Adaptive Grazing Management for Weed Control

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Managing Weeds with Grazing

Prescribed grazing is the controlled implementation of the timing, frequency, and intensity of grazing to achieve specific goal(s).

The grazing manager can

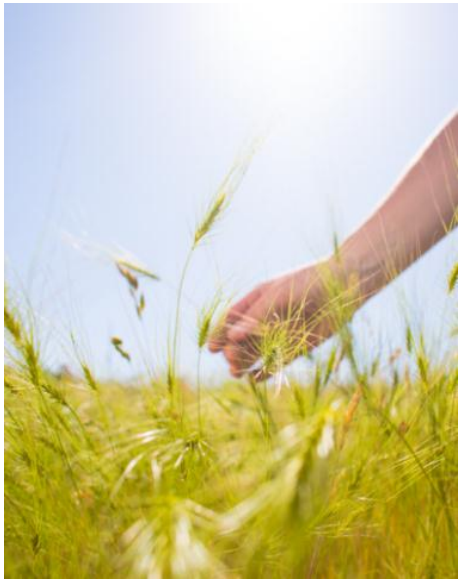
1. Type of livestock (*e.g., cattle, sheep, goats*).
2. Number of livestock (*stocking density – head/acre*).
3. Duration of grazing (*stocking rate – head/acre/year*).
4. Seasonal timing of grazing (*e.g., spring, summer, etc*).
5. Frequency of grazing (*e.g., 1X, 2X per growing season*).
6. Spatial distribution of grazing (*e.g., fences, water*).

Managing Weeds with Grazing

- Plot scale research (<5 acres) results: Timing and intensity shown to reduce cover of weedy species.

Yellow starthistle
Centaurea solstitialis
75-90% reduction in flower heads
(e.g., Thompson et al. 1993)

Medusahead
Taeniatherum caput-medusae
30-100% reduction in canopy cover
(e.g., DiTomaso et al. 2008)



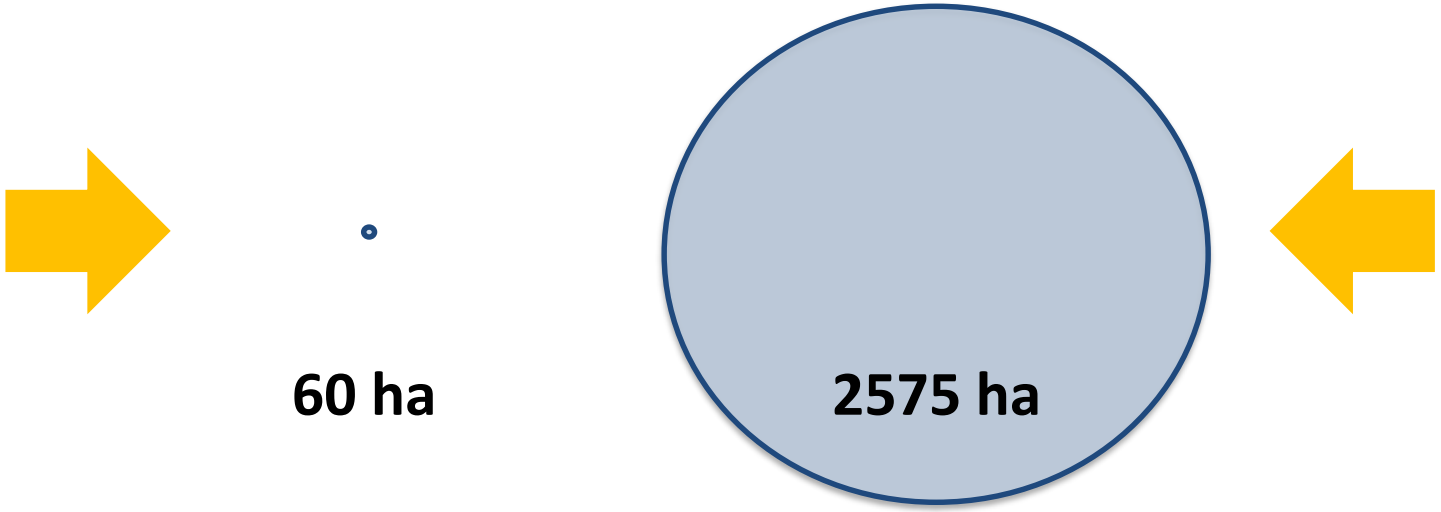
Relative Spatial Scale of Grazing Research and On-Ranch Grazing Management

