

Water Quality Conditions Associated with Cattle Grazing and Recreation on National Forest Lands



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UC DAVIS
UNIVERSITY OF CALIFORNIA



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VETERINARY MEDICINE



100
UC Cooperative
Extension

University of California
Agriculture and Natural Resources

Sacramento Bee Exclusive, 2010

USFS Grazing Allotments

“Nowhere is the water dirtier...”

“Livestock waste found to foul
Sierra waters”

“...incredible weapon of mass
destruction”

Multi-Partner Collaboration

- **US Forest Service**
- **UC Davis**
- **UC Cooperative Extension**
- **USFS Permittees**
- **Regional Water Quality Control Boards**
- **Rangeland and Forest Stakeholders**



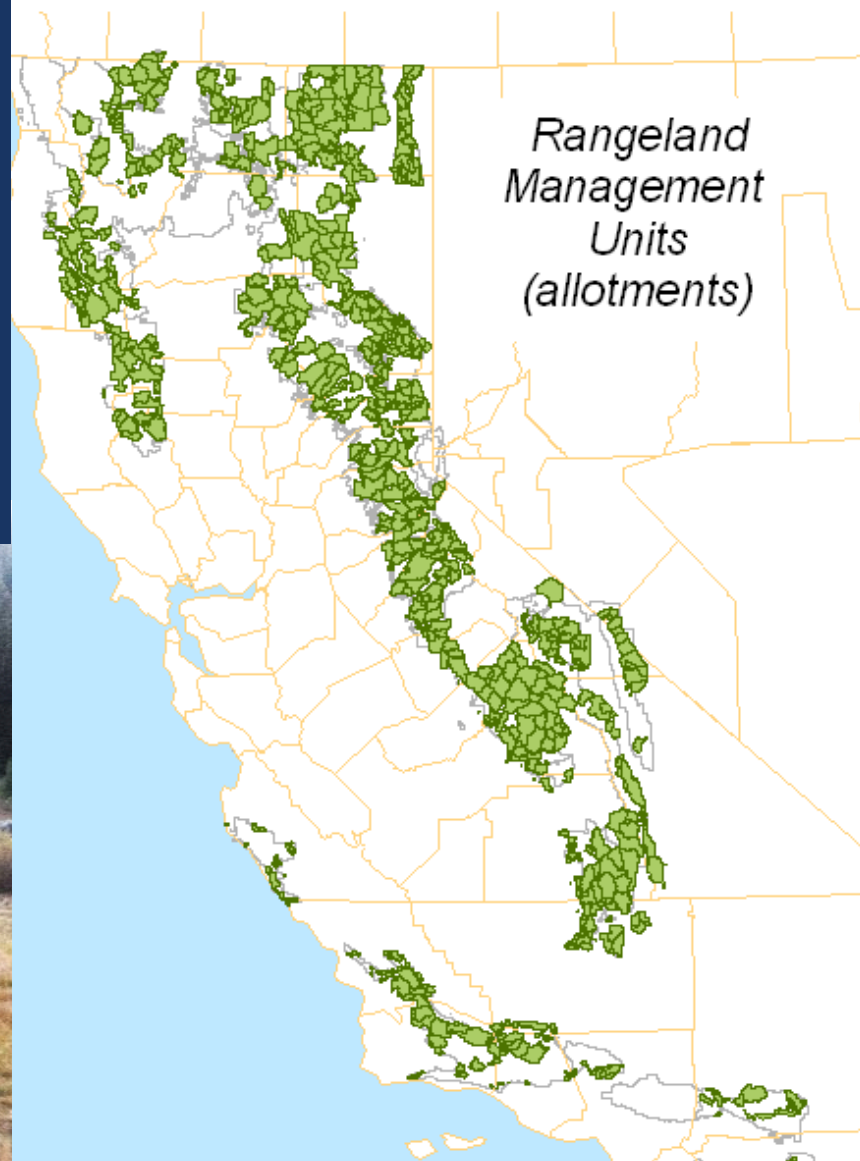
USFS Public Grazing Allotments in CA

500 Grazed Allotments

