California rangeland status, structure and function

Valerie Eviner, UC Davis
<table>
<thead>
<tr>
<th>Million acres</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rangeland Area</td>
<td>57</td>
</tr>
<tr>
<td>Available for Grazing</td>
<td>41</td>
</tr>
<tr>
<td>Area Grazed</td>
<td>34</td>
</tr>
</tbody>
</table>

FRAP 2003
Grasslands (including within hardwood woodlands) provide over 2/3 of CA livestock forage.

Table 7. Total annual forage production on available primary rangelands by land cover class

<table>
<thead>
<tr>
<th>Land cover type</th>
<th>Grazing Capacity in AUMs per acre</th>
<th>Area (millions of acres)</th>
<th>Total AUMs (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conifer Woodland</td>
<td>0.2</td>
<td>1.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Grassland</td>
<td>0.7</td>
<td>9.2</td>
<td>6.6</td>
</tr>
<tr>
<td>Shrub</td>
<td>0.3</td>
<td>11.6</td>
<td>3.4</td>
</tr>
<tr>
<td>Desert</td>
<td>&lt;0.1</td>
<td>14.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Hardwood Woodland</td>
<td>0.7</td>
<td>4.6</td>
<td>3.2</td>
</tr>
<tr>
<td>Wetland/Riparian*</td>
<td>1.8</td>
<td>0.4</td>
<td>0.8</td>
</tr>
<tr>
<td>Total</td>
<td>0.4</td>
<td>41.7</td>
<td>14.8</td>
</tr>
</tbody>
</table>

AUM = animal unit month

FRAP 2003
States

- Oak woodland
- Oak savanna
- Shrubs
- Exotic annual grassland (grasses and forbs)
- "New" exotics
  - Medusahead
  - Goatgrass
  - Yellow starthistle
- Native grassland (grasses and forbs)
Major driver of function/composition

- **Timing** of precipitation and warm temperatures
- Variability in precipitation
- Past 20 years, 6-8 fold annual variation in precipitation
- At least 8 multi-year droughts since 1900

Biswell 1956, Eviner & Firestone 2007
Factors influencing production and states and transitions

- **Precipitation**: amount, seasonality
- **Soil**: nutrients (N,P, S), water
- **Grazing**: timing, intensity, frequency, type, duration
  - Also herbivory by: grasshoppers, elk, deer
- **Fire**: timing, intensity, frequency, type
- **Soil disturbance by animals**: (gophers, ground squirrels, feral pigs, earthworms) e.g. pocket gophers turn over entire soil surface every 3-15 years
- **Granivory**: voles, mice, ants
- **Pathogens**: barley yellow dwarf virus, sudden oak death
- **Competition between plant groups**
<table>
<thead>
<tr>
<th></th>
<th>Plant community</th>
<th>Nitrogen availability</th>
<th>Other</th>
<th>Key determinants of impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire</td>
<td>Spring burning often increases forbs in short-term</td>
<td>Short-term increase in nitrogen availability</td>
<td>Short-term erosion</td>
<td>Timing Frequency</td>
</tr>
<tr>
<td>Soil disturbance by mammals</td>
<td>Often increases forbs in short-term potential to increase annual exotics</td>
<td>Short-term increase in nitrogen availability, soil carbon release</td>
<td></td>
<td>Timing Frequency</td>
</tr>
<tr>
<td>Grazing</td>
<td>Generally increase native annual forbs</td>
<td>No impact to slight increase in N pools, cycling Redistriubution</td>
<td>Compaction Alter small mammal activity Trampling of thatch Increase root allocation</td>
<td>Timing Frequency Duration Intensity Grazer Type Weather Vegetation type</td>
</tr>
<tr>
<td>Grazing exclusion</td>
<td>Increased thatch can: - Decrease production -Decrease forbs (2-fold) - Increase fire -Increase goatgrass</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
States alter function

- Oak woodland ↔ Oak savanna
- Shrubs

- Exotic annual grassland (grasses and forbs)

- “New” exotics
  - Medusahead
  - Goatgrass
  - Yellow starthistle

- Native grassland (grasses and forbs)
Annual state is “weird”

- Mediterranean climate- cool season grasses dominate
- Invaders are early successional in their native range, stable state in CA (this is getting increasingly common throughout W. US rangelands)
- Standard rangeland assessments don’t work in CA- annual is considered “degraded” state

(a) GENERAL SCHEME OF THE RANGE SUCCESSION MODEL

Westoby et al. 1989
Need different frameworks to assess annual function.

Oak woodland  <->  Oak savanna

Exotic annual grassland (grasses and forbs)

“New” exotics
- Medusahead
- Goatgrass
- Yellow starthistle

Native grassland (grasses and forbs)
Future challenges

• Invasive species
• Temperature Change
  – increased temperature, 2-4 fold increases in frequency of heat stress days
• Precipitation Change
  – Mean annual precipitation predictions
    • Northern California- 0-18% decrease (Greatest decrease in the Central Valley and North Coast)
    • Southern California- 26% decrease to 8% increase
  – Seasonality
    • Shorter growing seasons (most decreases in late spring/summer)
    • Moderate winter decreases- but less frequent, more intense storms
    • Spring/fall precipitation not well-modeled (but likely most important for vegetation composition)
  – Annual variability will increase
    • 1.5-2.5 fold increase in frequency of critically dry years
    • Increased El Nino frequency
• Nitrogen deposition- increase invasion
• Land use change
  – Projected to lose 750,000 acres of rangeland by 2040-2100)
• Increased expectations of what rangelands should deliver