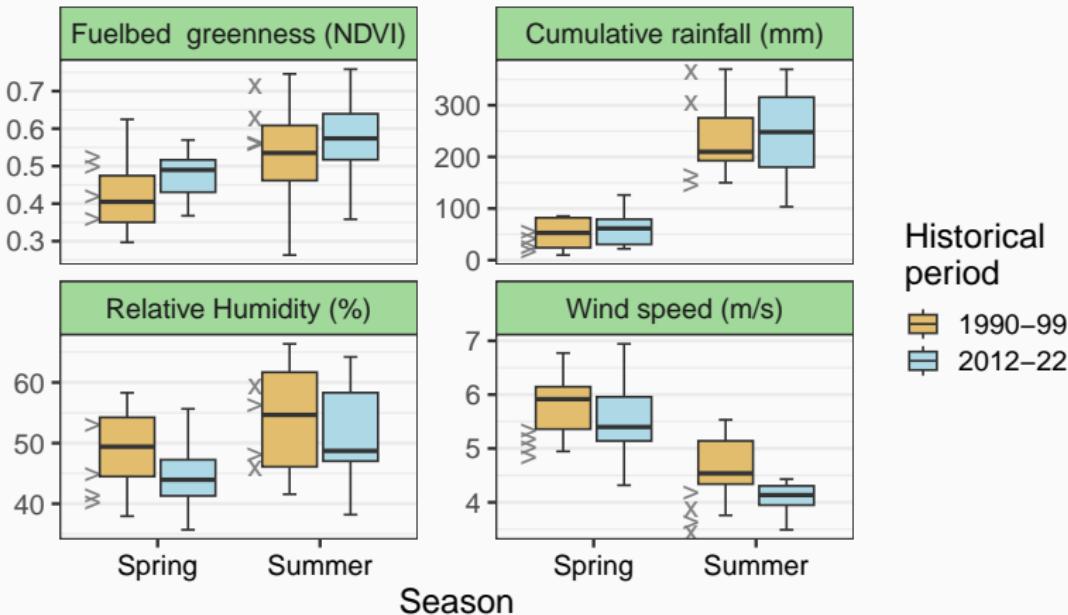
42 years of fuel & precipitation history

- Successful burn seasons were within historical norms
- Summers without fire were historical anomalies



42 years of change in fuel & weather

- Greener but less humid springs?
- Less windy summers??



> = successful burn season, x = not successful

Main take-aways

- Summer burns ought to be possible more often than not
- Potential no-go thresholds, *but likely site-specific*
Examples from these data:
 - NDVI > 0.55-0.6?
 - > 275 mm rain by Aug 1?
- Little evidence conditions are substantially changing



Thoughts, feedback, and discussion



Barriers to summer Rx fire

All opportunities and limitations fit within fire regime concept

- Biophysical

mostly, too wet

- High live moisture fuel content (*photosynthesis*)
- High dead moisture fuel content (*humidity*)
- Poor convection/smoke dispersal (*humidity*)

