Use of prescribed burning for the control of invasive plants

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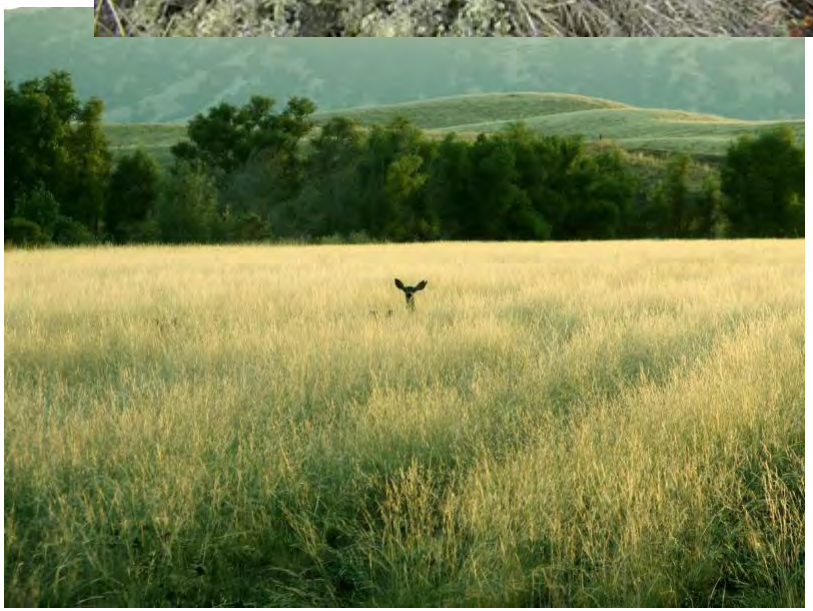
Fire is a natural part of many ecosystems

Adenostoma fasciculatum (chamise)

Artemisia tridentata (sagebrush)

Native California grasslands and oak woodlands were burned nearly every year intentionally by the native peoples



Three ways fire and invasive plants interact

- Burning can lead to the establishment of new invasive species
  - Mainly with windblown seed (e.g., Asteraceae)

Cirsium vulgare
bull thistle

Cirsium arvense
Canada thistle

Hypochaeris glabra
smooth catsear

Asclepias speciosa
showy milkweed

Epilobium brachycarpum
Tall annual willowherb

Three ways fire and invasive plants interact

- Burning can lead to the establishment of new invasive species
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- Invasive plants can change plant communities by altering the historic fire regimes
  - Suppression (not common in the western US)
  - Promotion (very common in the western US)

Bromus tectorum (downy brome or cheatgrass)

- Historically community composed of bunchgrasses interspersed with long-lived perennial shrubs
- Historic fire regimes were infrequent (>50 yrs)
- With invasion, fine fuel accumulation was greater than shrub/perennial grass communities
- Dry fuels extended fire season by one to three months
- **End result, cheatgrass fires became common, occurring at <5 yrs intervals**

Impacts on vegetation change

- Cheatgrass filled an unoccupied resource niche following fire
- Most native perennials unable to re-establish in cheatgrass dominated sites
- Native perennial shrubs only revegetate through seeds after fire
- **End effect is native vegetation replaced with pure patches of cheatgrass**

Impacts on livestock, wildlife and economy

- Undependability of cheatgrass as a source of forage for cattle and sheep
- Reduction in native shrubs important for wildlife habitat
  - Sagebrush is the main food or shelter for 170 native bird and mammal species, including sage grouse, pygmy rabbits and pronghorn antelope.
  - Drop in rabbit population has secondary impact on birds of prey (e.g., bald and golden eagles)

Pennisetum ciliare
(Buffelgrass)

In Hawaii, invasion of perennial grasses provides abundant fuel and increases fire frequency. This leads to dominance by more fire-tolerant non-native species.

Pennisetum setaceum
(Crimson fountaingrass)

Impacts of buffelgrass in Arizona can be devastating on native cactus in Sonoran Desert

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- Invasive plants can change plant communities by altering the historic fire regimes
  - Suppression (not common in the western US)
  - Promotion (very common in the western US)
- Fire can be used as a tool for the control of invasive plants

Risks associated with prescribed burning

- Escaped fires
- Air quality
- Soil erosion
- Effects on invasion of other non-desirable species
- Impacts on non-target plants
- Impacts on other animals and insects

Growth forms and life cycles

- Winter annuals
  - Most effective group to control, especially those that have an extended season
    - Annual grasses, such as medusahead (*Taeniatherum caput-medusae*), barb goatgrass (*Aegilops triuncialis*), ripgut brome (*Bromus diandrus*)
    - Yellow starthistle (*Centaurea solstitialis*)
- Summer annuals
  - Generally easy to control with burning, but few invasives fall into this category
- Biennials
  - Single burn events not typically effective
    - Spring burn for garlic mustard (*Alliaria petiolata*)

Growth forms and life cycles

- Herbaceous perennials
  - Few examples of success in the western US
  - Some success with smooth brome and Kentucky bluegrass in east, but timing is critical
- Woody plants
  - Can be controlled if they do not resprout from base. If they resprout, integrated approaches need to be used
    - Juniper (*Juniperus* spp.)
    - Mesquite (*Prosopis* spp.)

Principles of using prescribed burning to control annual invasive plants

- Reduce seedbank
  - kill seed before they shatter
  - understand seed longevity, germination timing and biology, effects of fire on germination
- Effects of heat on seed survival
  - Seeds protected in some species, i.e. yellow starthistle
    - requires that plants be killed before seeds become viable
  - For annual grasses, typically need direct heat on seed
    - seed on soil surface do not get exposed to sufficient heat to kill them in grassland fire

Burn timing

- Need enough fuel to carry a fire (or a fire with proper intensity)
- Timing can also influence non-target species
  - Burning too early may injure desirables that have not completed their life cycle
  - Burning late can favor perennial grasses
  - Burning too late may reduce invasive plant control

How to manipulate fire intensity

- Delay grazing to build up fuels
- Late afternoon fires
  - not often recommended because of winds
- Backing fires compared to headfires

