Adaptive Grazing Management for Weed Control

Leslie Roche, Ken Tate, Josh Davy, D.J. Eastburn
University of California-Davis, Davis, CA
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*

60 ha

2575 ha

*Warning: Objects are to Scale*
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
Medusahead reductions in dry Springs.
• Medusahead reductions in dry Springs.
• No further reductions in wet Springs.
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• Ungrazed Treatments: Medusahead replaced by other undesirable plants (ripgut, red brome).
- 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).

Plant Community

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

2009: Composition significantly diverged between treatments.

2011: Remained significantly different.

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

and more!...
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**

**Economic and Ecological Sustainability**

- **Vegetation**
  - Increase plant diversity
  - Increase forage species diversity
  - Increase forage production
  - Reduce medusahead

- **Livestock**
  - Maintain or increase livestock weight gain
  - Minimize operating/practice costs

- **Habitat**
  - Increase grassland bird diversity
  - Increase variation in vegetation structure
  - Increase native wildlife and habitat diversity

- **Soil health/Water quality**
  - Minimize compaction
  - Restore soil fertility
  - Maintain or restore water quality
Stakeholder Prescribed Adaptive Grazing Management Project

Computer Surveys

Group Discussions

Advisory Team meetings
Stakeholder Prescribed Adaptive Grazing Management Project

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

<table>
<thead>
<tr>
<th>GOAL</th>
<th>MONITORING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Production</td>
<td>Steer weight gains (ADG, total gain, gain/acre)</td>
</tr>
<tr>
<td></td>
<td>Available forage</td>
</tr>
<tr>
<td>Plant Cover, Diversity</td>
<td>Cover and frequency of invasive weeds, desirable forage groups, richness</td>
</tr>
<tr>
<td>Habitat Diversity</td>
<td>Ground bird hiding cover (veg structure)</td>
</tr>
<tr>
<td>Soil Health</td>
<td>Cattle fecal distribution, cover</td>
</tr>
</tbody>
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## Stakeholder Prescribed Adaptive Grazing Management Project

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- Stakeholder Prescribed Adaptive Grazing Management Project

- Fall/Spring monitoring

- Targeted sampling sites

- Sample sites
Stakeholder Prescribed Adaptive Grazing Management Project – MH % Cover

Baseline

Year 3
<table>
<thead>
<tr>
<th></th>
<th>Year 1 ADG (lbs/day)</th>
<th>Year 2 ADG (lbs/day)</th>
<th>Year 3 ADG (lbs/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fall</td>
<td>Spring</td>
<td>Fall</td>
</tr>
<tr>
<td>Season-Long (T1)</td>
<td>0.8</td>
<td>2.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Fall-Spring (T2)</td>
<td>0.3</td>
<td>3.2</td>
<td>-1.1</td>
</tr>
<tr>
<td>Fall Spring-Targeted (T3)</td>
<td>0.3</td>
<td>2.6</td>
<td>-0.7</td>
</tr>
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</table>
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.
• No impact of grazing on starthistle cover.
Stakeholder Prescribed Adaptive Grazing Management Project – Standing Crop

<table>
<thead>
<tr>
<th>lbs/acre</th>
<th>200-500</th>
<th>500-1500</th>
<th>1500-2500</th>
<th>2500-3500</th>
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<tbody>
<tr>
<td>Standing</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Crop</td>
<td></td>
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## On-Ranch Grazing Strategies
### California 2011 Mail Survey

<table>
<thead>
<tr>
<th>Strategy (n = 473)</th>
<th>No. Pastures</th>
<th>Grazing Duration</th>
<th>Livestock Density (ac/AU)</th>
<th>Timing of Rest</th>
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<tr>
<td><strong>Extensive Rotation (46%)</strong></td>
<td>2 to &gt;10</td>
<td>&lt;5 to 11</td>
<td>Growing season</td>
<td></td>
</tr>
<tr>
<td><strong>Season Long Continuous (35%)</strong></td>
<td>2 to 5</td>
<td>Year</td>
<td>11 to 20</td>
<td>None</td>
</tr>
<tr>
<td><strong>Year Long Continuous (19%)</strong></td>
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<td>2 to &gt;10 Weeks</td>
<td>&lt;5 to 11 Growing season</td>
<td></td>
</tr>
<tr>
<td><strong>Fall/Spring &amp; Winter Grazing Treatments</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Season Long Continuous</strong></td>
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<td><strong>Intensive Rotational</strong></td>
<td></td>
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|                           | “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

<table>
<thead>
<tr>
<th></th>
<th>Richness</th>
<th>Medusahead cover (%)</th>
<th>Visual obstruction (cm)</th>
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<tbody>
<tr>
<td><strong>Season-Long (T1)</strong></td>
<td>5</td>
<td>5.6</td>
<td>37</td>
</tr>
<tr>
<td><strong>Fall-Spring (T2)</strong></td>
<td>6.3</td>
<td>6.5</td>
<td>26</td>
</tr>
<tr>
<td><strong>Fall Spring-Targeted (T3)</strong></td>
<td>5.5</td>
<td>6.3</td>
<td>24</td>
</tr>
<tr>
<td><strong>Control Plots</strong></td>
<td>4.3</td>
<td>4</td>
<td>35</td>
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Oak Pastures: Years 1 & 2

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<th>Medusahead cover (%)</th>
<th>Visual obstruction (cm)</th>
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<tbody>
<tr>
<td>Season-Long (T1)</td>
<td>8.2</td>
<td>7.7</td>
<td></td>
</tr>
<tr>
<td>Fall-Spring (T2)</td>
<td>8.1</td>
<td>6.7</td>
<td></td>
</tr>
<tr>
<td>Fall Spring-Targeted (T3)</td>
<td>7.9</td>
<td>8.2</td>
<td></td>
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<tr>
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<td>8.5</td>
<td>8.6</td>
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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.
Agricultural & Natural Resources Goals

- Livestock production
- Forage production
- Weed management
- Water quality
- Soil health
- Riparian health
- Wildlife
- Recreation
- Carbon sequestration

Roche et al. 2015.
Prescribed Grazing Strategies Recommended for Study
Stakeholder Engagement Workshops

- Ranchers
- Rangeland Professionals
- Conservation Professionals

- 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
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.