



Attributes of Fully Functioning Prairie

- Treeless or nearly so
- Extensive
- Full set of disturbance drivers



Post-Settlement North American Grasslands—Change in Drivers

- Vast numbers of free-ranging large native herbivores eliminated by late 19th century
- Controlled grazing by exotic ungulates
- Other change
 - Cultivation
 - Tree planting
 - Fire suppression
 - Decimated wildlife populations
 - Fragmentation and homogenization



Rangeland—Naturally Heterogeneous

Heterogeneity:

- Degree of difference among a set of things (Pickett et al. 2003)
- Variability in vegetation stature, composition, density, and biomass



Heterogeneity Matters

- **Hydrology** –Belnap et al 2005, Ludwig et al. 2000, Eldridge et al 2002
- **Fire behavior** –Fuhlendorf and Engle 2001 - Archibald et al. 2005- Kerby, Fuhlendorf and Engle 2007
- **Grazing patterns** –Senft et al 1987, Stuth 1991, Fuhlendorf and Engle 2004, Fryxell et al. 2005
- **Soil aggregate stability and nutrient cycling** – Herrick et al. 2002, Augustine 2002, Anderson et al. pending
- **Ecosystem stability** –Brown 2003, Holling and Meffe 1996, van de Koppel and Rietkerk 2004
- **Species invasion** –Deutschewitz et al. 2003, Cummings Fuhlendorf and Engle 2007
- **Root of biological diversity** –Christensen 1997, Wiens 1997, Fuhlendorf and Engle 2001, Fuhlendorf et al. 2006



Homogeneity management—

- An agronomic model
- Forage quality and harvest efficiency



Homogeneity management of native grassland



grazing systems



livestock water development



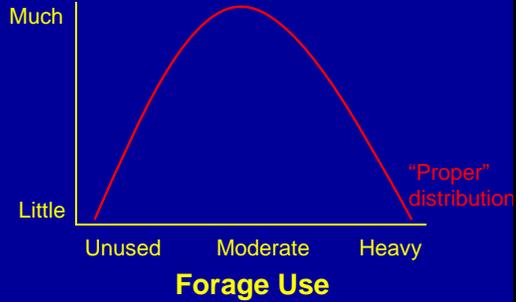
fire

**Manage for Spatial Uniformity of Forage Use:
A Cardinal Principle of Range Management**

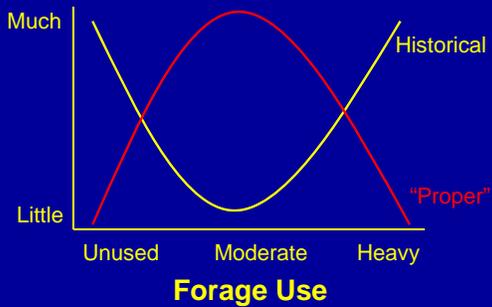
- Addresses degradation via repeated heavy use of attractive areas
- Spatial optimization of forage harvest



Proportion of Grassland Area

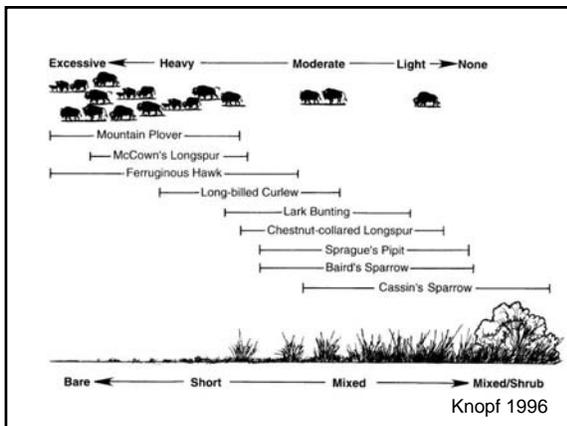


Proportion of Grassland Area

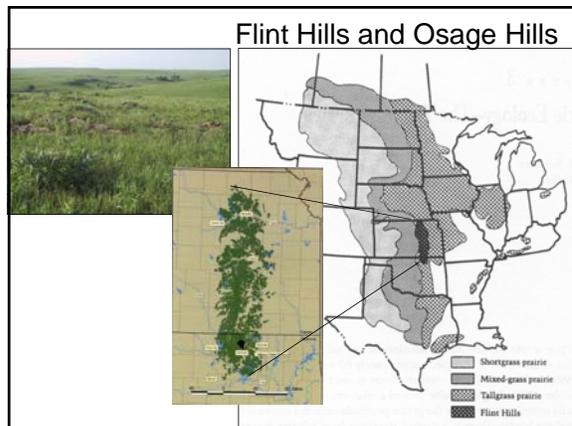


Consequences of Managing for Spatial Uniformity of Forage Use

- Ignores evolutionary history and disturbance processes
- Favors a few preferred species of plants
- Reduces biodiversity



