Adaptation to Drought: Rangeland Systems

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Outline
Complex rangeland systems
Management challenges in drought
Transforming decision-making
  • Needs-based strategies
  • Keep Calm and CARM on
Flexibility
Heterogeneity
Survey Says: What works
Projections
**Complex Social-Ecological Systems**

Coupled human-natural systems at multiple scales

Complexity and uncertainty preclude management Rx

Feedbacks mediated by many knowledges and adaptive actions

Resilience: ability to “bounce back” and avoid state change

Fig. 1. Conceptual diagram of a coupled human and natural system (CHANS) with feedbacks mediated through environmental knowledge (including TEK), monitoring and adaptation, adapted from (Verstraete et al., 2009)

(Berkes and Folke, 1998; Glaser 2006; Fernandez-Gimenez et al., 2017)
Drought: Management Challenges

• No two droughts the same
• Limited ability of prediction and reliable seasonal forecasts
• Need for proactive planning
• Time scale:
  • Short term (fencing) vs. long term (plan for state shifts from grassland to woodland).
• Trees, shrubs, grasses differ in sensitivity to drought

A proposed conceptual framework for considering how more extreme droughts associated with climate change may differentially impact rangeland types, based on plant types and their relative abundances.

(Breshears et al., 2016; Derner and Augustine, 2016; Crimmins and McClaran, 2016)
Decision-Making

Adaptation to climate and weather impacts, including drought, will require:
- continual learning and changes in response to multiple types of stresses across multiple scales by many actors.

Rangeland managers in semi-arid and arid rangelands already experience high levels of weather variability and have developed many effective responses.

(Coppock, 2011; Adger, 2010; Wilmer et al, 2016)
Manager success in drought depends on knowing when to act under high levels of uncertainty.

Managers are diverse in their perceptions of risk, skills in planning, financial and emotional flexibility and interest in adapting. They come from different backgrounds. They need tailored adaptation approaches.

Facilitated collaborative learning amongst managers/stakeholders may assist skill development, climate awareness and adoption of climate tools. Expect slow, incremental change.

Keep Calm and CARM On:

Collaborative Adaptive Rangeland Management

- Ongoing 10-year study at ARS research station in Nunn, CO
- Collaboration: Building trust and learning
  - Ranchers
  - Gov’t Agencies
  - Conservation NGOs
  - Scientists
- Adaptive management
- Complexity promotes learning, builds trust

(Wilmer et al, In review, Fernandez-Gimenez et al, In prep)
Flexibility strategies

Mobility: Move risk and resources across space. Examples: Secure forage/pastures in diverse landscape/topographic positions, or far from one another.

Storage: Move risk and resources across time. Examples: Hay/storage, grass-banking.

Diversification: Move risk and resources across asset class. Examples: Diversified income and agricultural activities, diverse classes (e.g. yearling cattle and cow-calf) and species of livestock. Diversification of livestock class can enable flexible stocking rate decision-making.

Pooling: Move risk and resources across organizations/household. Examples: Broad social networks to exchange innovations, ideas, technology, labor, equipment, forage, etc.


(Agrawal and Perrin, 2008)
flexibility strategies

Julie Kennedy
Heterogeneity for Flexibility

• Predict it
• Track it
• Use conservative stocking rates
• Flexible stocking
• Use inherent spatial variability

Heterogeneity - basis for conservation

(Derner and Augustine, 2016; Fuhlendorph et al, 2001; Tews et al, 2004)
Survey Says:

Drought management strategies Wyoming ranches use to balance forage demand with forage supply, reported as the percentage of respondents who use each practice. (Kachergis et al., 2014)

Proactive and reactive drought management strategies

Limited use currently, but potential is high for flexibility

Drought preparation
- Reserve forage supply
  - Stock conservatively: 48%
  - Rest pastures: 47%
  - Grassbank: 22%

Vary stocking rate with forage supply
- Incorporate yearling livestock: 28%
- Use weather predictions to adjust stocking rate: 16%

Drought response
- Reduce forage demand
  - Reduce herd size: 80%
  - Wean calves early: 47%
  - Sell retained yearling livestock: 24%

Increase forage supply
- Purchase feed: 63%
- Rent additional pasture: 42%
- Move livestock to another location: 27%
- Place livestock in a feedlot: 15%
- Apply for government assistance: 23%
- Earn off-farm income: 16%

Drought impacts
- Grazing capacity: 75%
- Profitability: 54%
- Winter feed availability: 53%

- Irrigation water availability: 47%
- Calf weaning weights: 36%
- Livestock reproductive rates: 20%
Survey Says:
Proactive and reactive strategies for drought impact management from the 2011 California Rangeland Decision-Making Survey N=443 (Macon, et al., 2016)

<table>
<thead>
<tr>
<th>Proactive (Preparing for drought)</th>
<th>%</th>
<th>Reactive (Responding to drought)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock conservatively</td>
<td>34</td>
<td>Reduce herd size</td>
</tr>
<tr>
<td>Rest pastures</td>
<td>23</td>
<td>Purchase feed</td>
</tr>
<tr>
<td>Incorporate yearling cattle</td>
<td>21</td>
<td>Apply for government assistance programs</td>
</tr>
<tr>
<td>Grassbank/Stockpile forage</td>
<td>12</td>
<td>Wean calves early</td>
</tr>
<tr>
<td>Use weather predictions to adjust stocking</td>
<td>11</td>
<td>Rent additional pastures</td>
</tr>
<tr>
<td>Add other livestock types for flexibility</td>
<td>3</td>
<td>Move livestock to another location</td>
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<tr>
<td></td>
<td></td>
<td>Earn additional off-ranch income</td>
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<tr>
<td></td>
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<td>Sell retained yearlings</td>
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<td>Place livestock in a feedlot</td>
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<td>Maintain herd size; allow condition declines</td>
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<tr>
<td></td>
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<td>Add alternative on-ranch enterprise</td>
</tr>
</tbody>
</table>
(Derner et al., in review)
Conclusions

- Complexity requires adaptive management
- Collaboration makes it happen!
- Drought poses management challenges but strategies already exist
- Flexibility
- Heterogeneity
- Reactive vs. Proactive
- Projected changes require ongoing learning, adaptation
Questions?
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