Cattle & Water Quality Research

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Rangeland Management and...

Water quality, species of concern, riparian and meadow health, soil quality, invasive plants, forage production, and livestock performance...

Rangeland Watershed Laboratory
http://rangelandwatersheds.ucdavis.edu

Rangeland Management and...

Public Lands Research
• Grazing Allotment Water Quality
• Yosemite Toad Adaptive Management Project
• Long-Term Range Monitoring

USFS Public Grazing Allotments in CA

500 grazed allotments
8,000,000 acres
430,000 Animal Unit Months
~70,000 head of cattle

Public Lands Grazing & Water Quality

“Bee Exclusive: Livestock Waste Found to Foul Sierra Waters”
Sacramento Bee 25 April 2010

• Prompted multi-partner collaboration.
  • U.S. Forest Service
  • UC Davis
  • UC Cooperative Extension
  • Permittees
  • Regional Water Quality Control Boards
  • Range stakeholders

Public Lands Grazing & Water Quality

OBJECTIVES
1. Quantify fecal indicator bacteria and nutrient concentrations in surface waters.
2. Compare to a) Regulatory benchmarks, b) Recommended benchmarks for eutrophication concerns, and c) Estimates of nutrient background concentrations.
3. Examine relationships between water quality, environmental conditions, cattle grazing, and recreation.
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Is public lands cattle grazing degrading environmental quality and putting human health at risk?

PUBLIC LANDS GRAZING & WATER QUALITY

COMPREHENSIVE WATER QUALITY SURVEY
• 12 USFS public lands grazing allotments, 5 National Forests.
• 320,000 acres
• 155 stream collection sites, monitored monthly during grazing-rec period (Jun-Nov, 2011).
• Key Grazing Areas
• Recreation Areas
• Areas with No Concentrated Use Activities

Total of 743 water samples collected
• Fecal Indicator Bacteria: Fecal coliform, E. coli
• TN, NO3-N, NH4-N, TP, PO4-P

Percentage of 743 stream water samples exceeding benchmarks

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Overall ( % of 743)</th>
<th>Key Grazing Area ( % of 462)</th>
<th>Recreation Area ( % of 125)</th>
<th>No Concentrated Use Activities ( % of 156)</th>
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</thead>
<tbody>
<tr>
<td>FC &gt; 20 cfu/100ml</td>
<td>50</td>
<td>48</td>
<td>46</td>
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<td>E. coli &gt; 190 cfu/100ml</td>
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<td>NO3-N &gt; 300 µg/L</td>
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<td>TP &gt; 100 µg/L</td>
<td>2</td>
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**Mean FIB and Nutrient Concentrations**

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<tr>
<td>FC (cfu 100/ml)</td>
<td>87 ± 12 a</td>
<td>55 ± 9 b</td>
<td>90 ± 12 a</td>
</tr>
<tr>
<td>E. coli (cfu 100/ml)</td>
<td>42 ± 6 a</td>
<td>29 ± 7 b</td>
<td>43 ± 8 a</td>
</tr>
<tr>
<td>Total N (µg/L)</td>
<td>61 ± 4 a</td>
<td>38 ± 3 b</td>
<td>64 ± 6 a</td>
</tr>
<tr>
<td>NO₃ (µg/L)</td>
<td>17 ± 1 a</td>
<td>16 ± 1 a</td>
<td>25 ± 2 b</td>
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<tr>
<td>NH₄ (µg/L)</td>
<td>11 ± 0.6 a</td>
<td>10 ± 1 a</td>
<td>10 ± 0.7 a</td>
</tr>
<tr>
<td>Total P (µg/L)</td>
<td>24 ± 4 a</td>
<td>14 ± 4 a</td>
<td>17 ± 2 a</td>
</tr>
<tr>
<td>PO₄ (µg/L)</td>
<td>7 ± 0.3 a</td>
<td>5 ± 0.2 b</td>
<td>8 ± 0.6 a</td>
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**Public Lands Grazing & Water Quality**

**RESULTS**

- Observed nutrient concentrations were at least one order of magnitude below levels of ecological concern, and similar to background estimates.
- All but the most restrictive fecal indicator bacteria (FIB) water quality benchmarks were broadly met.
- Throughout the study period, US EPA recommended E. coli benchmarks were met for over 90% of samples collected and over 83% of sites (no exceedances).

*Our results do not support previous concerns of widespread microbial water quality pollution across these grazed landscapes, as concluded in other surveys.*


**Public Lands Grazing & Yosemite Toad**

**Multi-Pronged Approach to Address Potential Linkages**

**Sierra National Forest**

- Cattle Exclusion Experiments
  - Fine-scale breeding pool habitat response
  - Water quality
  - Vegetative Cover
- Cross-Sectional Survey
  - Coarse-scale habitat overlap of cattle and toads

**CATTLE EXCLUSION EXPERIMENTS**

- 2006-2008
- 3 Sierra National Forest Allotments
- 9 Meadows, 36 breeding pools
  - Toad occupied & toad unoccupied pools

**RESULTS**

- Observed nutrient concentrations ~ 1 order of magnitude below levels of ecological concern.
- Turbidity, temperature, depth, and cover not significantly different among grazed and ungrazed treatments
- No grazing treatment-induced trends.

Public Lands Grazing & Yosemite Toad

CROSS-SECTIONAL SURVEY
• 2006-2008
• 3 Sierra National Forest Grazing Allotments, 24 Meadows

RESULTS
• Cattle select for higher forage quality diets (drier meadows)
• Toads more prevalent in wetter meadows.

Cattle grazing and conservation of Yosemite toad can be compatible goals

Meadow Conditions on National Forest Grazing Allotments

USFS REGION 5 RANGE PROGRAM CONDITION AND TREND MONITORING
• Sierra Nevada Forest Plan Amendment (early 2000s) – Set Standards and Guides for Sierra Nevada and Cascade Forests.
• 1999: USFS Region 5 Range Program initiated long-term meadow condition and trend monitoring program.
  • 1) Document baseline meadow conditions as new standards and guidelines were coming into use.
  • 2) Examine long-term trends in meadow condition following implementation of standard and guidelines.
• UC Davis Rangeland Watershed Lab partnering with USFS to analyze these data.

Range Condition Monitoring 1999-2012

• 850 Permanent plots
  – Read every 5 years
  – Over 270 with 10 years of data
• Plant species composition
  – Diversity
  – Richness
  – Function - Stabilization
• Current data analysis
  – Range Condition
  – Trend in Condition
  – Initial Condition x Weather x Site Type x Management
First Findings - Inyo National Forest

Meadow plant diversity, richness, and the frequency of soil stabilizing plants did not differ between grazed and non-grazed allotments in the 10 years following livestock removal.