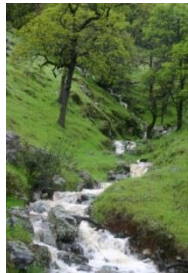


Water Quality Conditions & Management on Rangelands



Ken Tate, Leslie Roche, and Rob Atwill
UC Davis and UC Cooperative Extension



Grazing Workshop • Mariposa County UCCE • March 2014

CA Rangelands

Safe Water to Drink, Irrigate, Swim



Habitat



Fresh produce food safety

Potential grazing related pollutants

- 1) Fecal microbial pollutants – *Cryptosporidium*, *E. coli*, fecal coliforms
- 2) Sediment – erosion
- 3) Nutrients – nitrogen and phosphorus



On-Ranch Erosion Survey Results

- 1. Majority of sediment associated with road systems.**
- 2. Manage grazing for vegetative ground cover >80% and for vegetated stream banks.**
- 3. Natural sediment load can be high in certain watersheds.**
- 4. Legacy from past events & activities.**



Nutrient Water Quality

We consistently find N and P levels to be well below ecological concern in range and forest waters.

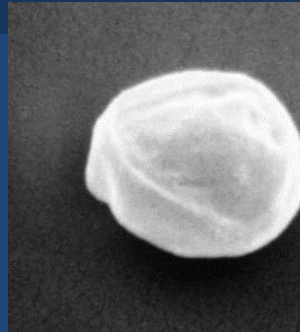
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Bay Area in 1995 - Cryptosporidium

Livestock



Pathogen



Drinking Water



Cryptosporidium

Contra Costa Times

Monday, January 6, 1997

Tiny parasite has water districts, cattle ranch



By DENIS CUFF
Staff writer

Cattle and water. They go together on many California landscapes where cows roam valleys above deep blue reservoirs.

A nasty bug has intruded on the pastoral scene: a parasite in animal droppings that can sicken people, even kill them when it gets into water sources.

Now some drinking water suppliers are questioning whether it's safe to mix cattle and reservoir lands.

The bug is cryptosporidium, a tough, tiny parasite that hits most people like the flu, but can kill AIDS patients or others with compromised immune systems.

Cryptosporidium has captured the attention of the water industry in the past three years because of some unusual features.

JOHN GARRETT JACKSON, 15, herds cattle recently from one of his father's fields to another on the family-leased ranch property off Vasco Road.

Parasite

FROM PAGE 1A

cond. "I think we are just beginning to understand that cryptosporidium is going to be a major water concern for the quality of drinking water in California."

The Contra Costa Water District this month recommended phasing out grazing in the buffer lands around its Los Vaqueros Reservoir under construction south of Brentwood. The reservoir will store drinking water for 400,000 people.

The neighboring East Bay Municipal Utility District is looking into tighter grazing restrictions on its land to protect the 1.7 million people

Scientists seek watery solution to halt 'mystery spore' outbreak

By DENIS CUFF
Staff writer

You might call it the mystery bug. Scientists did, giving this parasite the name cryptosporidium that translates as "mystery spore."

The parasite repeatedly stumped scientists, who didn't discover until 1976 that the microscopic organism could harm people.

It took until the early 1980s to document the first case of the parasite moving through drinking water to infect a human and cause

Parasite risks i

Cryptosporidium (top) has sporadic outbreaks, especially calves. Cattle and water. They go together on many California landscapes where cows roam valleys above deep blue reservoirs.



San Francisco water district targets cattle

The San Francisco Public Utilities Commission (PUC) seemed poised to ban cattle grazing in the northern Alameda County watershed.

In announcing a possible moratorium on livestock grazing, the commission cited concerns

Water district backs away from cattle grazing ban around lake

By DENIS CUFF
Times Staff Writer

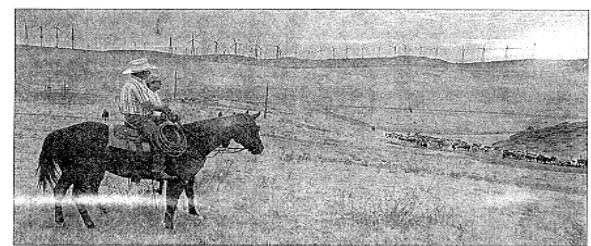
Backing off a proposed cattle ban to protect drinking water from a harmful parasite, a Contra Costa water supplier may allow some grazing on lands around the Los Vaqueros Reservoir.