Research

Fixed, controlled experiments

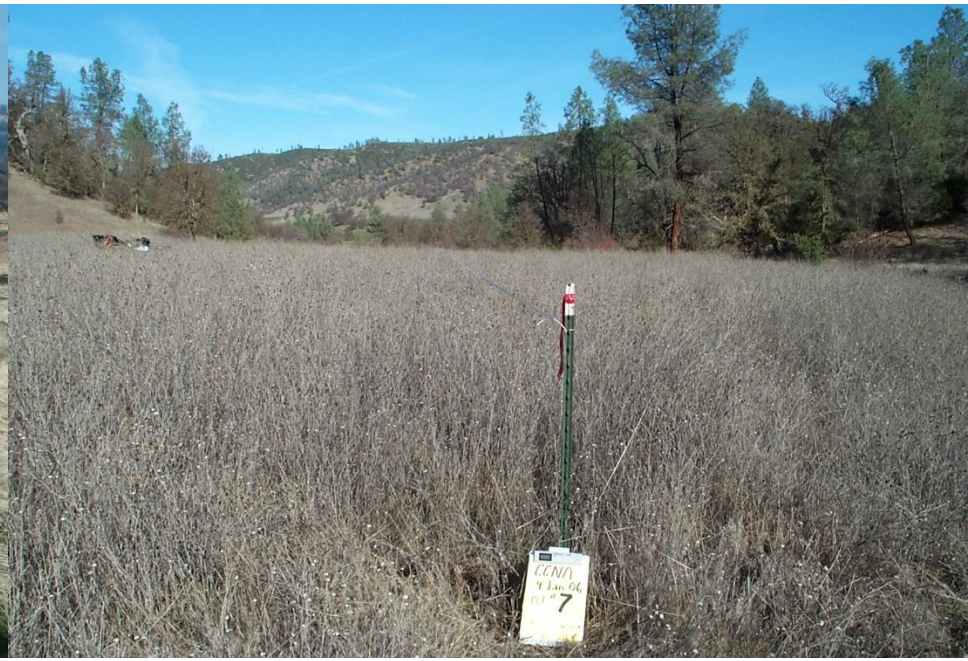
Management

Adaptively implemented, landscape strategies



Warning: Objects are to Scale

Cattle Grazing in a Noxious Weed-Dominated Rangeland



Case Study 1

UC CE NRCS U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

Cattle Grazing in a Noxious Weed-Dominated Rangeland

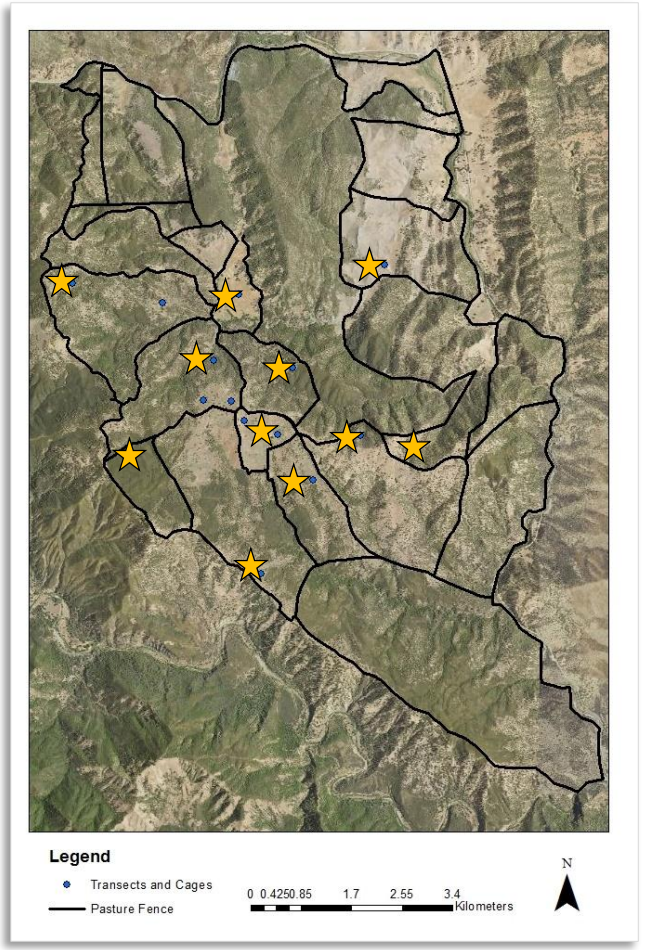
Bear Creek Management Unit

- 11,000 acres BLM-managed land
- Grazing terminated: 1999-2001
  - **Goal**: Enhance native plant cover
  - **Outcome**: Enhanced invasive weed cover
- Cattle grazing re-introduced: 2006

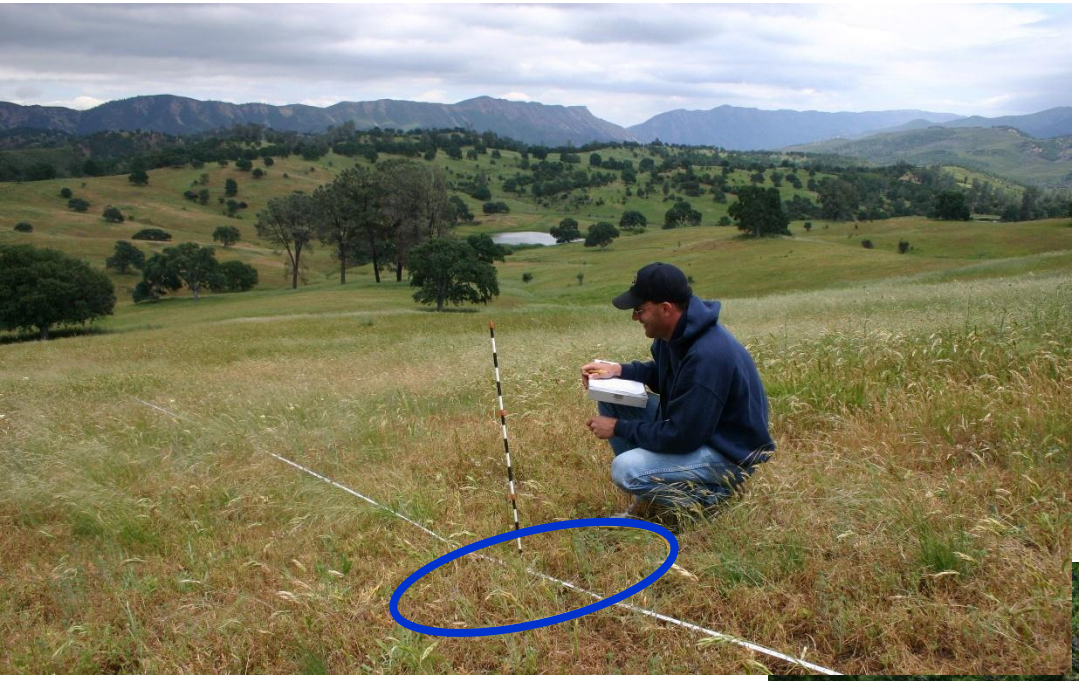
Cattle Grazing in a Noxious Weed-Dominated Rangeland

Rotational grazing system

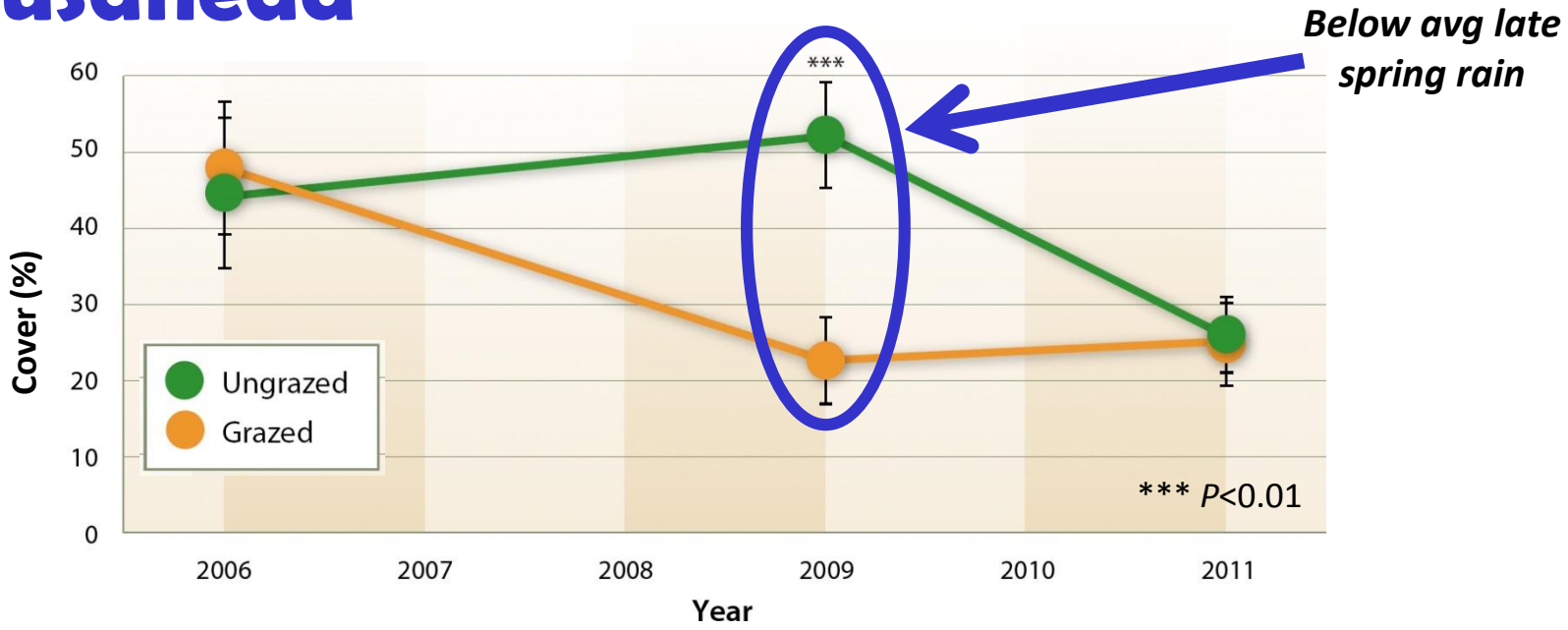
- 80-600 ac paddocks
- ~400 cow-calf pairs
- January-May, 2006-2011
- Grazed 2x
  - *Winter* – Target thatch
  - *Spring* – Target late-flowering invasives