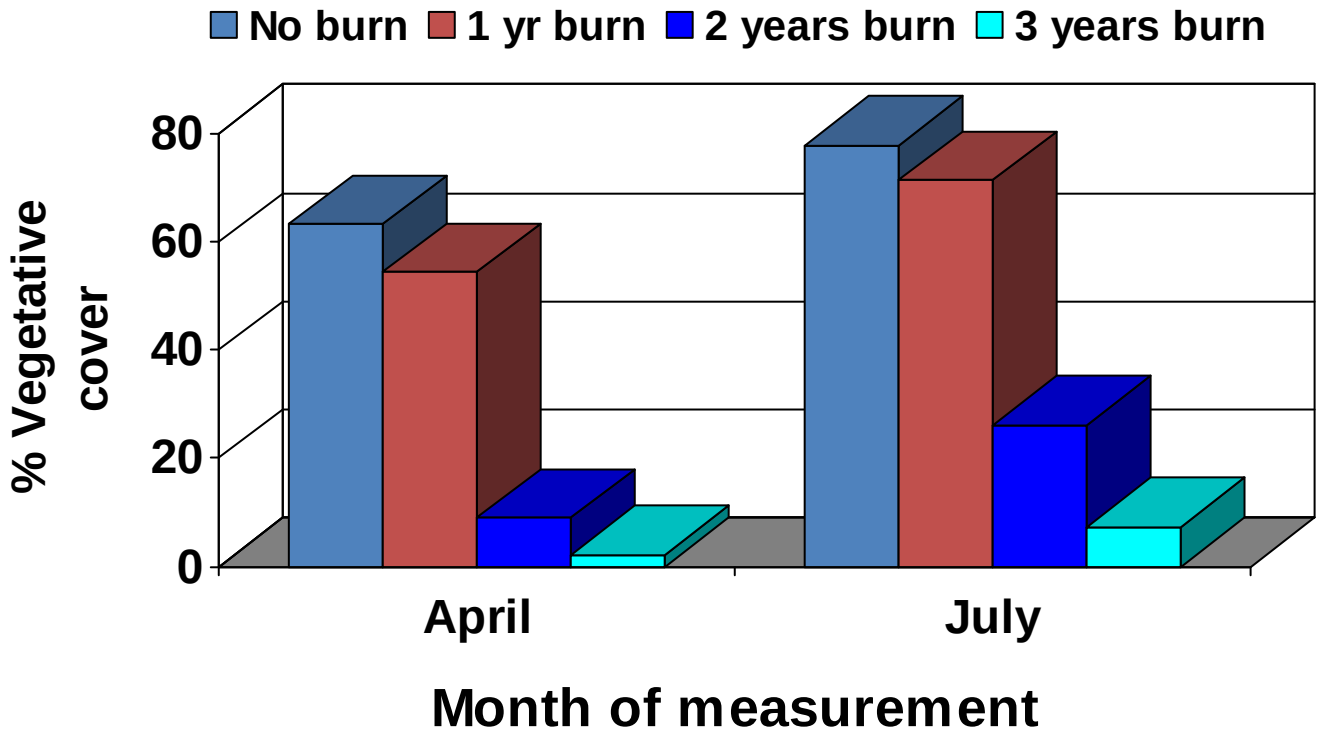
Effects on other species

- Generally broadleaf species (i.e., legumes, filarees) and perennial grasses increase more than annual grasses following burning
  - Native diversity generally benefits
    - » recycles nutrients
    - » increases solar radiation early in season, thus heating soil
    - » reduces native pathogen under moist litter
    - » increases light penetration to soil surface
    - » breaks dormancy

Centaurea solstitialis (yellow starthistle)


1474

Effect of consecutive burns on yellow starthistle vegetative cover

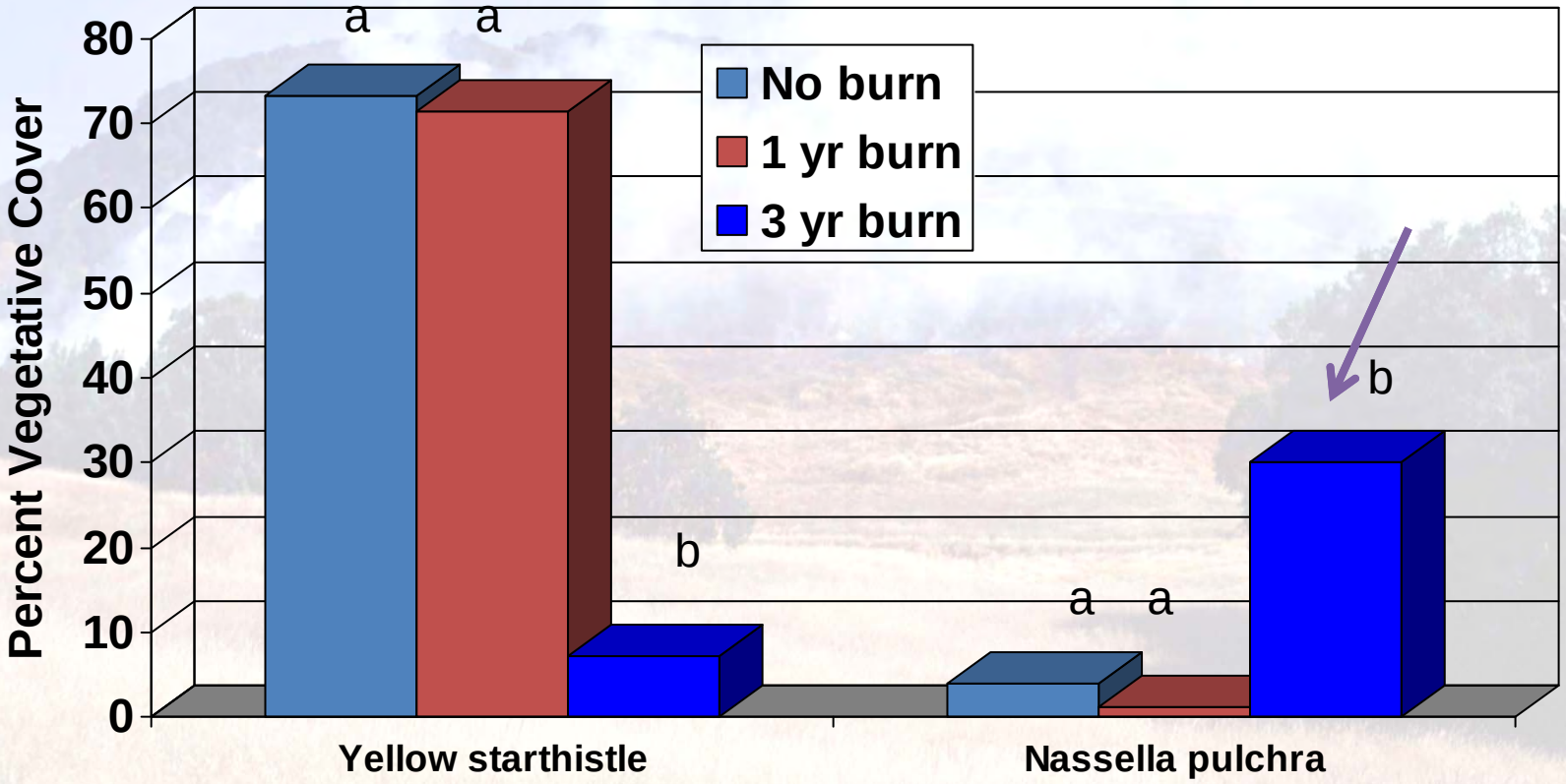


Seedbank and seedling count following 1 and 3 years of consecutive burning

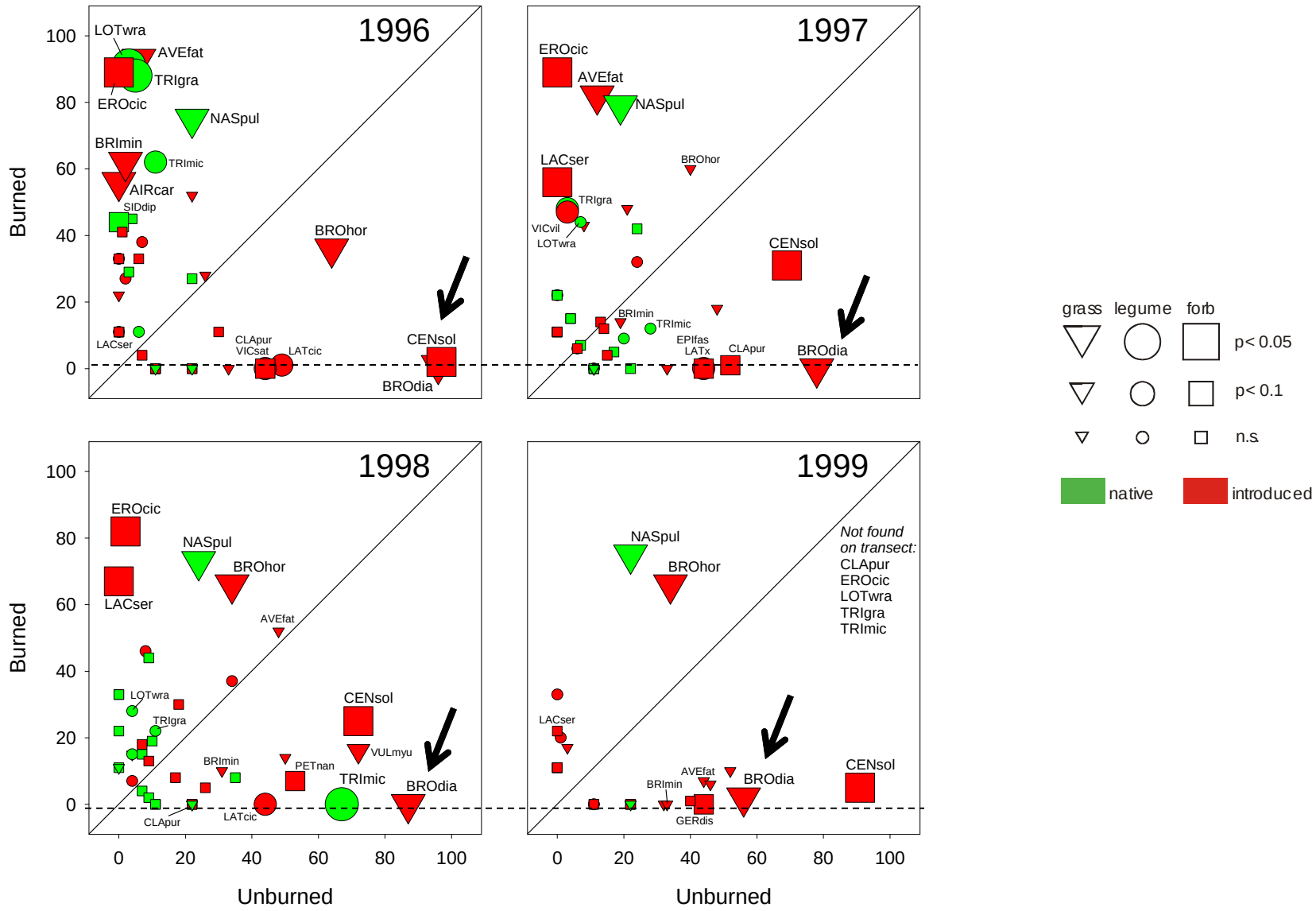
	Seedbank (Oct. 1995)		Seedlings (March 1996)	
Treatment	Seeds/m^2	% of unburned	Seedlings/m^2	% of unburned
Unburned	10,127 c*	-----	1,328 c	-----
1995 Burn	2,673 b	26	230 b	17
1993-1995 Burn	52 a	0.5	5 a	0.4