Contra Costa Water District planners say it's enough to control grazing by selectively banning it in some areas, fencing off the reservoir, and banning young calves on most of the 18,000 acres around the reservoir.

Manure from young calves has the highest risk for spreading cryptosporidium, a bug that has made the water industry wary.

Widely found in America's wetlands and in feces of many wild and domestic animals, cryptosporidium can resist chlorine and slip through many water filters to make healthy people sick and kill those with weak immune systems.

"Calves are the major shedders of crypto. By eliminating them, we can control the risk," said John Steere, a district watershed planner. "This



JOE PAULO, foreground, and Russell Jackson keep an eye on their cattle from horseback on Walker Ranch, where Jackson leases land for his herd to graze.

RECOMMENDATIONS

district would install fencing to keep

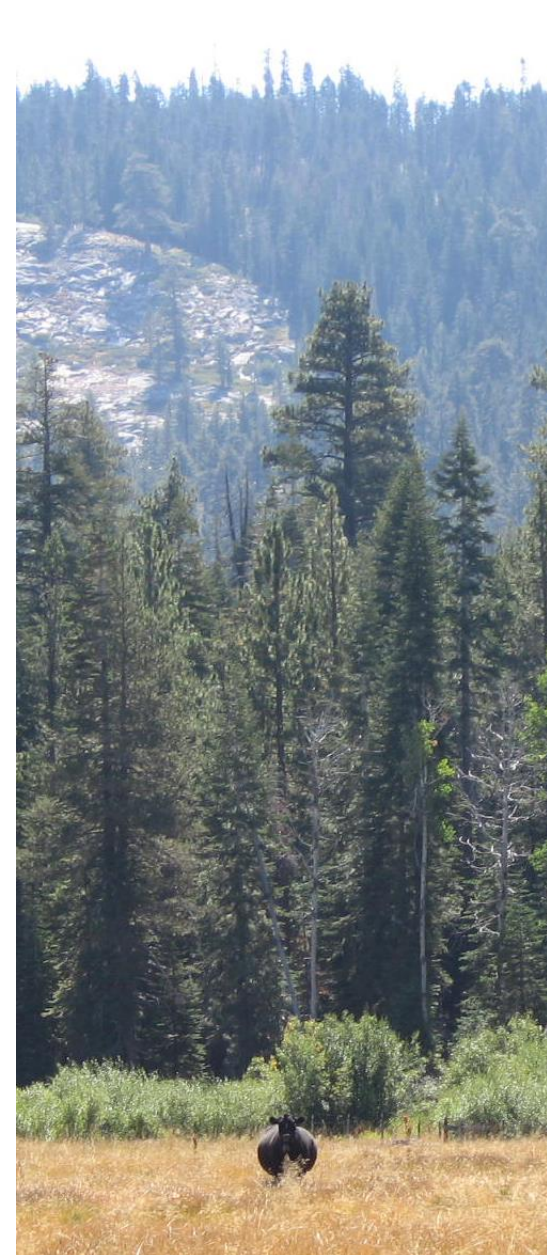
ness (cryptosporidiosis) lasts only a few days in most people with healthy immune systems, but those with severely weakened immune systems can develop chronic, life-threatening infections. Those at greatest risk include AIDS patients.

