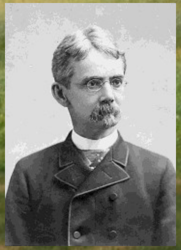
Rangeland response and management following drought

Mitch Stephenson – Range Management Specialist

Rangelands and drought

"Grass is the forgiveness of nature – Her constant benediction……"



John J. Ingalls, US Senator (KS) 1873-1891, "In Praise of Blue Grass"

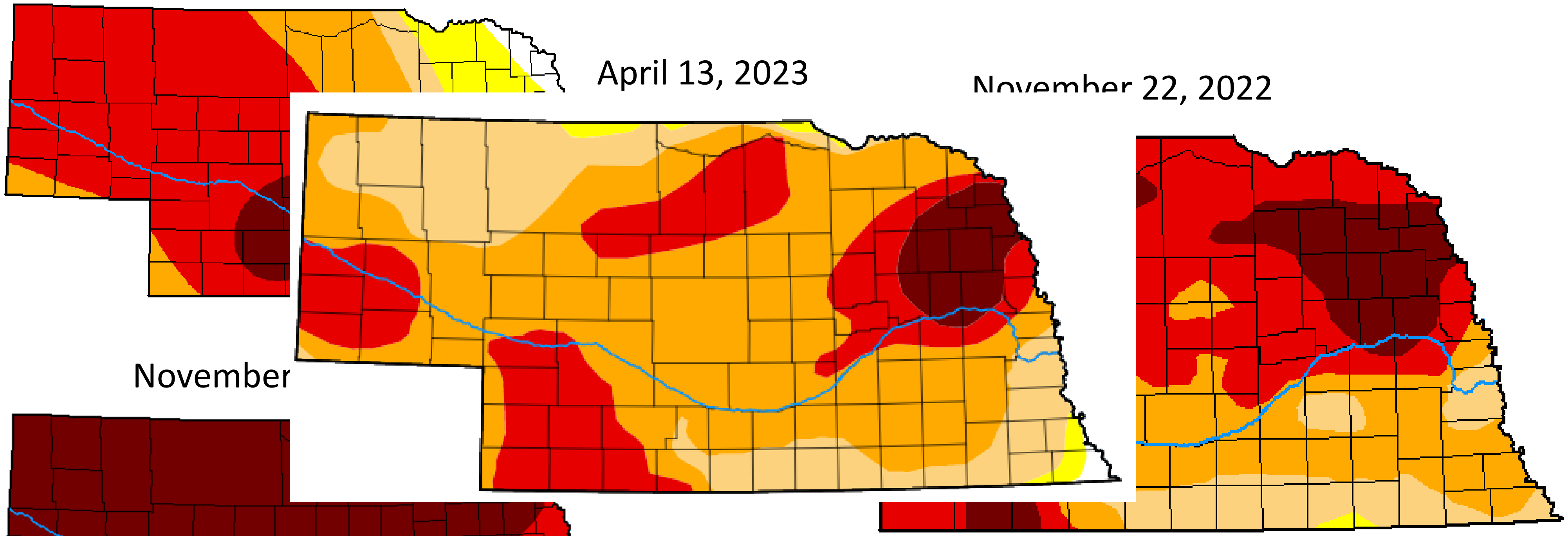
Where are we at?

November 19, 2002

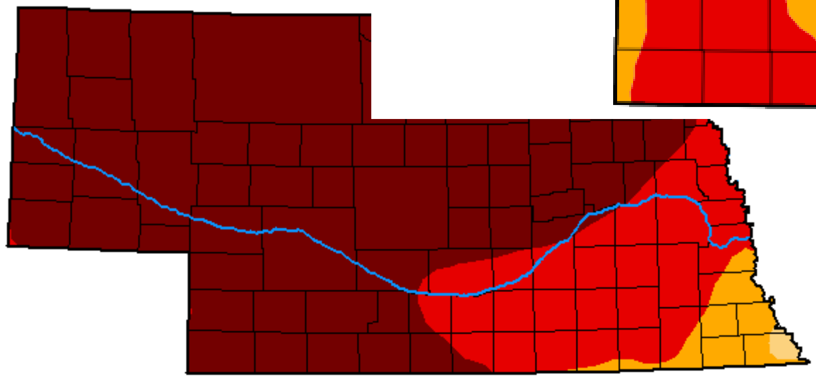
https://droughtmonitor.unl.edu/

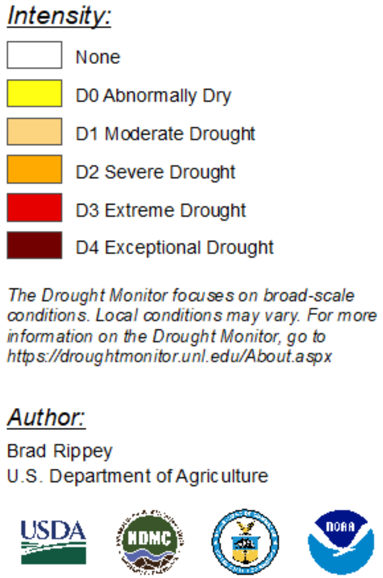
April 13, 2023

November 22, 2022



November



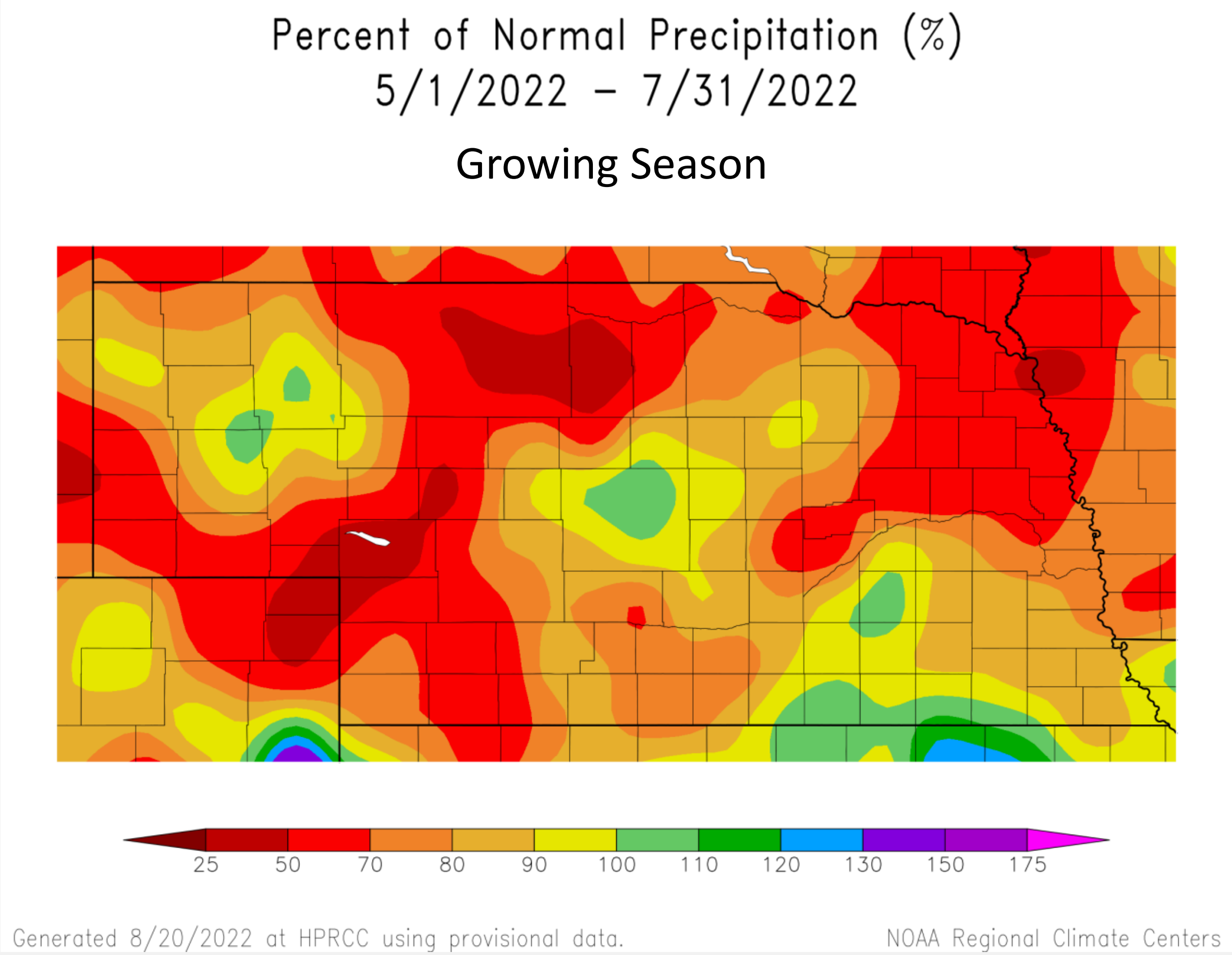


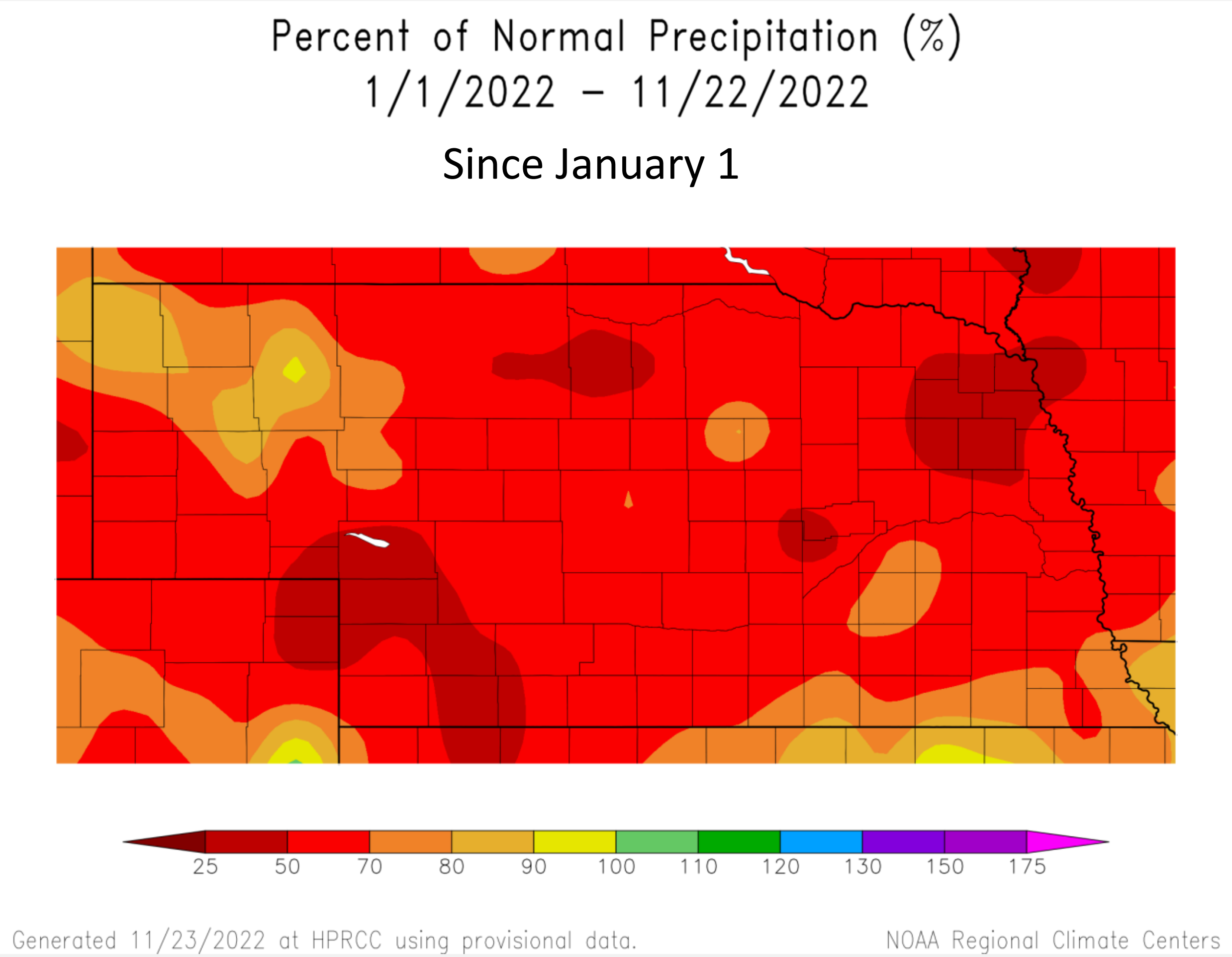
85% Severe drought (D2) and above

58% Extreme drought (D3) and above

17% Exceptional drought (D4) and above

Where are we at?





