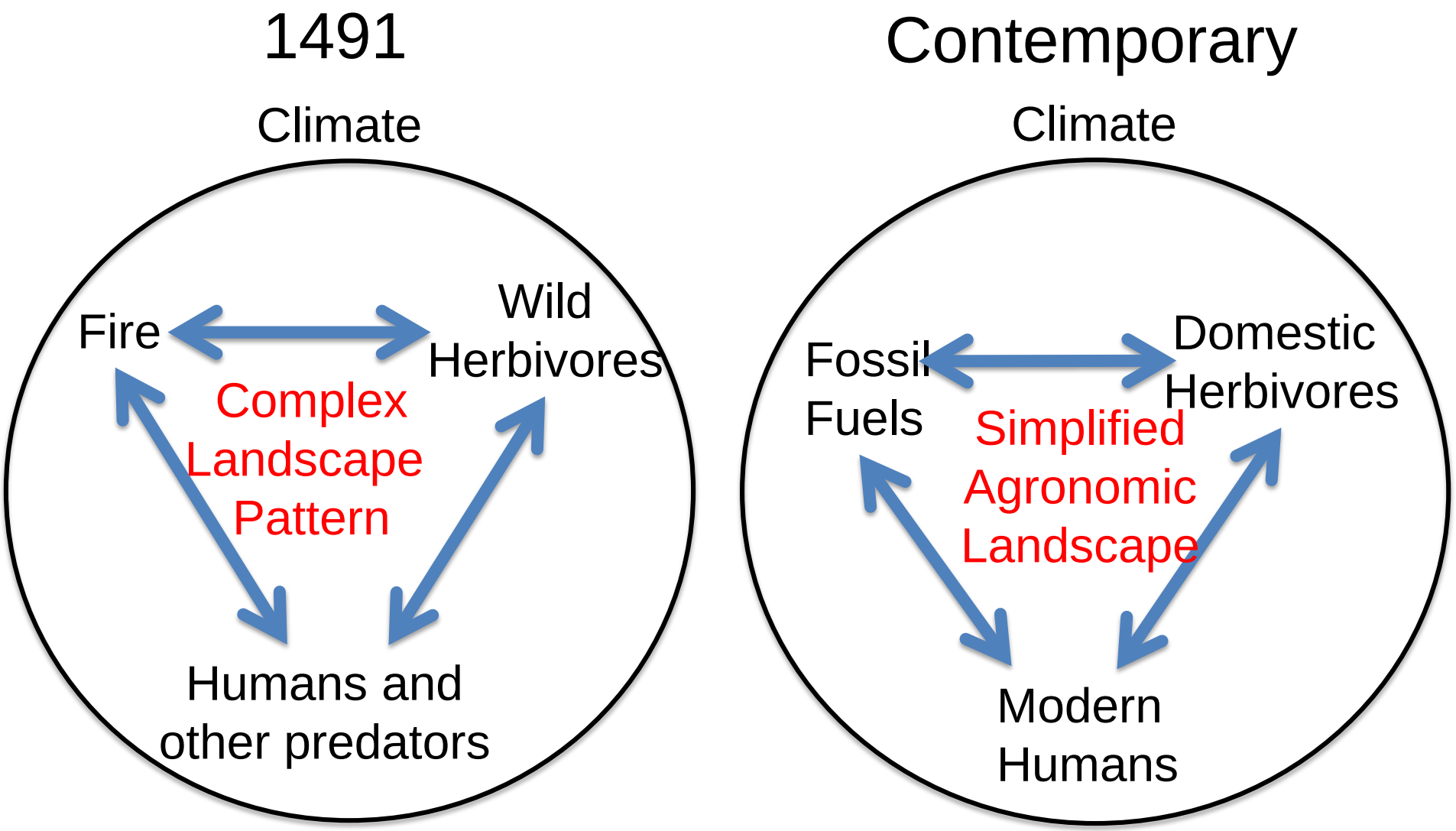
Fire and grassland: Is fire a tool or a process?

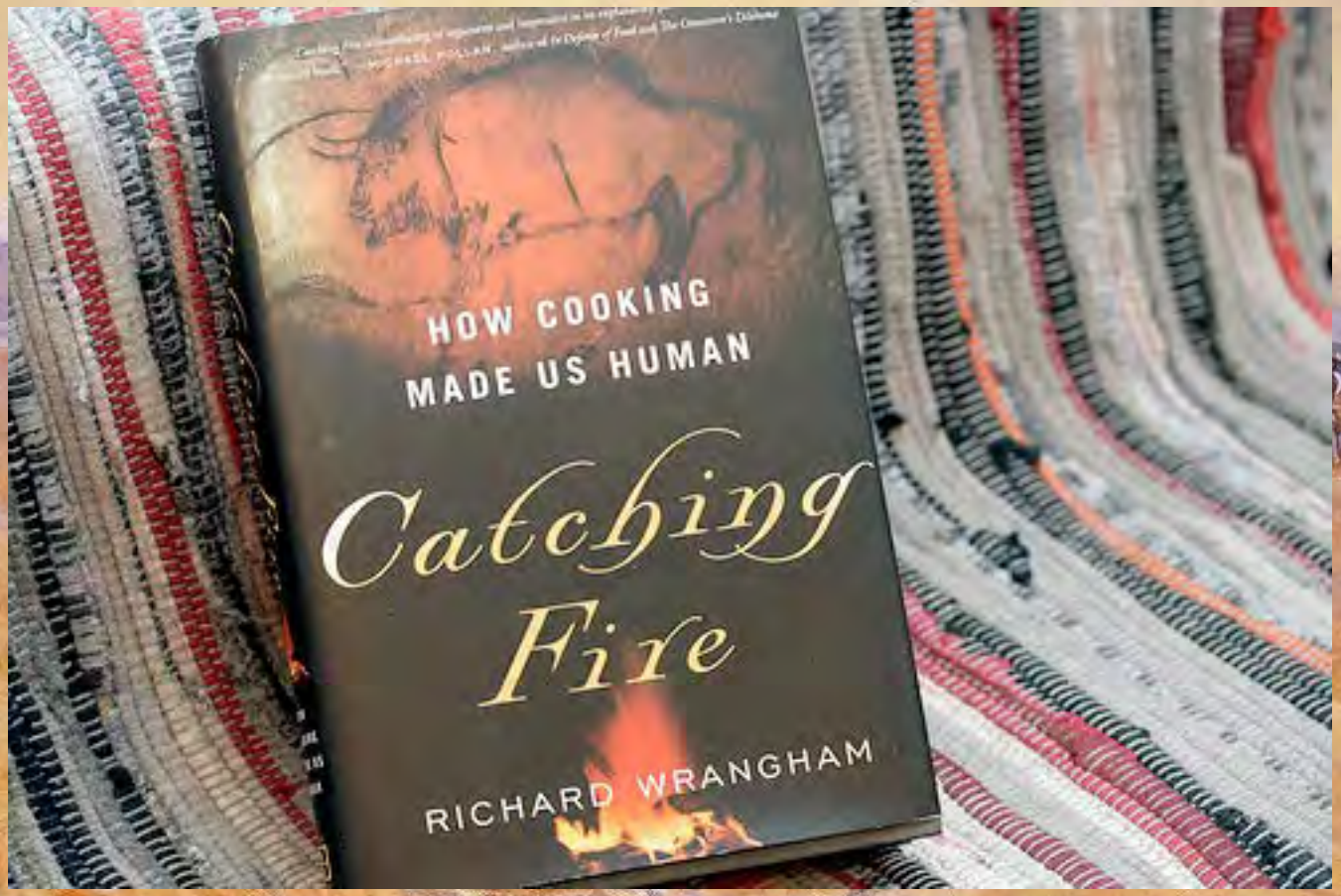
Samuel D. Fuhlendorf, Dirac Twidwell, John Weir

How do grasslands, savannas and shrublands work?