Species Composition, Cover, RDM

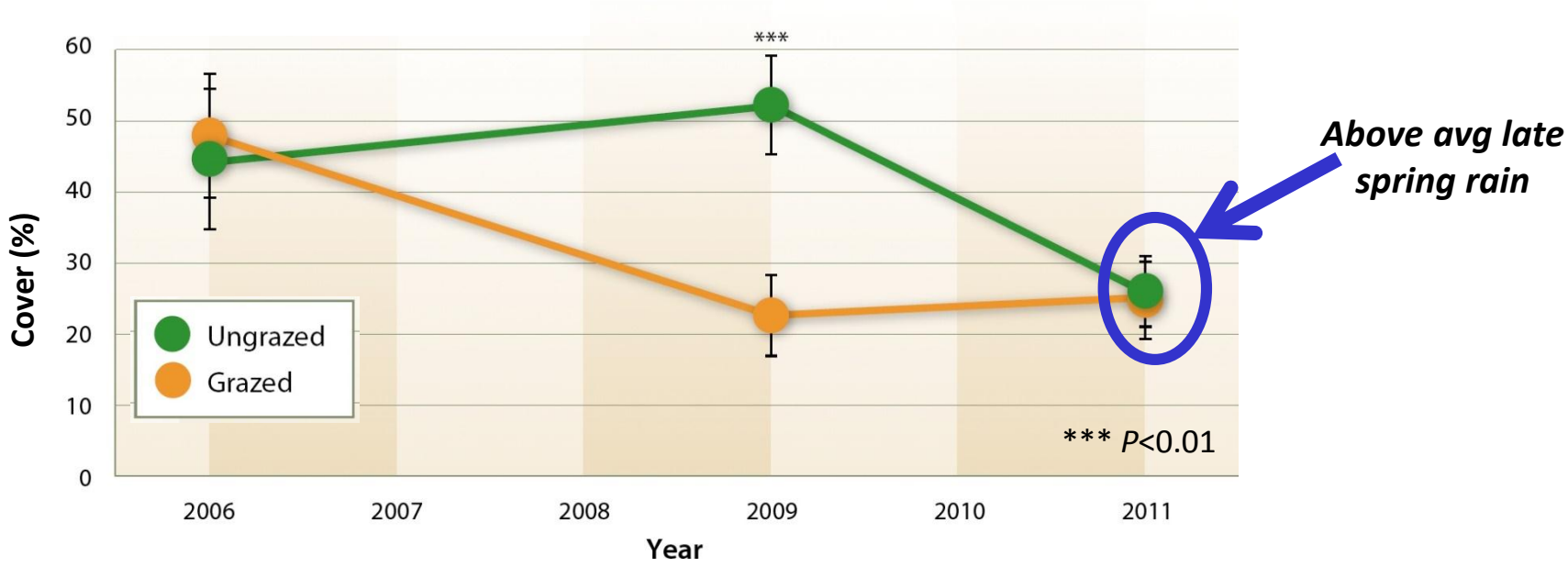


Medusahead



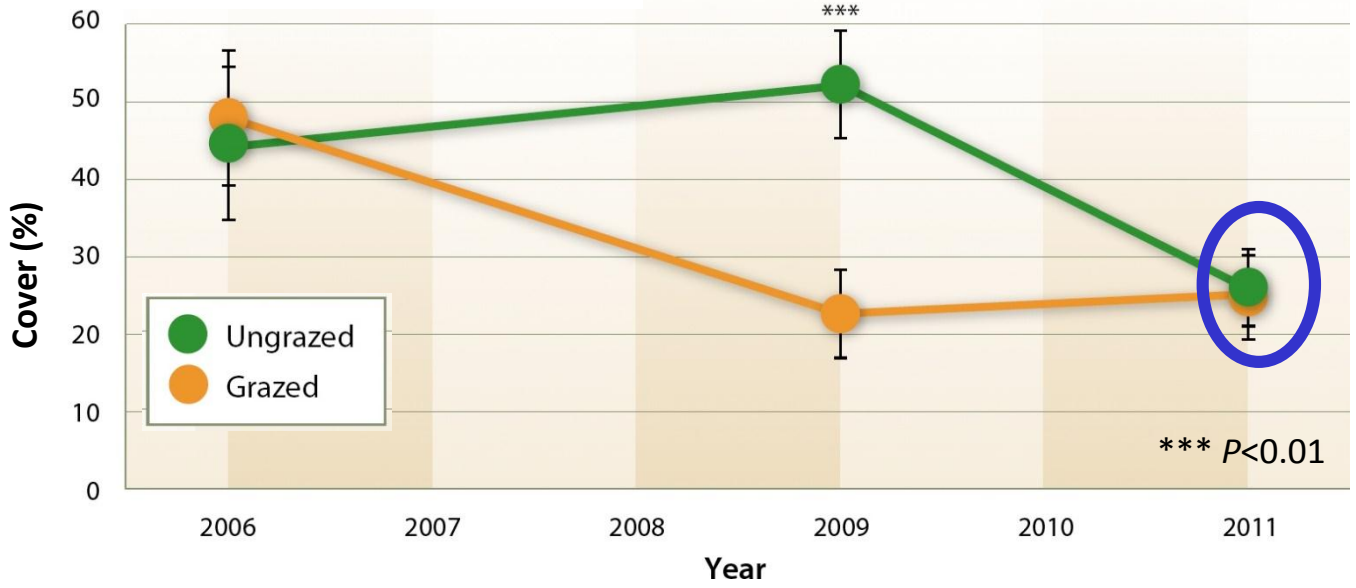
- Medusahead reductions in dry Springs.