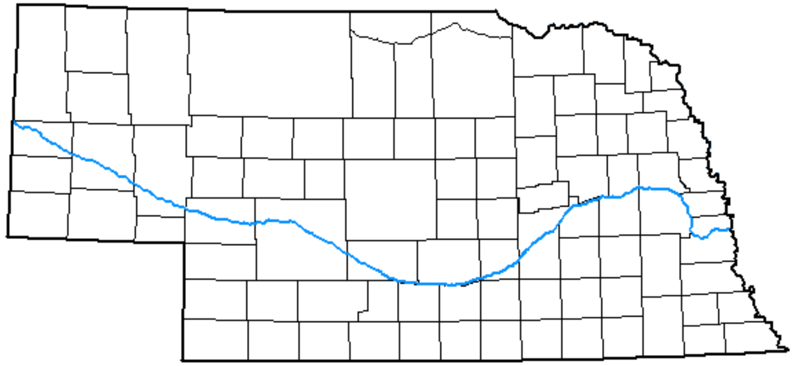
https://hprcc.unl.edu/

Where are we at?

https://droughtmonitor.unl.edu/

U.S. Drought Monitor

Nebraska



November 27, 2018

(Released Thursday, Nov. 29, 2018)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	100.00	0.00	0.00	0.00	0.00	0.00
Last Week *11-21-2018*	100.00	0.00	0.00	0.00	0.00	0.00
3 Months Ago *08-30-2018*	96.33	3.67	0.34	0.00	0.00	0.00
Start of Calendar Year *01-04-2018*	9.32	90.68	2.03	0.00	0.00	0.00
Start of Water Year *09-27-2018*	99.83	0.17	0.00	0.00	0.00	0.00
One Year Ago *11-30-2017*	91.35	8.65	2.03	0.00	0.00	0.00

Intensity:

- None
- 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. For more information on the Drought Monitor, go to https://droughtmonitor.unl.edu/About.aspx

Author:
Richard Heim
NCEI/NOAA

droughtmonitor.unl.edu

Rangeland drought

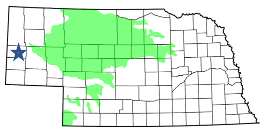
Drought (n)

A period without precipitation during which the soil water content is reduced to such an extent that plants suffer from lack of water.

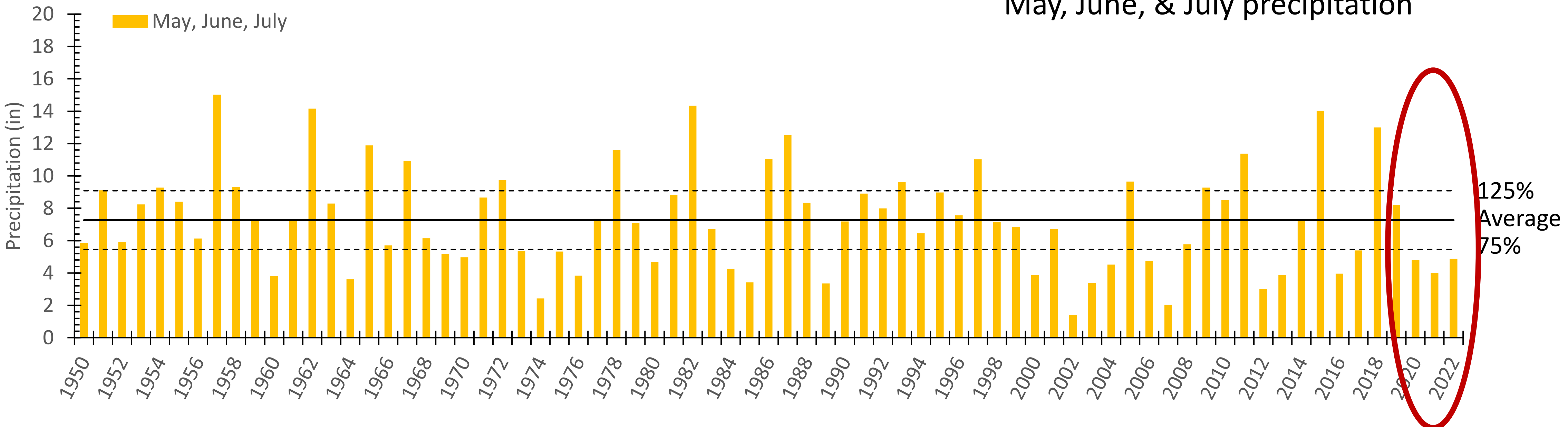
- *Short-term and long-term*
- *Often considered 75% of "normal" precipitation*
- *Effective precipitation*

"Drought is an inevitable part of normal climate fluctuation and should be considered as a recurring, albeit unpredictable, environmental feature which must be included in planning. Muddled views and lagged responses toward drought pose a threat to sustainable management of rangelands."

–Thurow and Taylor 1999



Scottsbluff, NE
- 34% of years below 75% of "normal"
May, June, & July precipitation



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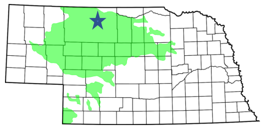
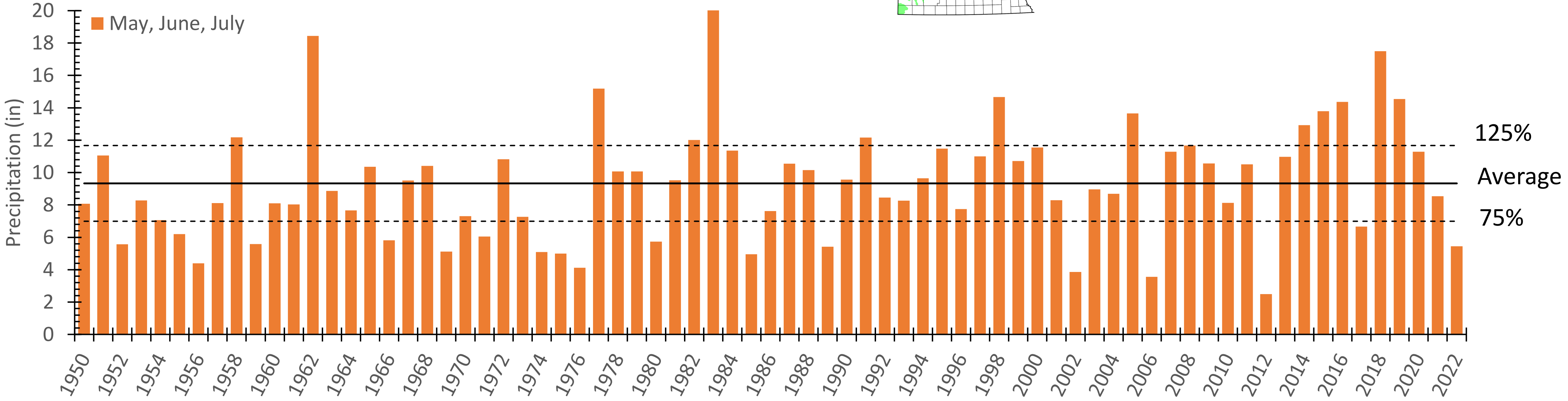
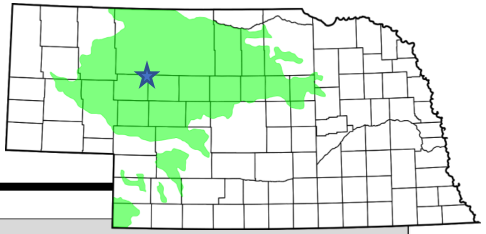


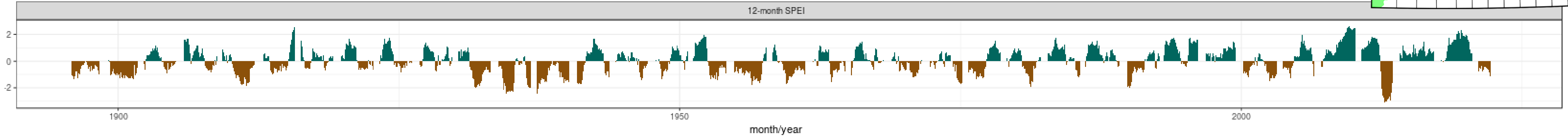
Valentine, NE

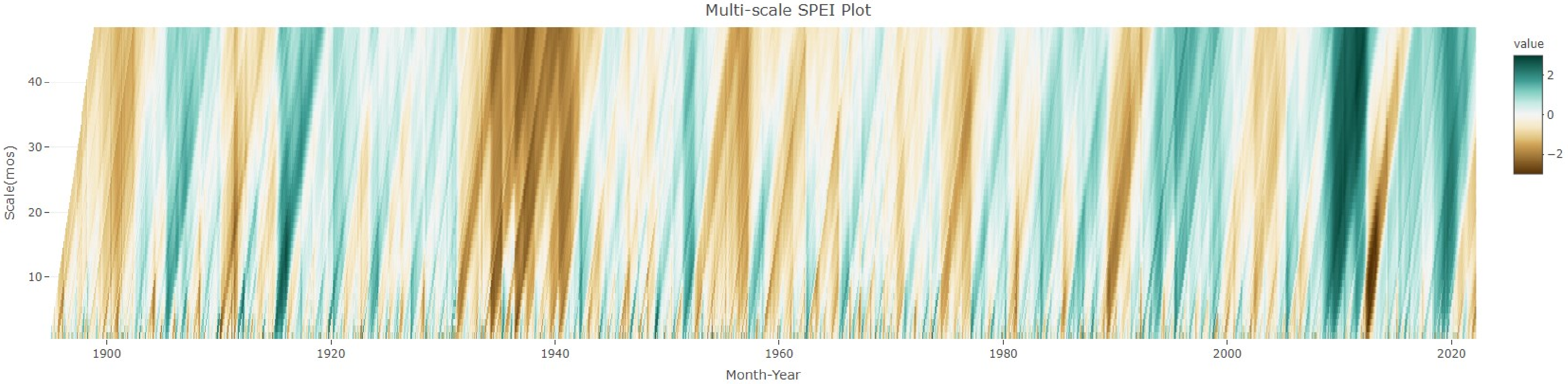
- 25% of years below 75% of "normal"



Historic weather patterns



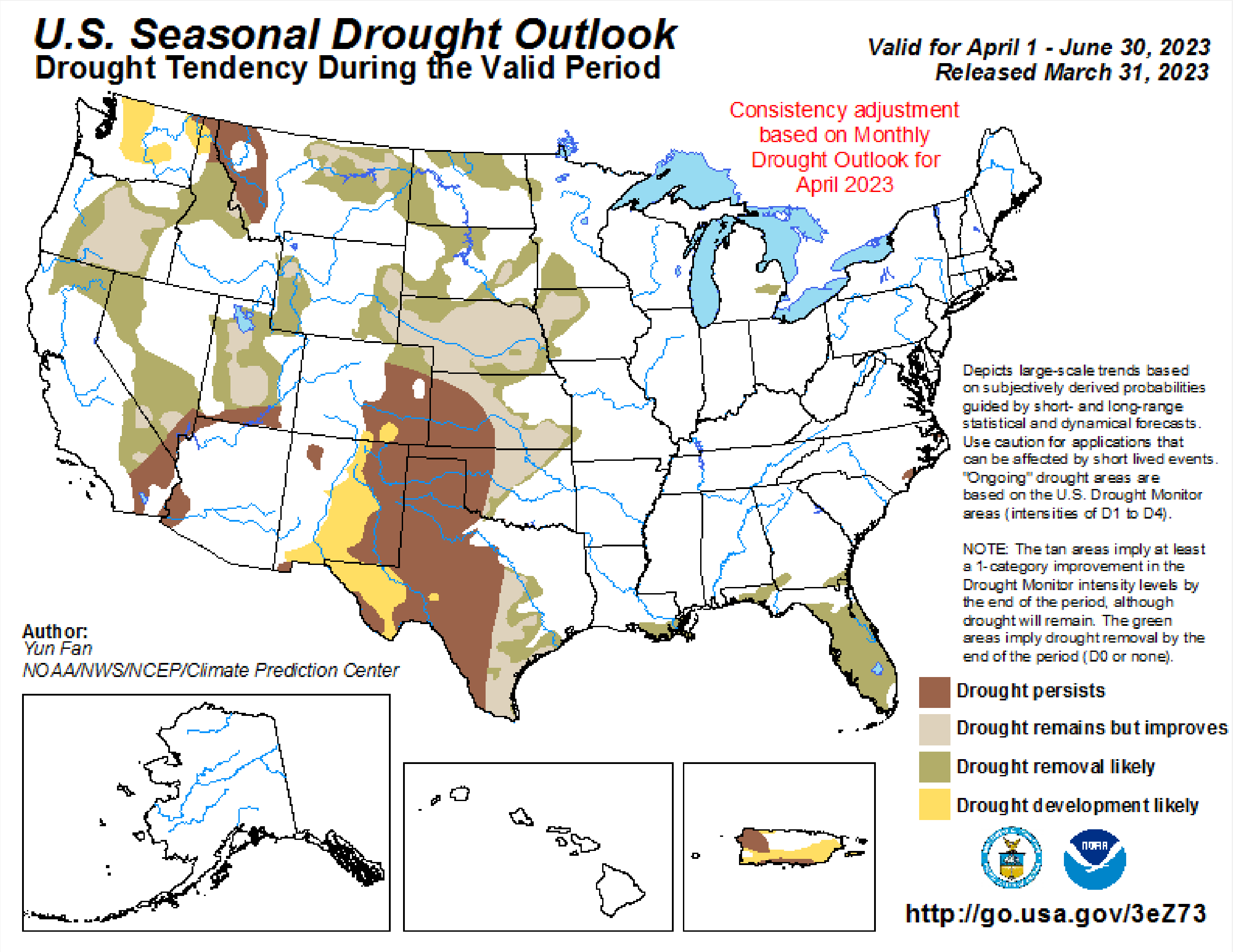




Standardized Precipitation Evapotranspiration Index (SPEI) – Drought index that considers both precipitation and evapotranspiration in calculating the effect of drought

uaclimateextension.shinyapps.io

How is the spring forecast looking?



