

### Cattle & Water Quality Research



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2013 Cattle Industry Summer Conference • Denver, Colorado  
Property Rights & Environmental Management/Federal Lands Policy Committees

### 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



Rangeland Watershed Laboratory



### 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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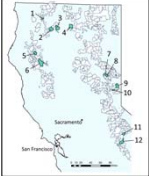


*Is public lands cattle grazing degrading environmental quality and putting human health at risk?*

### 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, NO<sub>3</sub>-N, NH<sub>4</sub>-N, TP, PO<sub>4</sub>-P



### Water Quality Benchmarks

Percentage of 743 stream water samples exceeding benchmarks

Benchmark	Overall (% of 743)	Key Grazing Area (% of 462)	Recreation Area (% of 125)	No Concentrated Use Activities (% of 156)
FC > 20 cfu/100ml	50	48	46	58
FC > 200 cfu/100ml	10	10	6	13
<i>E. coli</i> > 190 cfu/100ml	5	4	4	6
<i>E. coli</i> > 235 cfu/100ml	3	3	3	4
NO <sub>3</sub> -N > 300 µg/L	0	0	0	0
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### Mean FIB and Nutrient Concentrations

Benchmark	Key Grazing Area (n = 462)	Recreation Area (n = 125)	No Concentrated Use Activities (n = 156)
FC (cfu 100/ml)	87 ± 12 a	55 ± 9 b	90 ± 12 a
<i>E. coli</i> (cfu 100/ml)	42 ± 6 a	29 ± 7 b	43 ± 8 a
Total N (µg/L)	61 ± 4 a	38 ± 3 b	64 ± 6 a
NO <sub>3</sub> -N (µg/L)	17 ± 1 ab	16 ± 1 a	25 ± 2 b
NH <sub>4</sub> -N (µg/L)	11 ± 0.6 a	10 ± 1 a	10 ± 0.7 a
Total P (µg/L)	24 ± 4 a	14 ± 4 a	17 ± 2 a
PO <sub>4</sub> -P (µg/L)	7 ± 0.3 a	5 ± 0.2 b	8 ± 0.6 a

### Mean FIB and Nutrient Concentrations

Relative to conditions at time of sample collection

	Low Stream Flow		Turbid Water		Cattle Present		Recreation	
	Yes	No	Yes	No	Yes	No	Yes	No
No. Occurrences	51	692	37	706	130	613	28	715
FC (cfu/100 ml)	216**	72	212**	76	205**	56	36	84
<i>E. Coli</i> (cfu/100 ml)	114*	35	142**	35	115**	24	14*	41

\*\* P < 0.05 ; \* P < 0.01

Relative to US EPA's national *E. coli* benchmarks—the most contemporary and relevant standards for this study—over 90% of the 743 samples collected were below recommended criteria values.

### 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).

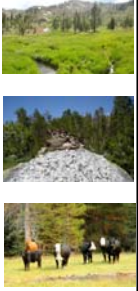
*"Our results do not support previous concerns of widespread microbial water quality pollution across these grazed landscapes, as concluded in other surveys."*

Roche, L.M., L. Kromschroeder, E. R. Atwill, R.A. Dahlgren, and K.W. Tate. 2013. **Water Quality Conditions Associated with Cattle Grazing and Recreation on National Forest Lands.** *PLOS ONE* 8(6): e68127.

### Public Lands Grazing & Yosemite Toad

#### Multiple-Use Management on Public Lands

- Yosemite Toad - Proposed for listing under ESA
  - Mountain Meadows – Key breeding and rearing habitat
  - Believed to be declining
  - Livestock as a potential driver of decline?
- 2005-2010 Yosemite Toad Adaptive Management Project
  - USFS, UC Davis, UC Berkeley, and range stakeholders.