8,000,000 Acres

330,000 Animal Unit Months

~70,000 Head of Cattle



USFS Public Grazing Allotments in CA

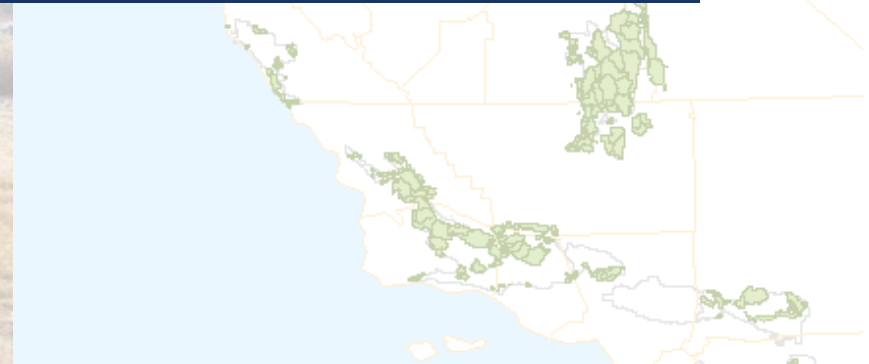
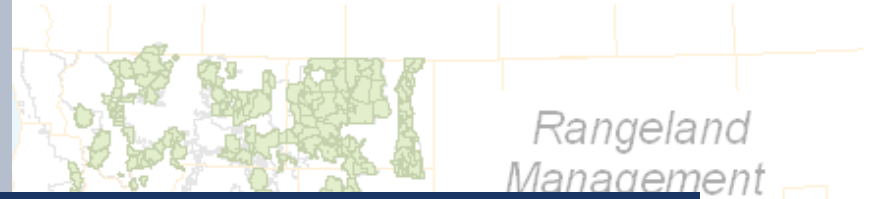
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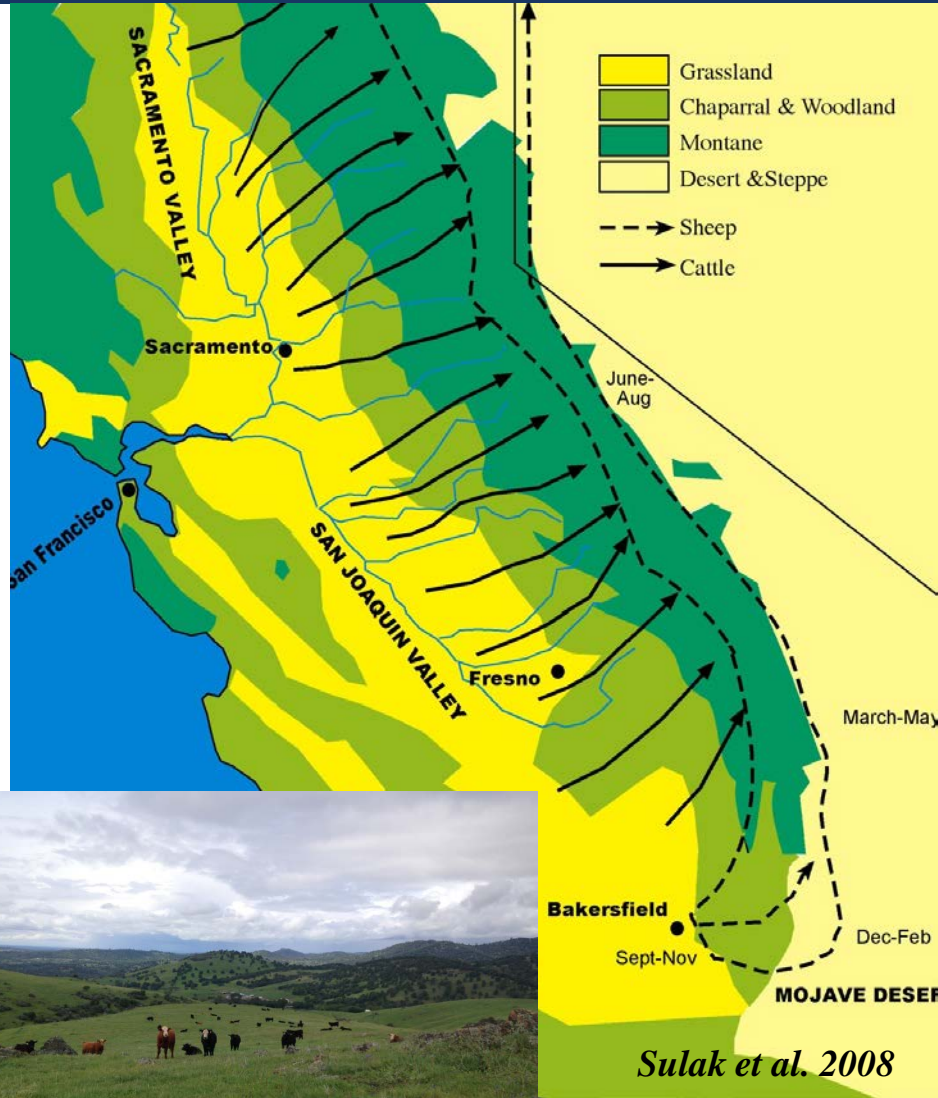
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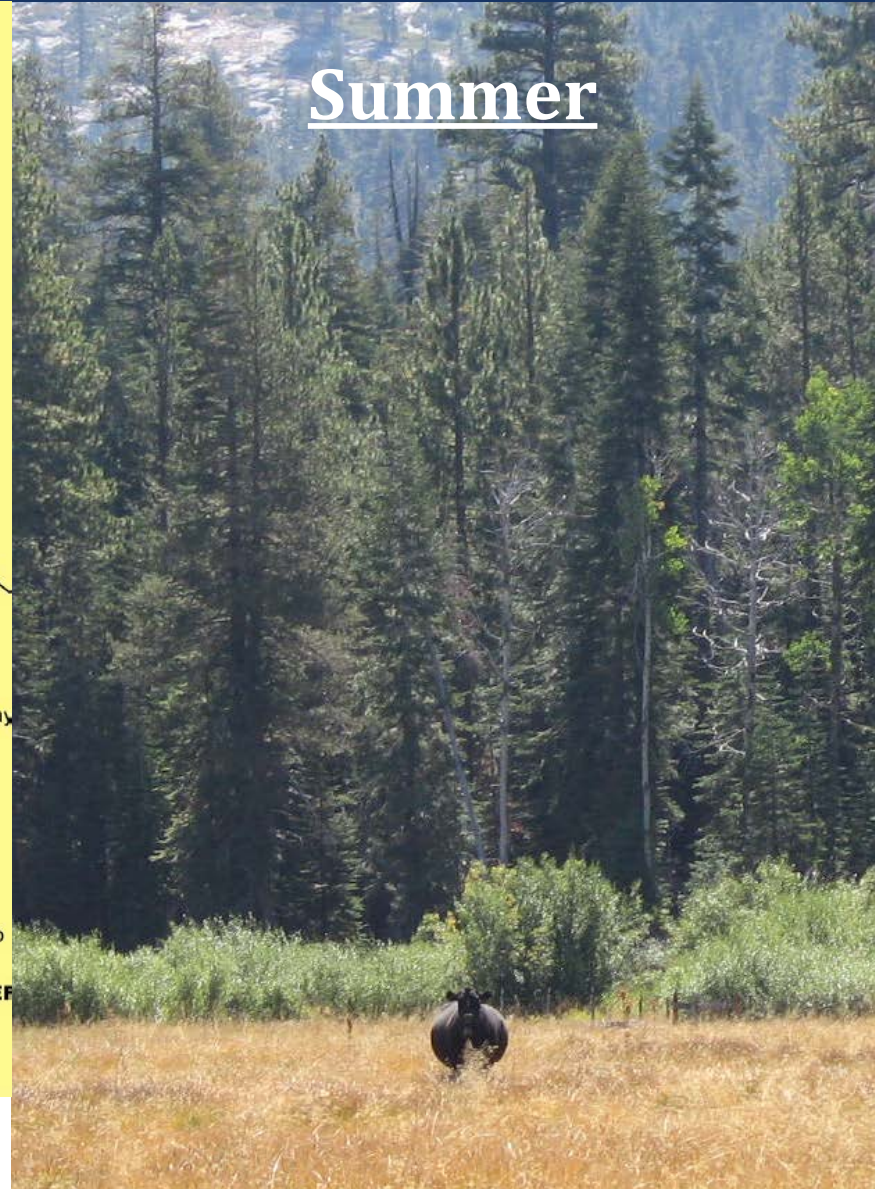
**Annual recreating
population of 26
million people.**