* different letters in columns denote statistically significant difference at the 95% confidence level

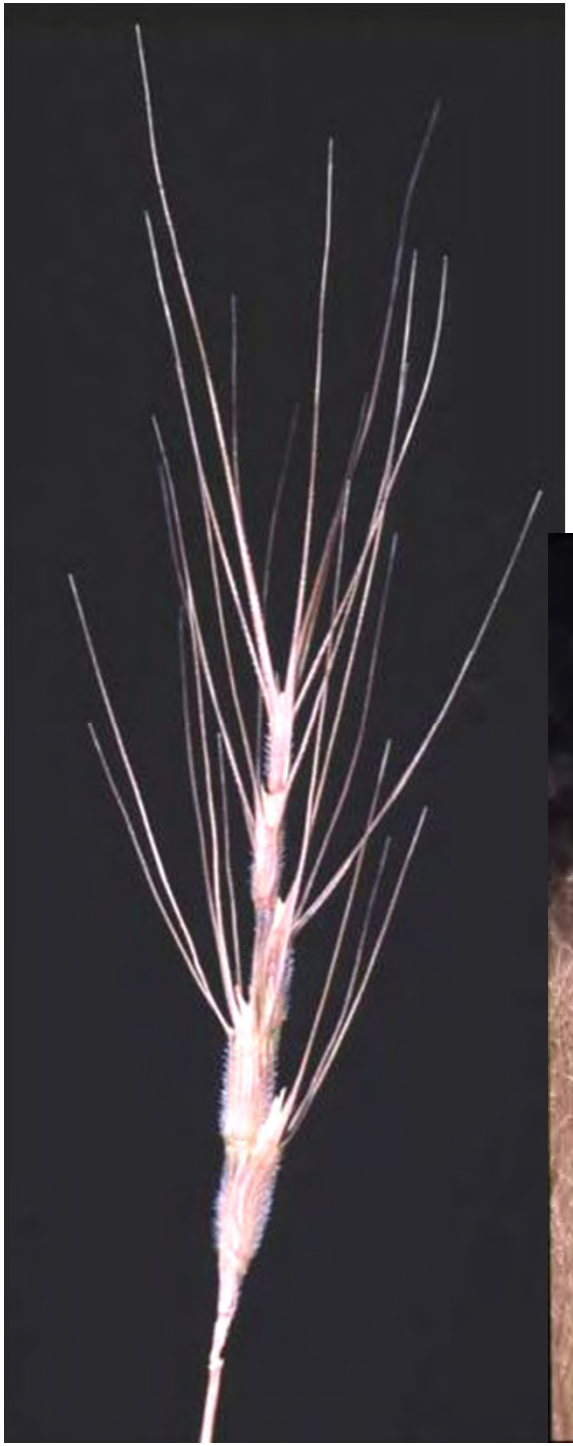
Vegetative cover in July



Bromus diandrus (ripgut brome)



Kyser and DiTomaso. 2002. Weed Science 50, 648



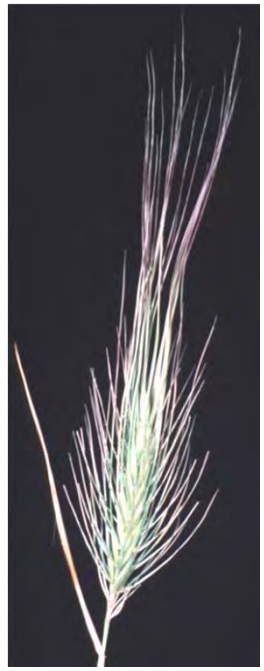
Aegilops triuncialis
(Barb goatgrass)

Barb goatgrass control burn

Vegetation type	% Vegetative cover or index value					
	Unburned			burn		
	1997	1998	1999	1997	1998	1999
				Pre-burn		
Grasses						
barb goatgrass	45	62	63	55	54	0
native perennials	0	0	1	1	9	10
total grasses	127	156	152	116	173	68

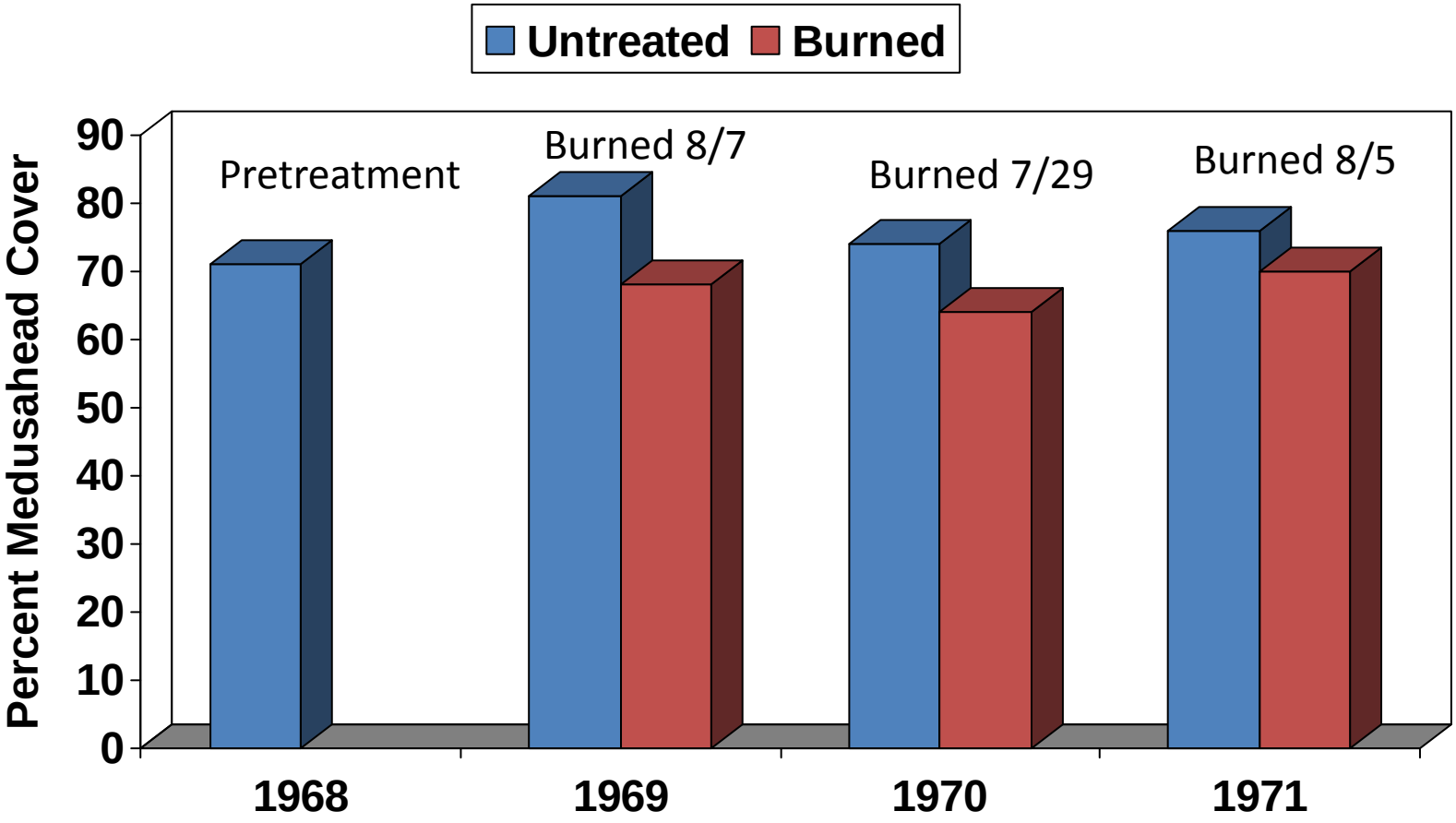
DiTomaso et al. 2001. Cal. Ag. 55, 47.