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



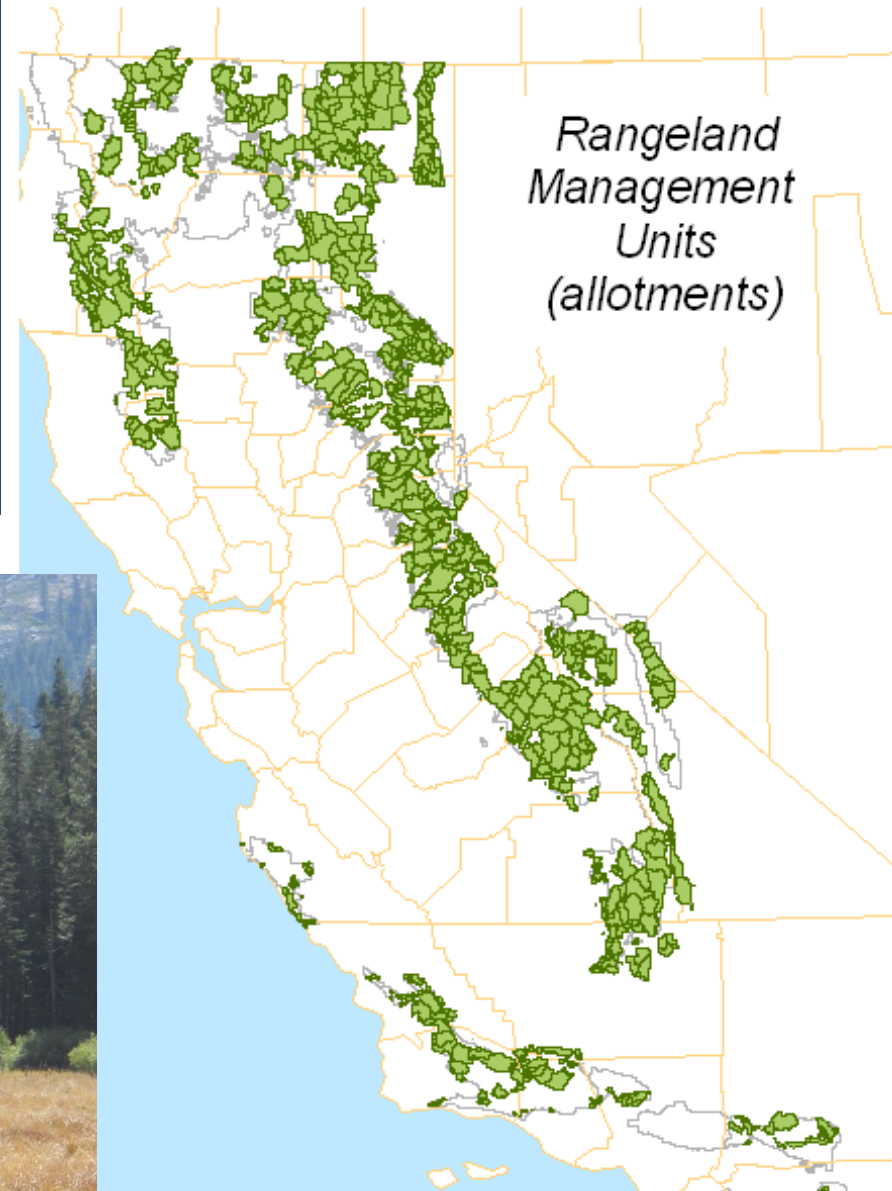
USFS Public Grazing Allotments in CA

500 grazed allotments

8,000,000 acres

430,000 Animal Unit Months

~70,000 head of cattle



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

2011 USFS GRAZING – RECREATION – WATER QUALITY STUDY

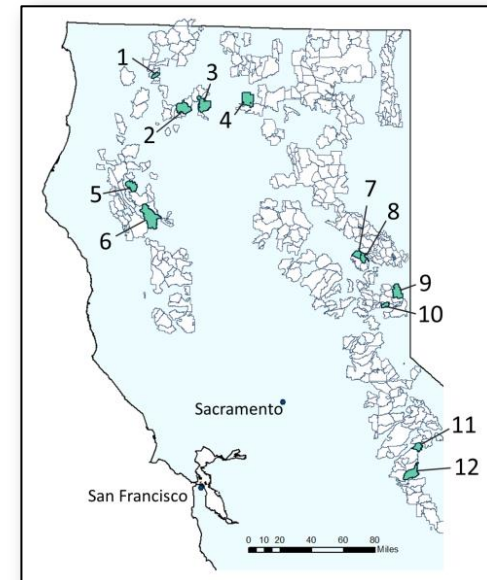
1. Quantify fecal indicator bacteria and nutrient concentrations in surface waters.
2. Compare to a) Microbial benchmarks for human health, b) Nutrient benchmarks for ecological health, and c) Estimates of nutrient background concentrations.
3. Examine relationships between water quality, environmental conditions, cattle grazing, and recreation.



Public Lands Grazing & Water Quality

COMPREHENSIVE WATER QUALITY SURVEY - 2011

- 12 USFS public lands grazing allotments, 5 National Forests.
 - 320,000 acres
- 155 stream collection sites, monitored monthly during grazing-recreation 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



Public Lands Grazing & Water Quality

RESULTS

- Nutrient concentrations were at least one order of magnitude below levels of ecological concern, and similar to background estimates.
- 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).
- Recreation sites had the cleanest water (*E. coli*), cattle grazing sites were higher but on average were well below levels of concern.