Medusahead



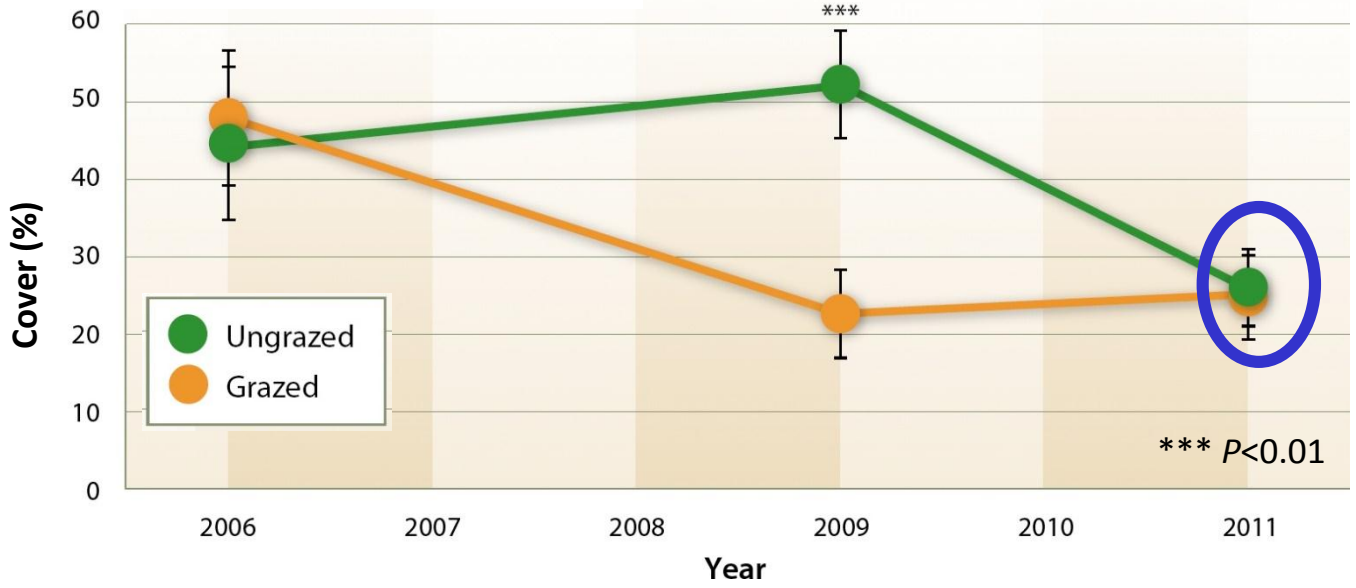
- Medusahead reductions in dry Springs.
- No further reductions in wet Springs.

Medusahead



- Medusahead reductions in dry Springs.
- No further reductions in wet Springs.
- Ungrazed Treatments: Medusahead replaced by other undesirable plants (ripgut, red brome).

Medusahead

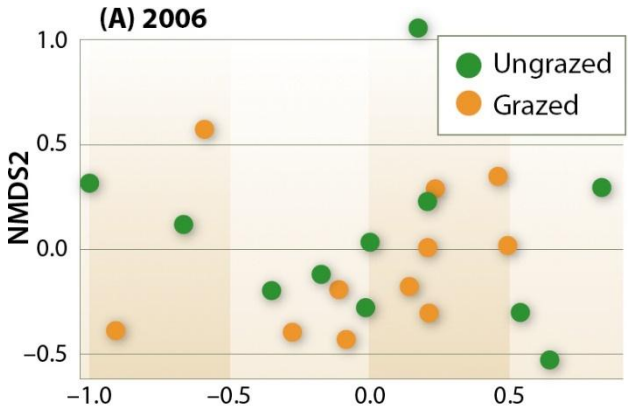


- Medusahead reductions in dry Springs.
- No further reductions in wet Springs.
- Ungrazed Treatments: Medusahead replaced by other undesirable plants (ripgut, red brome).
- Grazed Treatments: Increases in desirable plants (slender oats, filaree).

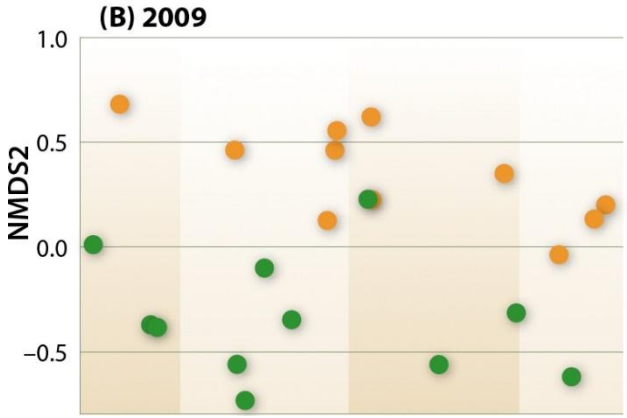
Davy et al. 2015. Calif. Agr.

Plant Community

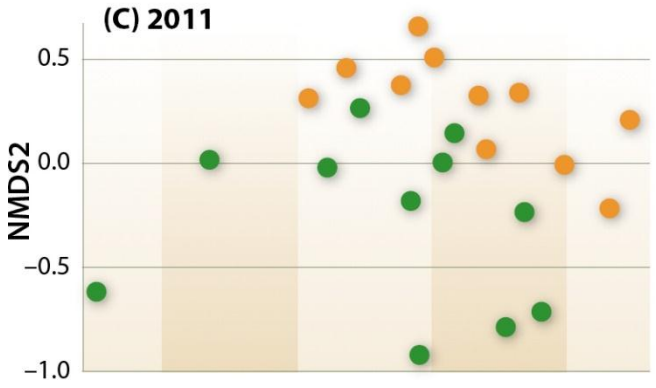
2006: Composition not statistically different between grazed/ungrazed treatments.



2009: Composition significantly diverged between treatments.



2011: Remained significantly different.



Davy et al. 2015. Calif. Agr.

What did we learn?

- Grazing more beneficial to management goals than no grazing.
- To be more effective – Late season grazing is key.
  - This study: Fixed grazing endpoint.
    - Not staying long enough to impact YST.
    - Not staying long enough to impact MH in late wet springs.
- Challenges: Available drinking water and animal welfare/production concerns in late season.

Stakeholder Prescribed Adaptive Grazing Management Project

Case Study 2

UC CE

California Cattlemen's Association – Since 1917

NRCS

Forest Service – U.S. Department of Agriculture

Point Blue Conservation Science

and more!...

USDA Agricultural Research Service

California Rangeland Conservation Coalition

Audubon California

California Farm Bureau Federation

The Nature Conservancy

Stakeholder Prescribed Adaptive Grazing Management Project

- Engage diverse stakeholder at the very beginning of research
- Stakeholders prescribed strategies (treatments) and goals (monitoring metrics).
- Implementing, monitoring, and adapting with stakeholder input.