Burning increased the native perennial grass *Hordeum brachyantherum* while controlling barb goatgrass

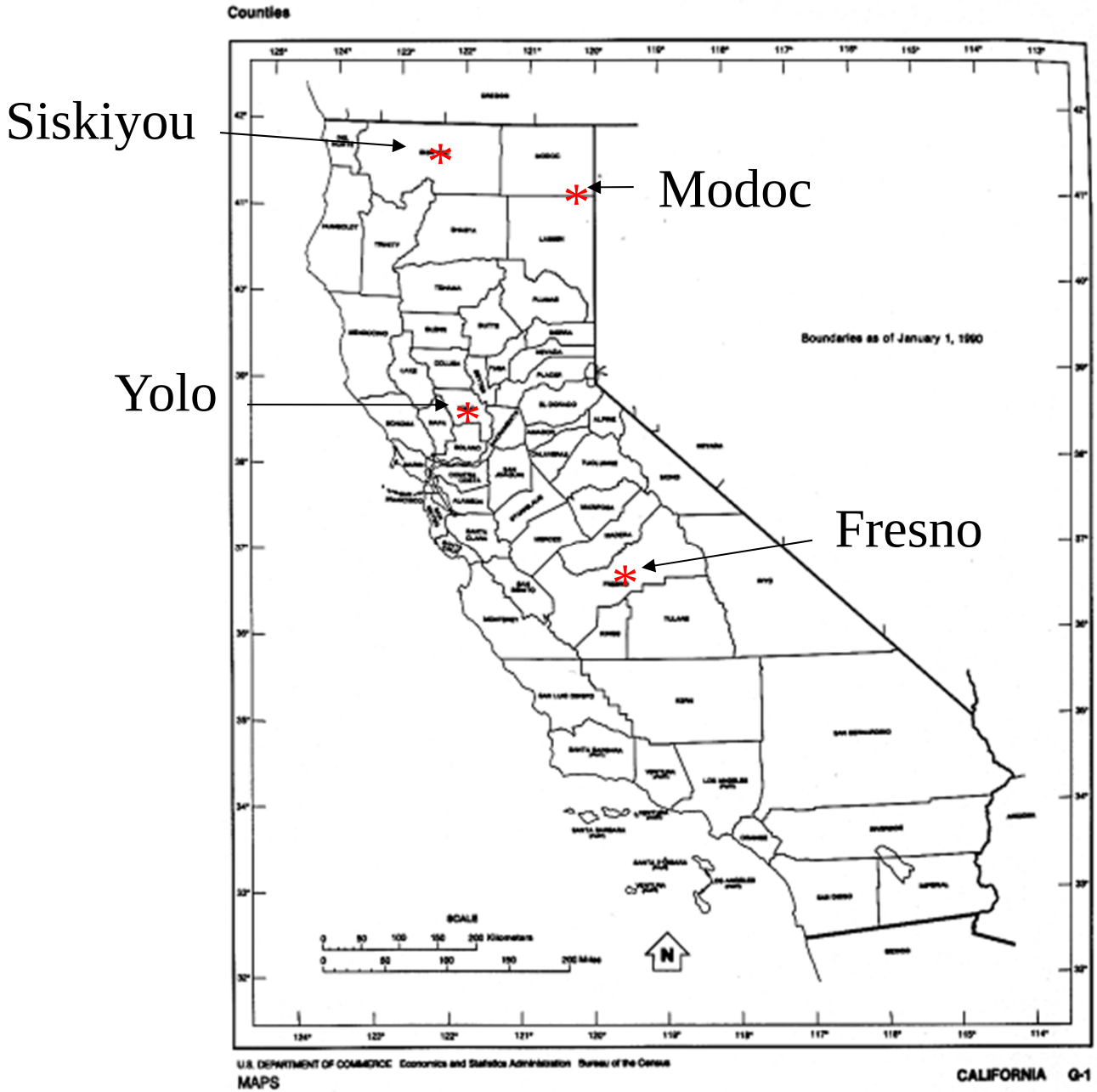


Taeniatherum caput-medusae
(medusahead)