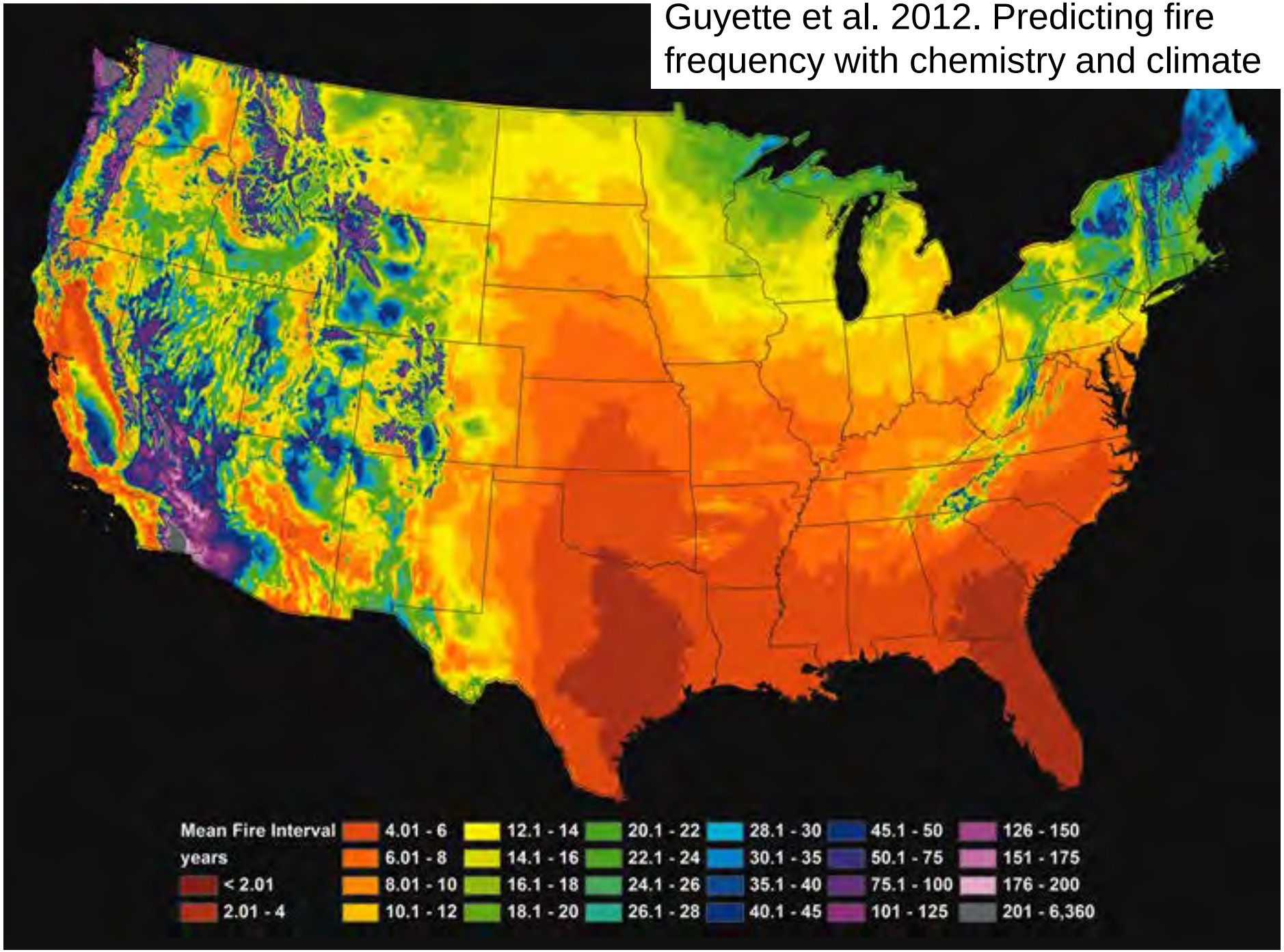


Humans and Fire

courtesy of www.charlesmarionrussell.org

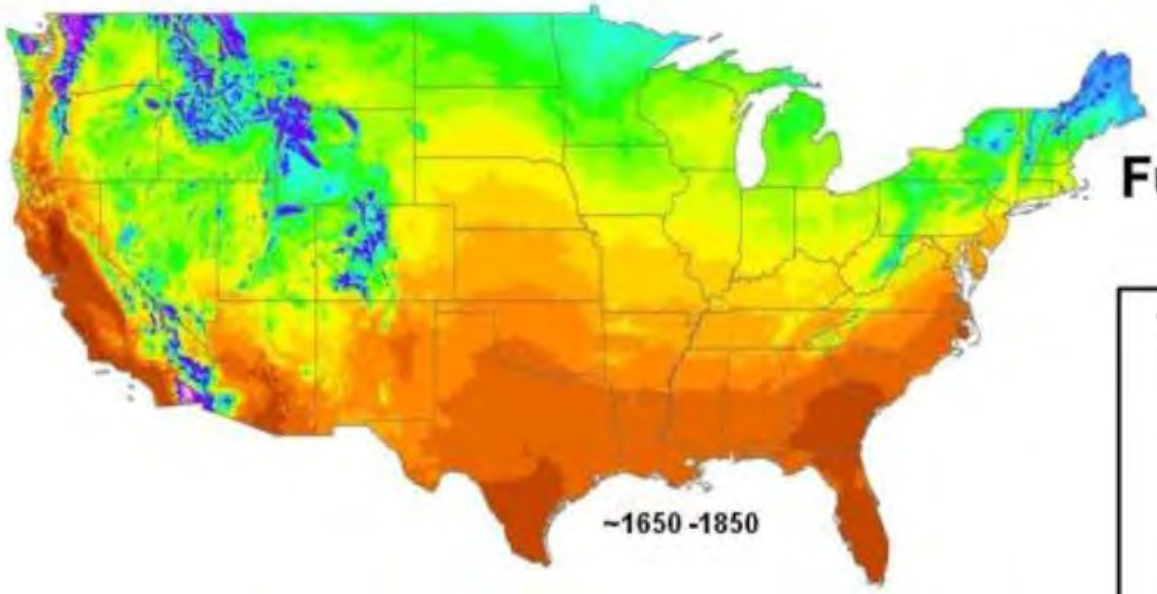


Guyette et al. 2012. Predicting fire frequency with chemistry and climate



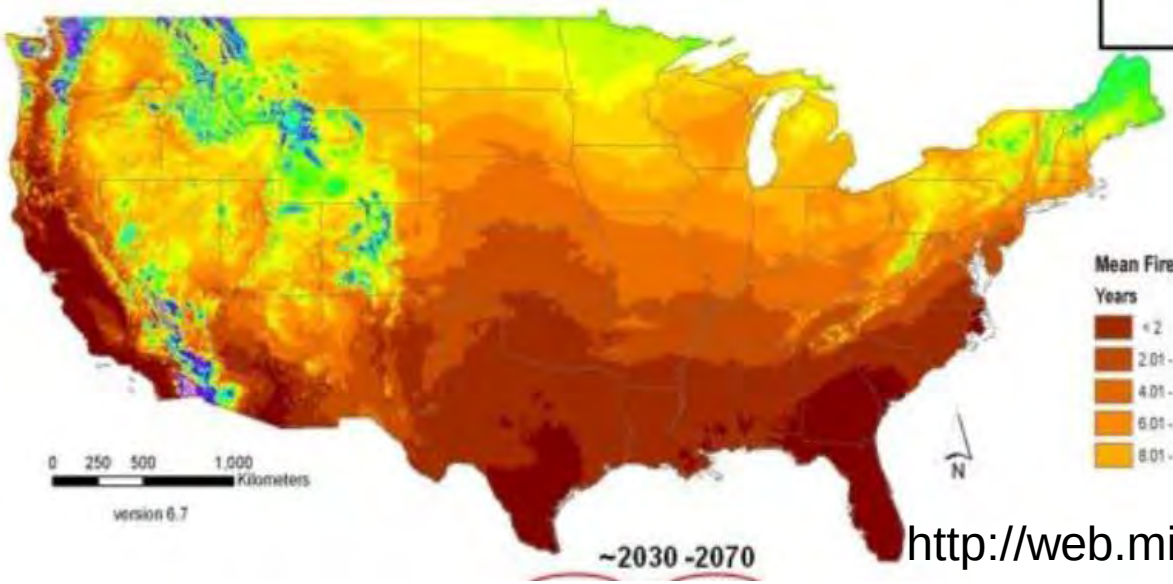
CLIMATE FORCING OF HISTORIC AND FUTURE FIRE FREQUENCY IN THE CONTINENTAL UNITED STATES

Michael C. Stambaugh[1], Richard P. Guyette[1], and Daniel C. Dey[2]
[1]Missouri Tree-Ring Laboratory, University of Missouri, School of Natural Resources,
[2]US Forest Service Northern Research Station



Future temperature forcing

Temperature only based forcing of potential fire frequency (MFI) at +3 °C.



http://web.missouri.edu/~guyetter/nafia.pdf

John Gast- American Progress-1862

Three-fourths of US lands dominated by native vegetation show moderate or high departure from reference conditions as a result of altered fire regimes (TNC 2009).

Important considerations for grassland ecosystems relating to fire

1. Simplistic science of fire: small plots, short term, fire vs. no fire

Assessment of Prescribed Fire as a Conservation Practice

Samuel D. Fuhlendorf,[1] Ryan F. Limb,[2] David M. Engle,[3] and Richard F. Miller[4]

http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/ceap/?cid=stelprdb1045811

- Studies are small and short
- Dominated by fire vs. no fire
- Usually treatments were one fire
- Little understanding of the role of intensity, frequency, season etc.
- Does not consider interaction of fire with other disturbances
- Very limited understanding of disturbances as a COMPLEX LANDSCAPE REGIME that are dynamic in space and time

Important considerations for grassland ecosystems relating to fire

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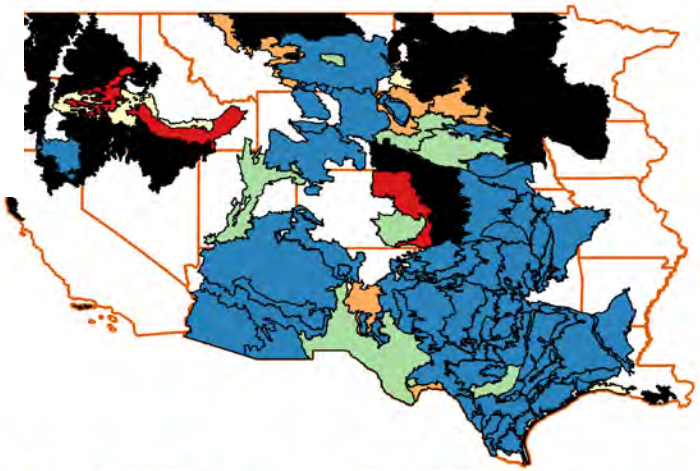
2. Effects of fire suppression/ woody plant encroachment

esa ECOSPHERE
SYNTHESIS & INTEGRATION

National-scale assessment of ecological content in the world's largest land management framework

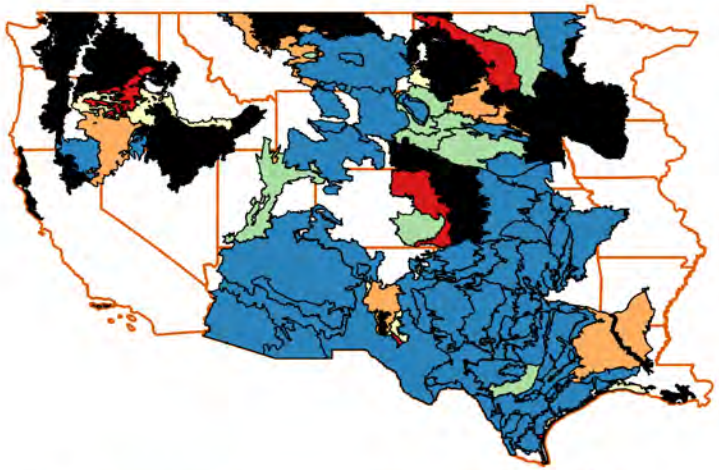
Dirac Twidwell,† Brady W. Allred, and Samuel D. Fuhlendorf