Flint Hills and Osage Hills



Greater Prairie-Chicken

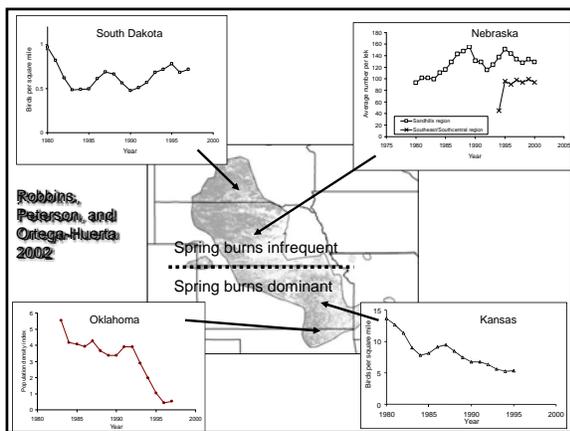
- Indicator species of habitat heterogeneity
- Requires
 - Expansive, treeless grassland
 - Diversity of structure among grassland patches



Prairie-Chicken Habitat

Habitat Requirements	Importance of Disturbance
nesting	minimal
brood rearing	minimal to some
foraging	some
lekking	substantial

(adapted from Taylor and Guthery 1980)



Annual burning + grazing (IES) Homogeneity Management

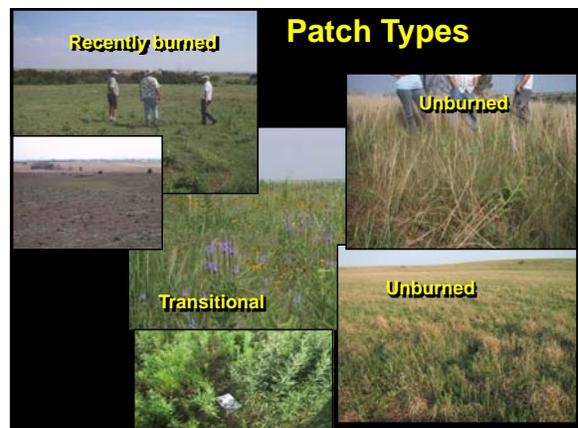
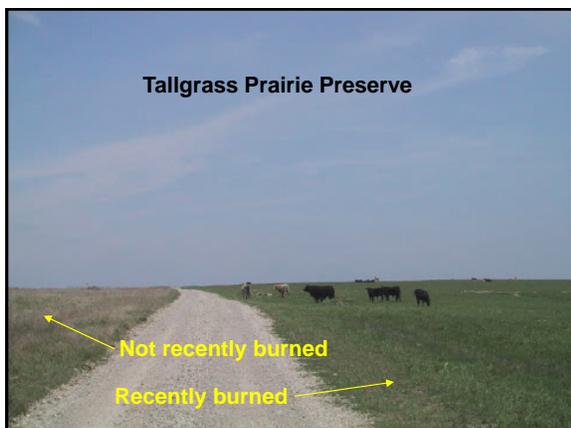
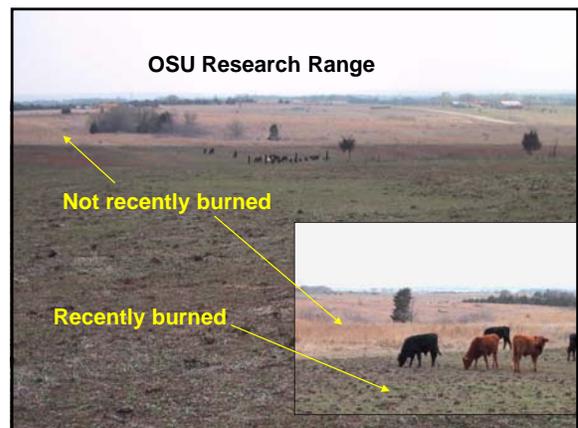
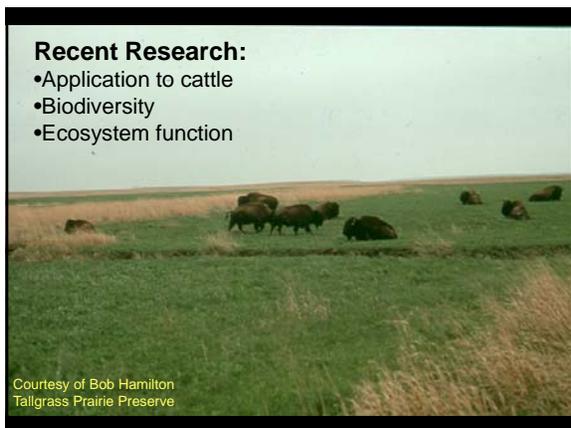
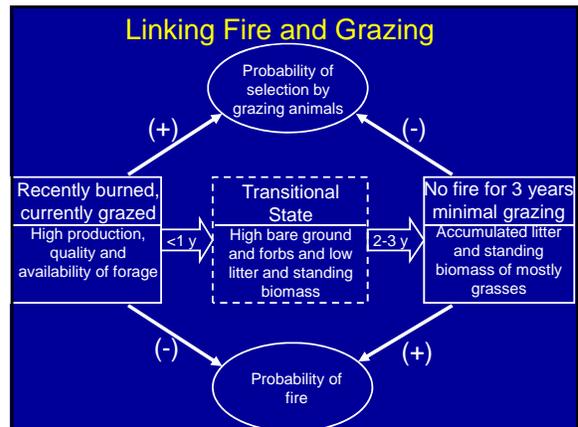
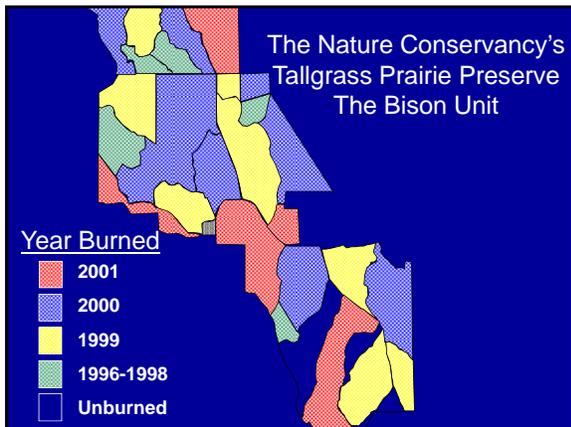