- La Niña has ended and El Nino Southern Oscillation (ENSO)-neutral conditions are expected to continue through the Northern Hemisphere spring and early summer 2023.

https://www.cpc.ncep.noaa.gov/

Pacific Decadal Oscillation (PDO) and El-Nino Southern Oscillation (ENSO)

PDO = Sea surface temperatures along the west coast in the pacific ocean

- 10 - 30 year cycle
- Warm phase = rainfall average or above
- Cold phase = high variability in precipitation (1999-2013)

In a cold-phase PDO with a La Niña during late winter/ spring, producers should decrease stocking from a moderate level. A clear example of this scenario was 2012, the fourth-most extreme drought in the last century.

ENSO = Sea surface temperatures along the equator

- 3-7 year cycle
- El Nino = wet conditions
- La Nina = dry conditions

2023

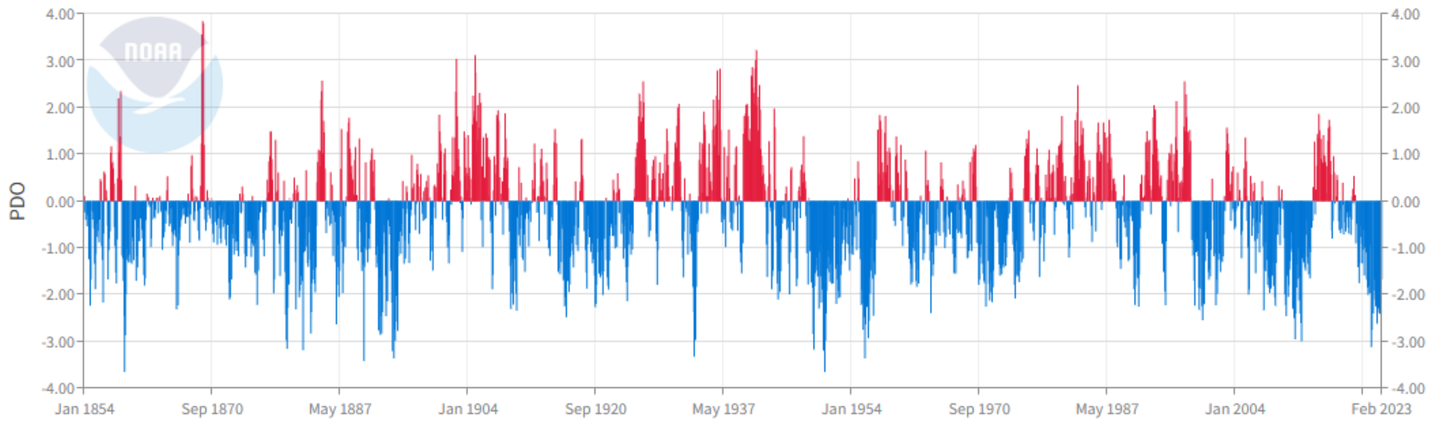
When ENSO is neutral, both ENSO and PDO have poor predictive power, so producers may rely more heavily on local precipitation forecasts.

When the PDO is in a warm phase and ENSO is in El Niño, stocking rates can be increased with less risk than in other phases. On the other hand, producers can reduce risk by stocking cautiously when warm phase PDO coincides with a La Niña year.

"Early warning for stocking decisions in eastern Colorado" – Raynor and Bruegger 2020

Pacific Decadal Oscillation (PDO) and El-Nino Southern Oscillation (ENSO)

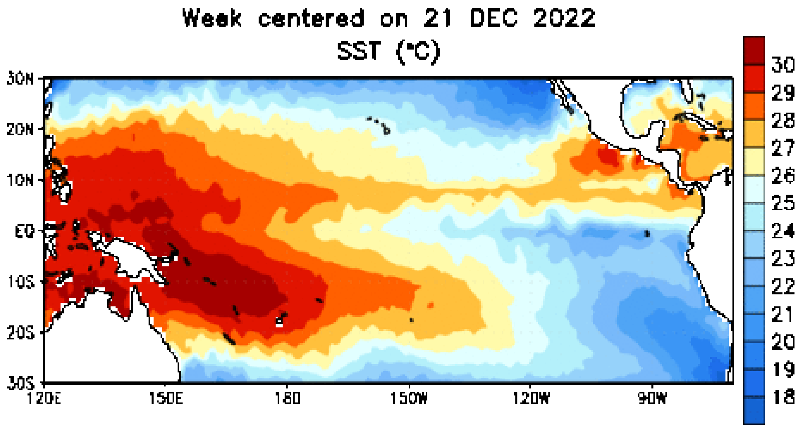
Pacific Decadal Oscillation (PDO)



Source: https://www.ncei.noaa.gov/pub/data/cmb/ersst/v5/index/ersst.v5.pdo.dat

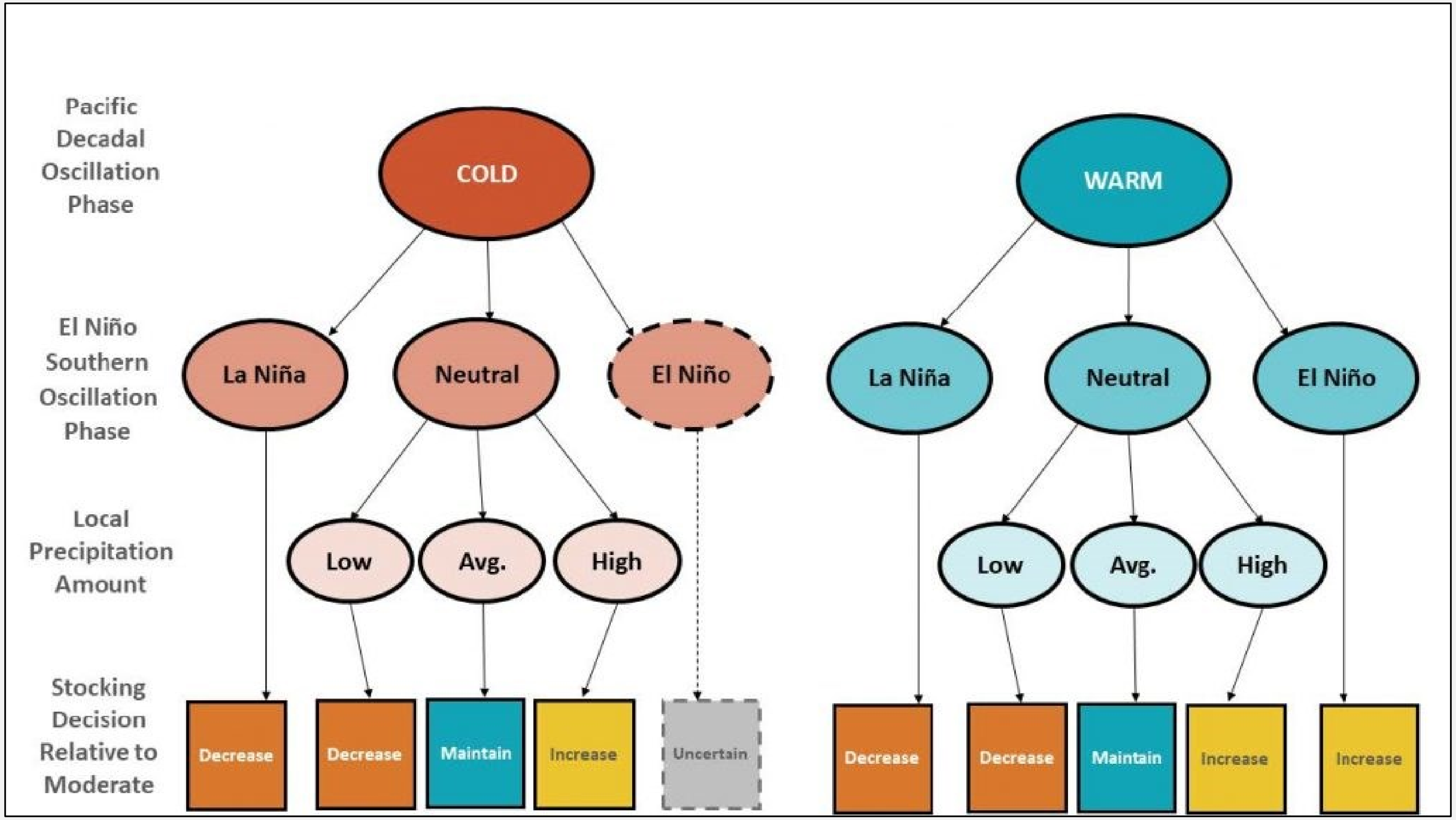
Powered by ZingChart

El-Nino Southern Oscillation (ENSO)



Climate Prediction Center (https://www.cpc.ncep.noaa.gov/)

Stocking decisions based on sea surface temperatures



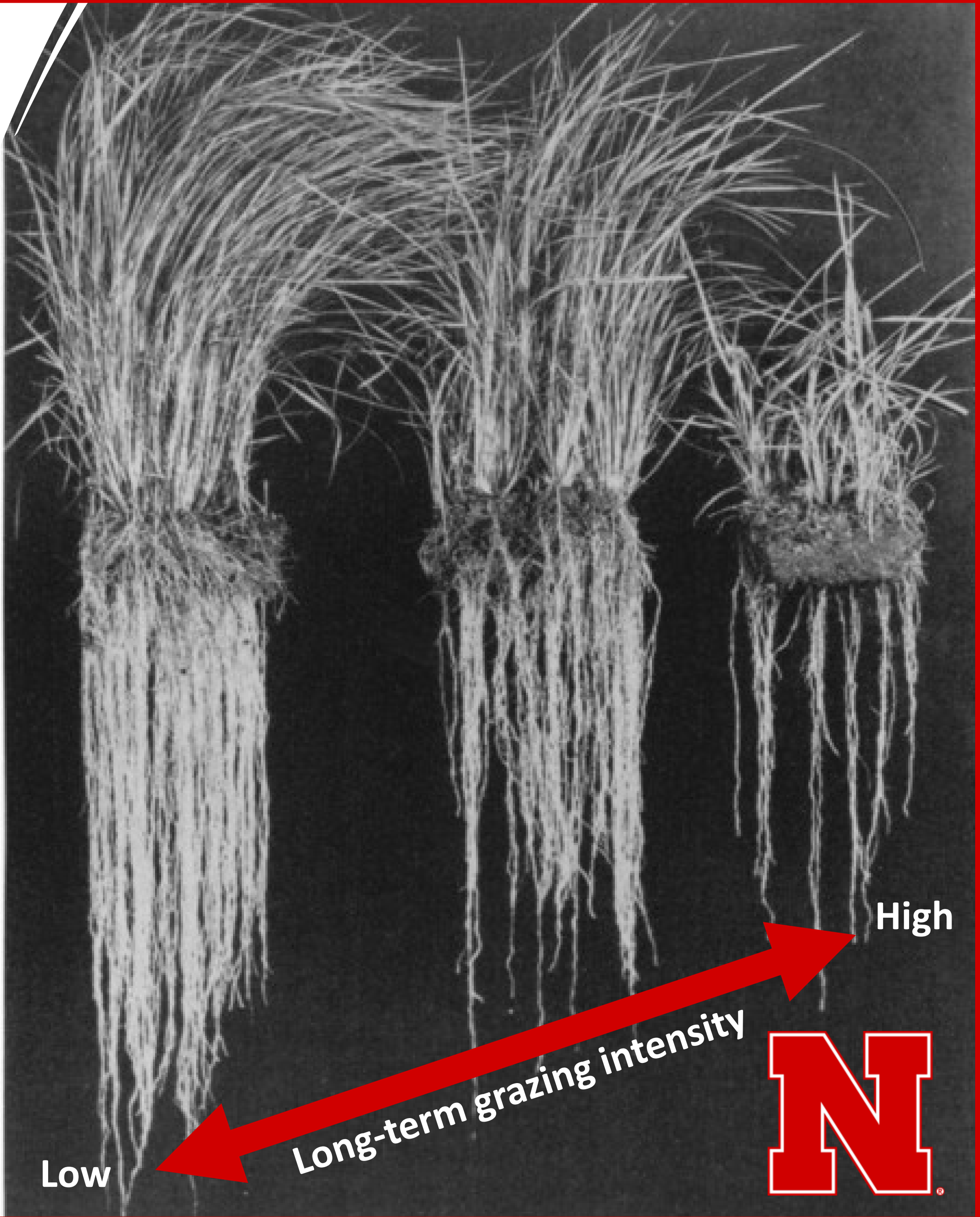
"Early warning for stocking decisions in eastern Colorado" – Raynor and Bruegger 2020

Influence of grazing intensity on below ground biomass

- Little bluestem plants collected in areas with long-term **heavy** grazing intensity had fewer roots than plants collected in areas with long-term **low** grazing intensity