Ecological factors causing state transitions



Woody reduction

71% of ESDs

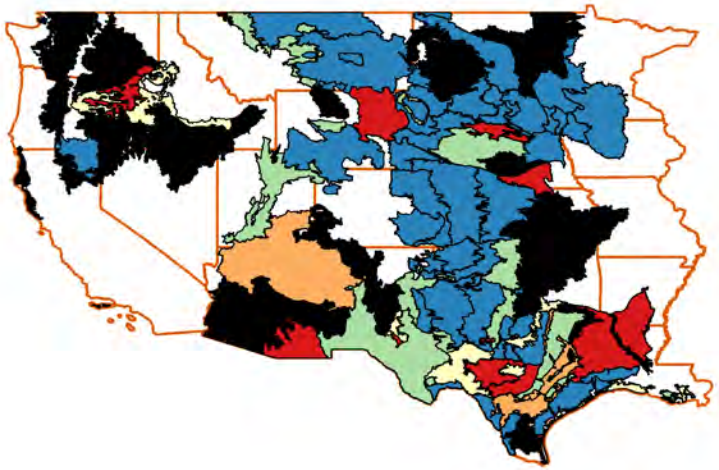


Woody encroachment

68% of ESDs

Percent land area

0	41 - 60
1 - 20	61 - 80
21 - 40	81 - 100

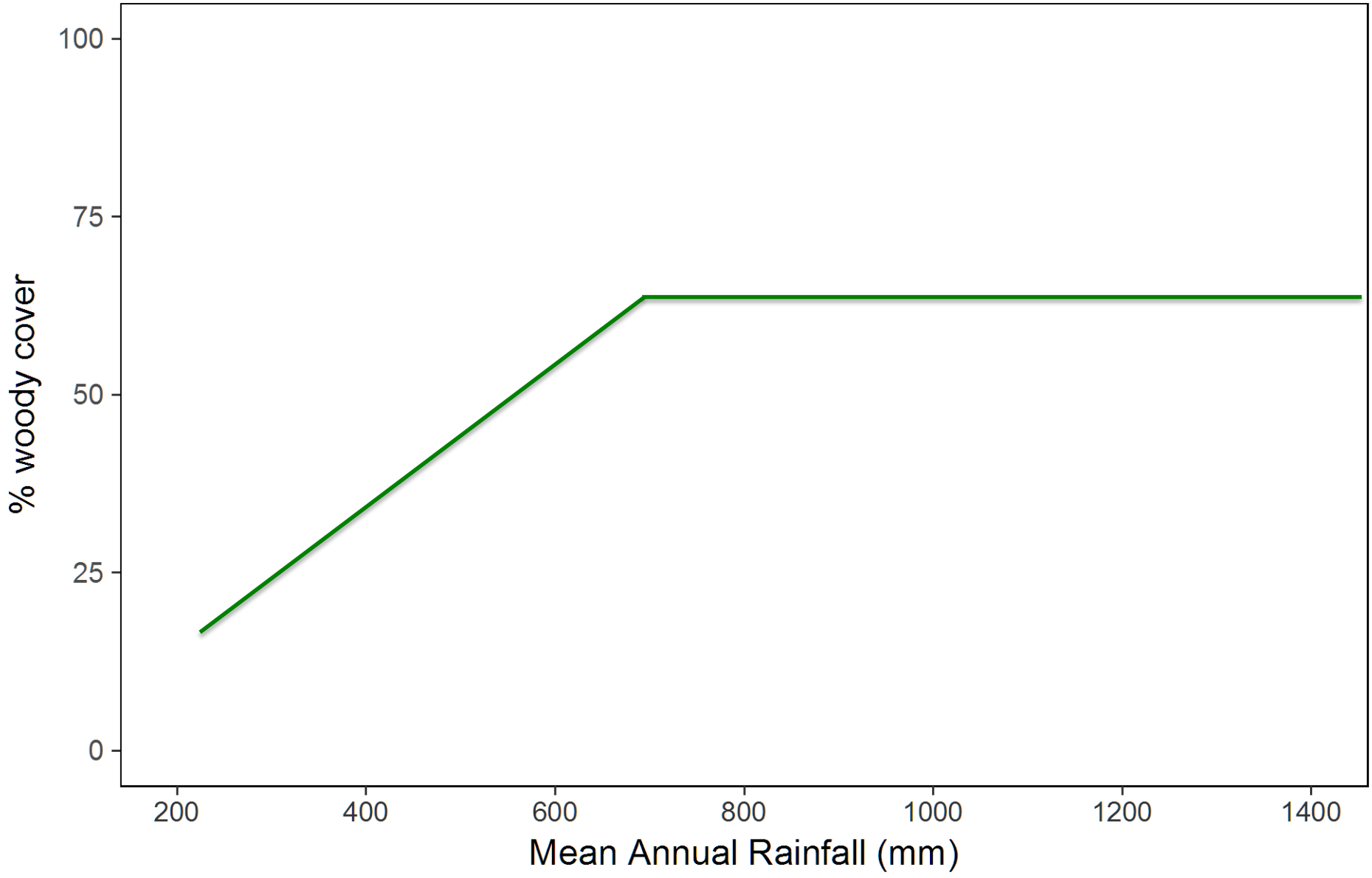


Herbaceous composition shift

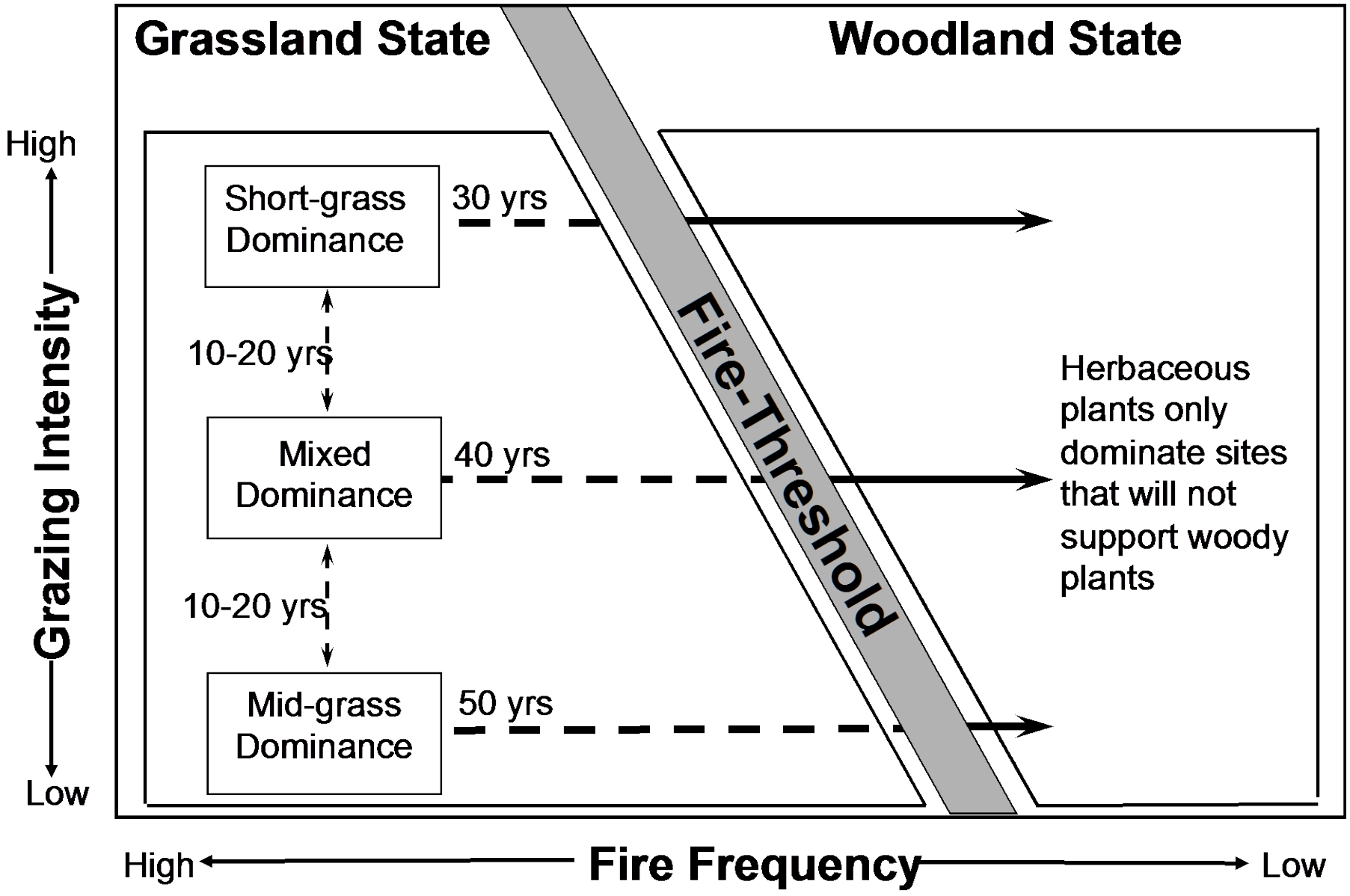
57% of ESDs

Twidwell et al. 2013

Potential Woody Plant Cover across Great Plains

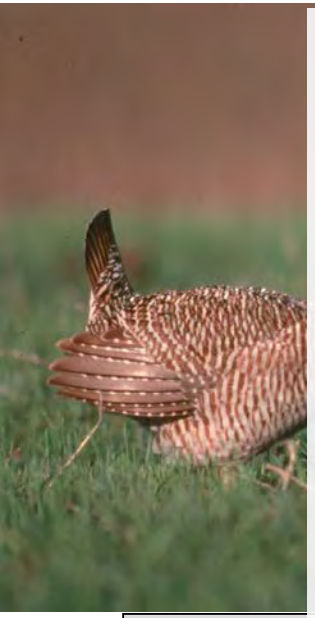


Rheinhardt Scholtz et al. In Press

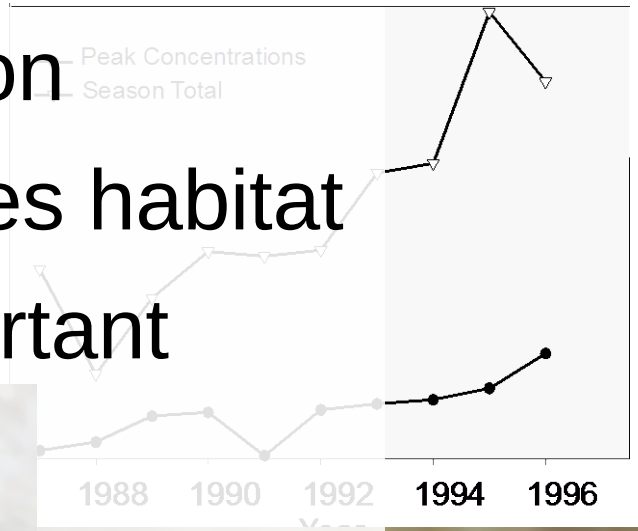


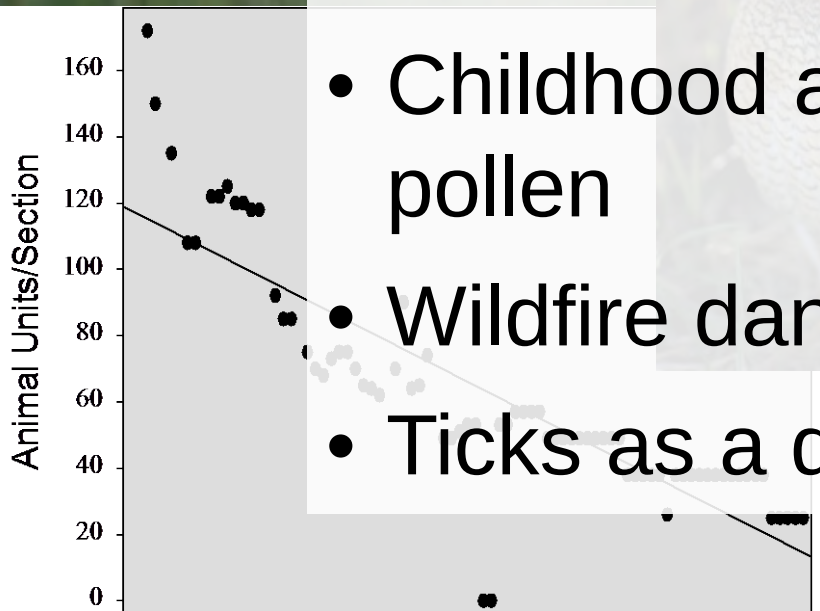
Fuhlendorf et al. 1996; 2008; Fuhlendorf and Smeins 1997; Briske et al. 2003; 2005

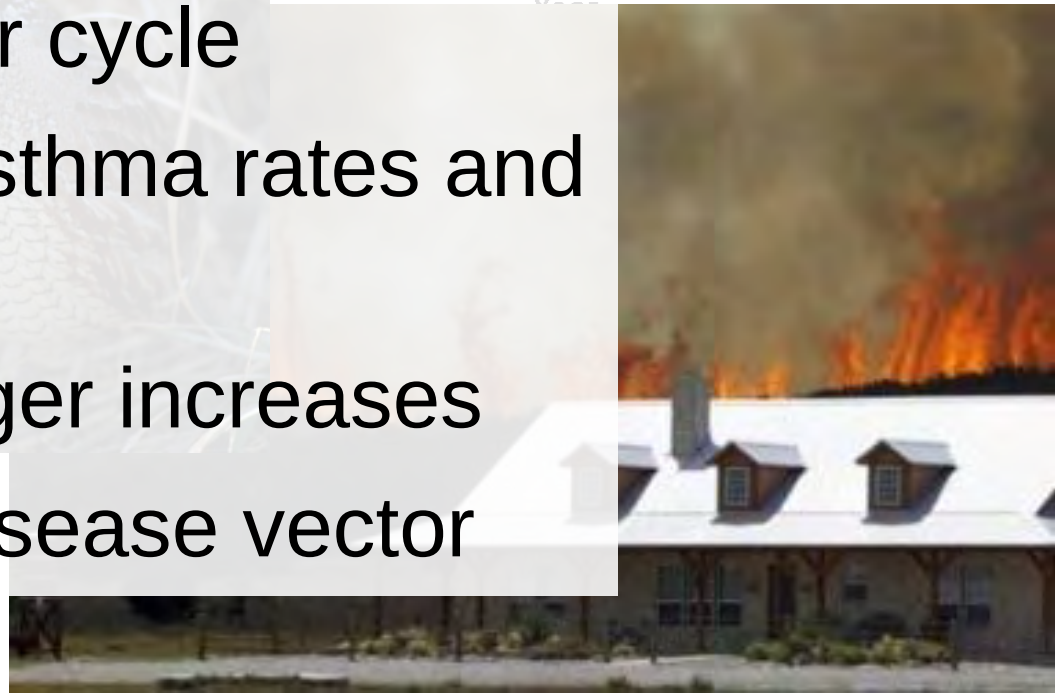
Ecosystem services associated with fire suppression and WPE



- Livestock production
- Endangered species habitat
- Economically important wildlife habitat
- Altered water cycle
