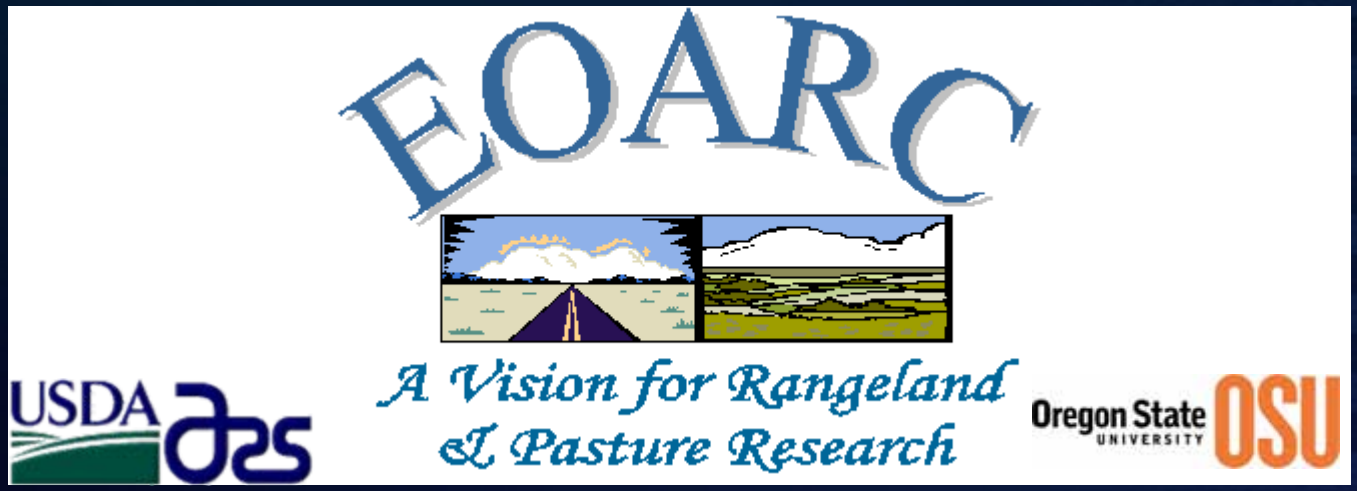
Climate Change and Rangelands: What are the Management Implications?



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Preindustrial CO_2	Current CO_2
270-280 ppm	375 ppm

about a 34% increase

Increasing CO_2 also increases water use efficiency, and is effectively equivalent to increasing soil moisture.

The same increase in precipitation would be 12” (30.5 cm) to 16” (41 cm).

Ziska, Reeves and Blank, 2005. The impact of recent increases in atmospheric CO_2 on biomass production and vegetative retention of cheatgrass (*Bromus tectorum*): implications for fire disturbance. Global Change Biology 11: 1325-1332.