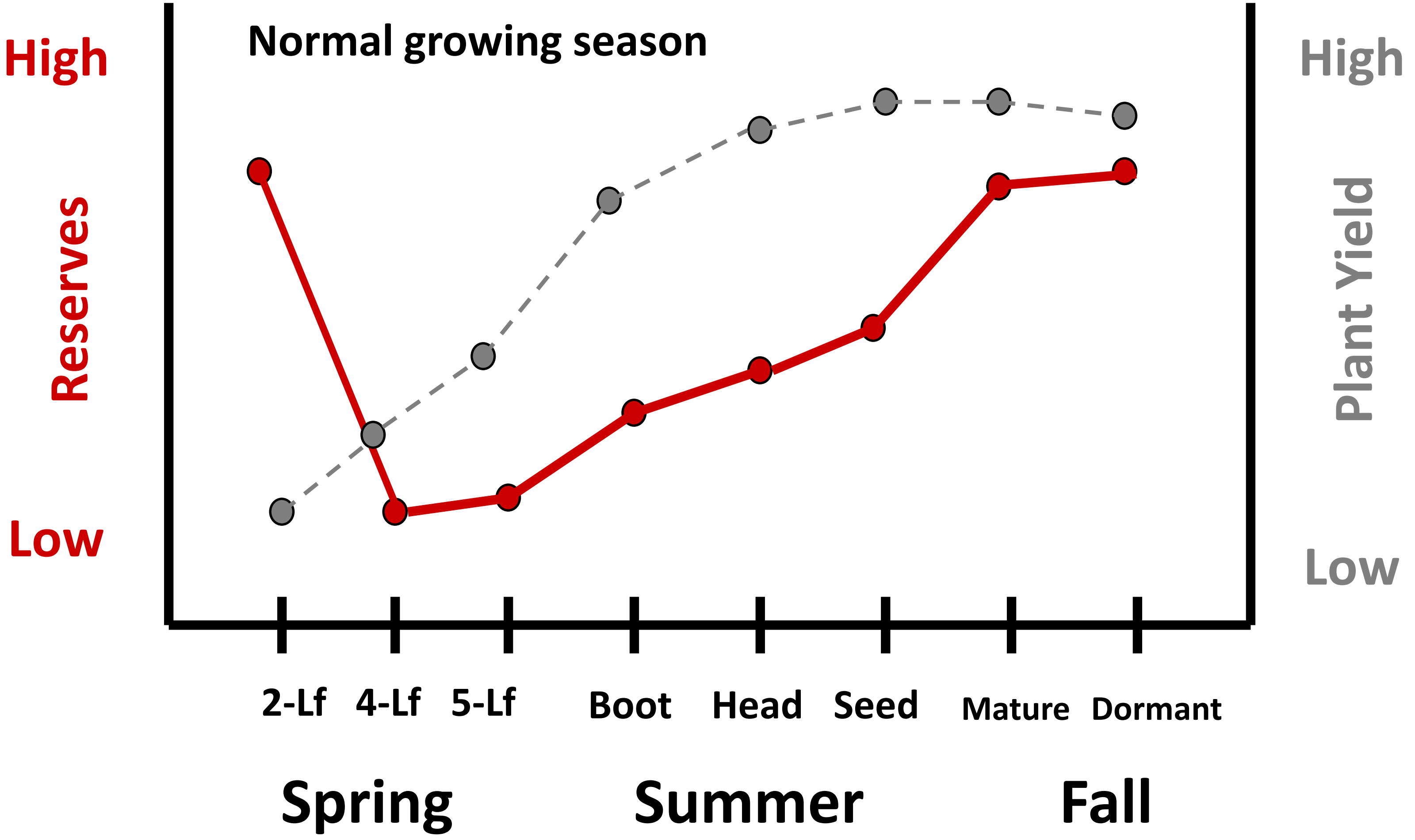
- Long-term grazing intensity was the result of differences in grazing distribution across the pasture

- J. E. Weaver 1950 – Effects of different intensities of grazing on depth and quantity of roots of grasses



Rangeland response during drought

Carbohydrate reserves (●—●) and perennial plant yield (●- -●) in relation to growth stage



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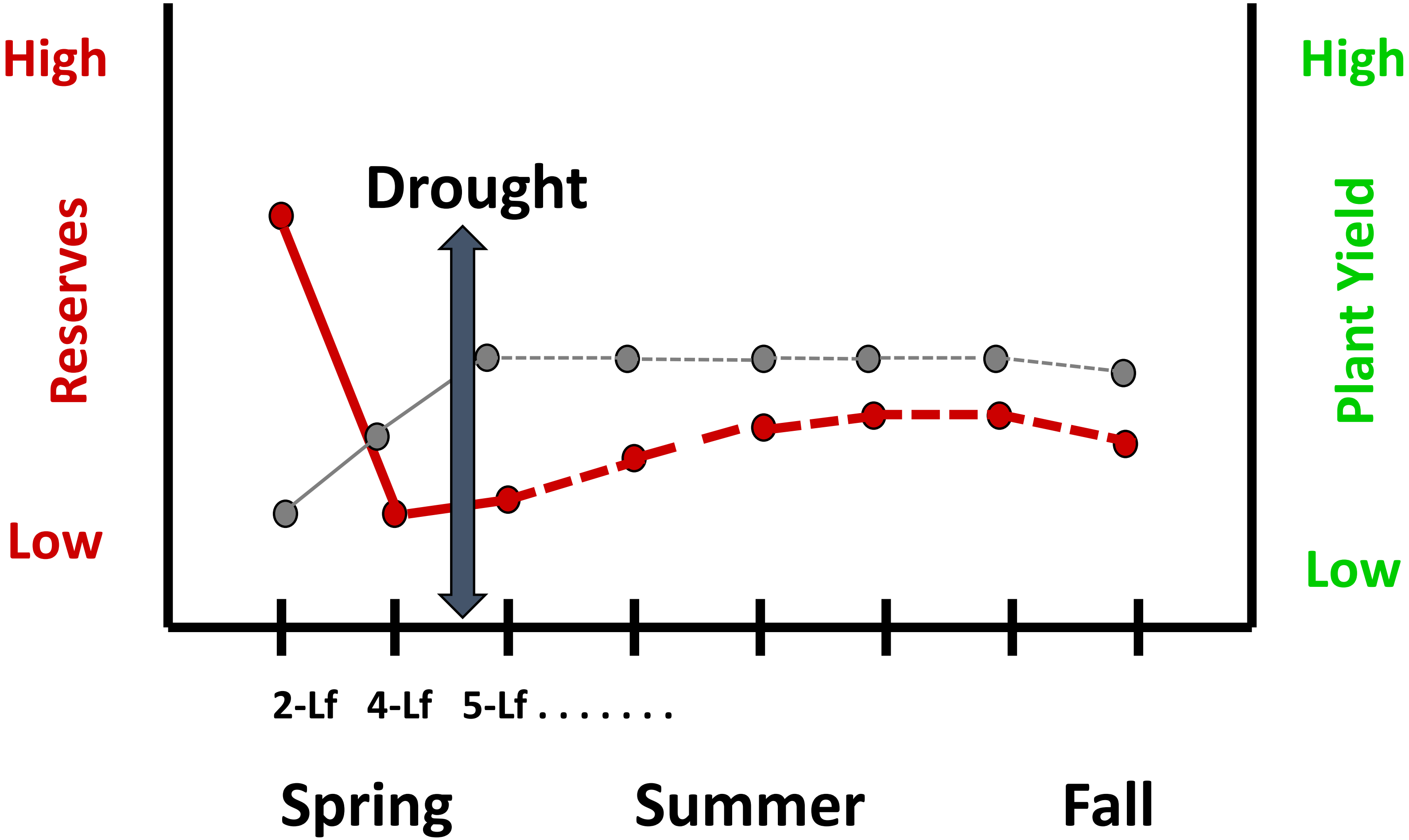


- Reduced above and below ground growth
- Earlier plant maturity
- Fewer reproductive tillers
- Reduces bud formation that will produce next years tillers
- Lower carbohydrate reserve storage
- Increased annual forbs in years following drought
  - Decreased perennial plant vigor and increased soil nitrates

Effect of long-term 1930s drought

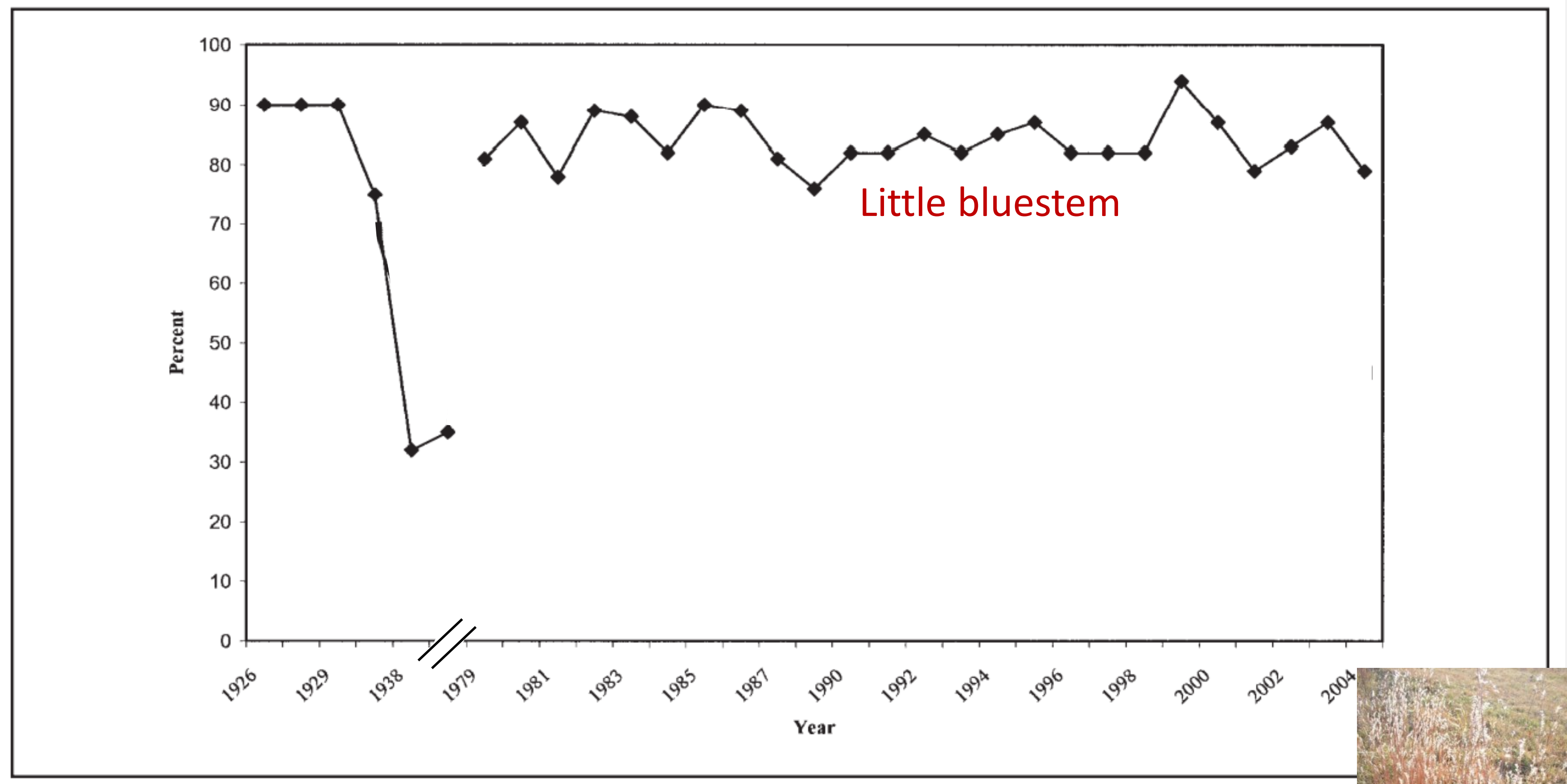
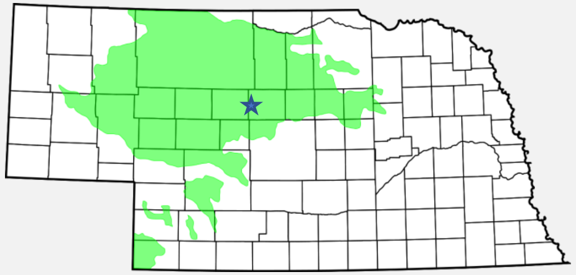


Figure 3. Frequency (%) of *Schizachyrium scoparium* (Scsc) and *Bouteloua hirsuta* (Bohi) during the period of 1926 to 2004.

