Adapting to climatic variability for livestock operations: Flexible stocking strategies

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Road map

• High variability in precipitation
• Difficulty in matching animal demand with forage availability
• Flexible stocking strategies
  – Using seasonal weather predictions
  – Incorporation of yearlings
  – Working through the process
Spring precipitation variability

High variability for April, May and June precipitation (Cheyenne, WY, USA)

Mean: 170 mm
Std Dev: 70.2
Range: 42.4-341.2
CV: 41.3
Forage production variability

Difficulty for ranchers is matching this forage production variability with animal management flexibility across years.
Flexible stocking – making it work?

Traditional management
Moderate stocking: 50% use of “average production” with half of that for livestock consumption.

Missed opportunity to use “extra” forage (33% of years)
Reduce numbers or shorten grazing season (33% of years)
Flexible stocking with *high quality precipitation forecasts* could **double** economic returns

<table>
<thead>
<tr>
<th>Stocking Rate</th>
<th>Conservative</th>
<th>Flexible</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cow-calf</td>
<td>Multiple</td>
</tr>
<tr>
<td>% forage to cow-calf</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>% years yearlings purchased</td>
<td>0</td>
<td>55</td>
</tr>
<tr>
<td>Annual net returns</td>
<td><strong>$55,126</strong></td>
<td><strong>$63,076</strong></td>
</tr>
<tr>
<td>Advantage of Multiple</td>
<td><strong>$7,950 (14%)</strong></td>
<td><strong>$45,701 (66%)</strong></td>
</tr>
<tr>
<td>Advantage of flexible multiple to conservative cow-calf</td>
<td></td>
<td><strong>$60,095 (109%)</strong></td>
</tr>
</tbody>
</table>

Adapted from Torell et al. 2010
Rangeland Ecology and Management 63:415-425
Flexible stocking: First approximation

Process

- Estimate forage production from spring precipitation
- Multiply estimated forage production by 25% for livestock intake
- Multiply estimate of available livestock intake by land area
- Divide product by 354 kg to estimate AUMs

Caveats

- Reliability of predictions for spring precipitation
- Moderate stocking approach
- Assumption is that productivity is similar across land area
Use forage production function responses to precipitation

Can use prediction functions from the local rangeland ecosystem as a first approximation of forage

\[ \lambda = 5.2 + 1.6 \times \text{Precipitation} \]

Modified from Derner and Hart 2007
Rangeland Ecology and Management 60:270-276
Limited use currently, but potential is high for flexibility.
Tweaking the First Approximation

- Continue to check seasonal precipitation predictions and climatic patterns
  - (El Nino/La Nina)
- Check seasonal temperature forecasts as well
  - If predicted warmer, then this could reduce available soil water for forage production
- Update forage estimate with actual precipitation values at end of April, and end of May
  - Could require substantial animal number flexibility

Which fork in the road to take?
### Additional tweaking: The “art”

<table>
<thead>
<tr>
<th>Variable</th>
<th>Decrease estimate</th>
<th>Increase estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plentiful end of prior growing season soil moisture</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Inadequate end of prior growing season soil moisture</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Excess plant residual biomass</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Marginal plant residual biomass</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>“Grassbanked” pastures</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Limited or no “stored” forage</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Not in drought, nor predicted to be</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>In drought/predicted to be, or recovering from drought</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Livestock Economics: Bull market</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Livestock Economics: Bear market</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Risk tolerance: High</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Risk tolerance: Low</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Take home messages

• Provides opportunity to more effectively match animal demand with forage availability across years
  – Could potentially double net economic returns

• Accuracy of current seasonal precipitation predictions is not sufficient to overcome low risk mentality of ranchers
Questions?

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