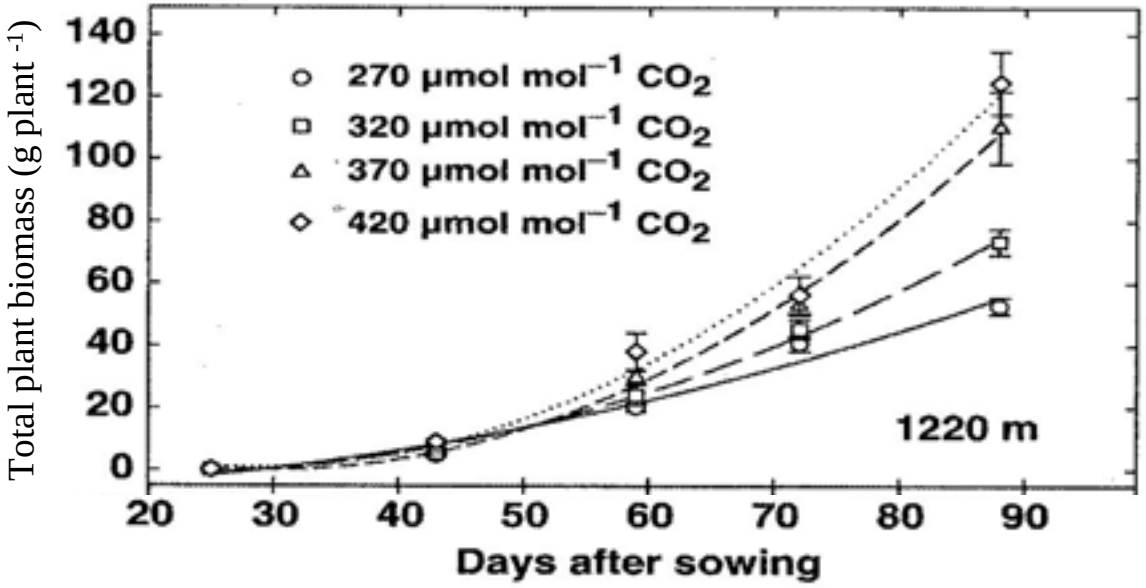
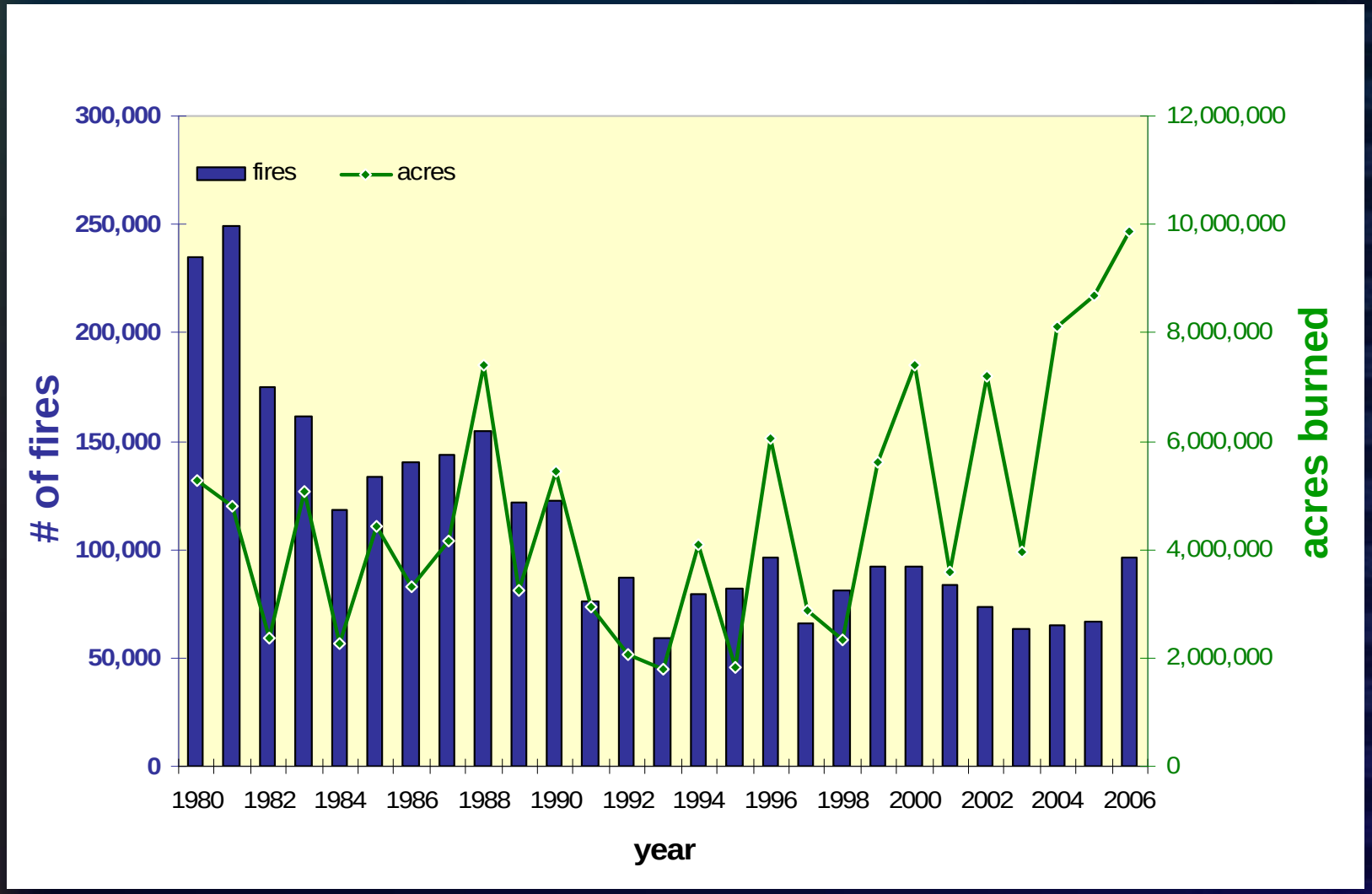


Fig. 1 Total biomass of cheatgrass (*Bromus tectorum* g per plant) over time (days after sowing, DAS) as a function of increasing [CO_2] for three populations collected at different elevations in northern Nevada. Significant [CO_2] differences were observed after 59 DAS. Bars are ± SE.

Total Wildland Fires, 1980-2006



National Interagency Fire Center data

Knapp, Soule and Grissino-Mayer, 2001. Detecting potential regional effects of increased atmospheric CO_2 on growth rates of western juniper. Global Change Biology 7: 903-917.

Compared climate/growth relationships (using tree-ring chronologies during 1896-1949 (low CO_2) and 1950-1998 (higher CO_2).

	early 20th century	later 20th century
overall growth		23% greater
matched drought years		63% greater
matched wet years		30% greater

Measurements taken at 7 sites in central Oregon.

These are some of the responses we might attribute to increasing atmospheric CO_2

- Higher overall plant productivity
- Shifts in species composition (often not understood)
- More cheatgrass biomass → fires?
- Faster woody plant establishment (juniper)
- Other invasives also seem to do well

J. Xiao and A. Moody. 2004. Photosynthetic activity of U.S. biomes: responses to the spatial variability and seasonality of precipitation and temperature. Global Change Biology 10: 437-451.

- Increases in precipitation and temperature are largely a result of more fall precipitation and increased minimum temperatures.
- Water limited systems (grassland and open shrubland) are more likely to benefit from increased fall precipitation and a longer growing season (compared to more mesic biomes)
- Further increases in productivity are likely if historical trends hold.

The Great Habitat Squeeze

- Juniper has been expanding at the mid elevation range
- Cheatgrass and medusahead have been expanding at the lower elevations

Implications for Conservation

- More attention to plant competition and fire resistance may be needed at lower elevations
- Maintaining habitat at the upper elevations should be a priority (we need to keep the quality habitats that we have)
- I'm biased, but research should be a priority and the research needs to be focused on the right problems

The Toolbox is Pretty Limited for Annual-Dominated Systems

- We really don't have good solutions for restoring annual grass-dominated systems
- There are situations where cheatgrass is responding to a short-term increase in soil nitrogen
- Distinguish between a transient response and longer-term threat

Weeds and Sage-Grouse

- Annual grasses will create a loss of lower-elevation habitats. Increasing CO2 levels may increase the productivity of cheatgrass and the risk of fires (at increasingly higher elevations)
- Solutions will likely involve multiple steps and treatments, rather than anything simple (sorry, no Calvary on the horizon)