"Seventy-eight years of vegetation dynamics in a Sandhills Grassland" Stubbendieck and Tunnel 2008

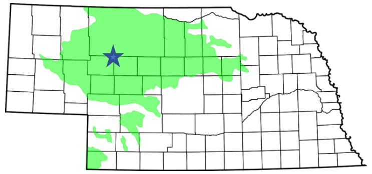
"…before the great drought of 1933-1940, [Little bluestem] was the most frequent and abundant of the grasses in the Sand-hills landscape. But its losses by drought, which were 90 to 100 percent, equaled or exceeded those in true prairie"

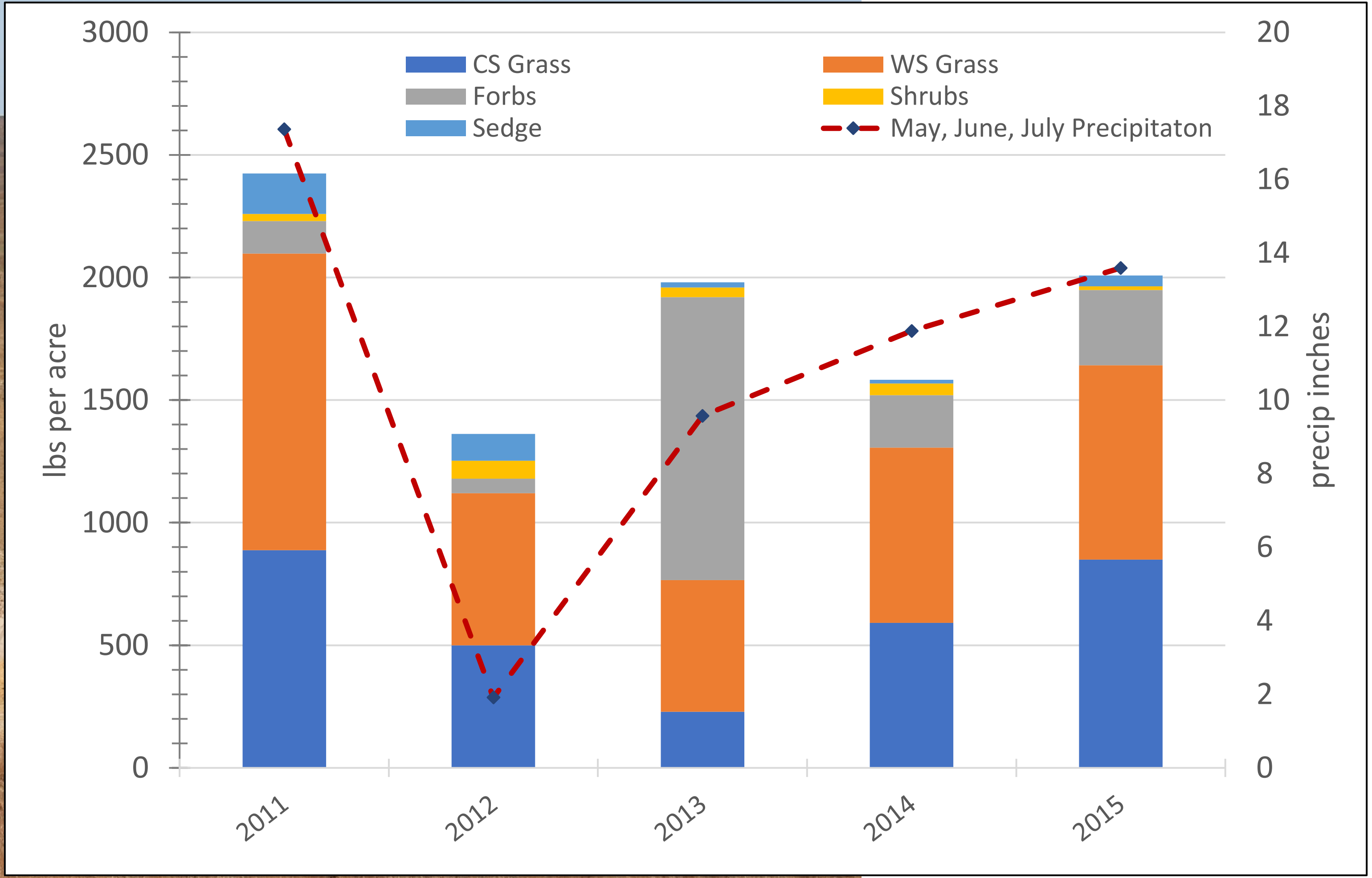
"Native vegetation of Nebraska" - J. E. Weaver 1965



2012 Drought in the Sandhills

August 2012





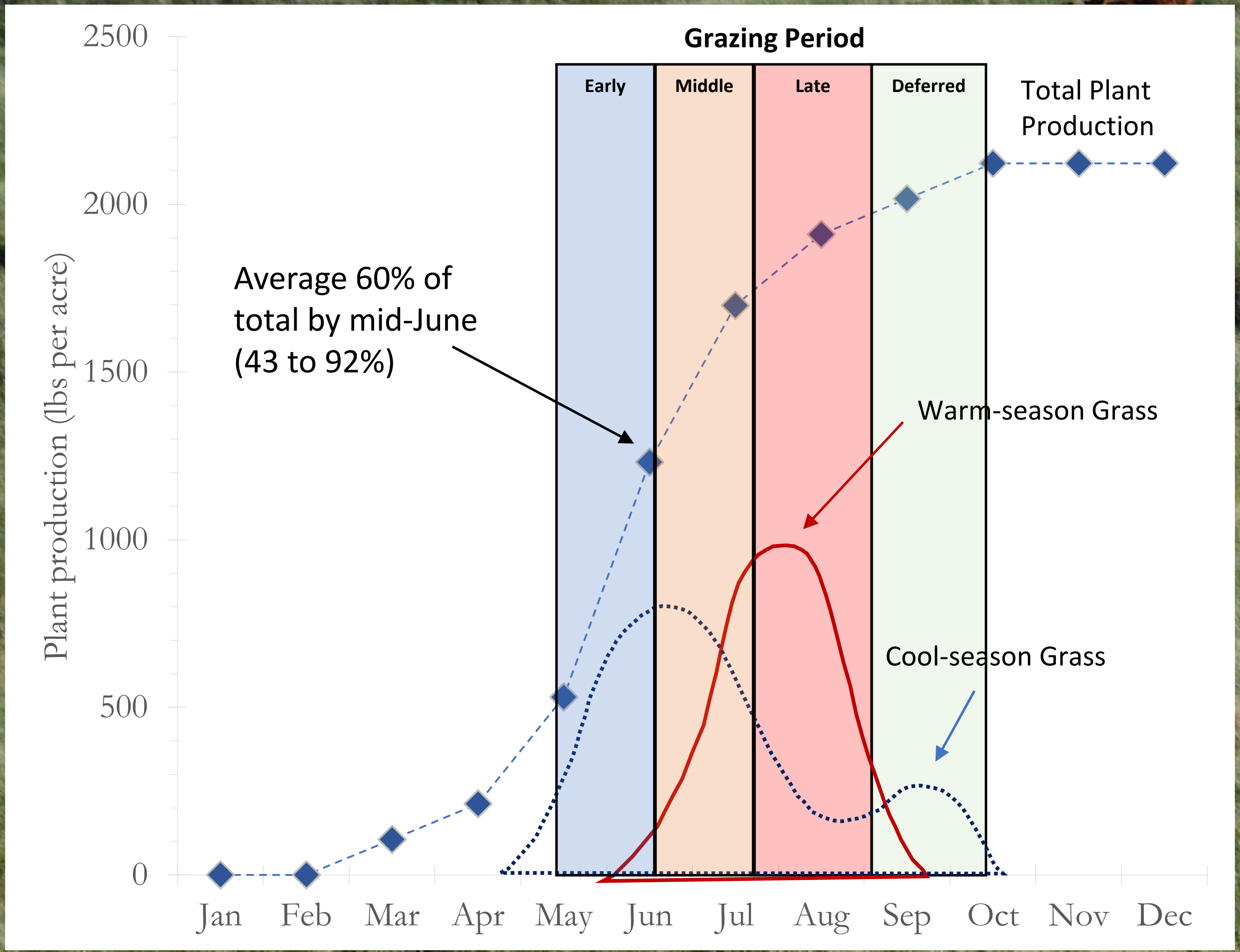
August 2013

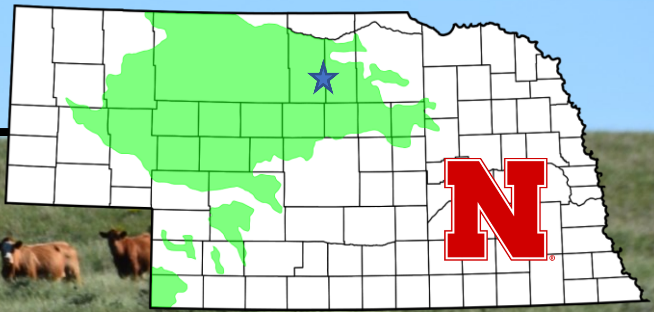
- Total plant production in 2012 was 75% of average
- 2013
  - Forb - 60% of the total biomass
  - CS grasses - 42% of average
  - WS grasses - 60% of average
- Reduced vigor of perennial species and increased nitrates in the soil
- Post drought management
  - Important to consider what the plant community if telling us in years following drought

Slide credit: Dr. Jerry Volesky

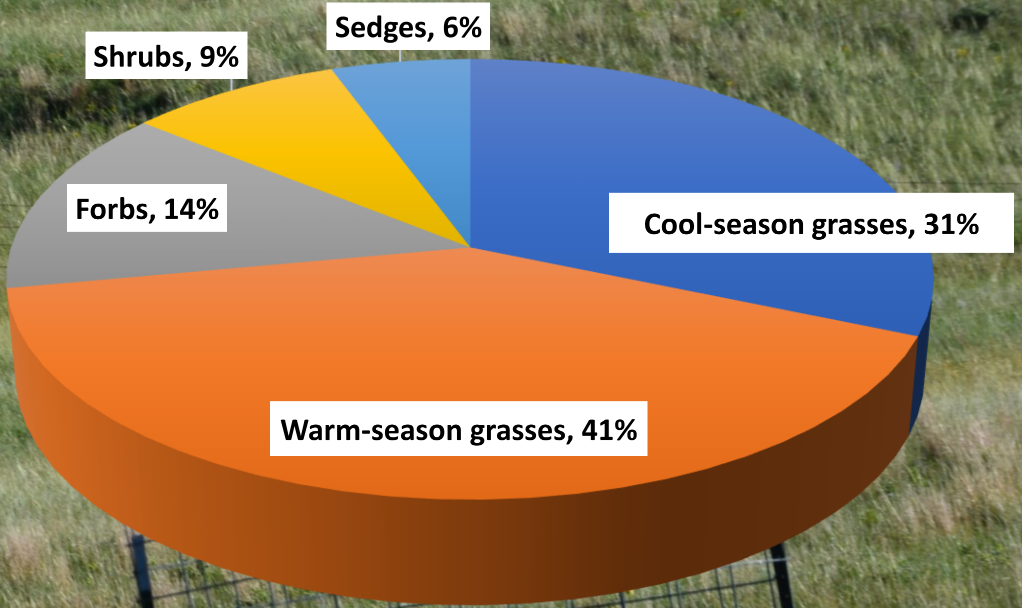
Rangeland response during drought

Plant production growth curve and grazing periods (2001 – 2022)

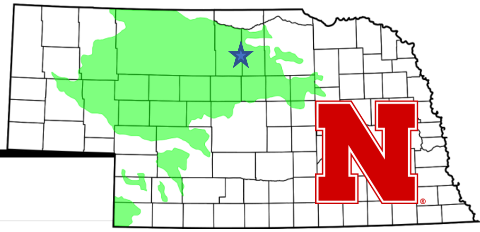


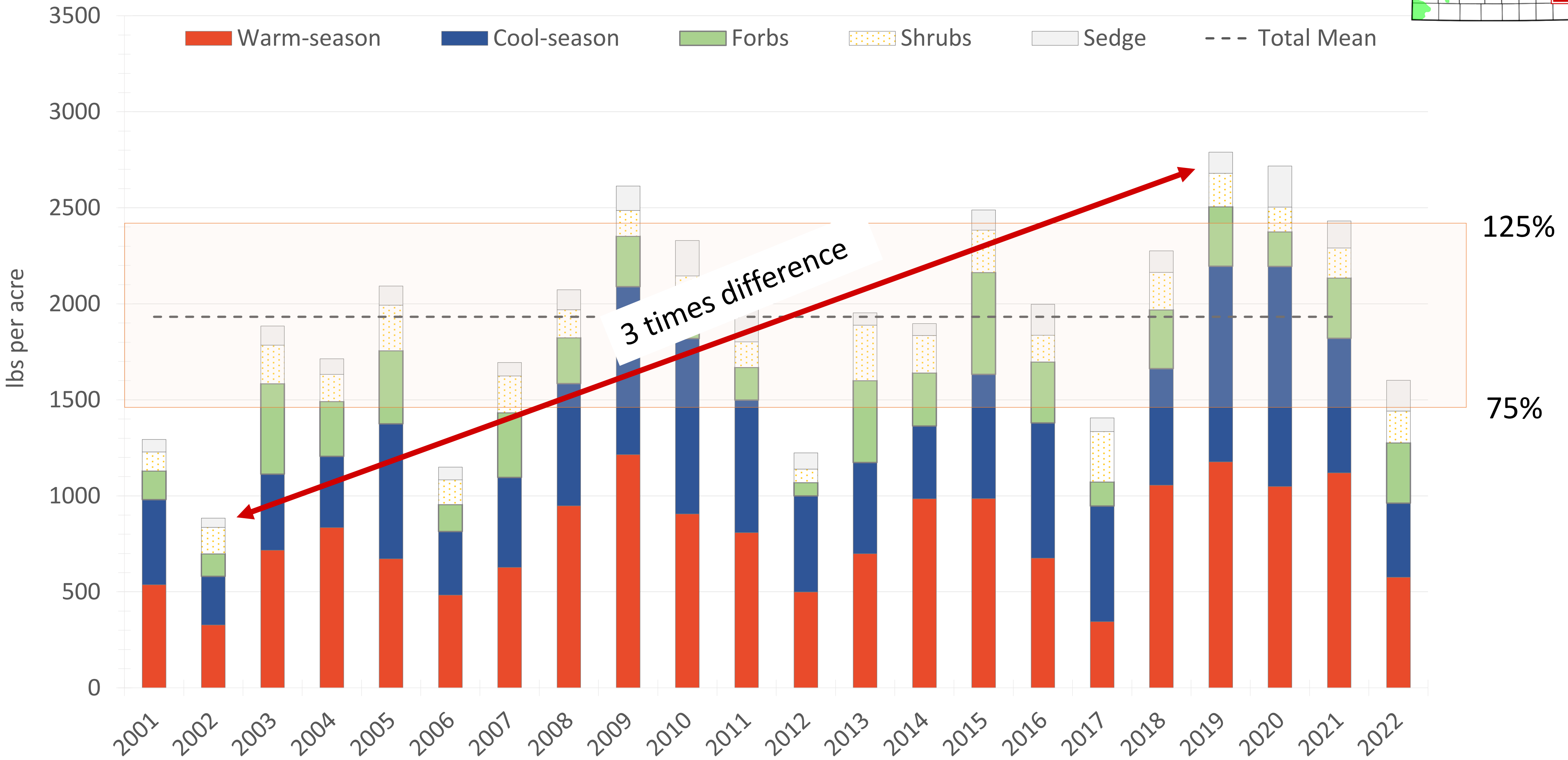


UNL Barta Brothers Ranch (BBR)