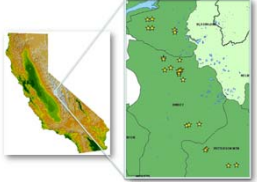


### Public Lands Grazing & Yosemite Toad

#### 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



### Public Lands Grazing & Yosemite Toad

#### CATTLE EXCLUSION EXPERIMENTS

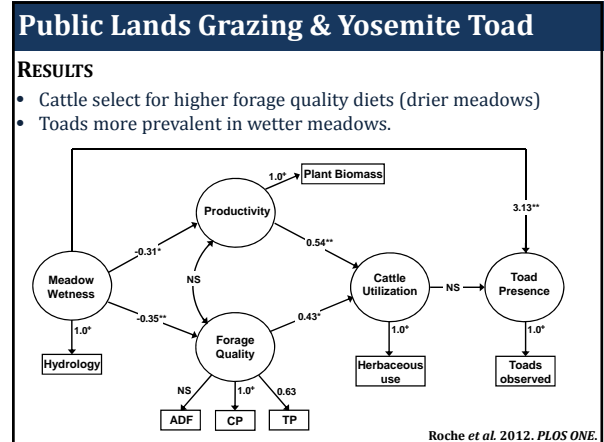
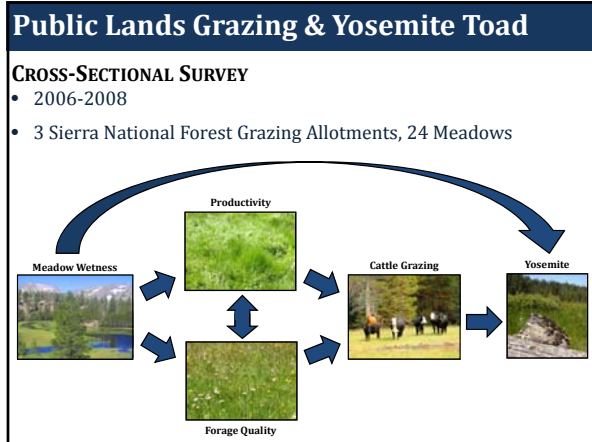
- 2006-2008
- 3 Sierra National Forest Allotments
- 9 Meadows, 36 breeding pools
  - Toad occupied & toad unoccupied pools



#### 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.

Roche et al. 2012. *Rangeland Ecology & Management.*



### Cattle grazing and conservation of Yosemite toad can be compatible goals

**Cattle Grazing and Yosemite Toad (*Bufo canorus* Camp) Breeding Habitat in Sierra Nevada Meadows**  
 L.M. Roche, B. Allen-Diaz, D.J. Eastburn, and K.W. Tate. 2012. Rangeland Ecology & Management 65:56-65.

**Cattle grazing and conservation of a meadow-dependent amphibian species in the Sierra Nevada**  
 L.M. Roche, A.M. Latimer, D.J. Eastburn, and K.W. Tate. 2012. PLOS ONE.

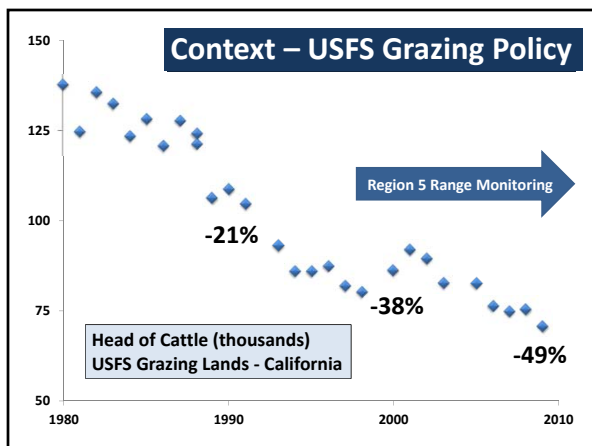
**Determining the effects of livestock grazing on yosemite toads (*Bufo canorus*) and their habitat: an adaptive management study**  
 B. Allen-Diaz, S. McIlroy, K.W. Tate, L.M. Roche, A. Lind. 2010. USFS Region 5 Final Report.

**Determining the effects of cattle grazing treatments on Yosemite toads (*Anaxyrus canorus*) in montane meadows.**  
 S. McIlroy, A.J. Lind, B.H. Allen-Diaz, L.M. Roche, W.E. Frost, R.L. Grasso, and K.W. Tate. In Review. PLOS ONE.

### 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

The map shows the distribution of 850 permanent monitoring plots across California, with a concentration in the Sierra Nevada and Cascade mountain ranges. A legend indicates that purple dots represent 'Plot Sites' and purple shaded areas represent 'Allotments'.