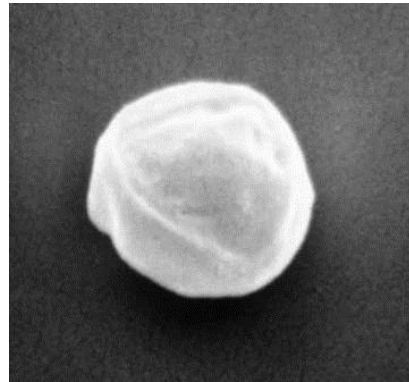
“Our results do not support previous concerns of widespread microbial water quality pollution across these grazed landscapes, as concluded in other surveys.”

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.

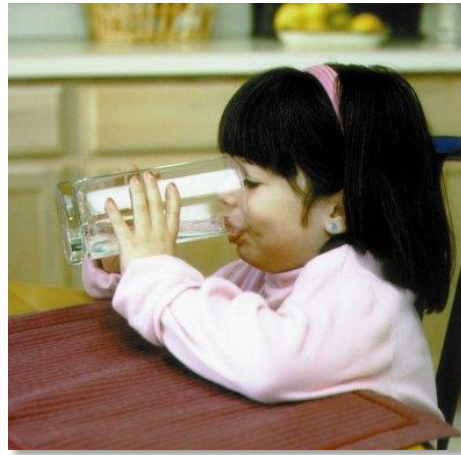
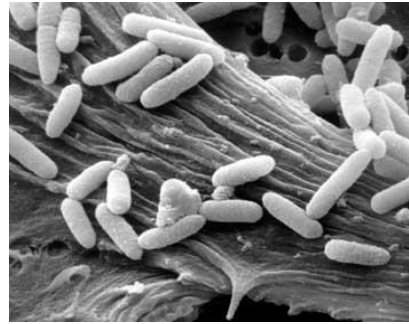
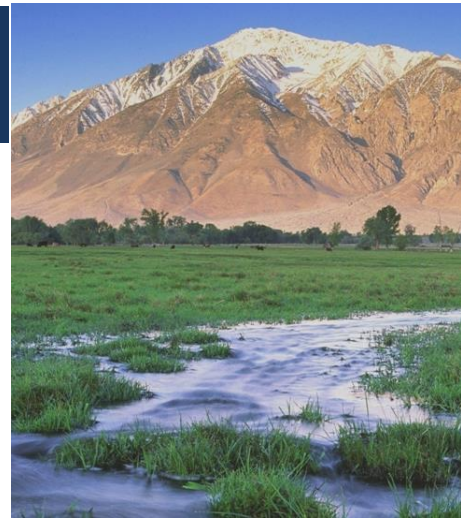
18 years of microbial WQ study



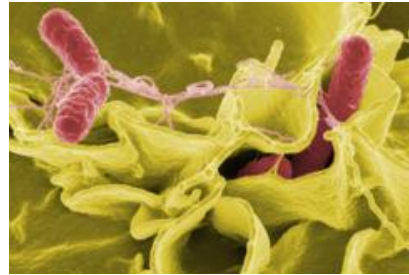
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E. Coli O157:H7



Salmonella





RANGELAND WATERSHED LABORATORY

Microbial Water Quality Information Center

Rangeland Watershed Laboratory Home [Plant](#)

Microbial Sources



Beneficial Uses



Rangeland Watersheds: Uses and Benefits to Society

Eighty-five percent of the State's surface drinking and irrigation water are generated and stored within California's 30 million acres of rangeland watersheds. These watersheds are often extensively grazed by livestock, predominantly beef cattle. Over the past 2 decades, microbial pollutants have been a primary water quality concern associated with livestock production on California's rangeland watersheds. Drinking water treatment procedures may not be completely effective against some microbial pathogens (especially *Cryptosporidium*), so managing livestock is a vital practice to reduce the prospect of extensive waterborne outbreaks as in Milwaukee in 1993.