Private Foothill Ranches & High Elevation Public Lands Connection



Summer



Fall - Spring

Public Lands Grazing & Water Quality Objectives

Public lands cattle grazing degrading environmental quality and putting human health at risk?

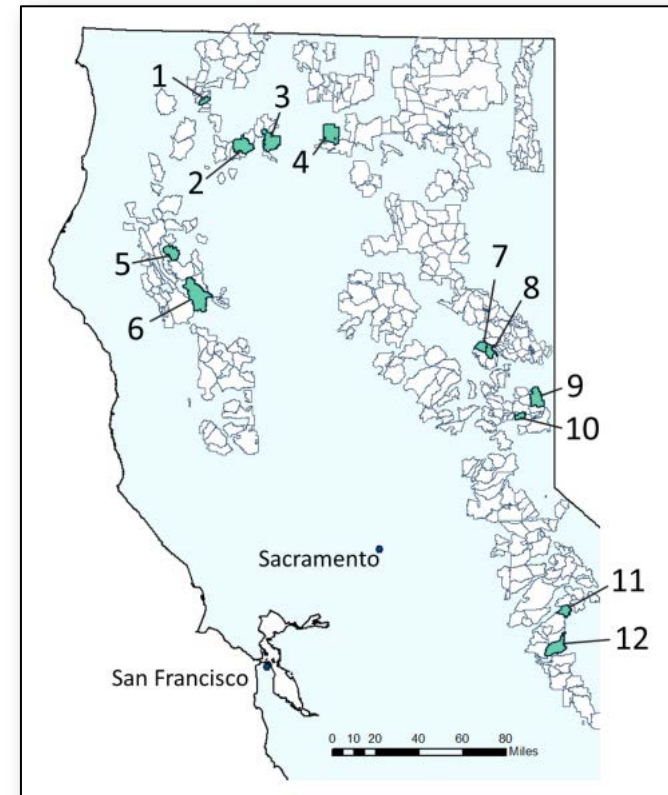


Public Lands Grazing & Water Quality

Cross-sectional, Longitudinal Survey

12 USFS public lands grazing allotments, 5 National Forests

- Klamath, Coast, Cascade, and Sierra Nevada Mountain Ranges.
- Represent diversity of climate, soil, vegetation, and resource use activities found across landscape.
- Study area: 320,000 acres.
- Elevation: 700-10,000 feet.



Public Lands Grazing & Water Quality

Cross-sectional, Longitudinal Survey

12 USFS public lands grazing allotments, 5 National Forests

155 sample sites monitored monthly during grazing-recreation period (Jun-Nov, 2011).

- **Key Grazing Areas** – Meadows/riparian areas cattle known to graze and occupy.

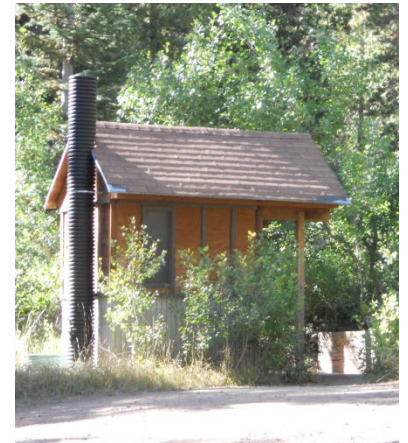


Public Lands Grazing & Water Quality Comprehensive Survey

12 USFS public lands grazing allotments, 5 National Forests

155 sample sites monitored monthly during grazing-recreation period (Jun-Nov, 2011).