Field Workshops

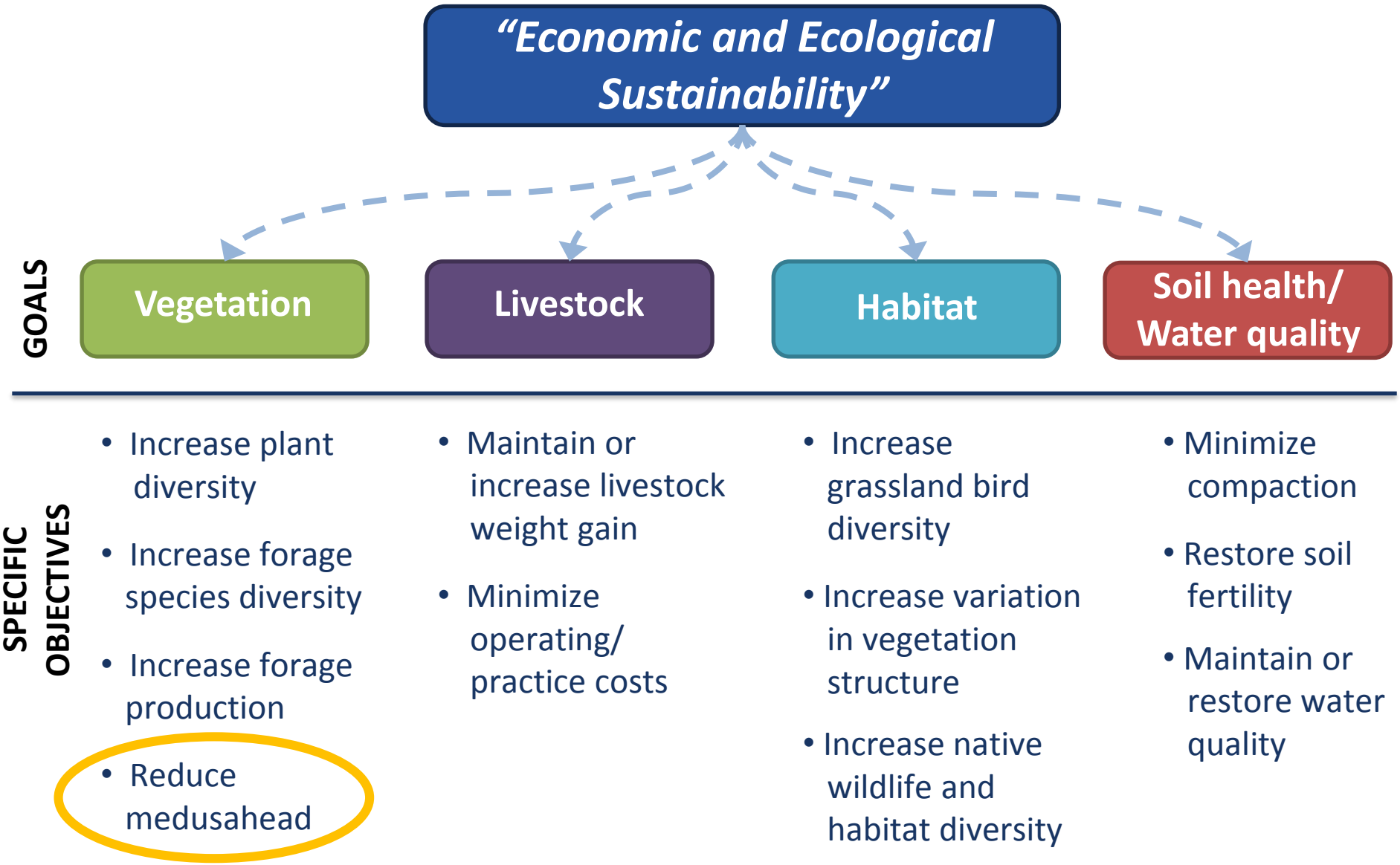
UC Research Facility
8 pastures, 1200 acres

1) Primary natural resource and agricultural goals.

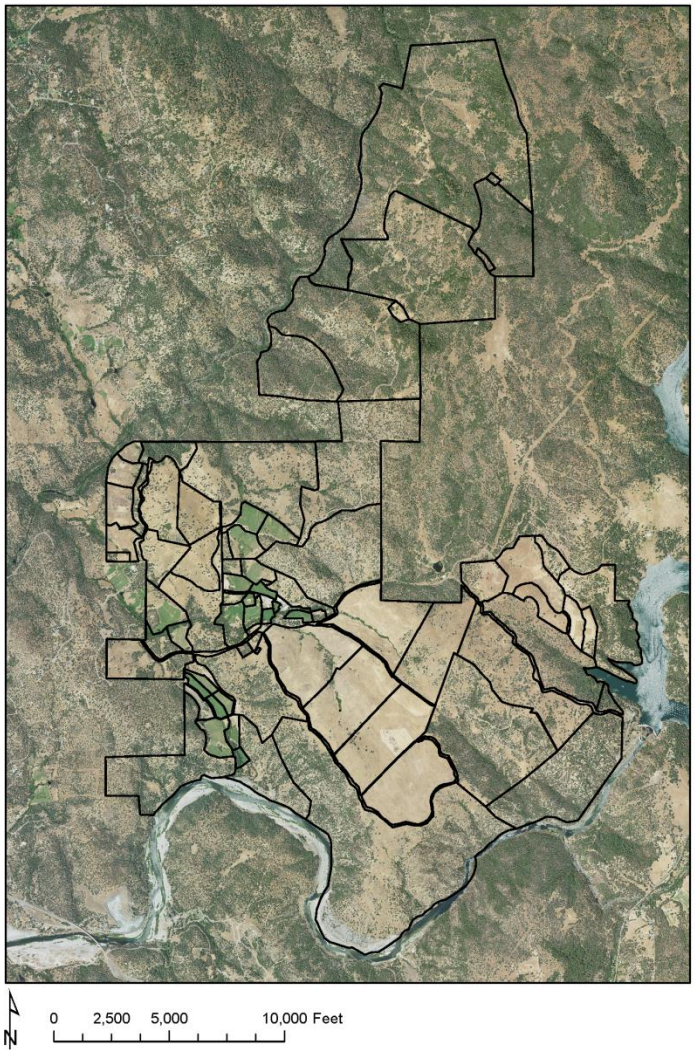
2) Potential challenges and opportunities for goals.

3) Adaptive management strategies to achieve goals.

Common Goals and Objectives



Stakeholder Prescribed Adaptive Grazing Management Project



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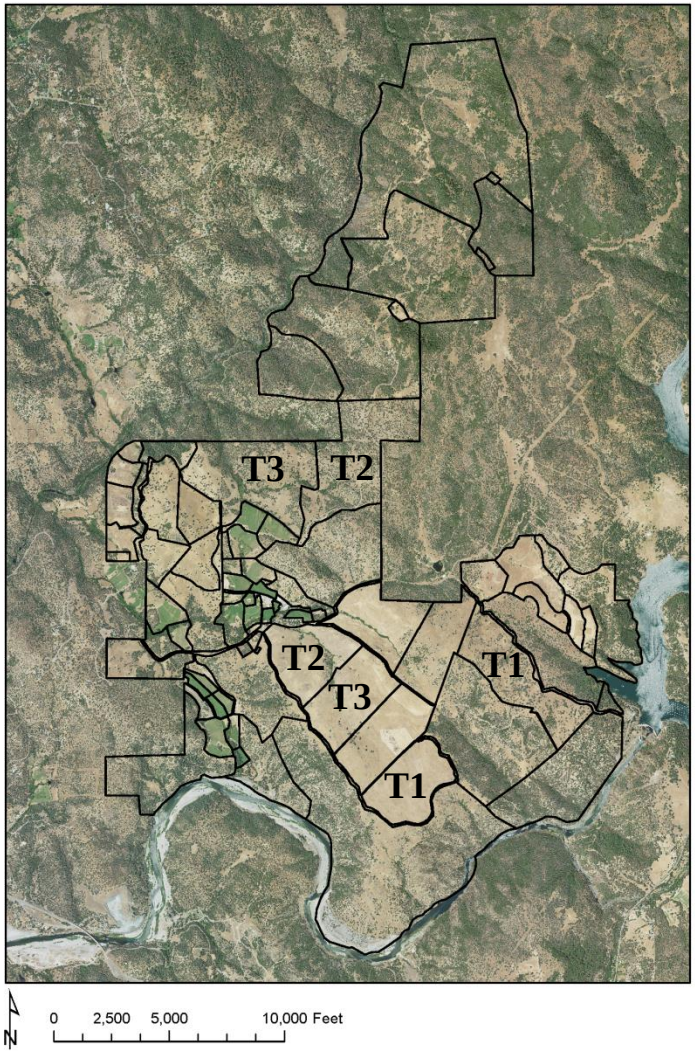

