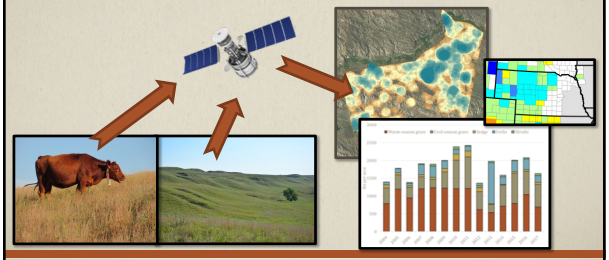
USING TECHNOLOGY TO BETTER UNDERSTAND RANGELAND AND CATTLE GRAZING DYNAMICS



MITCH STEPHENSON – UNL RANGE MANAGEMENT SPECIALIST

PRECISION AG TOOLS

- Variable Rate Technology
- Soil and crop yield mapping
- Computer based farm planning
- Remote sensing

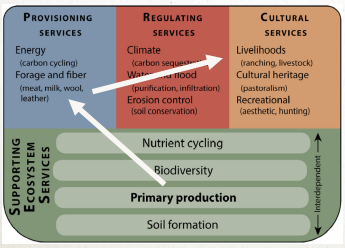
TECHNOLOGY TO ASSIST MANAGEMENT

- How much grass will I have this growing season?
- Has my vegetation cover shifted over time?
- Where are my cattle grazing?
- What are my cattle eating?

WHY IS IT IMPORTANT?

- **Ecosystem Services** provided by rangelands

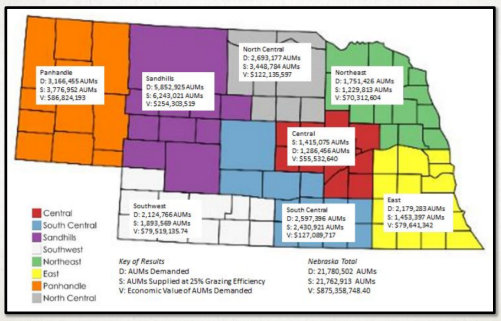
"Important benefits for humans that arise from healthy functioning ecosystems"



Robinson et al. 2019. Patterns of rangeland productivity and land ownership: Implications for conservation and management. Ecological Applications e01862

WHY IS IT IMPORTANT?

- Grazing Economic Value = $875 million in 2017

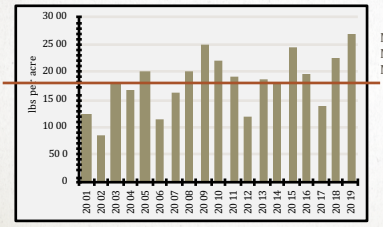


Cumming et al. 2019. Examining the capacity of Nebraska rangelands for cattle production. Western Economics Forum 17:46-61

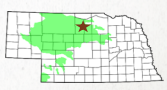
HOW MUCH GRASS WILL I HAVE THIS GROWING SEASON?

- "Ranching is a challenging and sometimes risky business, in part because highly variable seasonal weather patterns from year to year can cause rapid swings between boom and bust forage production."

– Reeves et al. 2015

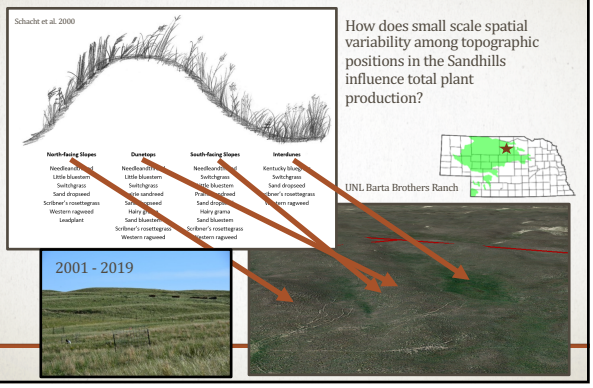


Min = 867 lbs per acre (2002)
Mean = 1800 lbs per acre
Max = 2665 lbs per acre (2019)