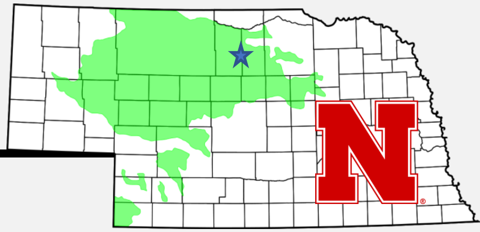


Plant production at BBR

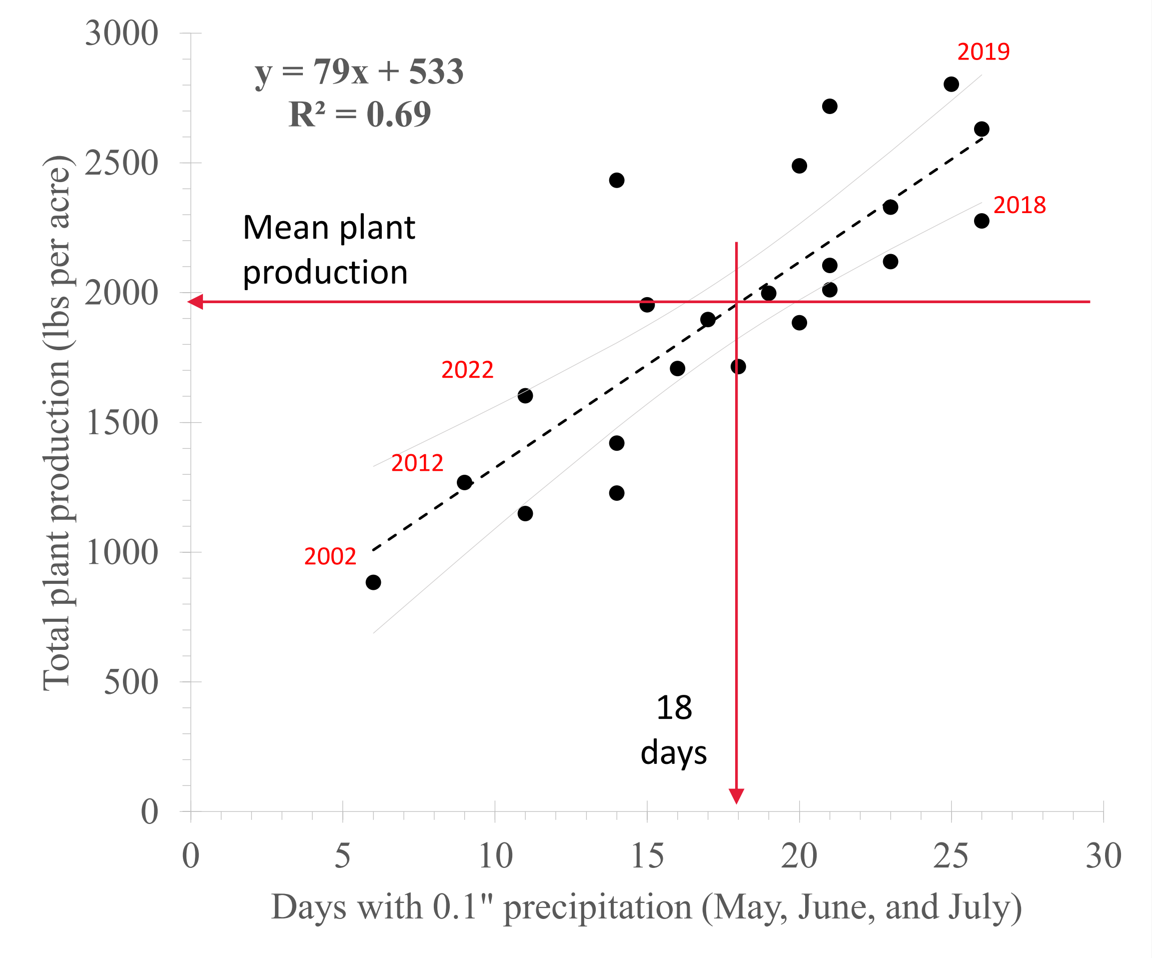




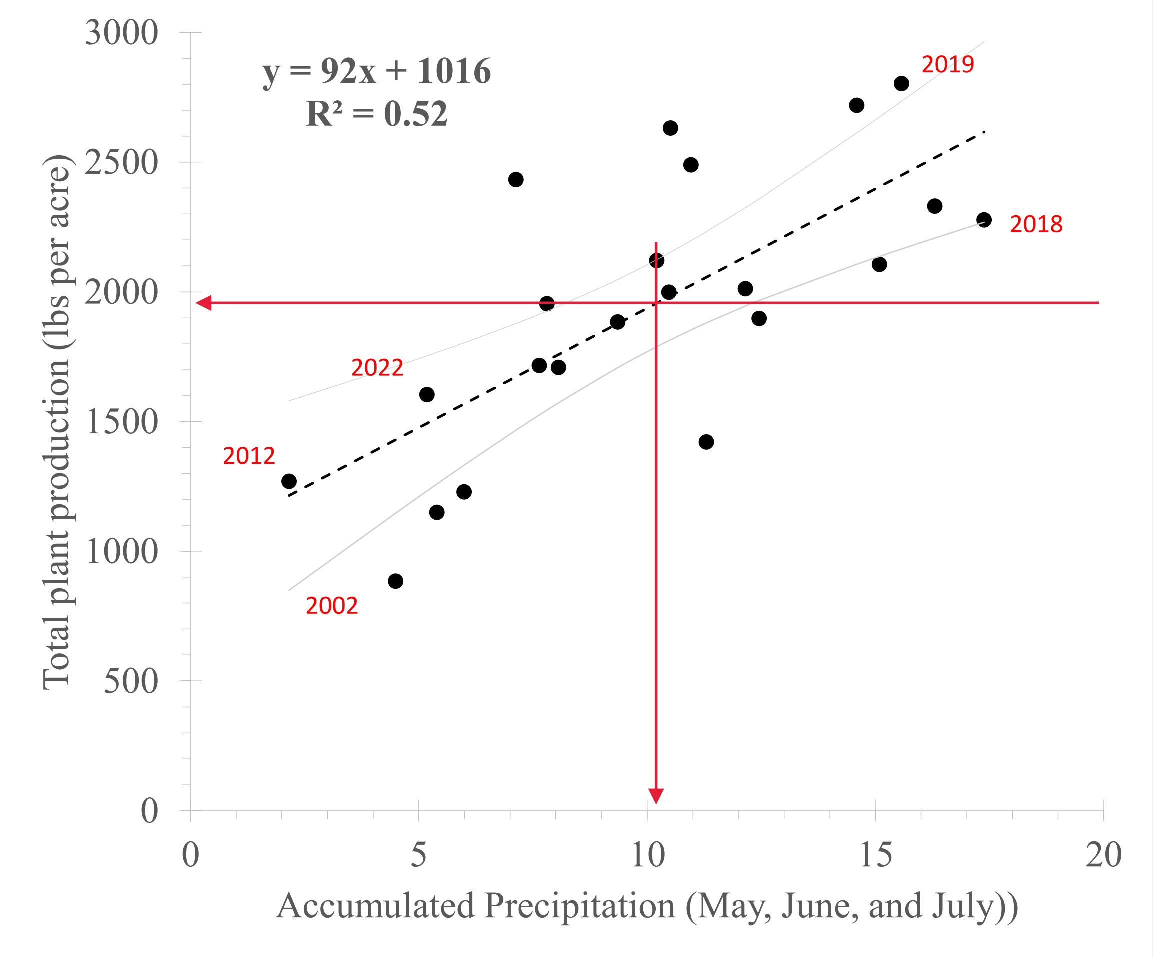
Precipitation : Plant Production Relationship



Number of days with 0.1” precipitation

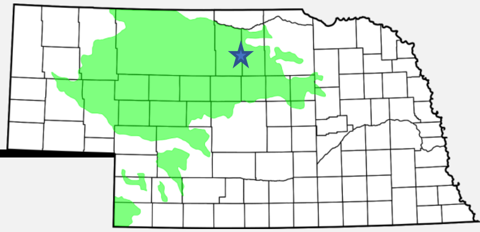


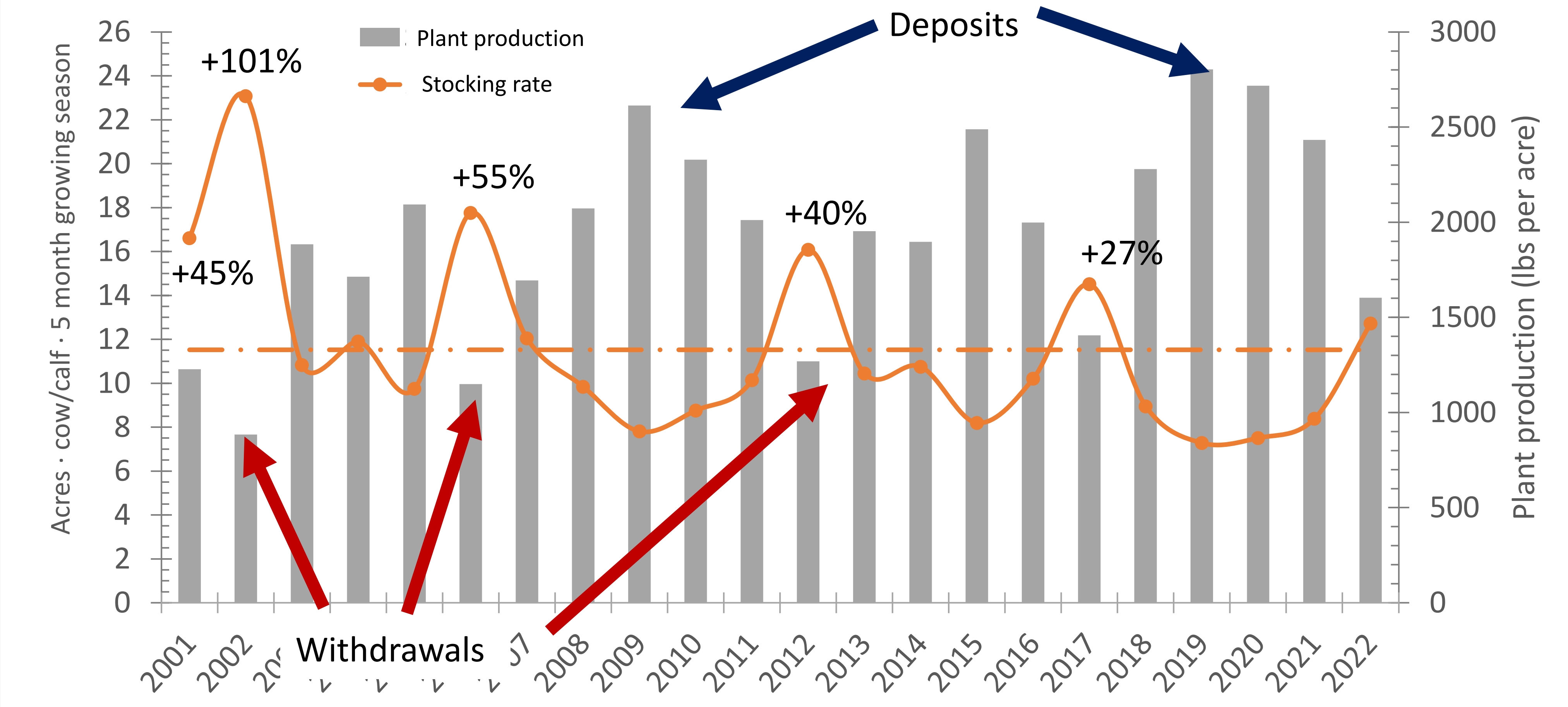
Total Precipitation



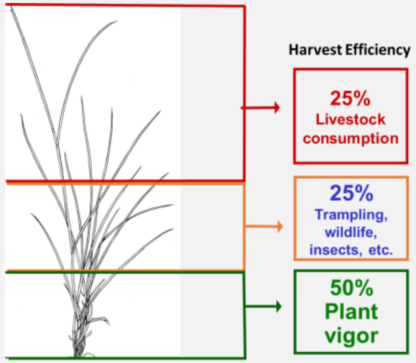
2001 to 2022

Estimated stocking rate at BBR



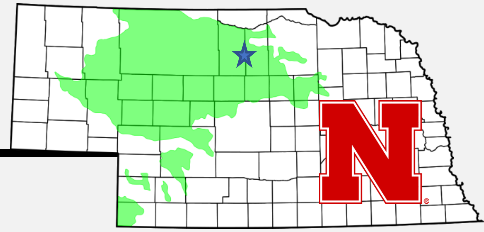


- **5-month grazing season**
- **1,932 lbs per acre**
- **0.71 AUMs per acre**
- **Pair = 1.5 AUE per month**



