Cheatgrass Die-off

Restoration Opportunities?

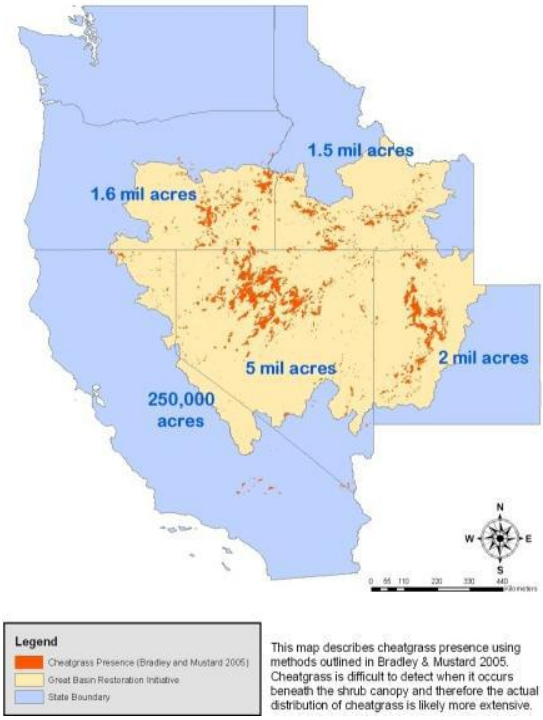


Figure from Don Major, GBRI

Problem

Cheatgrass dominated rangelands currently comprise at least 10 million acres in the Great Basin. In recent decades, die-off of cheatgrass (*Bromus tectorum*) has occurred across relatively large areas in the region. It has been estimated that the area affected around Winnemucca, NV, is about 500,000 acres. Issues associated with die-off include soil erosion, invasion by other weeds like burr buttercup (*Ranunculus testiculatus*) and knapweeds (*Centauria* spp), and a further decline in ecosystem services including air and water quality, wildlife habitat, and livestock forage. Information on the causes and consequences of the die-off can facilitate cheatgrass management, fuels management and fire suppression strategies, and conservation/restoration planning within the region.

Potential Causes

The causes of cheatgrass die-off are largely unknown, and are largely anecdotal at this time. Overtime, cheatgrass or other weedy species (forbs) typically reestablish on the site but timeframes vary. Suggested causes include:

- Multi-year drought
  - Increased die-off in Winnemucca area during recent drought
- Pathogens or insects
  - Die-offs often have distinct boundaries and occur as mosaics
  - Grasshopper herbivory (Meyer et al. 2007)
  - Head smut fungus epidemics (causal agent *Ustilago bullata*) (Meyer 2010)
  - Fungal seed bank pathogen black fingers of death (*Pyrenophora semeniperda*)
    - Likely not causal agent; may be used for control
  - Other fungal or soil pathogens? Soil borne fungal pathogens that can cause seedling blight or rot diseases and prevent stand establishment are likely candidates.
- Interactions among weather/climate patterns and pathogens or insects
  - Die-off occurs primarily on south and west slopes or low-elevation valleys in Winnemucca area.