T1 Season-Long Grazing
~6 months

T2 Fall/Spring Grazing
~3 months

T3 Fall/Spring, Targeted Grazing
~3 months

Grassland pastures ~ 3 head months/acre
Oak pastures ~ 1.2 head months/acre

Stakeholder Prescribed Adaptive Grazing Management Project

Goal	Monitoring
Agricultural Production	Steer weight gains (ADG, total gain, gain/acre)
	Available forage
Plant Cover, Diversity	Cover and frequency of invasive weeds, desirable forage groups, richness
Habitat Diversity	Ground bird hiding cover (veg structure)
Soil Health	Cattle fecal distribution, cover




Stakeholder Prescribed Adaptive Grazing Management Project

Goal	Monitoring
Agricultural Production	
Plant Cover, Diversity	
Habitat Diversity	
Soil Health	

Stakeholder Prescribed Adaptive Grazing Management Project – MH % Cover

Baseline

Year 3

Yearling Performance

	Year 1 ADG (lbs/day)		Year 2 ADG (lbs/day)		Year 3 ADG (lbs/day)	
	Fall	Spring	Fall	Spring	Fall	Spring
Season-Long (T1)	0.8	2.6	0.0	3.5	1.0	3.2
Fall-Spring (T2)	0.3	3.2	-1.1	4.1	0.3	3.4
Fall Spring-Targeted (T3)	0.3	2.6	-0.7	3.8	0.3	2.6

Findings after 3 years of extreme drought…

1. ~**15** to **25%** reductions in medusahead across all treatments.
2. Available forage was greatest within the intensive rotational grazing treatment pastures (rest-regrowth dynamics and ↑ forage harvest efficiencies).
3. Capacity to adapt to drought greatest in the intensive rotational grazing treatment pastures.
4. Intensive rotational grazing ↓ individual animal spring ADG, but ↑ available forage potentially supports ↑ spring stocking rate.

Take Home Points…

- In systems with high weed invasion/pressure – grazing shown to be more effective than exclusion.
- Experimental and experiential knowledge show that grazing timing and intensity are key to successfully meeting goals.
- Management context: real world constraints.
- Multiple goals must be considered – peril of single species management.
- Prescribed grazing should be considered as part of an integrated pest management program.

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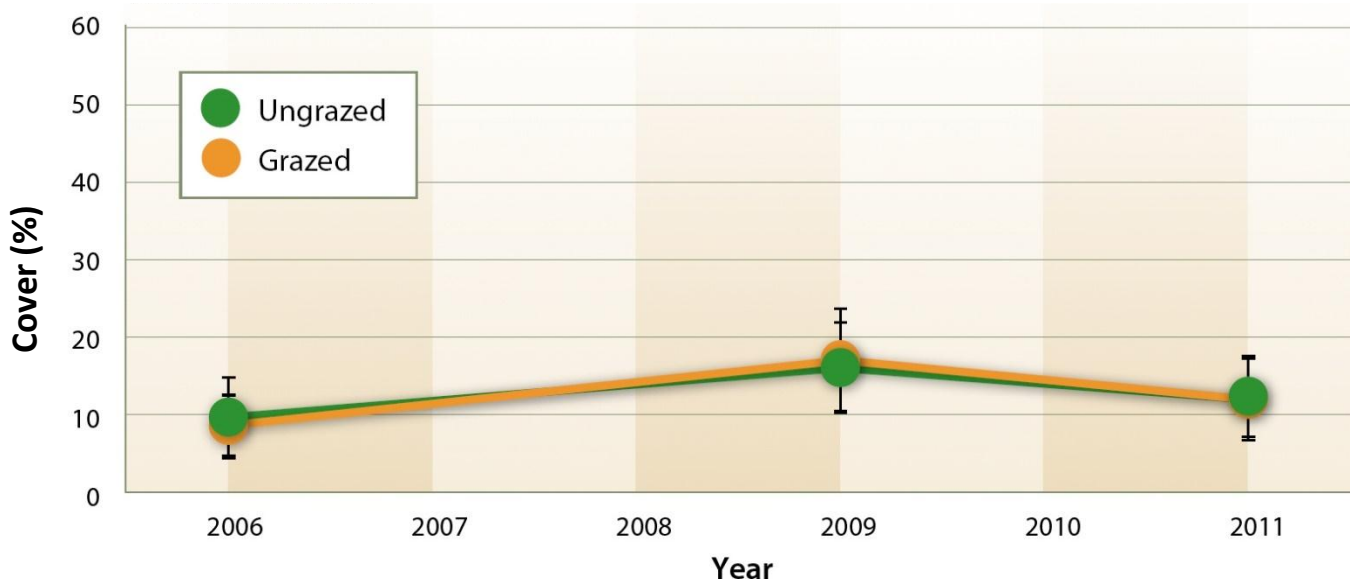
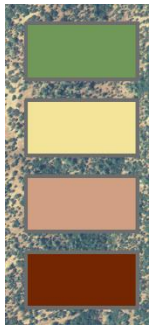
Yellow Starthistle



- No impact of grazing on starthistle cover.

Davy et al. 2015. Calif. Agr.

Stakeholder Prescribed Adaptive Grazing Management Project – Standing Crop



lbs/acre

200-500

500-1500

1500-2500

2500-3500

On-Ranch Grazing Strategies
California 2011 Mail Survey

Strategy (n = 473)	No. Pastures	Grazing Duration	Livestock Density (ac/AU)	Timing of Rest
Extensive Rotation (46%)	2 to >10	Weeks	<5 to 11	Growing season
Season Long Continuous (35%)	2 to 5	Month	11 to 20	Dormant season
Year Long Continuous (19%)	**2 to 5**	**Year**	**11 to 20**	**None**

Fall/Spring & Winter Grazing Treatments

Season-Long Grazing Treatment

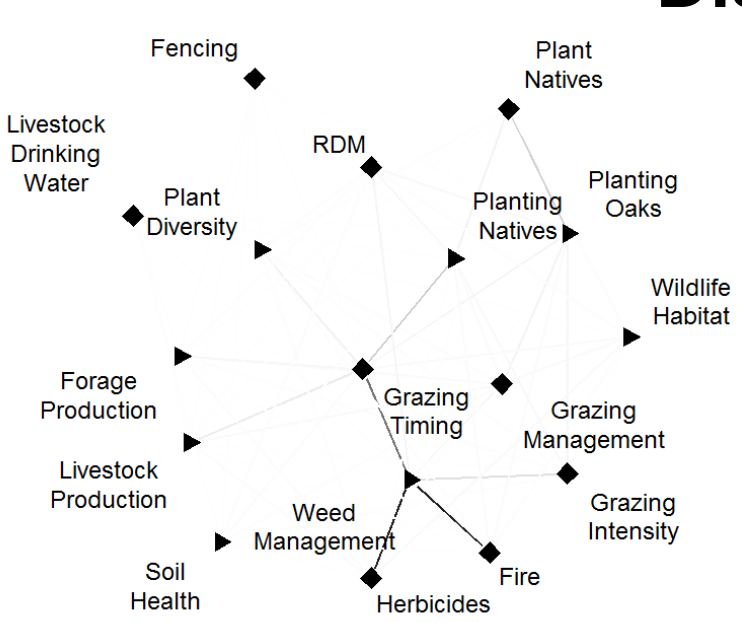
On-Ranch Grazing Strategies
California 2011 Mail Survey