- Childhood asthma rates and pollen
- Wildfire danger increases
- Ticks as a disease vector







Important considerations for grassland ecosystems relating to fire

1. Simplistic science of fire: small plots, short term, fire vs. no fire
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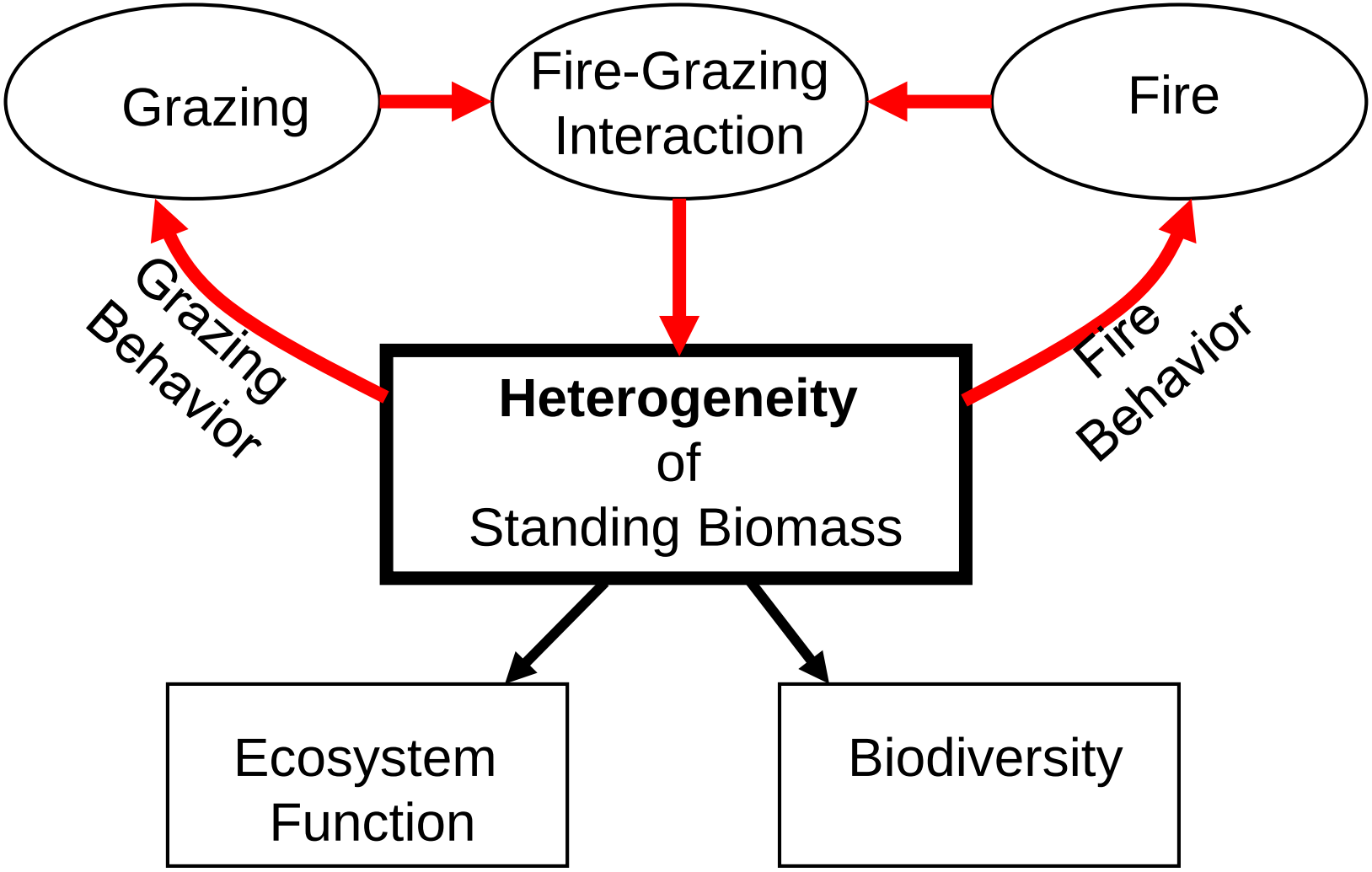
3. Decoupled fire and grazing (as well as drought)

Heterogeneity Paradigm

Patch Burning, Patch Burn Grazing, Pyric Herbivory



..this yard-square relic of original Wisconsin gives birth, each July, to a man-high stalk of compass plant or cutleaf Silphium*, ... It is the sole remnant of this plant along this highway, and perhaps the sole remnant in the western half of our county. What a thousand acres of Silphiums looked like when they tickled the bellies of the buffalo is a question never again to be answered, and perhaps not even asked….*