Overview

Indicators

Risk Factors

Science

FAQ

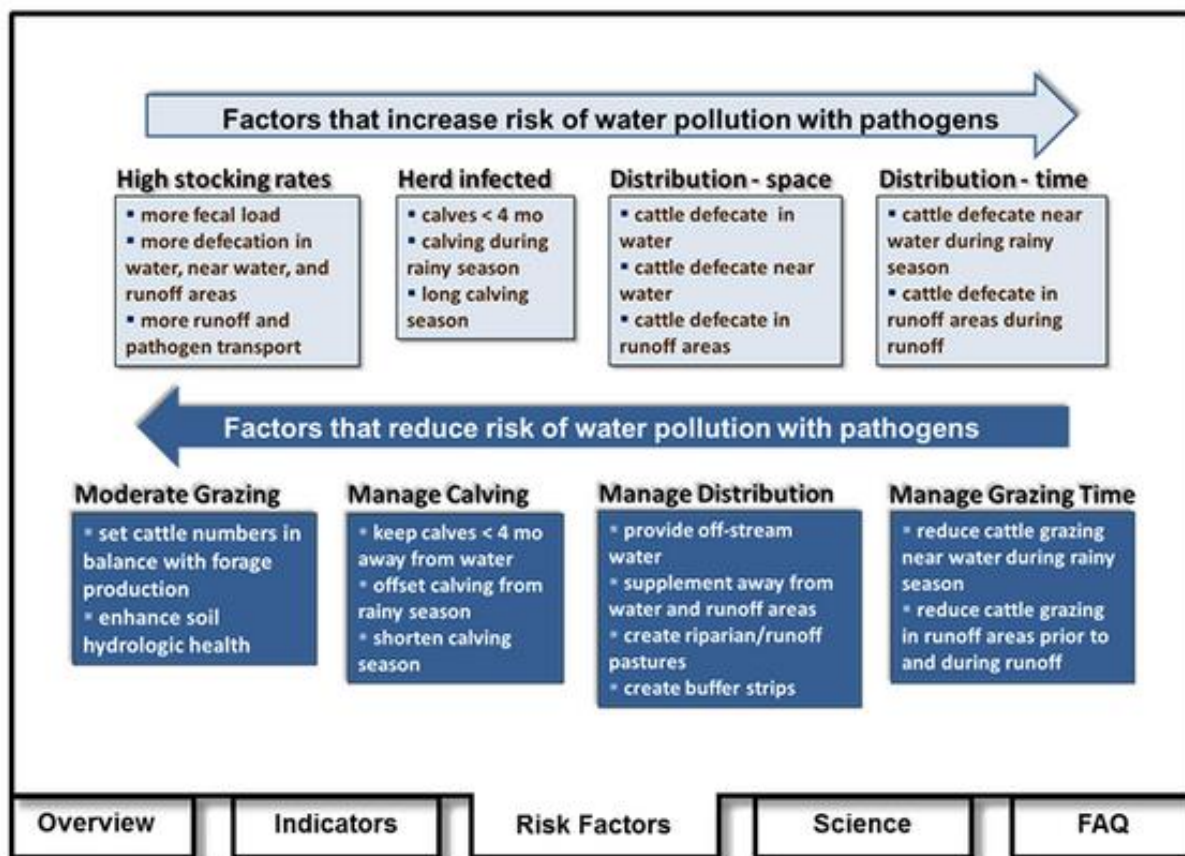
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RANGELAND WATERSHED LABORATORY

Microbial Water Quality Information Center

Rangeland Watershed Laboratory Home | [Plant](#)



Livestock and Range Management Risk Factors

There are management solutions to each of the microbial water quality risk factors shown in the figure below. The important concept is that there is a tool box of practices available to each manager that can reduce the risk of microbial water quality pollution by extensively grazing range beef cattle. Each of the tools will work better in certain locations and circumstances than in others. Implementation of multiple tools, adapted to site-specific conditions-opportunities-constraints, will likely be required in most cases to optimize risk reduction.

[More>>](#)



RANGELAND WATERSHED LABORATORY

Microbial Water Quality Information Center

Rangeland Watershed Laboratory Home | Plant

Rainfall

Vegetative Buffers

>90% of *E. coli* retained in the fecal pat or trapped within 1 ft

An additional 70% to 99.9% of *E. coli* trapped within 1 yard of fecal pat

cowpat → stream

Cryptosporidium dynamics in wildlife and livestock

Animal	% Infected
range beef cow	1-5*
range beef calve < 4 mo	10-20*
back country pack stock	0
feral pig	4-13
ground squirrel	7-15

***May not infect humans!**

C. parvum survival in fecal pats on range

Sun

Fecal Pat Temperature (F) =

Days Until >90% Mortality =

Once temperature in a cow fecal pat exceeds 104 °F all of the C. parvum in that pat die within a matter of hours. Fecal pats in direct sun achieve 104 °F once air temperature reaches 78 °F.