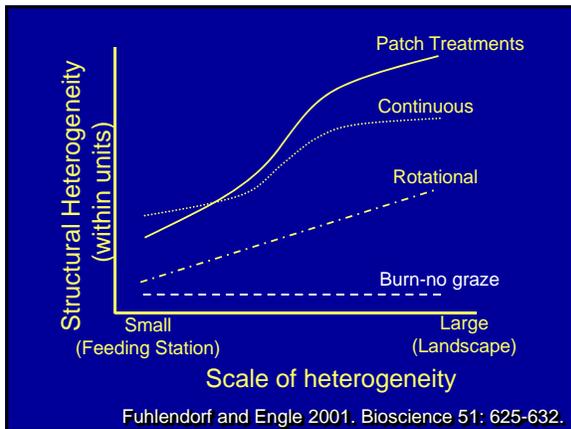
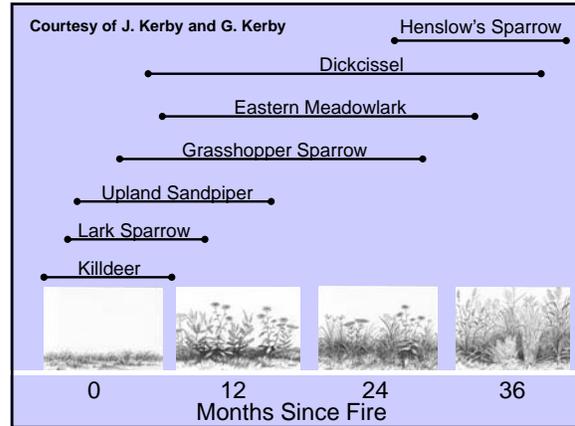
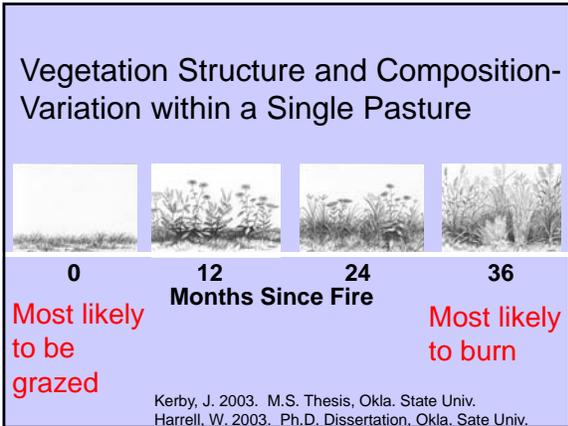
Fire-grazing Interaction Heterogeneity Management

Bison Enclosure

- 24,000 acres
- Moderately stocked (15 ac/AUY)
- No internal fences
- 33% burned annually







- ### Results of Heterogeneity Model
- Shifting mosaic of grazing disturbance driven by fire (pyric-herbivory)
 - Minimal area moderately disturbed
 - Array of plant communities: recently disturbed and others varying in time since disturbance

- ### Summary
1. Disturbance processes are coupled in native ecosystems; this drives ecosystem structure and function in important ways
 2. Most management reduces inherent heterogeneity
 3. Heterogeneity-based management can:
 - Approximate historical patterns
 - Increase biological diversity
 - Benefit many species of concern
 - Maintain livestock production
- Fuhlendorf and Engle. 2001. Bioscience 51: 625-632
Fuhlendorf and Engle. 2004. J. Applied Ecology 41: 604-614
Fuhlendorf et al. 2006. Ecological Applications