- Social

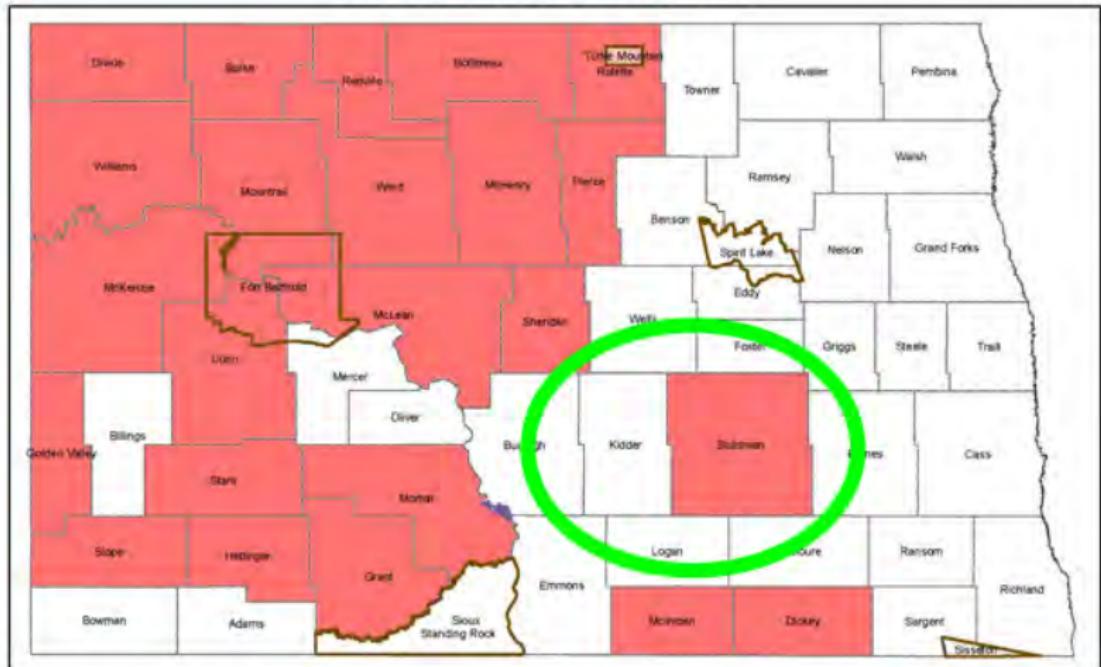
mostly, too dry

- Local burn restrictions
- Control issues

Social barriers

County-level burn restrictions

Fire Declarations and Burn Restrictions



0 25 50 100 Miles

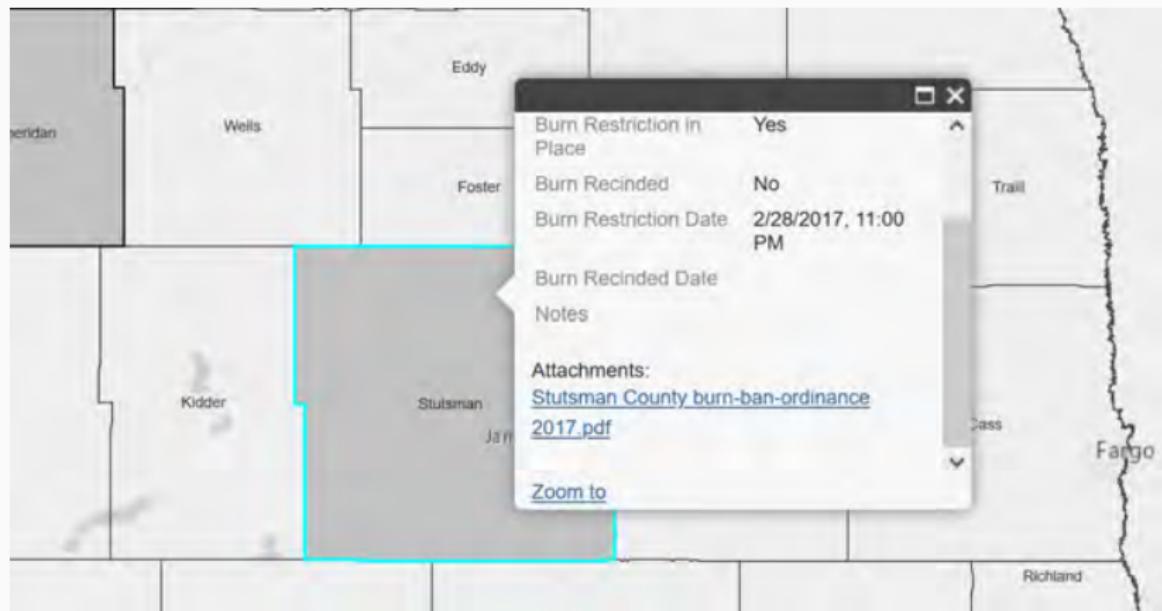


Legend

- Cahe WMA Burn Restriction (purple)
- County / Tribal Burn Restriction (red)

State declarations include all counties and tribal nations within the state regardless if there are existing local tribal declaration in place or not. Local tribal restrictions may be more restrictive, but not less restrictive than the state.

County-level burn restrictions



Tying burn restrictions to real-time conditions

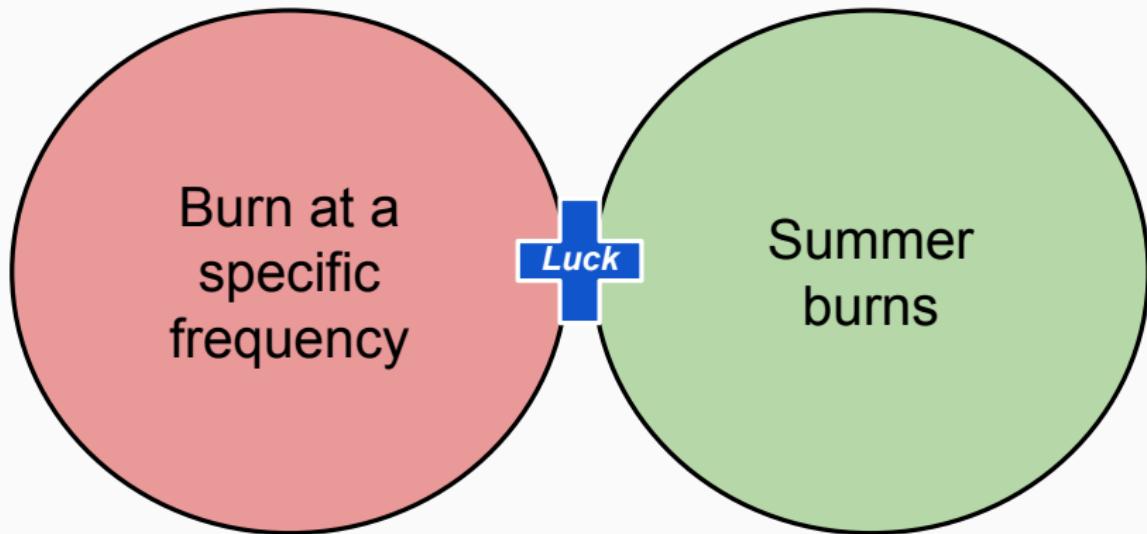
STUTSMAN COUNTY ORDINANCE 2017-01
PROHIBITIONS ON OPEN BURNING DURING A RED FLAG WARNING OR
WHILE THE STUTSMAN COUNTY FIRE DANGER RATING IS VERY HIGH OR
EXTREME – PENALTY

1. **Definitions**

- A. "Fire danger rating" is the risk categorization for open burning that Stutsman County publishes on the county's web site. The categories are low, moderate, high, very high, and extreme.

Fire regime management

Difficult to satisfy multiple socially-constructed parameters
(e.g. *force patterns*)



Fire regime management

Better to tweak controllable components towards desired objectives (e.g. support processes)