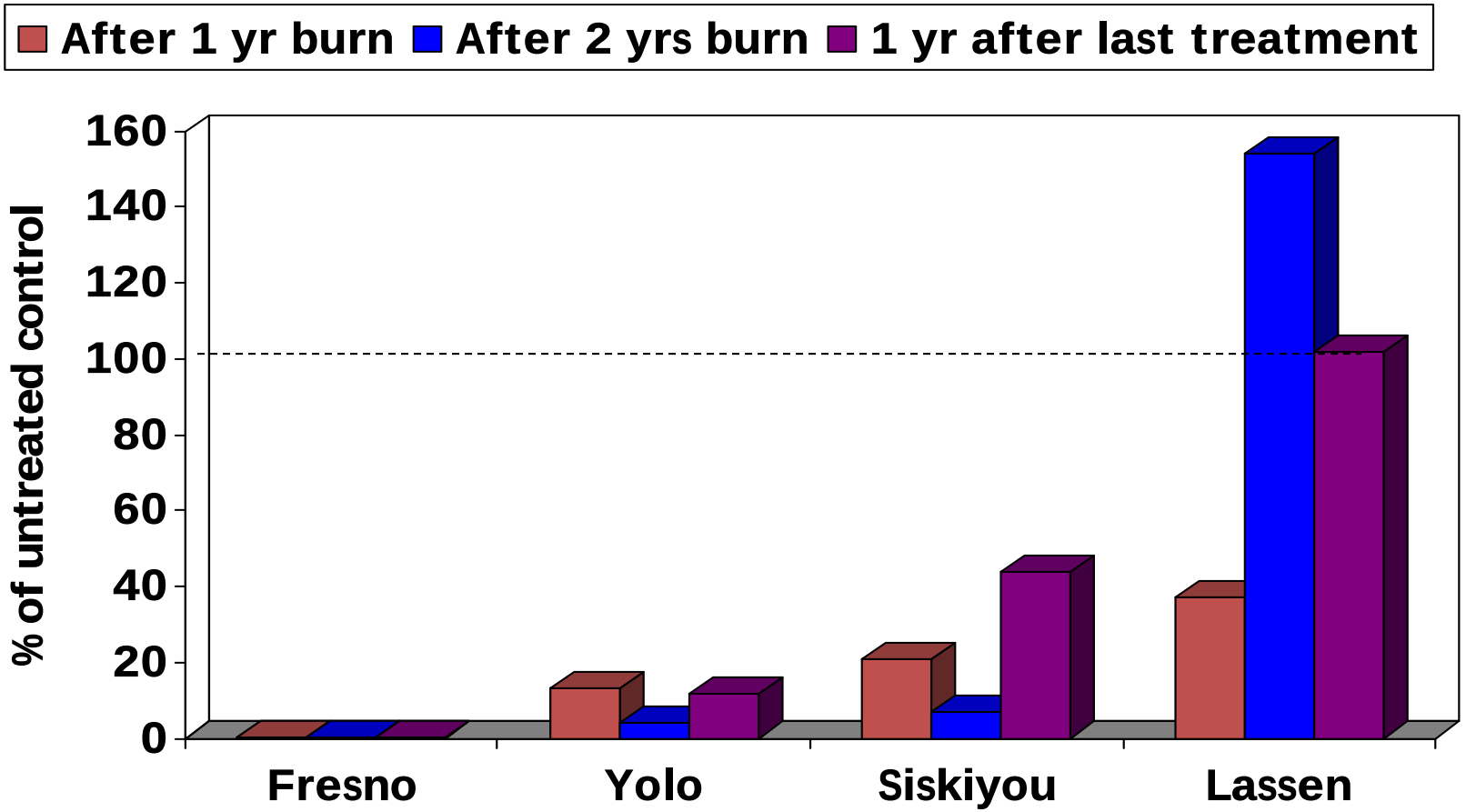
Effect of fire on medusahead control



From Young et al. 1972. J. Range Manage, 24:451

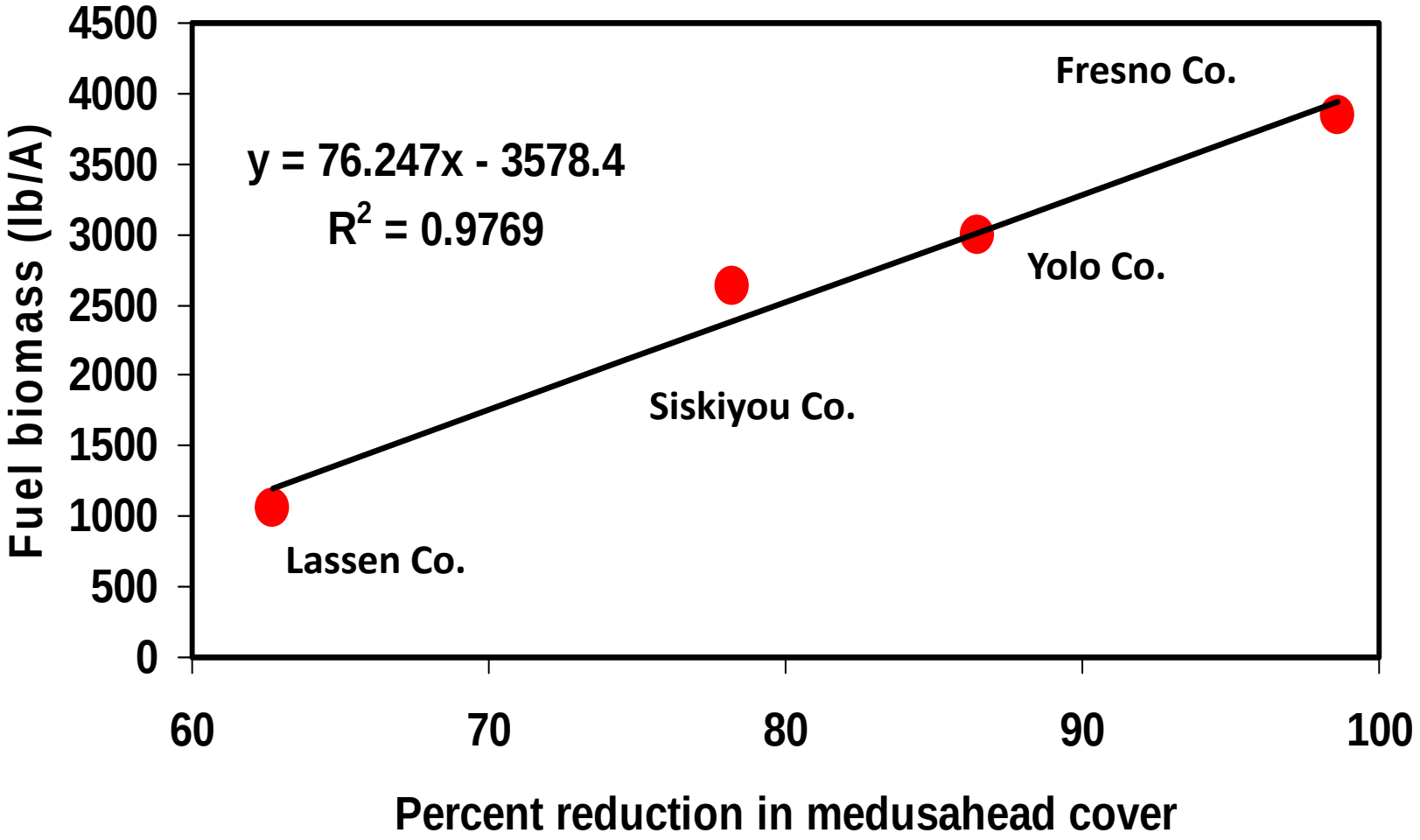

Siskiyou
Modoc
Yolo
Fresno
Counties
Boundaries as of January 1, 1990
SCALE
N
U.S. DEPARTMENT OF COMMERCE Economics and Statistics Administration Bureau of the Census
MAPS
CALIFORNIA G-1

Burning for medusahead control in four counties



Study site	Time period	Degree-days above 0 C, Oct-June	Expected frost-free days
Fresno	2001-2005	3871	238
Yolo	2001-2005	4193	265
Siskiyou	2002-2006	2365	125
Modoc	2002-2006	1992	90
XL Ranch (Young et al. 1972)	1967-1971	1791	75