Aldo Leopold,
A Sand Country Almanac

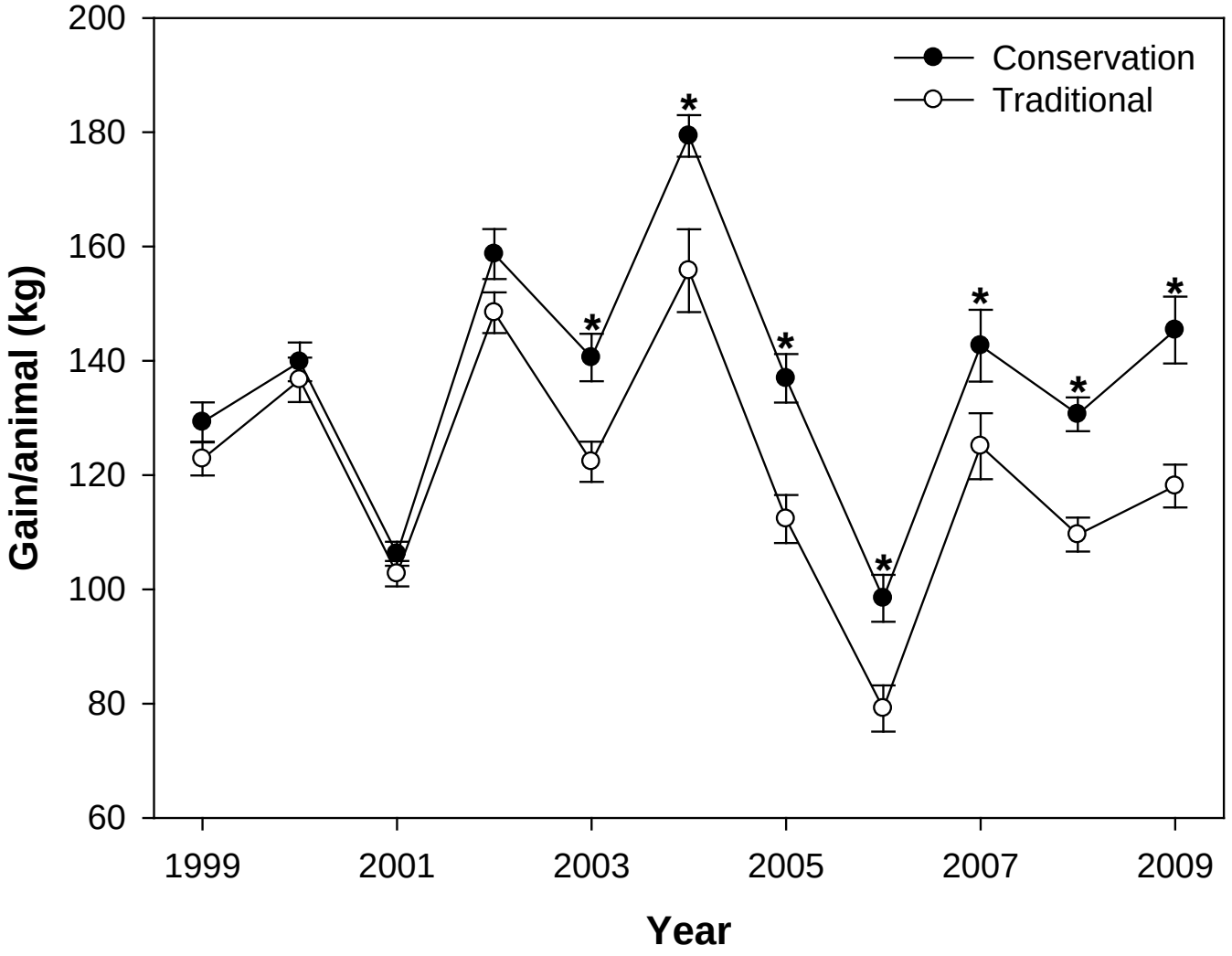
Silphium laciniatum L.


07/20/2009


07/20/2009

Weight Gains by Stocker Cattle on Mixed Prairie

Limb et al. (2011)



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3. Decoupled fire and grazing (as well as drought)
4. Replacement of shifting mosaic with non-shifting mosaic or uniformity

Fuhlendorf et al. 2009. *Conservation Biology*

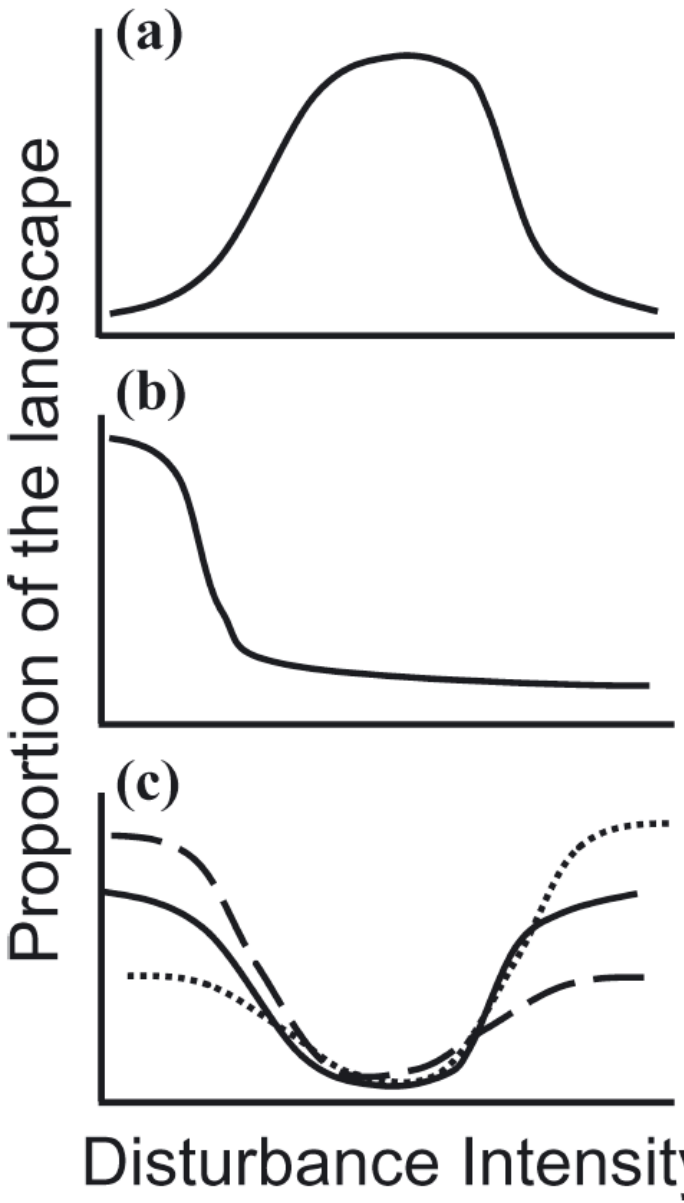


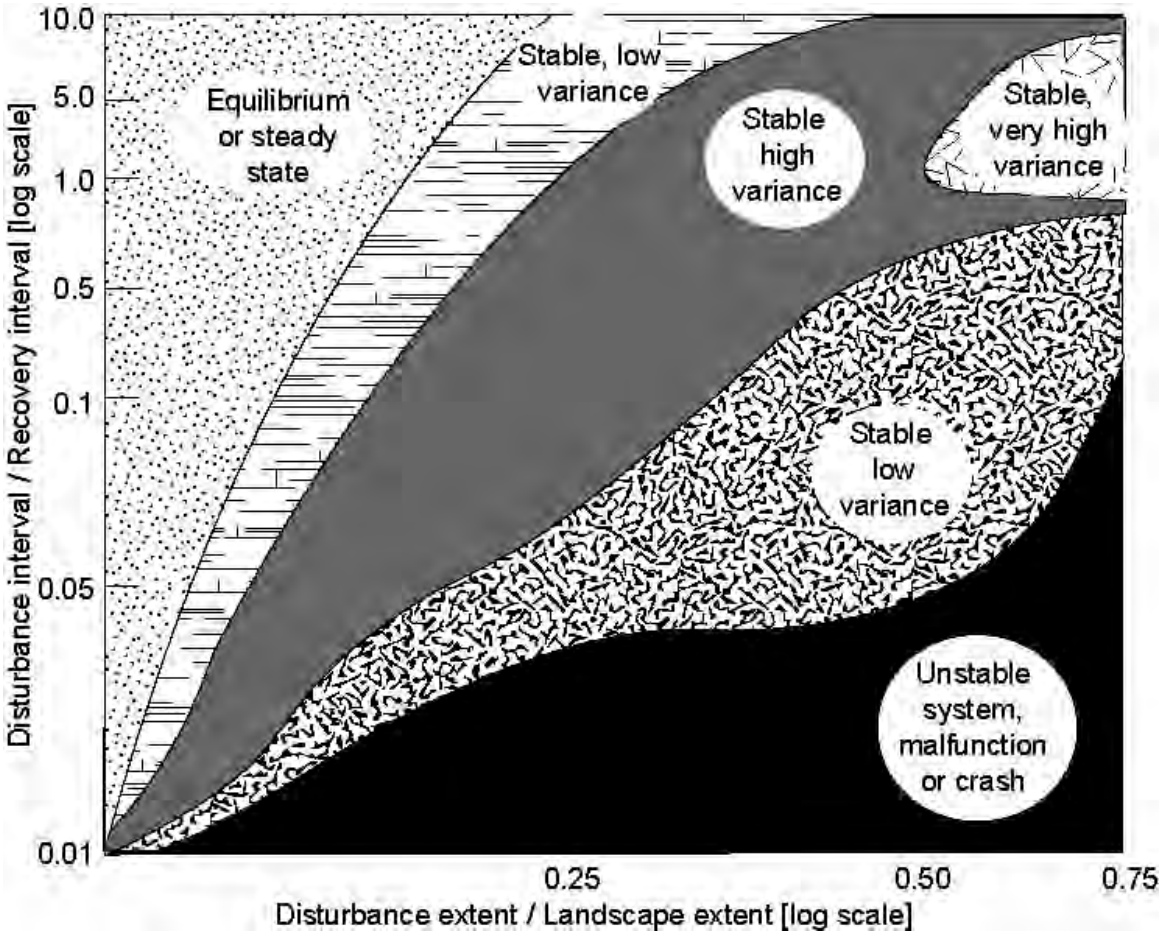
Figure 2. Conceptual models of the proportion of the landscape receiving different disturbance intensities. In grassland ecosystems, (a) represents the agricultural land-management model and the intermediate-disturbance hypothesis in which the majority of the landscape is moderately disturbed, (b) represents a protectionist model in which disturbance is minimized across the entire landscape, and (c) represents the landscape disturbance pattern expected from a fire and grazing interaction that creates a shifting-mosaic landscape.


