Nutrient Dynamics and Water Quality on Rangelands

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Nutrient impaired waterbodies with possible grazing impacts

80% of Reservoirs

Nutrient Pollution

Nitrogen
- organic forms
- ammonium (NH$_3$/NH$_4^+$)
- nitrate (NO$_3^-$)

Phosphorus
- organic forms
- adsorbed to particles
- dissolved phosphate (PO$_4^{3-}$)

Nutrients (N/P)

Where Grazing and Regulations Meet: Working Together for Ranching and Water Quality - Central Coast Rangeland Coalition Fall 2015 Meeting
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Atmospheric Nitrogen Deposition in California

Atmospheric N deposition on California rangelands is often in the range: 5 – 10 kg/ha/yr

Sierra Nevada Foothills Watershed Annual N Export Load

Most rangelands are sinks rather than sources for nitrogen

Atmospheric Nitrogen Deposition in California

Nitrogen kg/ha/yr

Natural Sources of Nitrogen

Big Springs Shasta Valley
Spring discharge = 90 cfs
NO$_3$-N = 0.48 mg/L
PO$_4$-P = 0.15 mg/L

Photo courtesy of Carson Jeffries

Scott Morford

Quantifying Rock N Reservoirs

Observed Total N in rock (mg N kg$^{-1}$)

- 0 - 250
- 250 - 500
- 500 - 750
- 750 - 1000
- > 1000

n = 951
Sites = 537
median = 428 mg N kg$^{-1}$

Background nutrient levels are not zero

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Background Level (mg/L)</th>
<th>Eutrophication Concern (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TN</td>
<td>0.15 – 0.53</td>
<td></td>
</tr>
<tr>
<td>NO$_3$-N</td>
<td>0.005 – 0.048 (0.06)</td>
<td>0.30</td>
</tr>
<tr>
<td>TP</td>
<td>0.018 – 0.312 (0.11)</td>
<td>0.10</td>
</tr>
<tr>
<td>PO$_4$-P</td>
<td>(0.15)</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Seasonal Pattern in Streamwater Nitrate in Non-grazed California Oak Woodlands

Winter Year

JAN

Summer Year

JAN

Fall Year

JAN

Spring Year

JAN
California oak woodlands – annual grasslands are naturally susceptible to seasonal nitrate leaching.

State-wide Survey
24 streams
2000 and 2001 water years

Nutrient Concentrations

Grazing Treatments
- No grazing
- 1500 lb/ac RDM
- 1000 lb/ac RDM
- 500 lb/ac RDM

Nitrate - Grazing

Nitrate - 500 lbs/acre RDM

Streamflow (cfs) vs. NO₃-N (mg/L)
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Conclusions

- Most California rangelands are sinks rather than sources for nutrients
- Background nutrient levels are not zero – there are many natural nutrient sources
- California oak woodlands – annual grasslands are naturally susceptible to seasonal nitrate leaching
- Rangeland streams rarely exceed nutrient thresholds for eutrophication, except during large storm events
- Accurate nutrient monitoring of rangelands is extremely challenging given temporal variability