UNL Barta Brothers Ranch

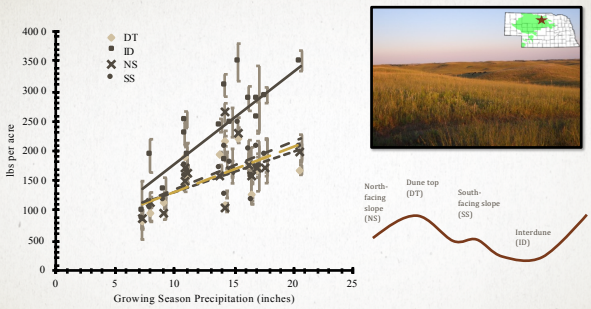
TEMPORAL AND SPATIAL VARIABILITY



How does small scale spatial variability among topographic positions in the Sandhills influence total plant production?

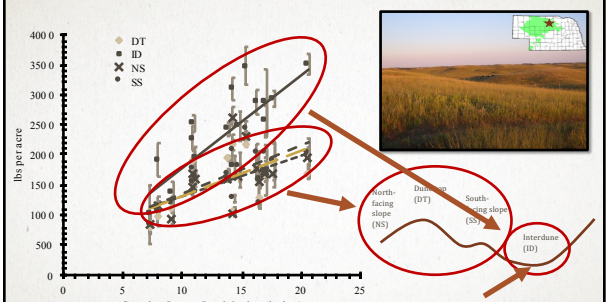
UNL Barta Brothers Ranch

TEMPORAL AND SPATIAL VARIABILITY



Stephenson et al. 2019 – Influence of precipitation on plant production at different topographic position in the Nebraska Sandhills

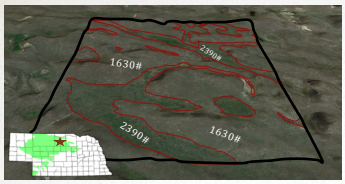
TEMPORAL AND SPATIAL VARIABILITY



Cool-season grasses especially sensitive to increases in soil moisture in wet years

Stephenson et al. 2019 – Influence of precipitation on plant production at different topographic position in the Nebraska Sandhills

SPATIAL AND TEMPORAL VARIABILITY



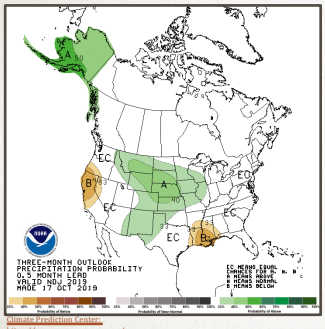
At the pasture scale, accounting for plant production differences by topographic positions can aid in better matching forage supply with livestock demand.

- Influences grazing distribution and use

- High uncertainty in plant production early in the growing season
  - **Tool #1 GRASS-CAST**

Stephenson et al. 2019 – Influence of precipitation on plant production at different topographic position in the Nebraska Sandhills

WEATHER-RELATED DECISION MAKING – GRASS-CAST



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

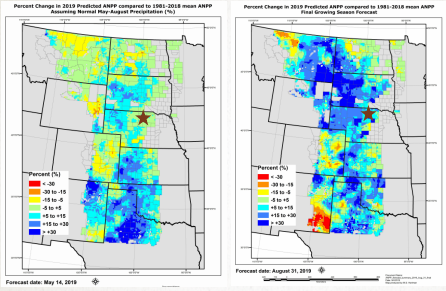
The "Grass-Cast" Procedure

1. **Observed** weather + **Forecasted** weather
2. **Evapotransp.** for the growing season
3. **Greeness** for the season
4. **Lbs/Acre** of Veg for season

http://grasscast.agsci.colostate.edu/

USDA Northern Plains Climate Hub U.S. DEPARTMENT OF AGRICULTURE | NATIONAL DROUGHT MITIGATION CENTER | COLORADO STATE UNIVERSITY