At a larger scale the matrix is burned
Unburned matrix
Burned Patch


Photo taken 9/24/03
Burned 9/10/02
Burned 3/22/03

Nature of the mosaic is depenedent on:

- Area disturbed / Landscape area
- Frequency of disturbance / rate of recovery



Turner et al. 1993

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5. Role in conservation of biodiversity

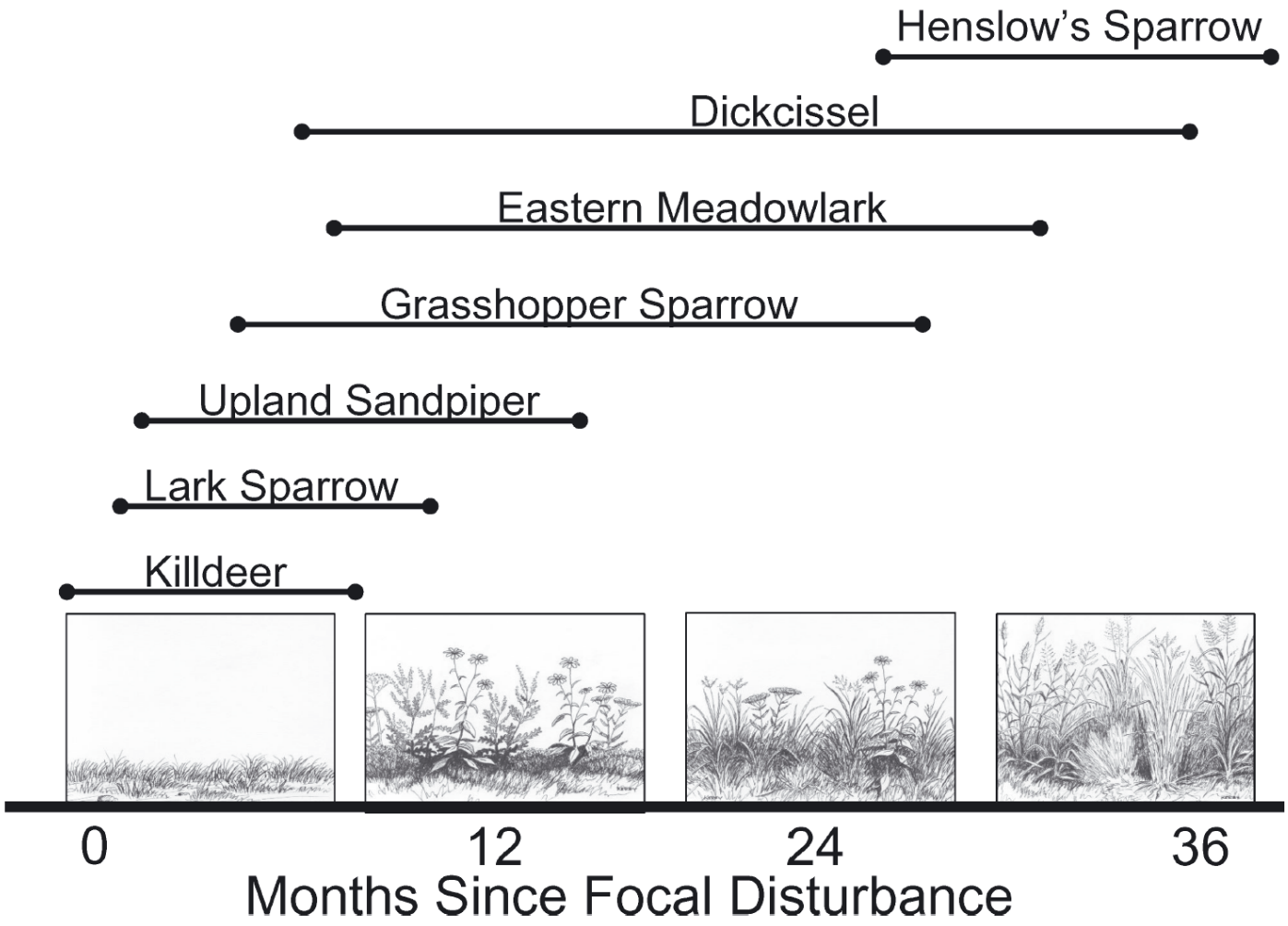


Figure 5. Response of grassland birds to time since focal disturbance by fire and grazing at the Tallgrass Prairie Preserve from 2001 to 2003. Art work in the figure courtesy of Gary Kerby.

Fuhlendorf et al. 2006
Fuhlendorf et al. 2009

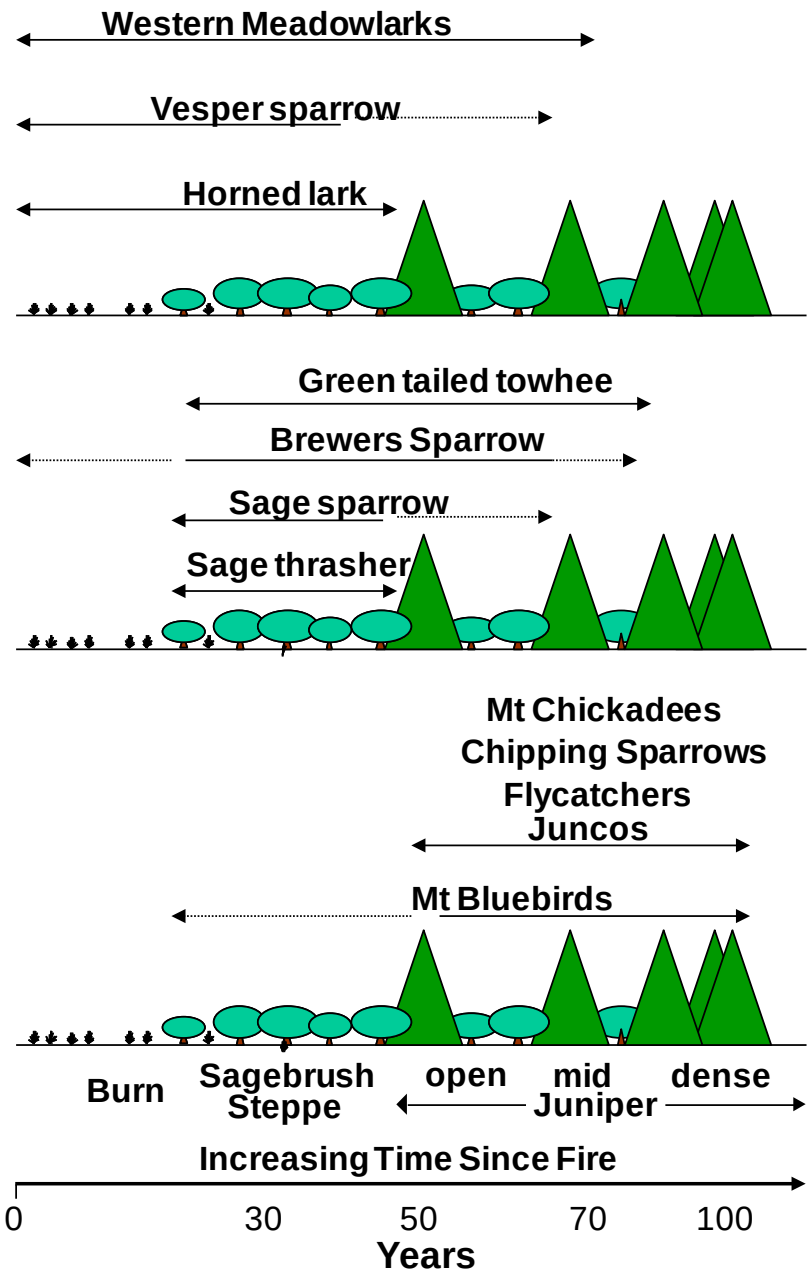
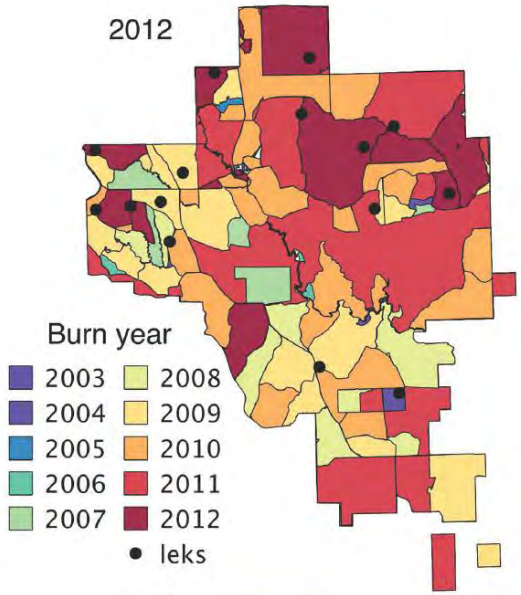
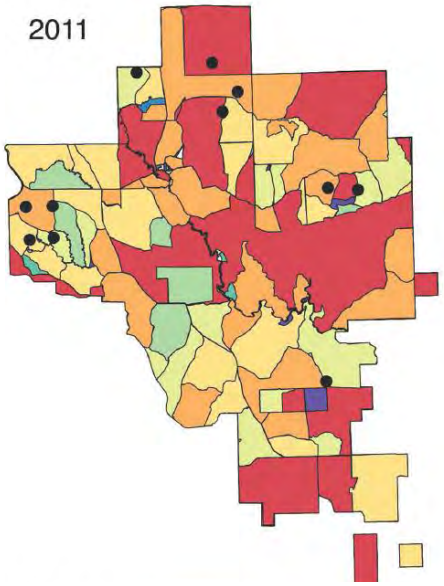
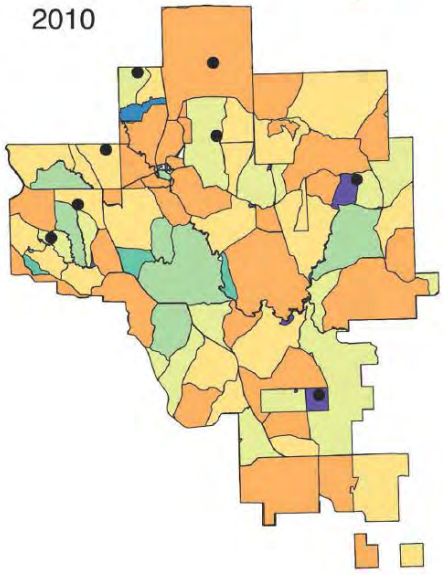