- **Recreation Areas** – Developed/undeveloped campgrounds, swimming areas, trailheads.



Public Lands Grazing & Water Quality Comprehensive Survey

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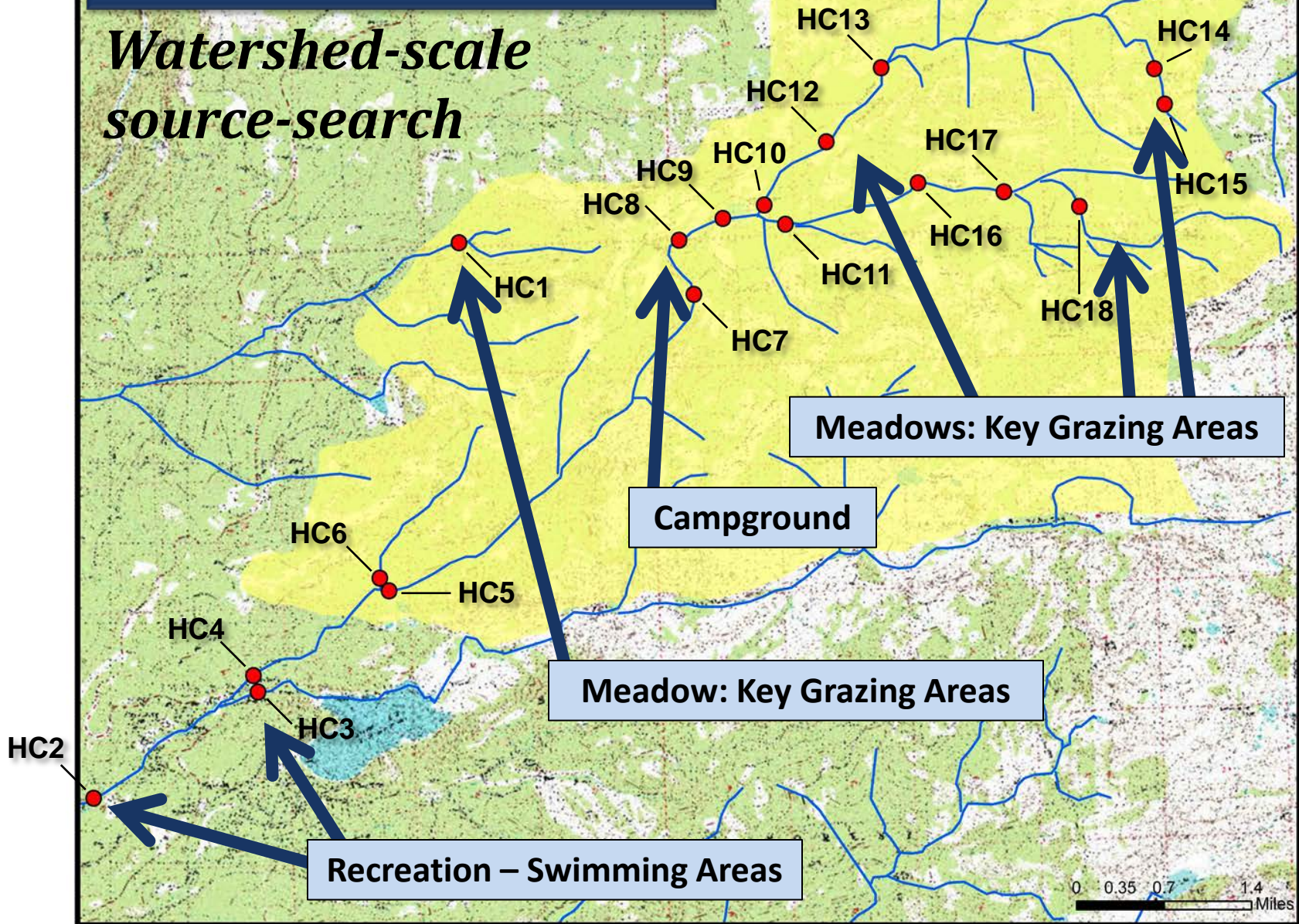
155 sample sites monitored monthly during grazing-recreation period (Jun-Nov, 2011).