Effect of fuel load on medusahead control one year after burning



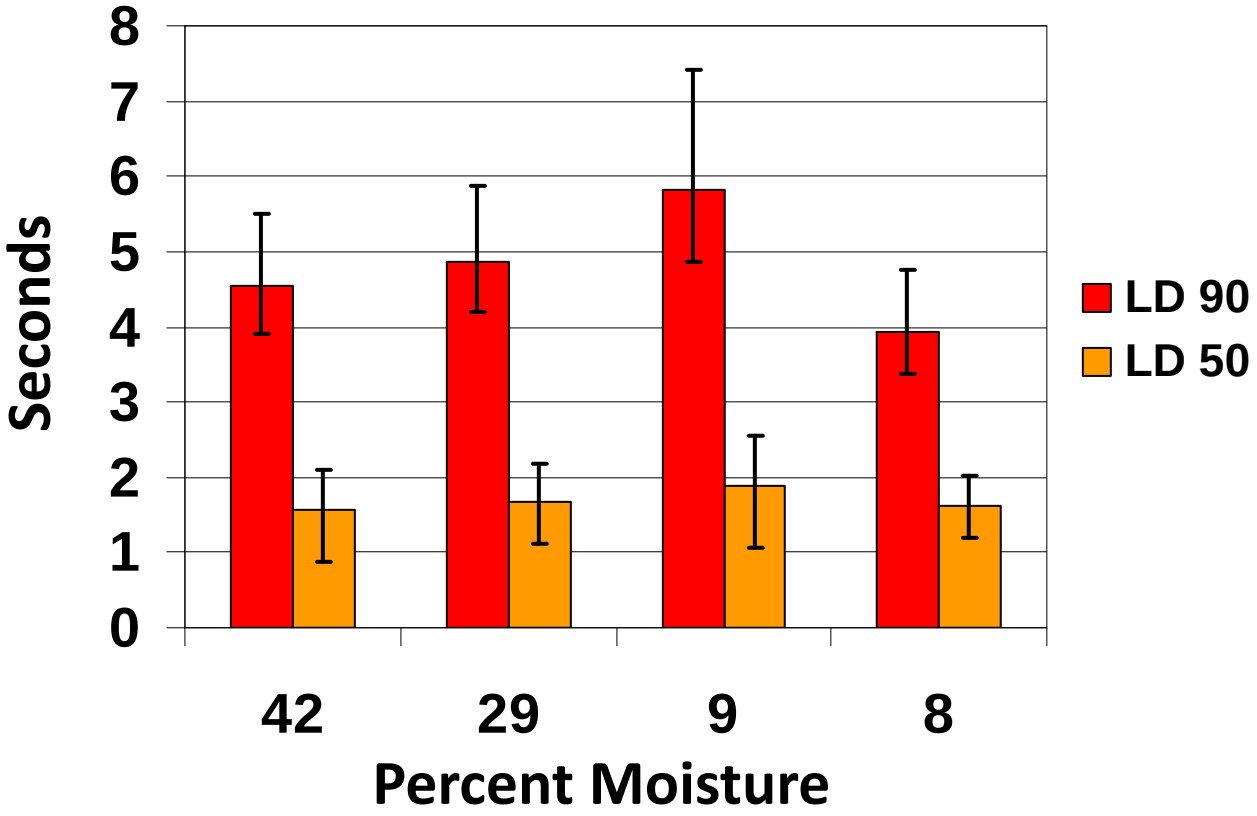
Medusahead

Flame Simulation

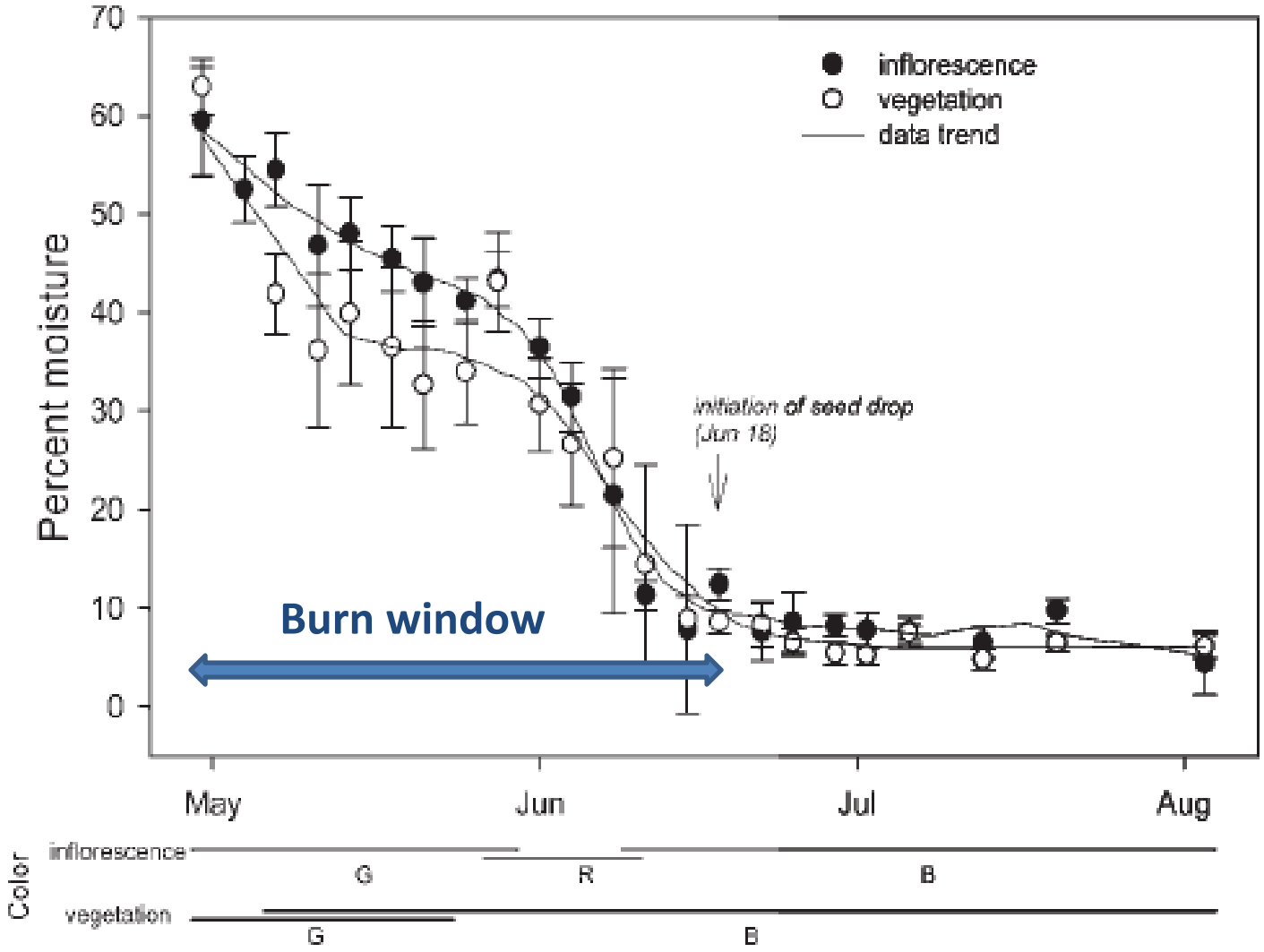
350-500 C

Medusahead ±

97.5% CL



Sweet, Kyser, and DiTomaso. 2008. Invasive Plant Science and Management 1, 158


70
60
50
40
30
20
10
0
Percent moisture
inflorescence
vegetation
data trend
initiation of seed drop
(Jun 18)
Burn window
May
Jun
Jul
Aug
Color
inflorescence
G
R
B
vegetation
G
B

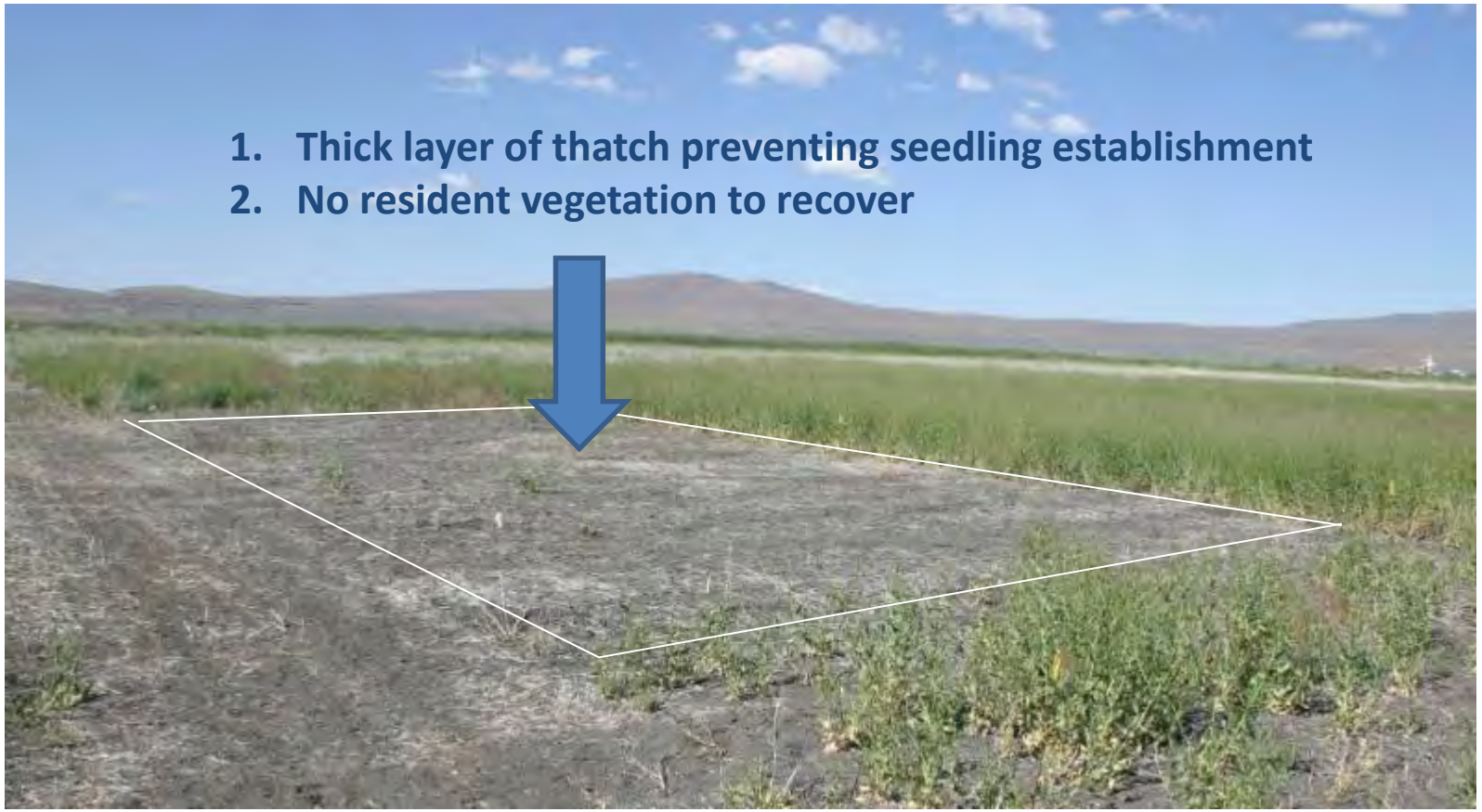
LD_{90} for the three annual grass species