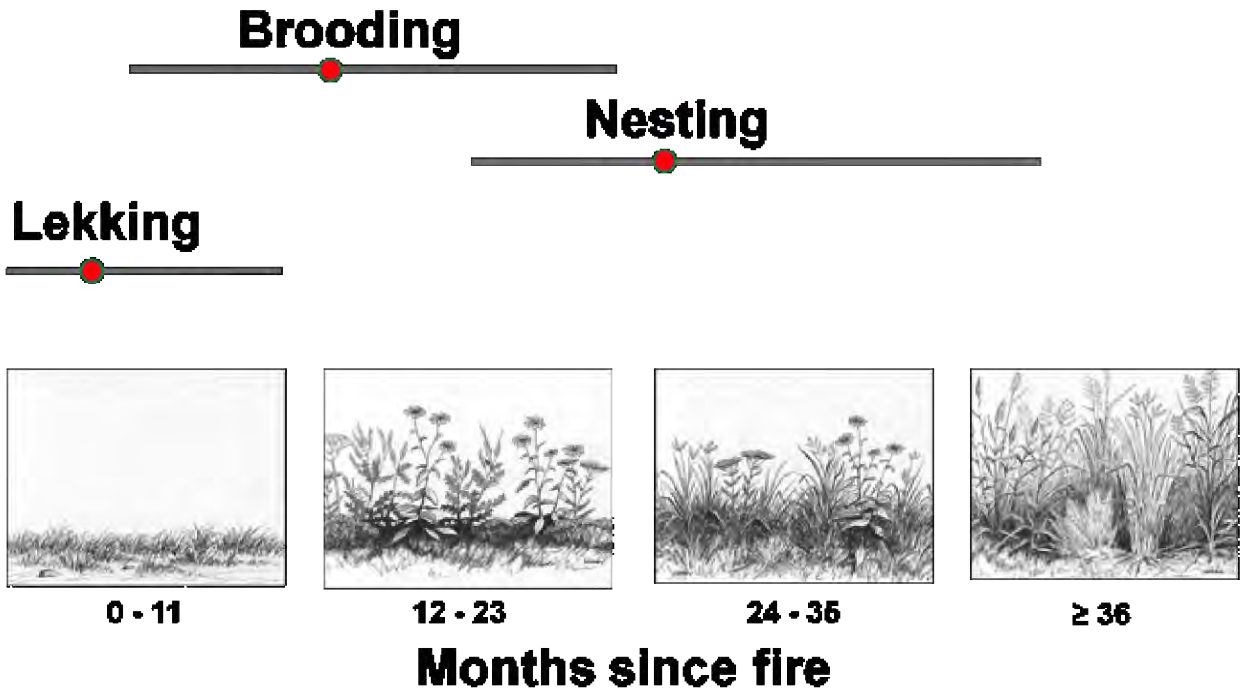
Figure 8. Response of birds to time since fire on Great Basin rangelands (Reinkensmeyer et al. 2007).







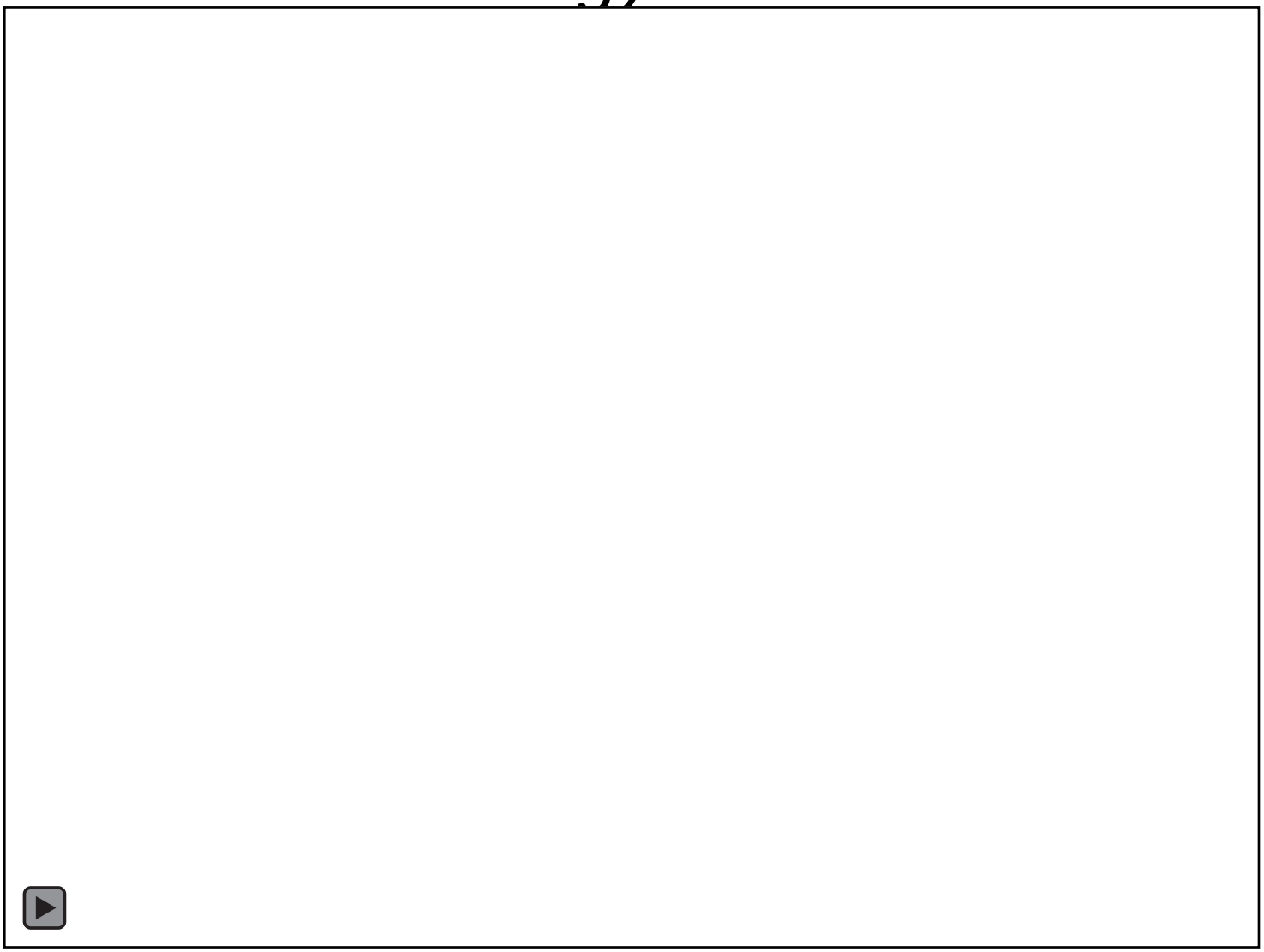
Prairie-chickens need heterogneity of disturbance regimes



Hovick et al. 2014, 2015

Pyric-carnivory: Raptor use of prescribed fires.

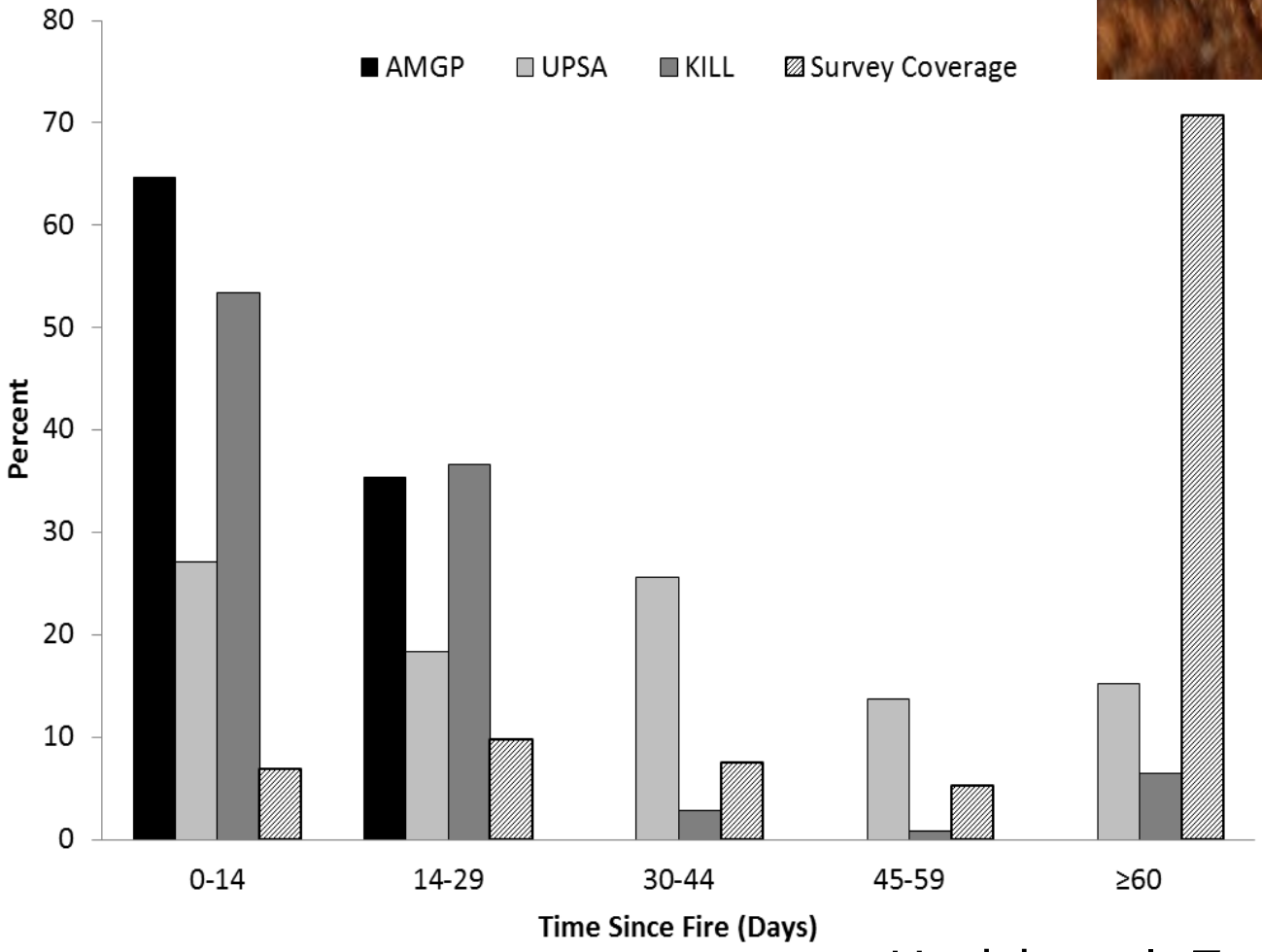
Hovick et al.~ *Ecology and Evolution 2017*



Birds of prey are starting fires DELIBERATELY: Kites and falcons are 'intentionally dropping smouldering twigs' to smoke out mice and insects in Australia

At least two birds of prey - black kites and the brown falcon - swoop on burning twigs and embers and carry them (pictured) to unburnt parts of the bush where they are thought to deliberately start bushfires, according to witnesses. They then capture large insects, frogs and animals rushing to escape

Shorebirds use fire on spring migration



Hovick et al. *Ecological Application 2017*


David Augustine

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5. Role in conservation of biodiversity
6. Compression of fire intensity – simplification of description of fire regimes