WEATHER-RELATED DECISION MAKING – GRASS-CAST



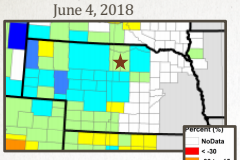
May 14, 2019 August 13, 2019

1. Real time data analysis of how current weather variables are likely to influence forage production
2. Projections into the summer on how different scenarios may play out
3. Early detection of drought

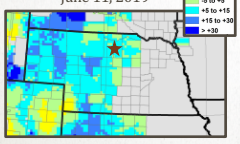
http://grasscast.agsci.colostate.edu/

DOES IT WORK?

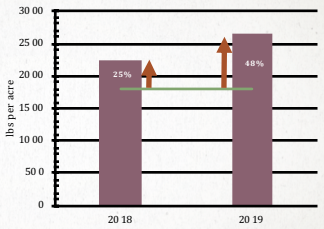
June 4, 2018



June 11, 2019



Barta Brothers Ranch 2018 and 2019



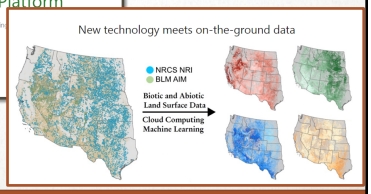
Use GRASS-CAST with visual observation and local weather data!

http://grasscast.agsci.colostate.edu/

HAS MY VEGETATION COVER SHIFTED OVER TIME?

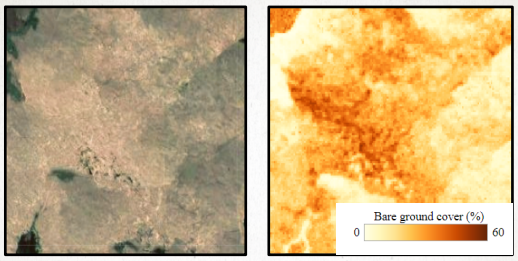
Tool #2: Rangeland Analysis Platform

- Satellites (every 16 days)
- 30 m resolution
- 1984 – present
- Annual, perennial, tree, shrub, and bare ground cover



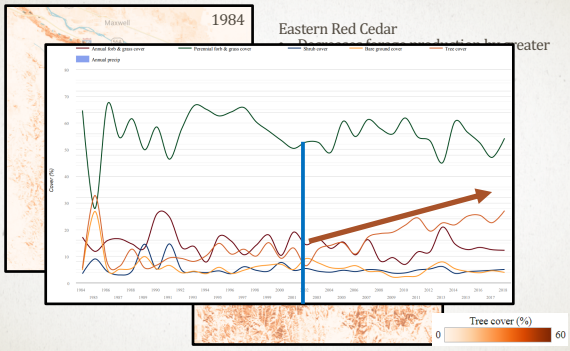
Jones, M.O., et al. 2018. Innovation in rangeland monitoring: annual, 30m, plant functional type percent cover maps for US rangelands, 1984–2017. Ecosphere 10.1002/ecs2.2430

VEGETATION COVER AT 30 M PIXEL ACROSS THE WESTERN USA

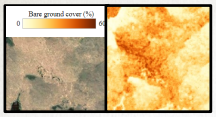


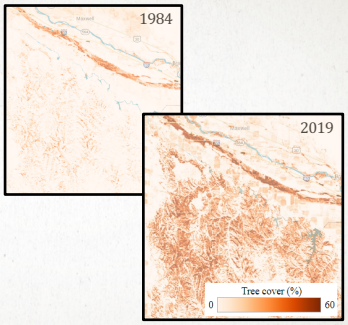
Ground Cover - A key indicator of Rangeland Health