- Flexibility is Critical

May, June, July Precipitation



	Days with 0.1" precipitation				Total Precipitation inches			
Year	May	June	July	Sum	May	June	July	Sum
2001	6	4	4	14	3.14	1.51	1.34	5.99
2002	2	3	1	6	2.47	1.76	0.26	4.49
2003	6	8	6	20	2.88	4.23	2.24	9.35
2004	4	8	6	18	3.09	2.32	2.23	7.64
2005	8	10	5	23	4.67	4.79	0.75	10.21
2006	1	7	3	11	0.39	3.71	1.3	5.4
2007	8	5	3	16	4.13	3.17	0.76	8.06
2008	8	7	6	21	6.5	3.85	4.74	15.09
2009	7	11	8	26	2.74	4.82	2.95	10.51
2010	6	11	6	23	3.43	10.54	2.33	16.3
2011	6	9	6	21	3.72	5.91	2.52	12.15
2012	4	4	1	9	1.39	0.47	0.30	2.16
2013	7	5	3	15	2.76	4.3	0.75	7.81
2014	4	9	4	17	0.87	9.12	2.46	12.45
2015	10	6	4	20	3.41	4.49	3.06	10.96
2016	7	4	8	19	4.08	1.82	4.58	10.48
2017	7	2	5	14	6.02	0.39	4.89	11.30
2018	8	10	8	26	5.57	6.51	5.3	17.38
2019	14	6	5	25	7.1	4.15	4.32	15.57
2020	8	4	9	21	3.69	5.2	5.7	14.59
2021	5	5	4	14	2.1	2.3	2.73	7.13
2022	5	2	4	11	2.39	0.76	2.03	5.18
75%	4.8	4.8	3.7	13.2	2.6	2.9	2.0	7.5
Average	6.4	6.4	4.9	17.6	3.5	3.9	2.6	10.0
125%	8.0	8.0	6.1	22.0	4.3	4.9	3.3	12.5

- Wet May-July can compensate for a dry winter
- Uncommon for July to "make up" precipitation amounts for a dry May and June
- In **2012**, July would have needed to have **10** events and **8.14** inches of precipitation to bring precipitation to average
- Flash drought in 2017 – late-May to early July < 10% of normal precipitation
- Early trigger dates are key in a drought plan.

Drought Planning for the Ranch

Steps	Drought Planning Steps	Ranch inventory	Ranch Monitoring
1	Identify planning partners and establish communication	Rainfall history/precipitation patterns	Precipitation
2	Identify ranch vision and objectives	Livestock numbers/stocking rates	Range condition
3	Inventory ranch resources	Pasture resources	Forage production
4	Understand drought risks and benefits	Feed availability and needs	Livestock production and health
5	Define and monitor drought	Production potential/stocking capacity	Feed and livestock markets
6	Identify critical dates for making decisions	Financial resources	Water resources
7	Identify strategies to implement before drought	Personnel resources	Ranch finances
8	Identify strategies to implement during drought		
9	Identify strategies to be implemented after drought		
10	Monitor and evaluate the drought plan		

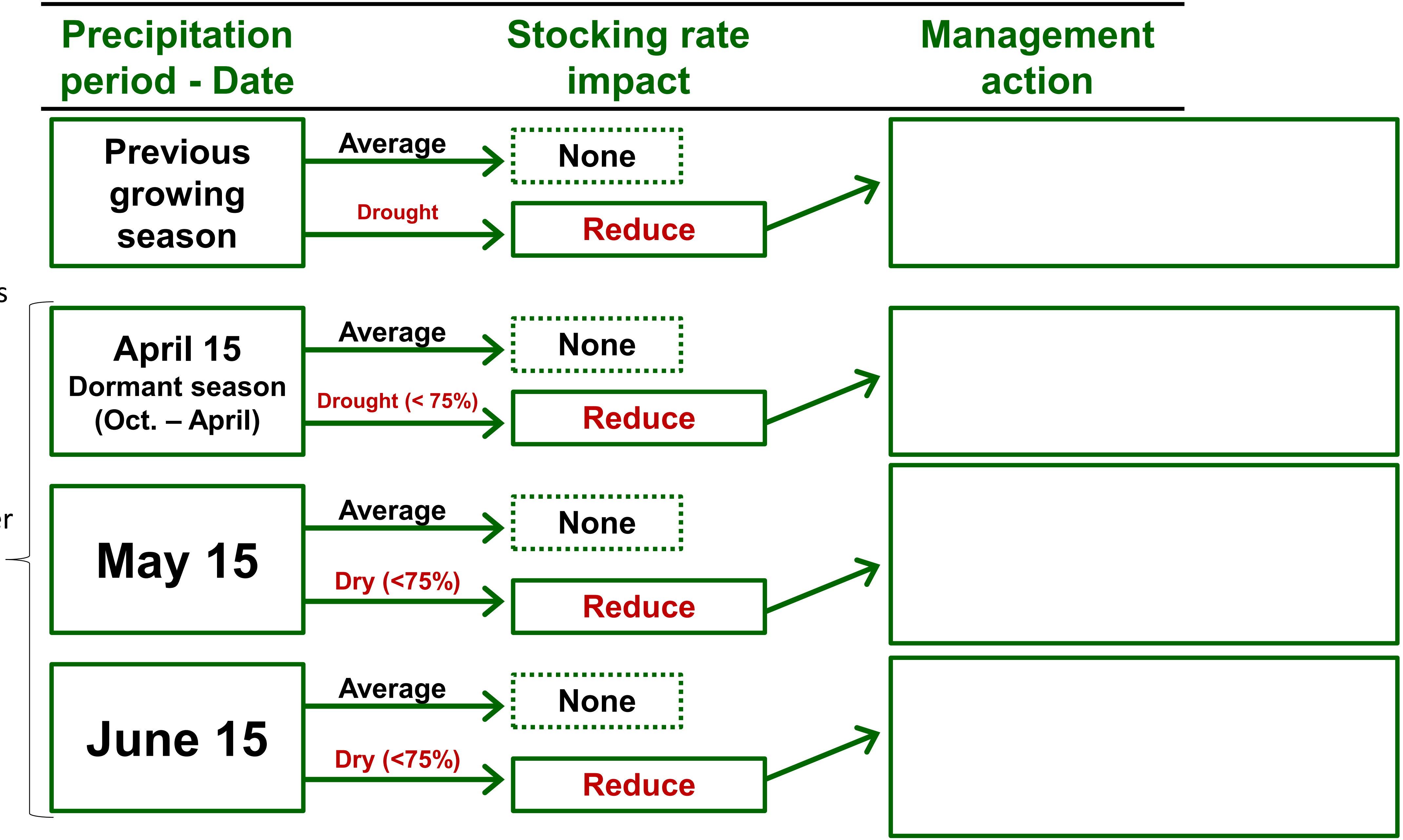
https://drought.unl.edu/ranchplan/

ONE SIZE DOES NOT FIT ALL!

Knutson and Haigh 2013 – A drought-planning methodology for ranchers in the Great Plains

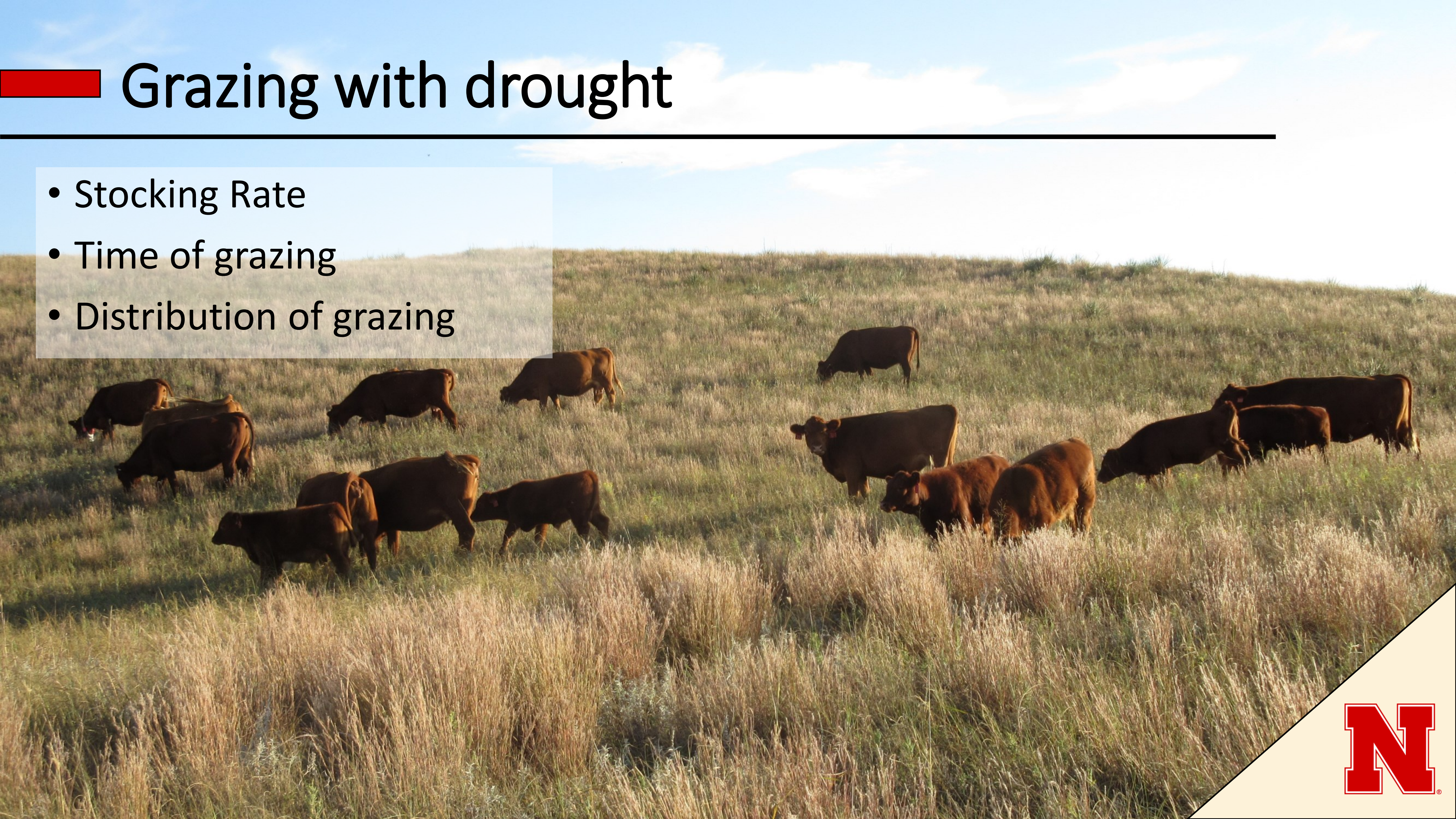
Example critical date and action flow plan.