Photo from Mike Pellant, GBRI

Management Concerns

Photo from Megan Hynes

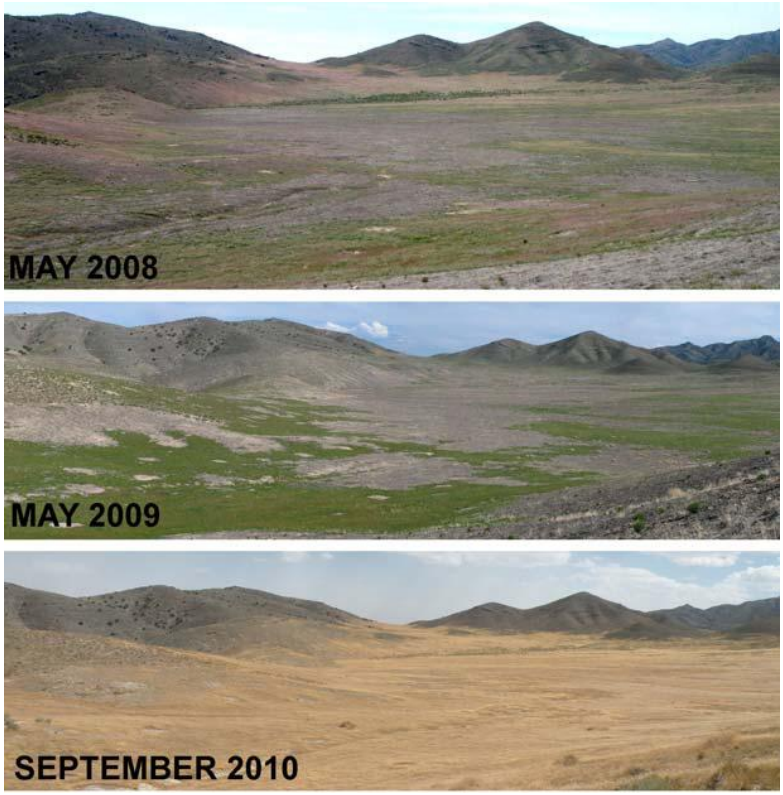
- Where are and what is the extent of the cheatgrass die-off areas?
- What are the causes of this die-off?
- Can we detect trends in the die-off (retraction, expansion, or areas of new occurrences) and can we predict future die-off based on weather/climate patterns?
- What are the successional trajectories of die-off areas over the elevation gradients over which the phenomenon is occurring?
- How does die-off affect soil erosion processes?
- What is the potential for restoration following die-off?

Proposed Research

- Remote sensing to evaluate large-scale locations, extent and trends.
  - Use of Quickbird (2.4 m) which can subsequently be scaled to the Landsat (30 m) and Advanced Wide Field Sensor (56 m) resolutions
  - Bruce Wiley and Collin Homer, USGS EROS, Sioux Falls, ND; Don Major, BLM NIFC and GBRI, Boise, ID)
- Remote sensing using Landsat Imagery to evaluate epidemiology (spatial patterns and dispersion on the landscape over time (1982-2011) and identify causal agents.
  - Peter Weisburg, UNR, Reno, NV
- Survey of intact stands is to identify herbivore and pathogen species that could potentially play a causal role in the die-off phenomenon.
  - Variables include plant community, seed bank, soils, soil microbiota, plant pathogens, vertebrate and invertebrate herbivores.
  - Susan Meyer, RMRS, Provo, UT + Beth Leger, Peter Weisberg, Matt Forester, Julie Beckstead, Zachary Aanderud, Bradley Geary
- Monitoring of incipient die-offs in an attempt to determine causal mechanisms.
  - Variables include plant community, seed bank, soils, soil microbiota, plant pathogens, vertebrate and invertebrate herbivores.
  - Susan Meyer, RMRS, Provo, UT and others.
- Manipulative experiments in dieoffs of different ages and in intact stands that include seeding cheatgrass and native species (Sandberg's bluegrass, squirreltail, sagebrush or shadscale) and monitoring the outcome.
  - Susan Meyer, RMRS, Provo, UT and others.

Restoration Opportunity

- Die-off is an ongoing process and die-off areas represent significant restoration opportunities
  - Nutrient availability increases following die-off
  - Established native perennials benefit from increase in resources
- Methods are needed for rapidly identifying new die-off areas
  - Education of region's managers concerning the problem
  - Reporting system for die-off areas
  - Landsat survey in spring of each year
- Methods are needed for assessing ability of die-off areas to support restoration species
  - Establishment/persistence of annual forbs?
  - Persistence of minimal level of cheatgrass?
  - Seeding trials fall after first identification of die-off area; full seeding in second fall?



Photos from Susan Meyer, RMRS