VEGETATION COVER AT 30 M PIXEL ACROSS THE WESTERN USA



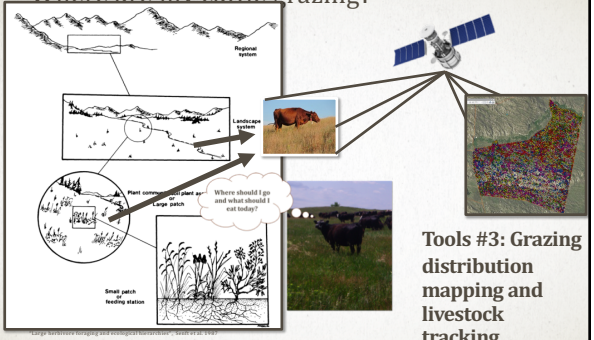
VEGETATION COVER AT 30 M PIXEL ACROSS THE WESTERN USA





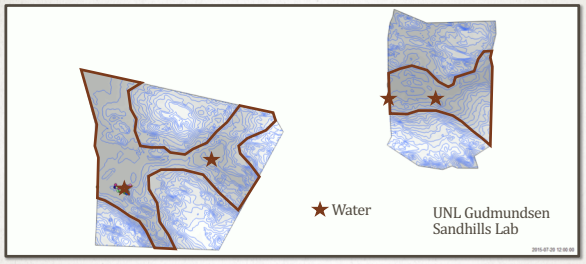
- The first time we have had the ability to get this much rangeland monitoring data at this spatial and temporal scale
- Use with on-the-ground monitoring!

Where are my cattle grazing?



Tools #3: Grazing distribution mapping and livestock tracking

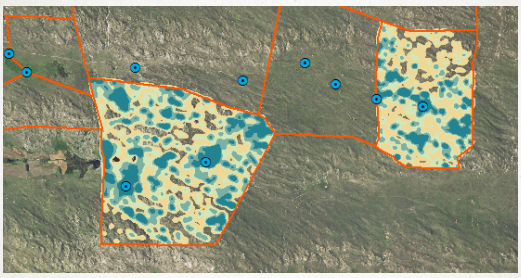
CATTLE BEHAVIOR AND SELECTIVITY



Heifer Pasture (1140 acres)

East Cow Pasture (642 acres)

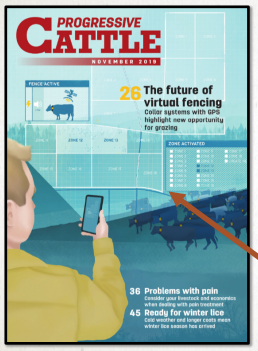
CATTLE BEHAVIOR AND SELECTIVITY



Heifer Pasture (1140 acres)

East Cow Pasture (642 acres)

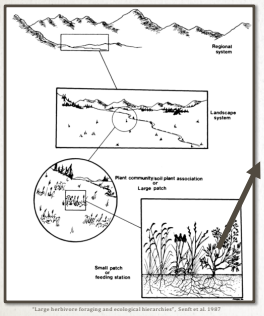
CATTLE BEHAVIOR AND SELECTIVITY



- GPS collars $1000s to less than $100
- Ear tags also look promising
- **Detection**
  - Algorithms associated with movement (think FitBit)
  - Health
  - Calving
  - Heat
  - Water use

- **Virtual Fence**
  - Goal of $10 per head for virtual fence collars for cattle.

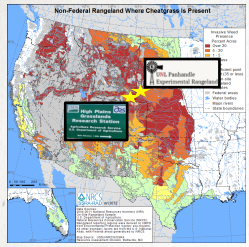
What are my cattle eating?