- Global weather patterns
- Sea surface temperatures
- Regional Climate predictions
- Local weather reports
- Grazing pressure
- Pasture conditions



Grazing with drought

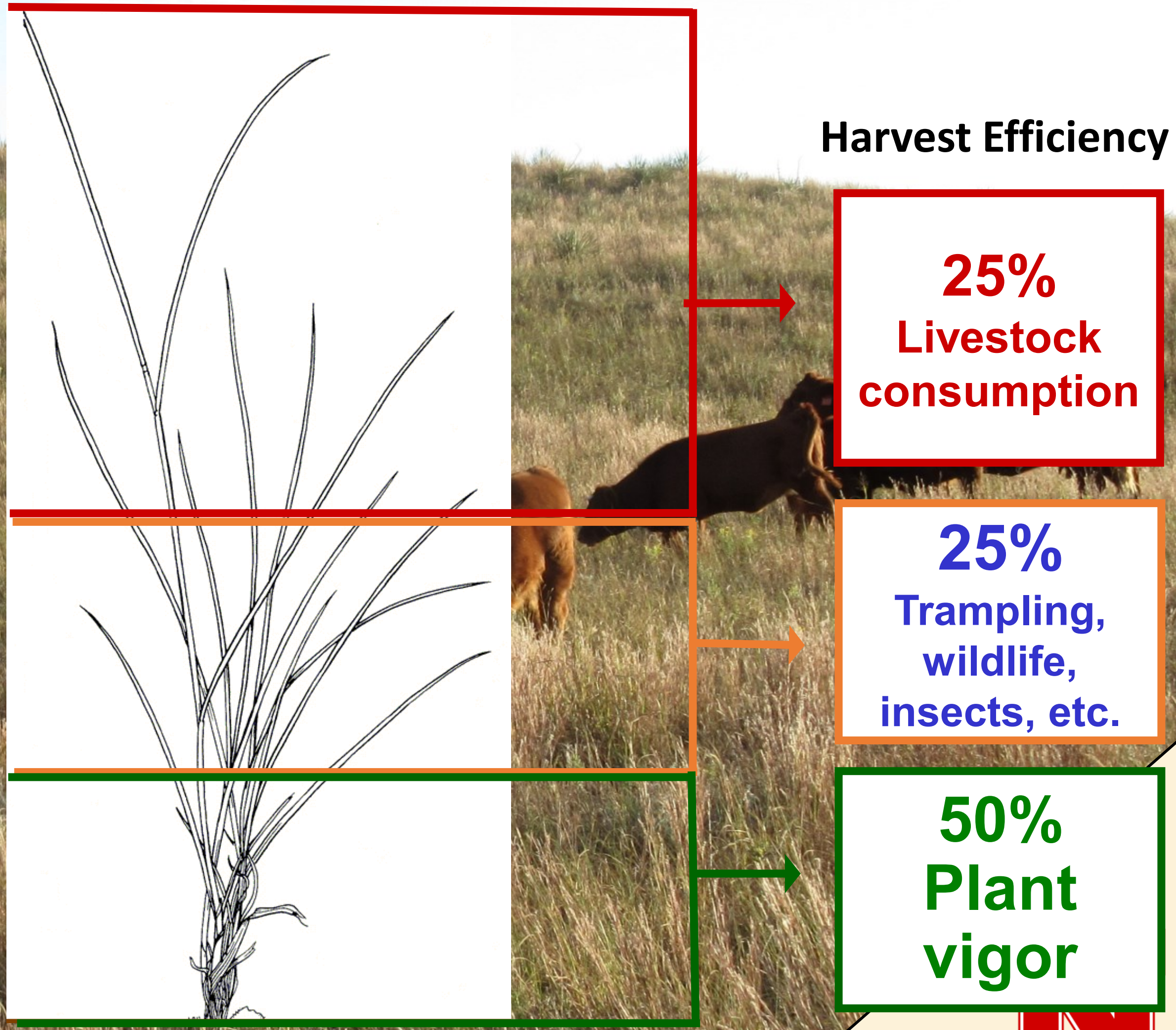
- Stocking Rate
- Time of grazing
- Distribution of grazing



Grazing with drought

Stocking Rate

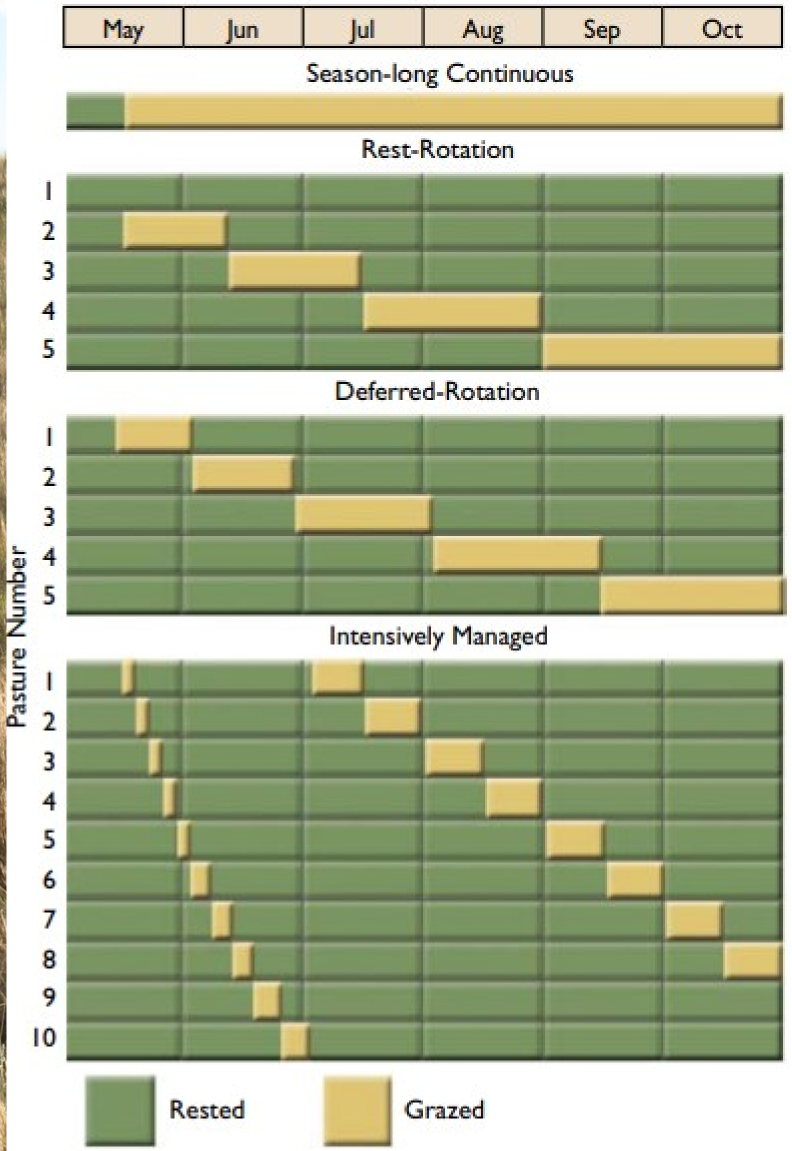
- Relationship between livestock and the forage resource
- Number of animals units grazing on a given amount of land for a specified time
- Take half – Leave half
- Leave enough leaf material
  - Photosynthesis
  - Ground cover
  - Structure
- Adequate recovery
  - Growing season
  - Dormant season



Grazing with drought

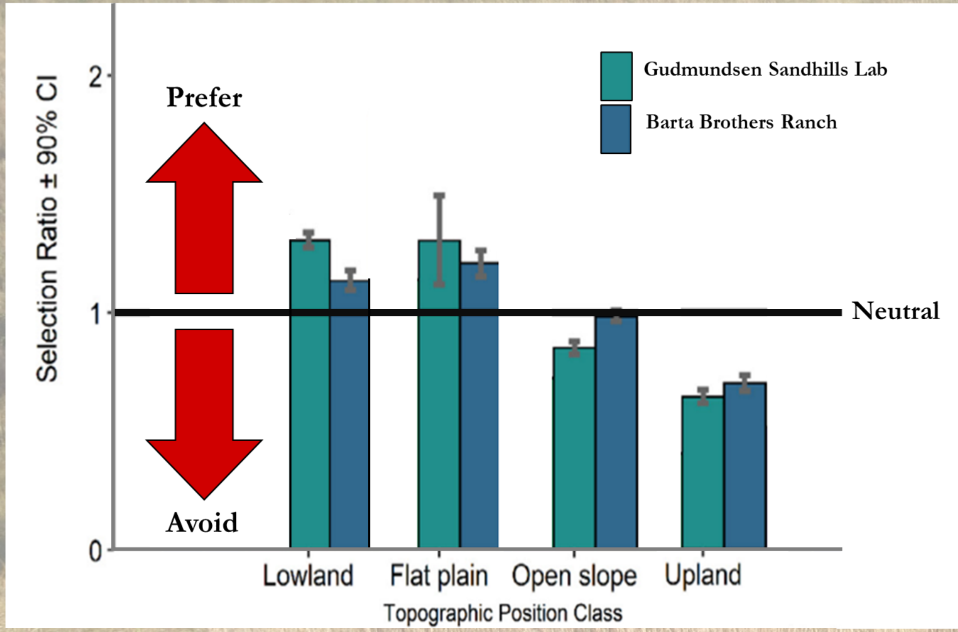
<u>Timing of grazing</u>

- Only 60% of root length for Sand bluestem when heavy defoliations occurred during June and August (Engel et al. 1998)
- Reduced subsequent year warm-season grass production when grazing occurred during elongation period (Stephenson et al. 2015)

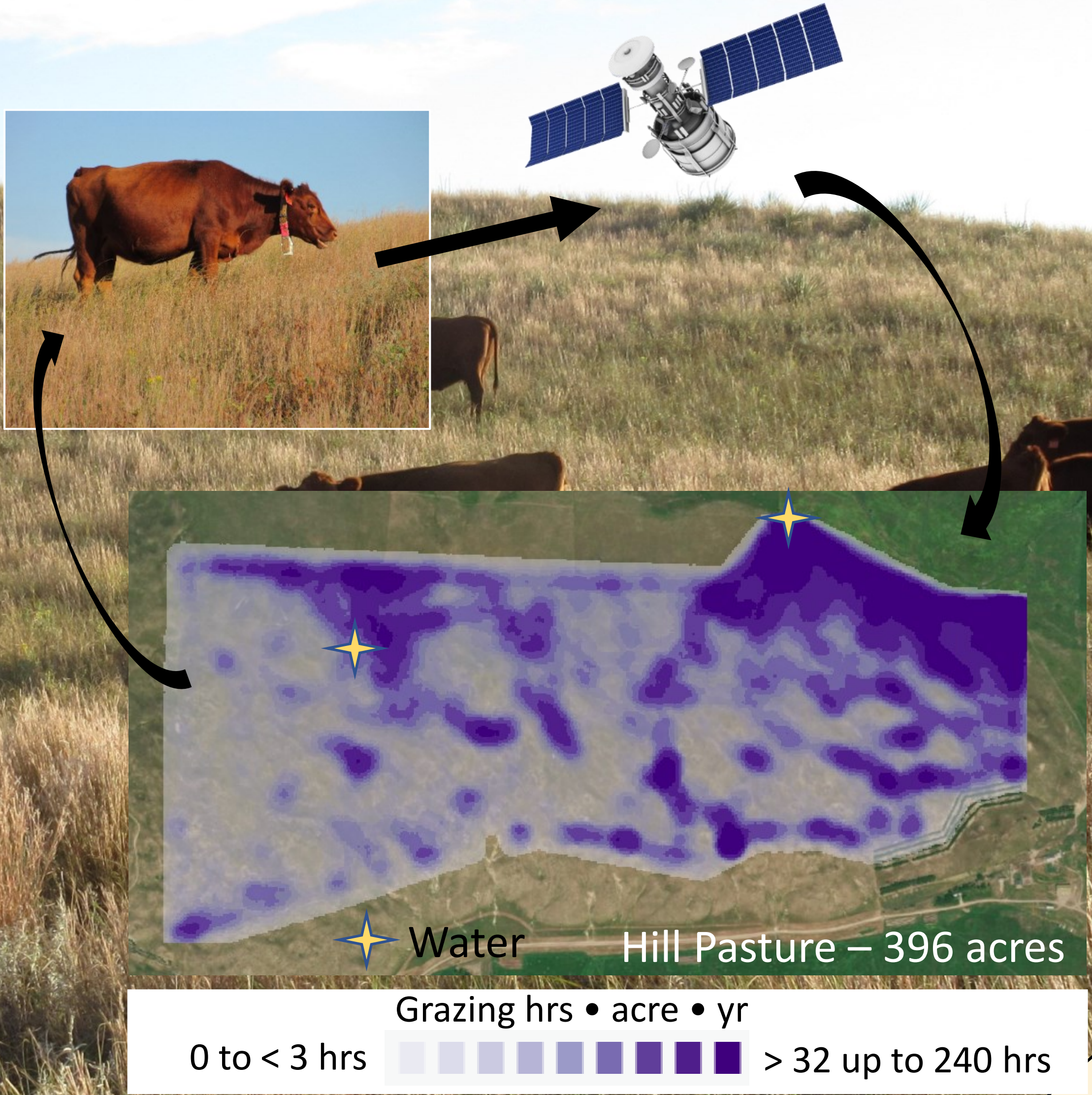


Grazing with drought

Distribution



Raynor et al. 2020 – Grazing distribution patterns related to topography



Resources

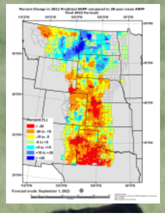
Rangeland Analysis Platform
rangelands.app

National Drought Mitigation Center
droughtmonitor.unl.edu

High Plains regional climate center
hprcc.unl.edu

Drought Risk Atlas
droughtatlas.unl.edu

EDIT
Ecosystem Dynamics Interpretive Tool
edit.jornada.nmsu.edu



Grassland Productivity Forecast
grasscast.unl.edu

Climate Prediction Center
CPC.NCEP.NOAA.GOV

THE UNIVERSITY OF ARIZONA | CALS COOPERATIVE EXTENSION
cals.arizona.edu/droughtandgrazing/tools

Institute of Agriculture and Natural Resources
UNL BEEF
beef.unl.edu/cattleproduction/drought

PRISM CLIMATE GROUP
prism.oregonstate.edu

Rangeland response during drought

"The man with the bare-looking range needs a rain the most, but when the rain comes he will get less benefit from it than the man whose range is covered with forage. "

E. J. Dyksterhuis, Regional Range Conservationist, Soil Conservation Service, Lincoln, NE 1951 "Use of Ecology on Range Land"

Questions

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