Species	LD_{90} value (seconds)
Barb goatgrass	**8.0**
Medusahead	**4.0**
Ripgut brome	**1.1**

Integrated approaches that incorporate prescribed burning into management of invasive plants

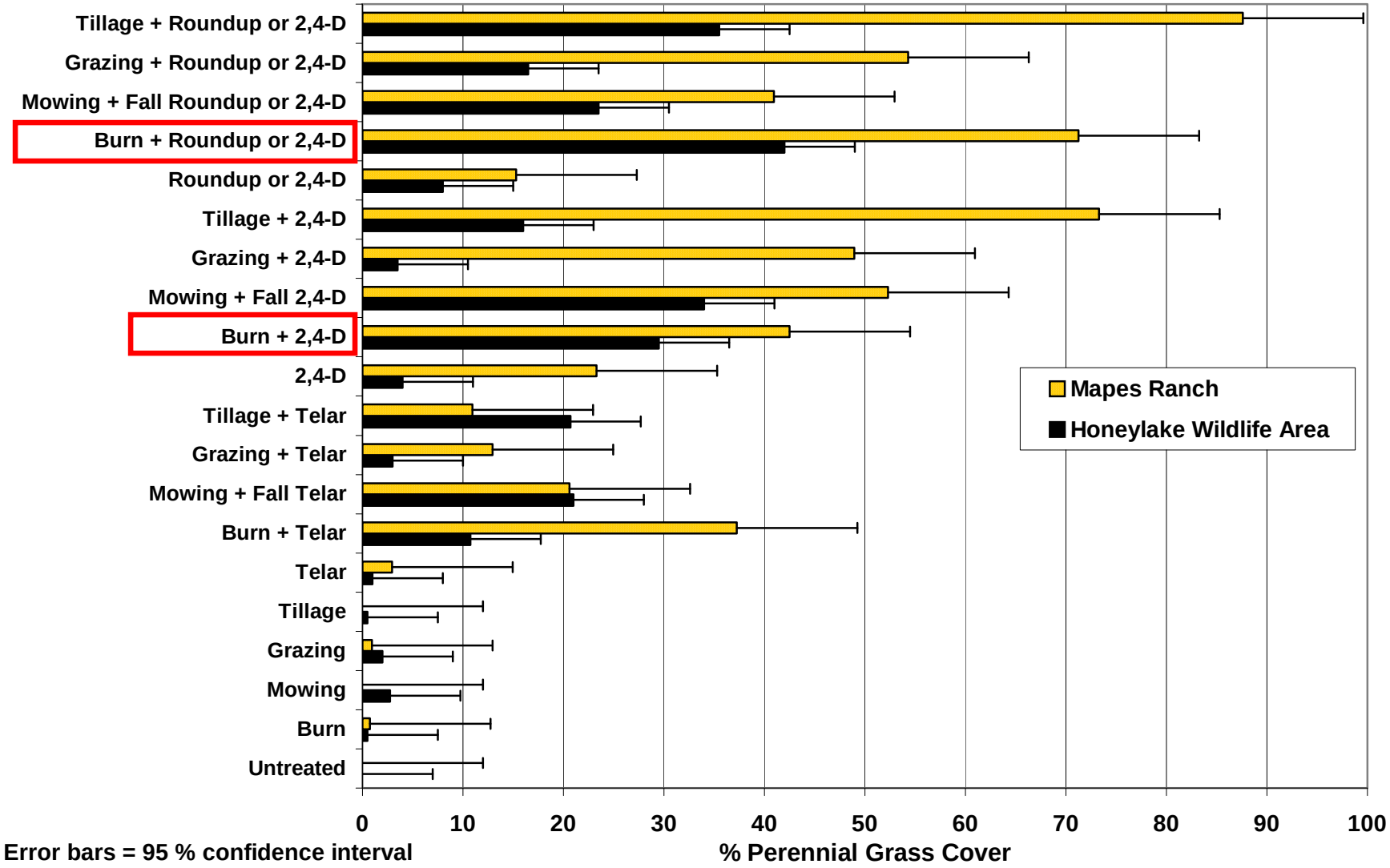
Lepidium latifolium
(perennial pepperweed)

Control of perennial pepperweed with herbicide



Winter Burning

The Influence of Site Preparation Treatments and Herbicides on Perennial Grass Establishment in June 2006 (15 months after 2nd seeding)



Error bars = 95 % confidence interval

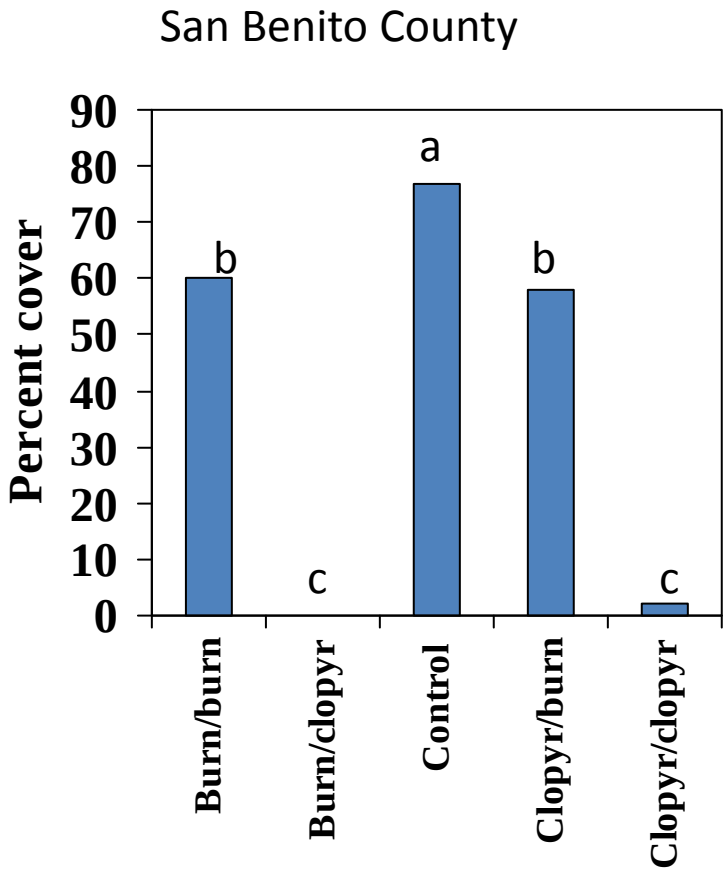
Wilson, Boelk, Kyser, and DiTomaso. Invasive Plant Science and Management 1, 17