Tool #4: Determining diet composition

Targeted grazing to control cheatgrass in mixed-grass rangeland

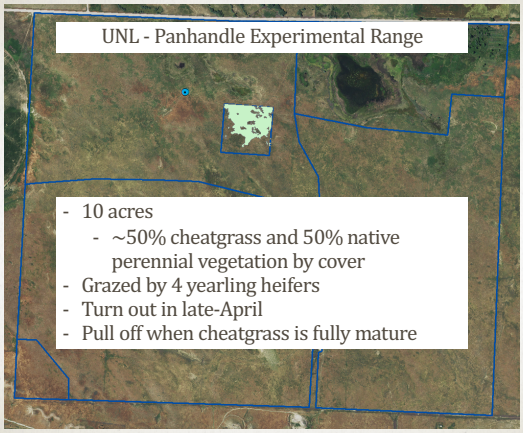
Dana Blumenthal, Mitch Stephenson, Justin Derner, David Augustine, Lauren Porensky, Julie Kray



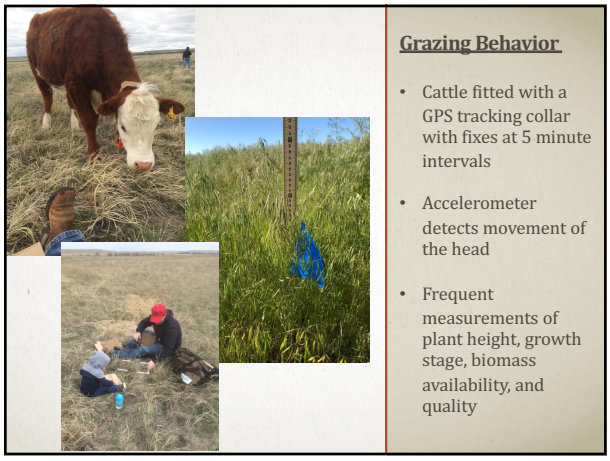
USDA Agricultural Research Service

Nebraska Lincoln

UNL - Panhandle Experimental Range

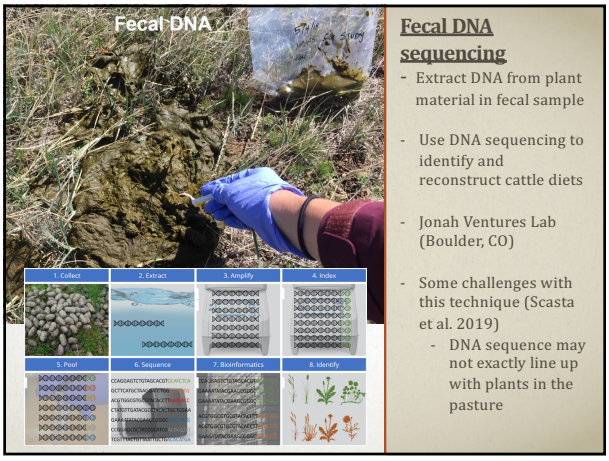


- 10 acres
  - ~50% cheatgrass and 50% native perennial vegetation by cover
- Grazed by 4 yearling heifers
- Turn out in late-April
- Pull off when cheatgrass is fully mature



Grazing Behavior

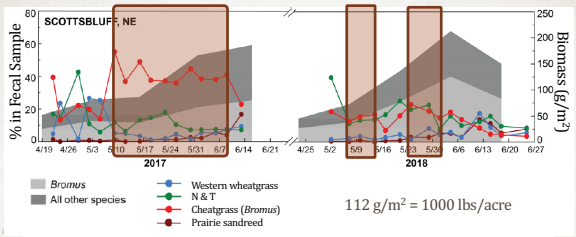
- Cattle fitted with a GPS tracking collar with fixes at 5 minute intervals
- Accelerometer detects movement of the head
- Frequent measurements of plant height, growth stage, biomass availability, and quality