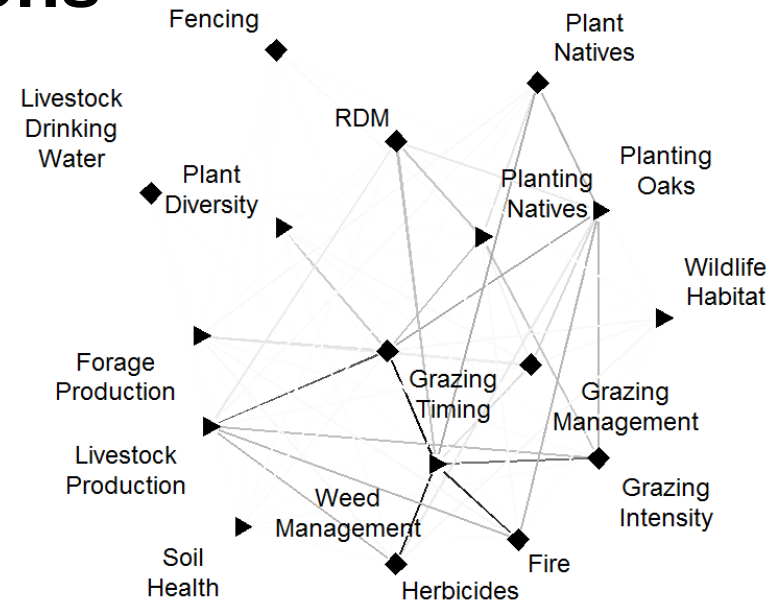
Strategy (n = 473)	No. Pastures	Grazing Duration	Livestock Density (ac/AU)	Timing of Rest
Extensive Rotation (46%)	**Fall/Spring & Winter Grazing Treatments**			
Season Long Continuous (35%)	**Season-Long Grazing Treatment**			
Year Long Continuous (19%)	**2 to 5**	**Year**	**11 to 20**	**None**
Intensive Rotational	***"We want see if this is a train-wreck or a success on your place before we try it on ours."***			

Mental models and group discussion in adaptive rangeland management

L. Jasny, L. Roche, K. Tate, and M. Lubell In prep.

Relating Goals to Methods: Mixed-Group Discussions





Before Discussion

After Discussion

Grassland Pastures: Years 1 & 2

	Richness		Medusahead cover (%)			Visual obstruction (cm)		
	Spring 2013	Spring 2014	Baseline	May 2013	May 2014	Baseline	May 2013	May 2014
Season-Long (T1)	5	5.6	37	15	18	22	18	19
Fall-Spring (T2)	6.3	6.5	26	7	8	18	14	9
Fall Spring-Targeted (T3)	5.5	6.3	24	13	11	18	17	26
Control Plots	4.3	4	35	38	19	14	52	73

Oak Pastures: Years 1 & 2

	Richness		Medusahead cover (%)			Visual obstruction (cm)		
	Spring 2013	Spring 2014	Baseline	May 2013	May 2014	Baseline	May 2013	May 2014
Season-Long (T1)	8.2	7.7	14	8	17	5	20	19
Fall-Spring (T2)	8.1	6.7	17	10	5	3	12	9
Fall Spring-Targeted (T3)	7.9	8.2	23	14	11	5	14	11
Control Plots	8.5	8.6	30	24	17	3	22	21

Ecosystem Services: Synergies

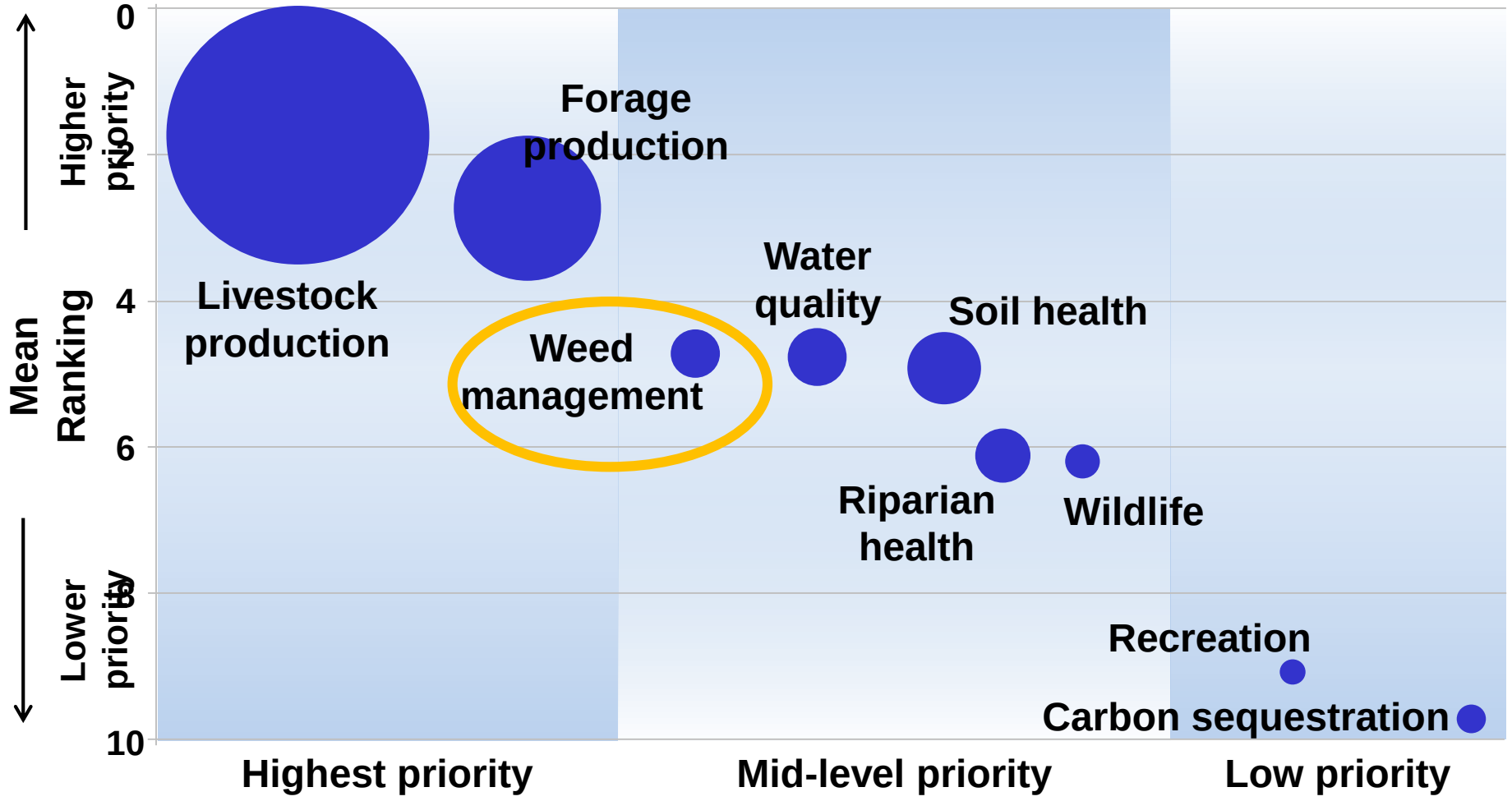
Managed livestock grazing can enhance herbaceous diversity and native plant richness in vernal pools and annual grasslands.