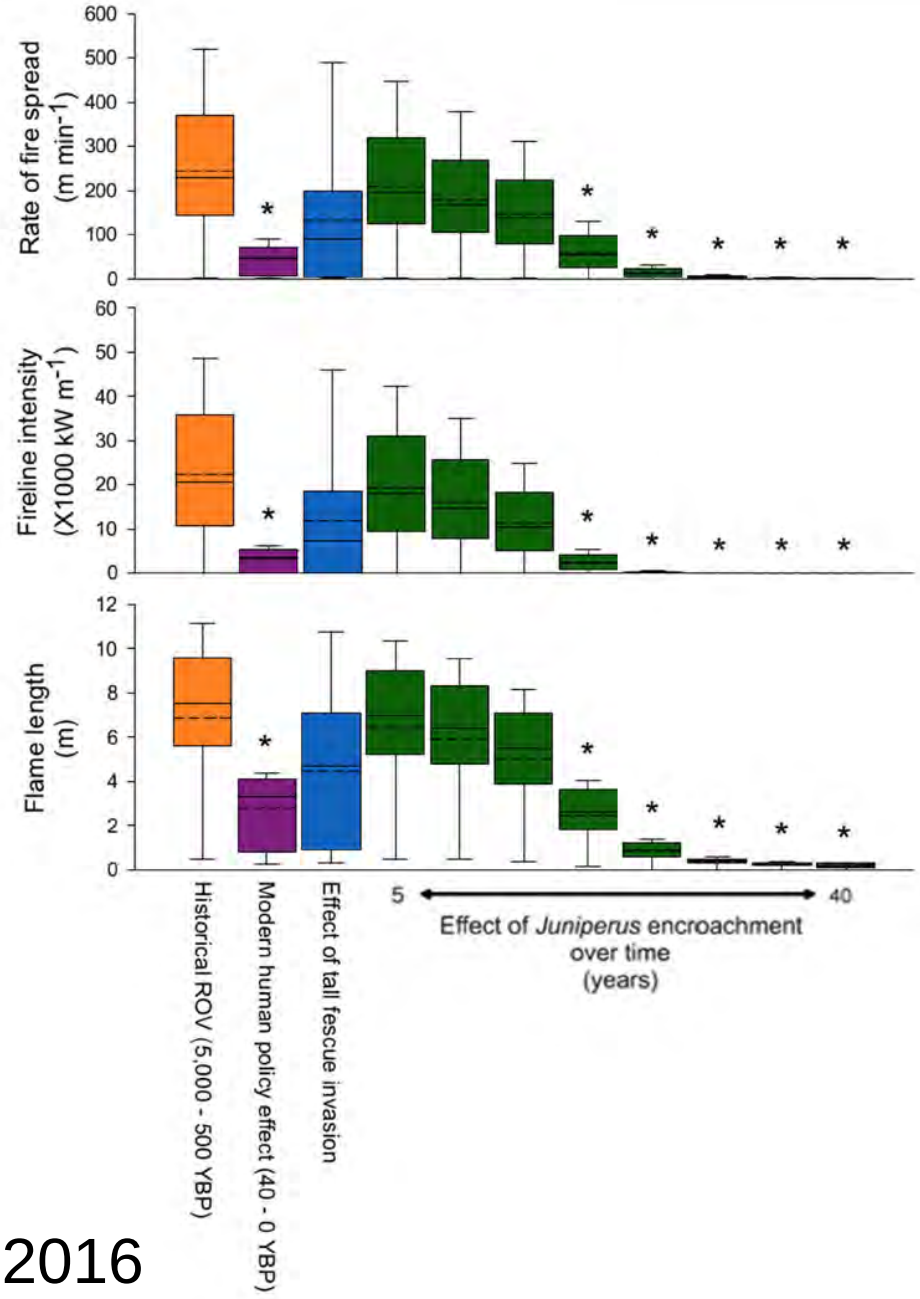
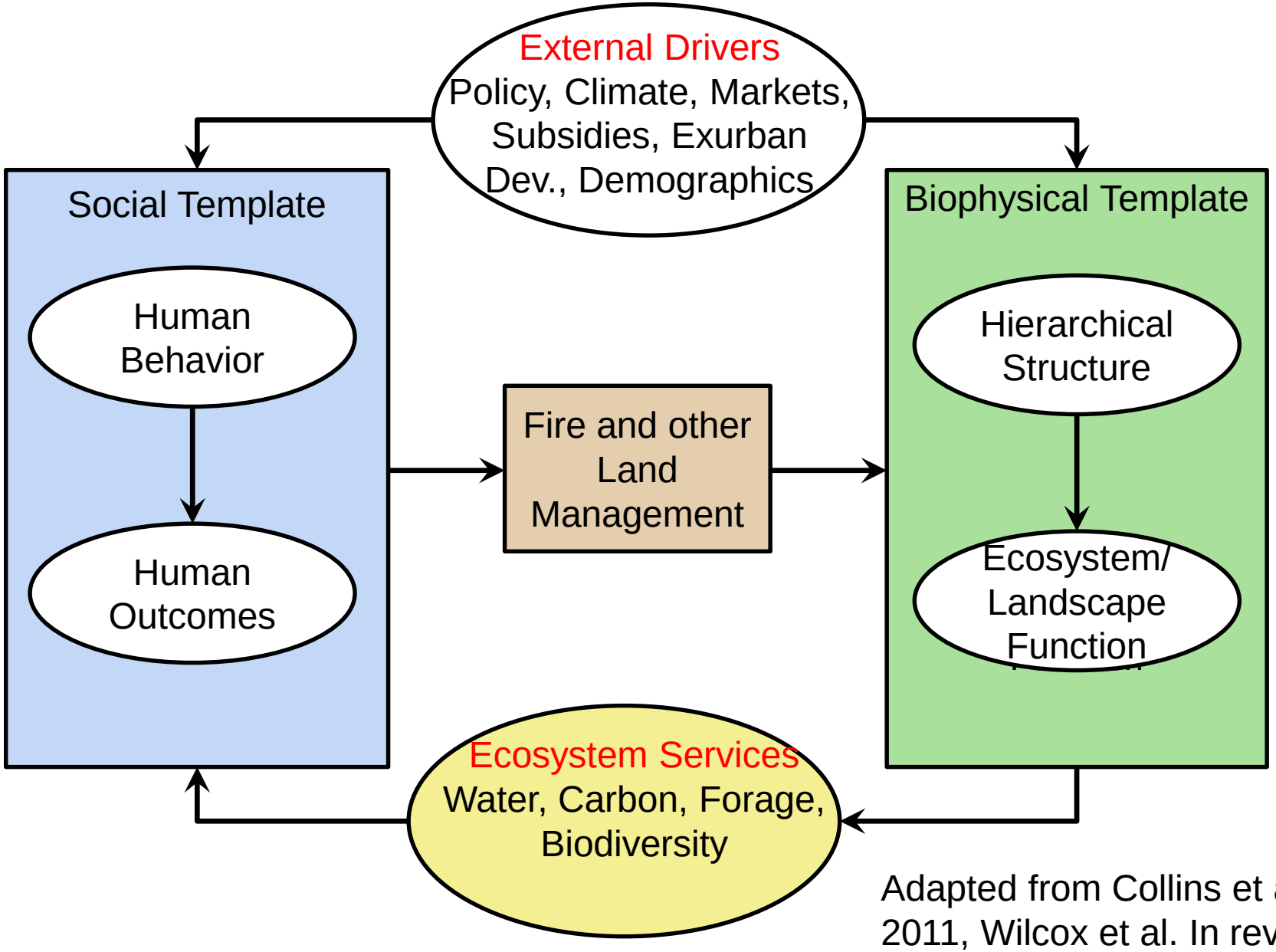


Figure 1. Departures from the historical range of variability (ROV) in surface fire behavior as a result of contemporary social prescribed fire policies and ecological invasions in tallgrass prairie. Confidence intervals represent the range of variability (ROV) across grass curing scenarios used in simulations, with *dashed lines in box plots* representing the mean value. *Asterisks* (*) indicate significant differences ($P < 0.05$) in fire behavior from historical levels as a result of isolating the effect of each modeled scenario.

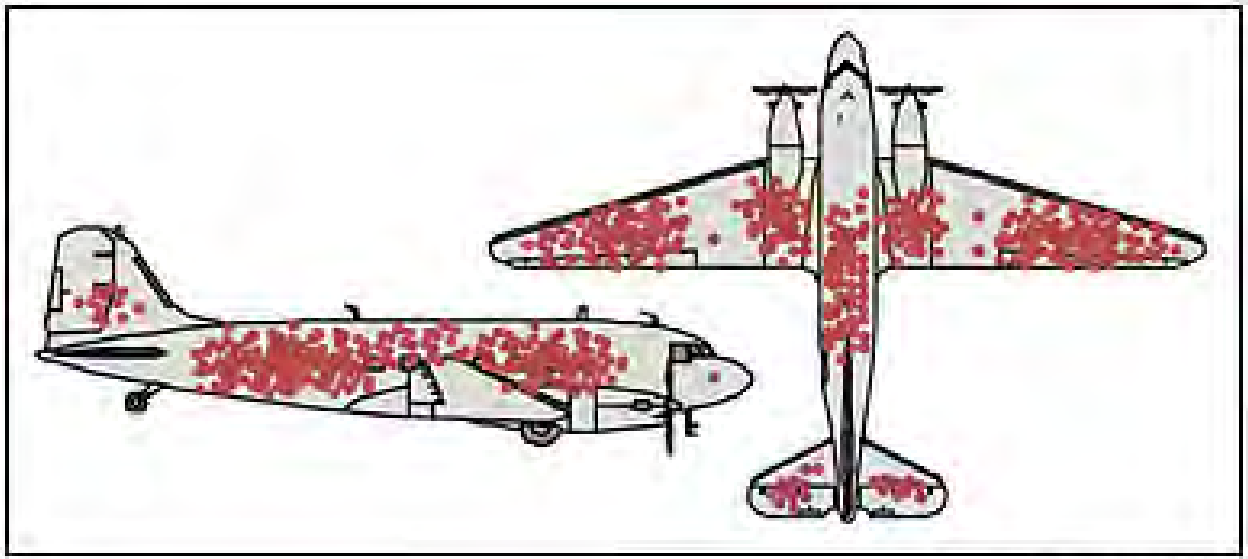
Twidwell et al. 2016

Social-Ecological Framework for Fire



Adapted from Collins et al. 2011, Wilcox et al. In review

Survivorship Bias



Credit: Cameron Moll

Questions?

Lana Lowe, Lands Director, Fort Nelson First Nation