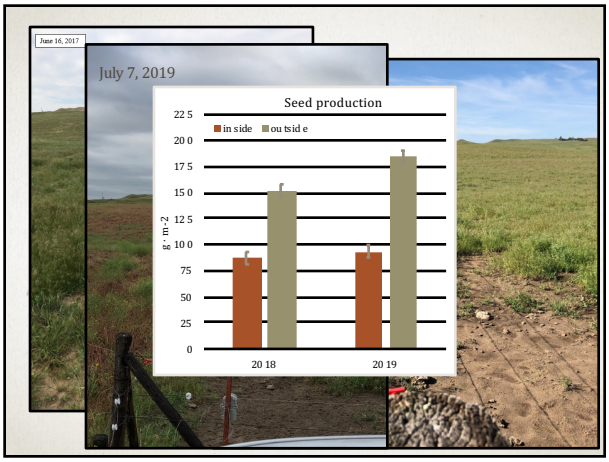
Fecal DNA sequencing

- Extract DNA from plant material in fecal sample
- Use DNA sequencing to identify and reconstruct cattle diets
- Jonah Ventures Lab (Boulder, CO)
- Some challenges with this technique (Scasta et al. 2019)
  - DNA sequence may not exactly line up with plants in the pasture

Biomass and Diet Selectivity



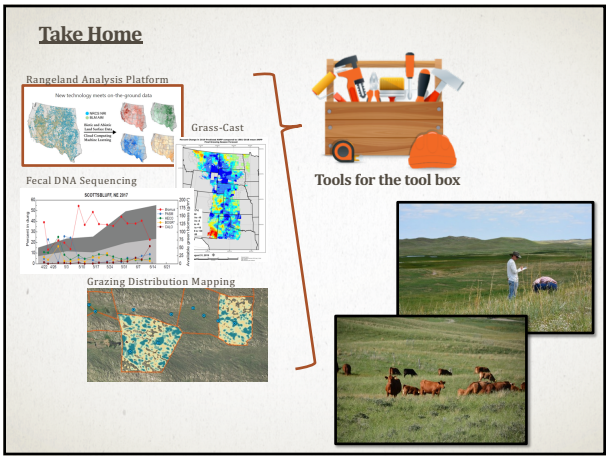
- 2017, high selection from May 10 to early-June
- 2018, lower selectivity & comparable use with needle and thread
- Yearly differences in cheatgrass growth patterns and quality
- DNA sequencing allows us to track selection over time



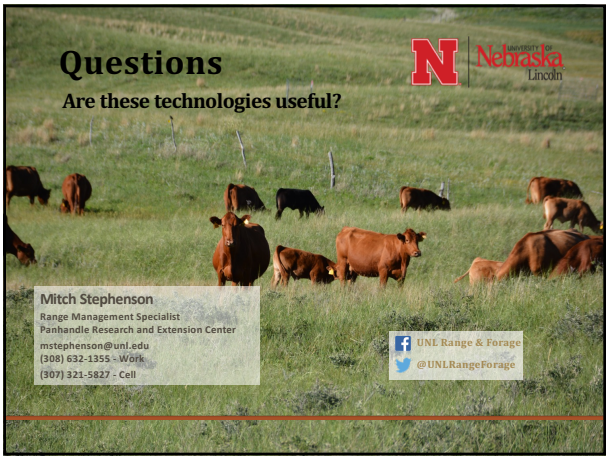
Take Home

- New web-based tools provide decision support for:
  - Predicting plant production (**GRASS-CAST**)
  - Estimating vegetation cover (**Rangeland Analysis Platform**)
- Technology continuously improving for tracking individual animals (**GPS and Behavior Tracking**)
  - Grazing distribution
  - Herd health and well being
  - Will it ever be commercially practical?
- Diet selection tools (**Fecal DNA Sequencing**)
  - Pinpoint species selection at different times
  - Targeted grazing
  - Management for specific species

Take Home




MITCH STEPHENSON
UNL RANGE MANAGEMENT SPECIALIST
PANHANDLE R & E CENTER
307-321-5827
MSTEPHENSON@UNL.EDU
UNL Range & Forage
UNLRangeForage


Questions
Are these technologies useful?
Mitch Stephenson
Range Management Specialist
Panhandle Research and Extension Center
mstephenson@unl.edu
(308) 632-1355 - Work
(307) 321-5827 - Cell
UNL Range & Forage
@UNLRangeForage