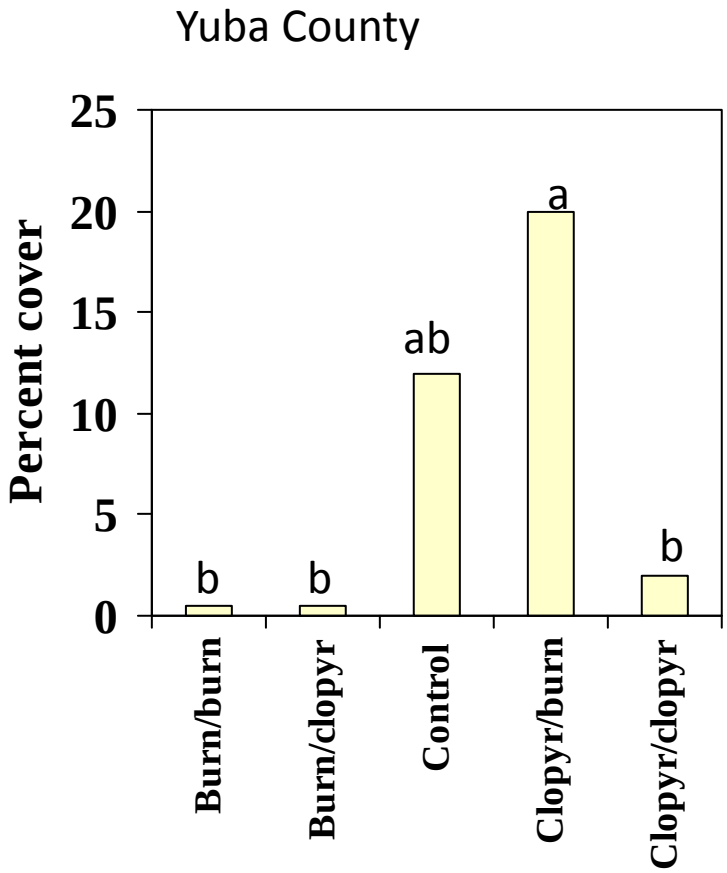
Yellow starthistle

Transline (clopyralid) treated rangeland on right

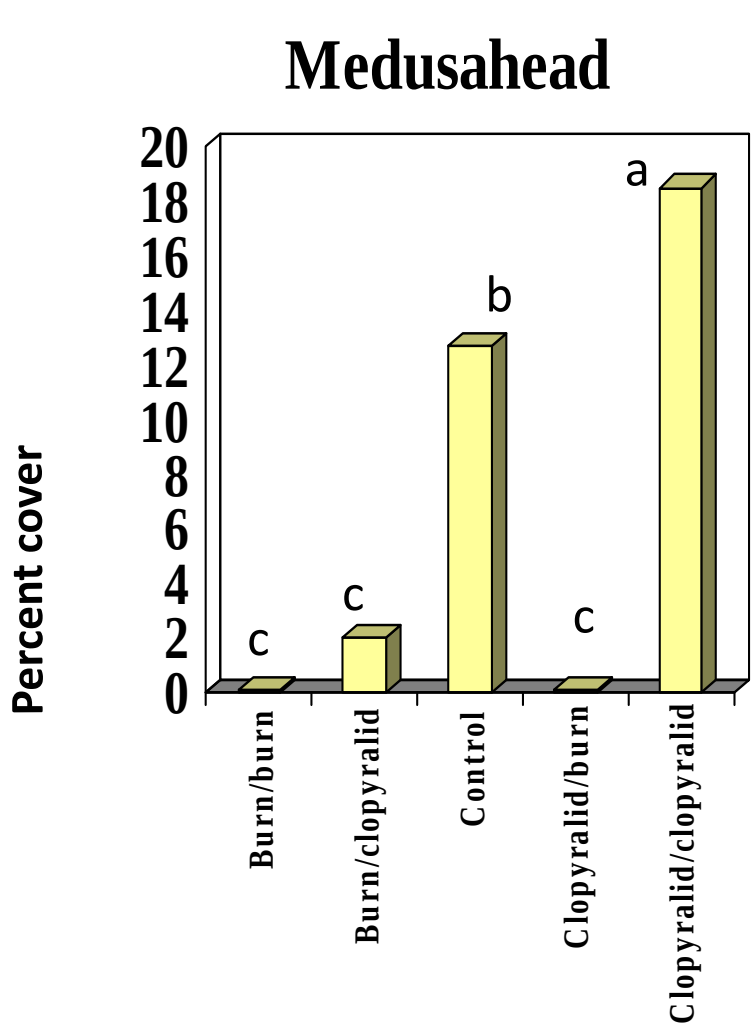

San Benito site following burn in 1999

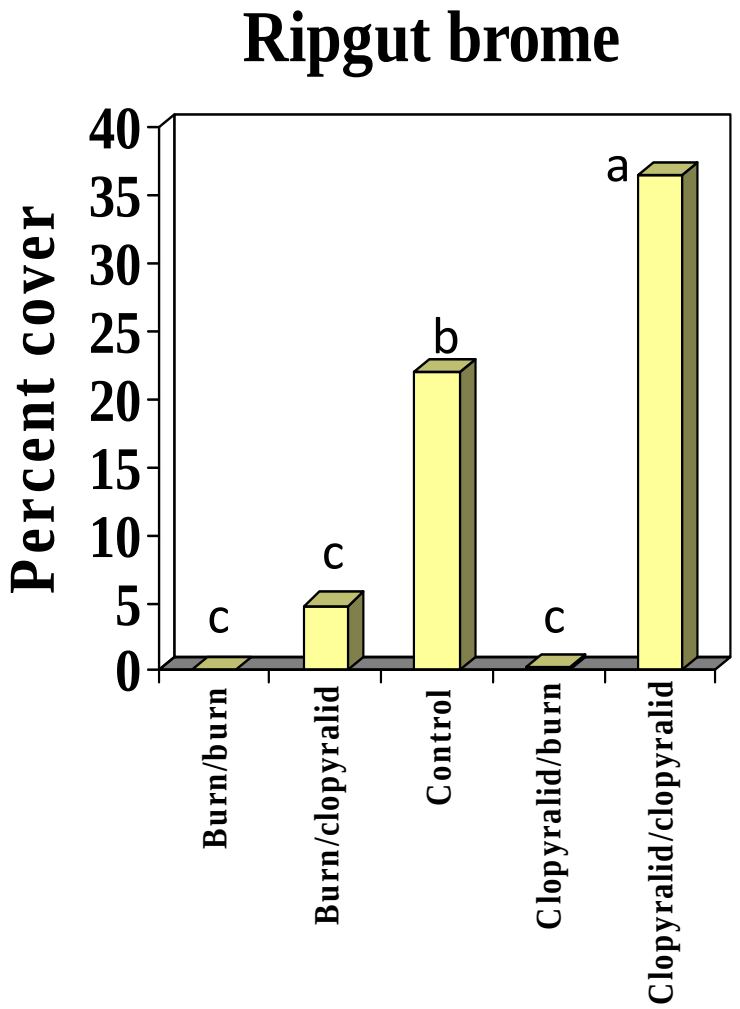
Yellow starthistle cover following two years of control





Yuba County


Medusahead
Percent cover
20
18
16
14
12
10
8
6
4
2
0
c
c
b
c
a
Burn/burn
Burn/clopyralid
Control
Clopyralid/burn
Clopyralid/clopyralid


Ripgut brome
Percent cover
40
35
30
25
20
15
10
5
0
c
c
b
c
a
Burn/burn
Burn/clopyralid
Control
Clopyralid/burn
Clopyralid/clopyralid

Integrated management of yellow starthistle at Ft. Hunter Liggett

Site	Treatment	Seedlings/m^2	
		Untreated	Treated (% untreated)
Military use			
2000	Burned 1999	117	271 (232%)
2001	Clopyr. 2000 Burn 2001	478	2 (0.4%)
2002	No treatment	363	0.8 (0.2%)
Wildland site			
2000	Burned 1999	435	547 (126%)
2001	Clopyr. 2000 Burned 2001	1560	6 (0.4%)
2002	No treatment	987	45 (5%)


Thank you!
Questions?