- **No Concentrated Use Activities**– Perennial flow tributary confluences with no concentrated use activities.



Sample Site Selection

*Watershed-scale
source-search*



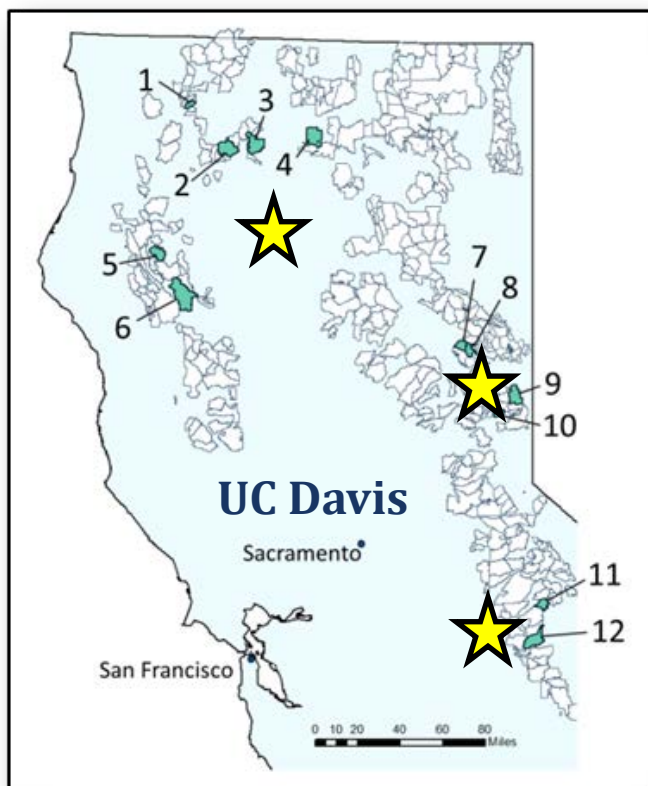
Water Quality - Measurements

All 155 Sample Sites, Every Sample Event:

- “Indicator” *E. coli* and fecal coliform (FIBs)
- Total N, nitrate ($\text{NO}_3\text{-N}$), ammonium ($\text{NH}_4\text{-N}$)
- Total phosphorus and soluble-reactive phosphorus ($\text{PO}_4\text{-P}$)

FIB Analysis Conducted w/in 8 hours

3 remote laboratories established to meet maximum 8 hour hold time restrictions.



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> > 100 cfu/100ml	9	8	7	11
<i>E. coli</i> > 235 cfu/100ml	3	3	3	4
NO ₃ -N > 300 µg/L	0	0	0	0
TP > 100 µg/L	2	2	2	<1
PO ₄ -P > 50 µg/L	<1	1	0	0



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Mean FIB 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

No significant differences in FIB concentrations between key grazing areas and areas of no concentrated use activities.

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FIB concentrations significantly lower at recreation areas.

Mean FIB Concentrations

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Mean FIB concentrations still below USEPA *E. coli* FIB-based benchmarks.