Weiss 1999; Marty et al. 2005; DiTomaso et al. 2008

Grazing as a tool to manage non-native invaders.

Livestock as ecosystem engineers.

Agricultural & Natural Resources Goals



Roche *et al.* 2015.

Prescribed Grazing Strategies Recommended for Study

Stakeholder Engagement Workshops

Working Groups

- Ranchers
- Rangeland Professionals
- Conservation Professionals

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- Decision-making priorities
- Group interaction and learning

Participants

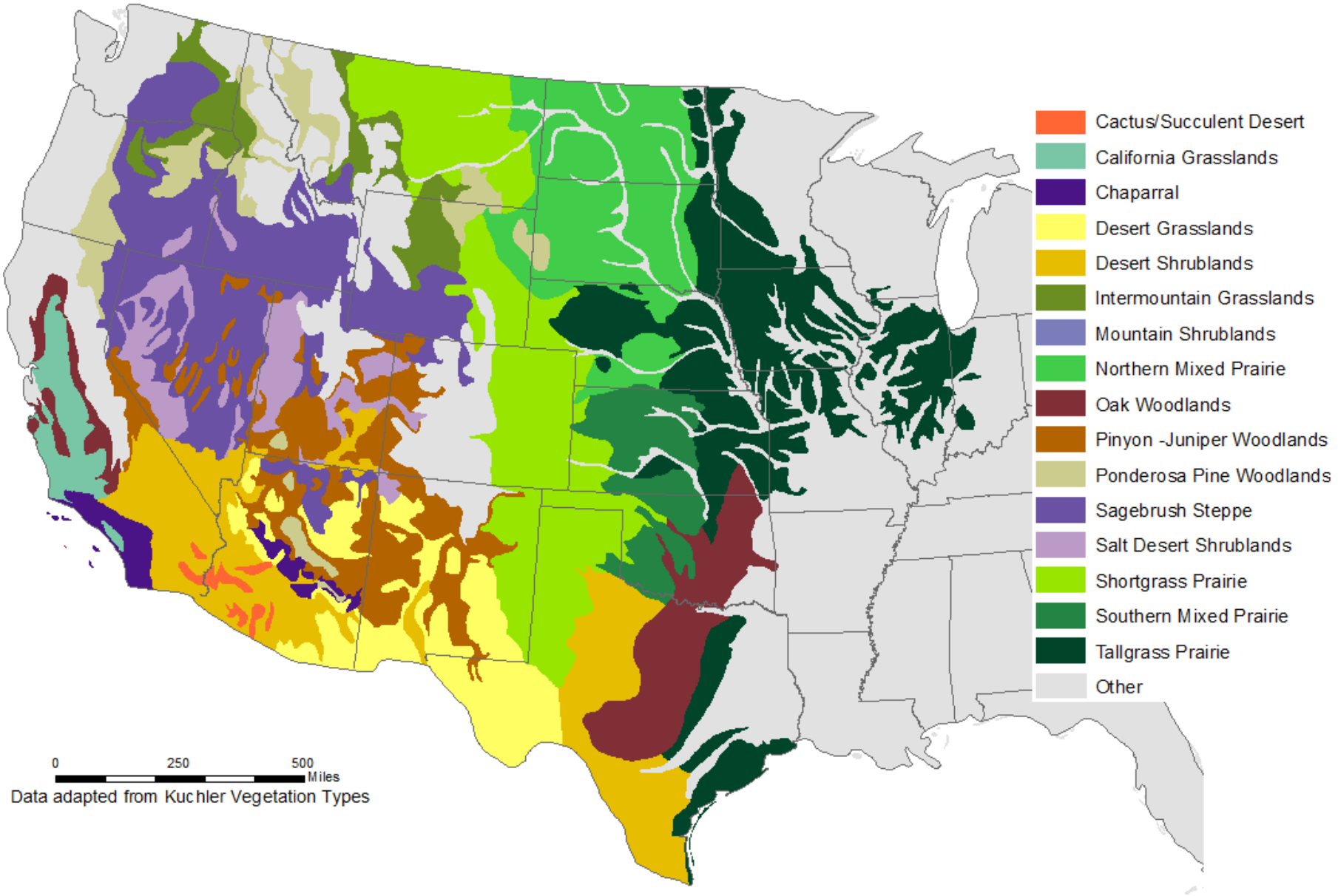
- Ranchers
- Ranch Managers
- Audubon California
- Beale Air Force Base
- CA Department of Fish and Wildlife
- Center for Natural Lands Management
- City of Fairfield
- Contra Costa Water District
- Defenders of Wildlife
- Department of Fish & Game
- East Bay Municipal Utility District
- East Bay Regional Parks
- Environmental Consultants
- Hedgerow Farms
- USDA NRCS
- Nevada Irrigation District
- Placer Land Trust
- Point Reyes National Park
- Point Blue Conservation Science
- San Francisco Public Utilities Commission
- The Nature Conservancy
- UC Cooperative Extension
- UC Davis Natural Reserve System
- US Fish & Wildlife Service
- US Forest Service




1. Rangeland ecosystems and plant invasion
2. Prescribed grazing management
3. Case studies in grazing management for weed control
4. Lessons learned



Rangelands


Cactus/Succulent Desert
California Grasslands
Chaparral
Desert Grasslands
Desert Shrublands
Intermountain Grasslands
Mountain Shrublands
Northern Mixed Prairie
Oak Woodlands
Pinyon -Juniper Woodlands
Ponderosa Pine Woodlands
Sagebrush Steppe
Salt Desert Shrublands
Shortgrass Prairie
Southern Mixed Prairie
Tallgrass Prairie
Other
0
250
500
Miles
Data adapted from Kuchler Vegetation Types

Plant Invasion

- Modern day rangeland plant communities dominated by exotic European annuals
- California: ~1800 non-native wildland plants (Cal-IPC, 2006)
- >40% of invasives found across rangeland habitats (Barbour, 2007)
- Spread of highly invasive weeds is a major threat to agroecosystem productivity and biodiversity
  - Impact native plants or other desirable and more palatable non-natives



Managing Weeds with Grazing

Infrastructure

- Fencing, drinking water, supplemental feeding, etc. facilities needed to implement grazing prescription.

Key Considerations

- Animal nutritional requirements, which vary annually (e.g., breeding, gestation, lactation, growth).
- Plant requirements to conduct critical functions (e.g., photosynthesis, reproduction).
- Mitigate potential negative impacts of animals on soils, riparian areas, habitat, non-target plant species, etc.