Mean FIB Concentrations

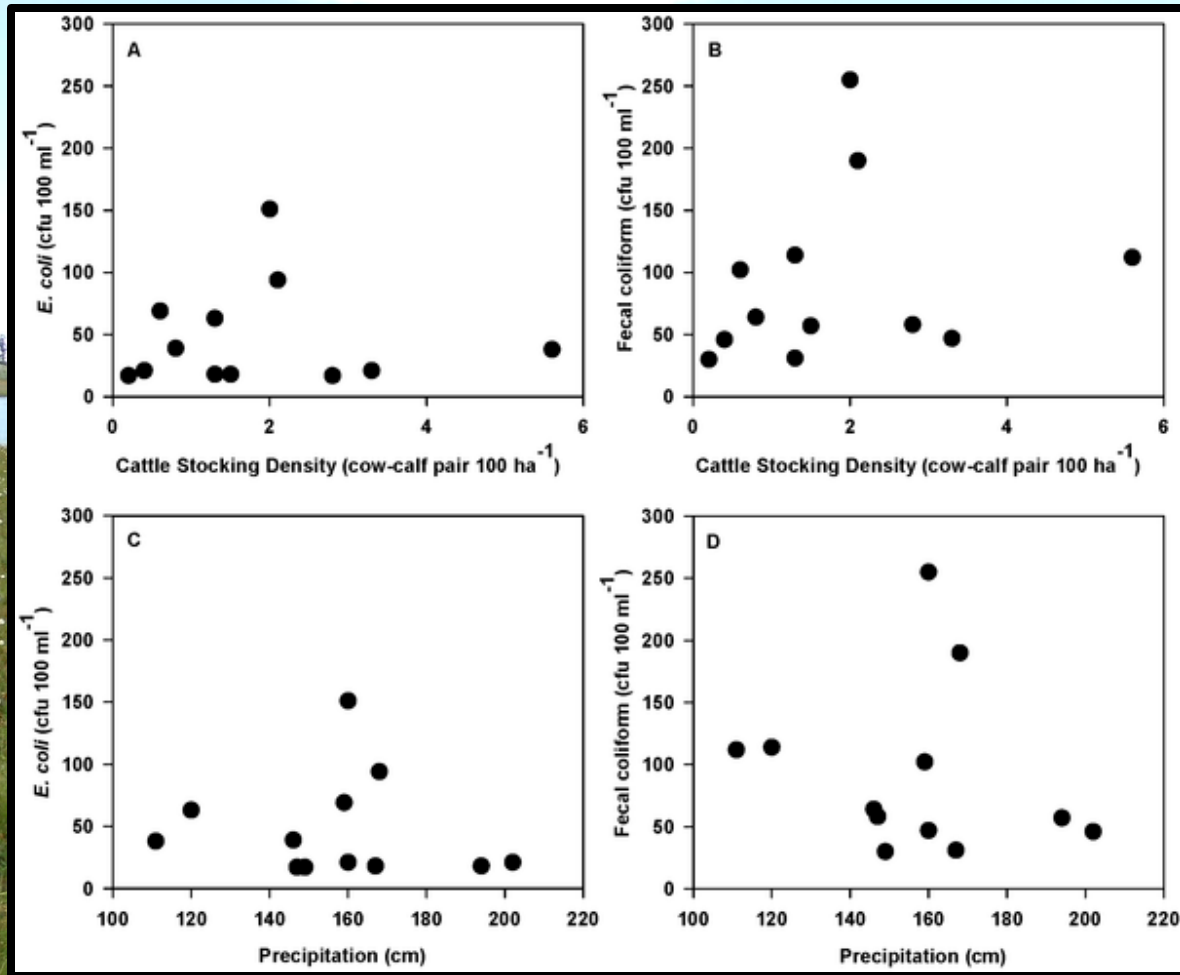
Relative to conditions at time of collection

	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

** $P < 0.05$; * $P < 0.01$

FIB concentrations higher when stream flow was low/stagnant, stream water was turbid, and when cattle were actively observed at sampling.

Allotment-Level Mean FIB Concentrations



No statistically significant relationships between FIB and cattle density or precipitation.

Public Lands Grazing & Water Quality

Conclusions

- Observed nutrient concentrations were ≥ 1 order of magnitude below levels of ecological concern, and similar to background estimates.
- All but the most out-of-date and restrictive fecal indicator bacteria (FIB) water quality benchmarks were broadly met.
- Throughout the study period, US EPA recommended *E. coli* benchmarks were met for >90% of samples collected and >83% of sites (no exceedances).

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

Why are our conclusions different than other surveys?

3 important distinctions

- 1) Study results compared to regulatory and background water quality benchmarks based on current science and policy.**
- 2) Land-use activities were directly compared on the same land units managed by a single agency (USFS).**
- 3) To date, this study is the most comprehensive water quality survey in existence for National Forest public grazing lands, including an assessment of 7 water quality indicators at 155 sites across 5 National Forests.**

Rangeland Watershed Laboratory

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.



<http://rangelandwatersheds.ucdavis.edu>