Grazing Intensity

None Heavy

800 lb/ac Residual Dry Matter

Sediment mg/L =

Nitrate mg/L =

E. Coli cfu/100ml =

Overview
Indicators
Risk Factors
Science
FAQ

Science of Rangeland Microbial Water Quality and Grazing Management

Click on a image to learn more about the science behind microbial water quality and California rangelands.

Stocking Rate and Water Quality

Grazing Intensity	Sediment mg/L	Nitrate mg/L	<i>E. Coli</i> cfu/100ml
None 4000+ lb/ac RDM	2	0.1	310
Moderate 800 lb/ac RDM	7	0.4	425
Heavy 500 lb/ac RDM	24	0.8	1250

Over 60% of cattle fecal loading is near livestock attractants in summer

We can position salt, feed, water to attract cattle and pathogens to “safe” areas – not near streams or runoff areas



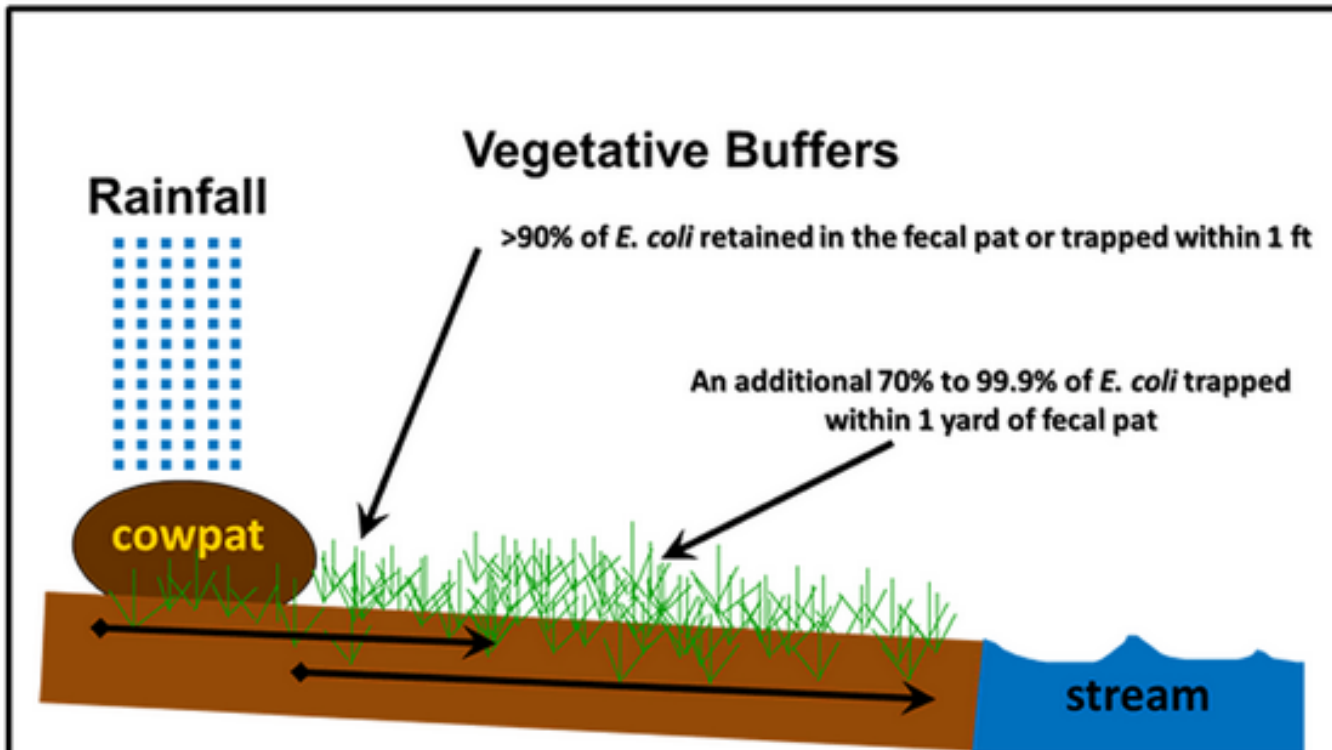
**Away from creek,
in areas with low runoff**



Opportunity

CA rangelands have great capacity to filter microbial and other pollutants transported in surface runoff

E. Coli and *Cryptosporidium* are trapped in fecal pat or soil during runoff.



Vegetative Buffer

Non-point source pollution as a result of overland flow during rainfall events is a common transport mechanism for pathogens. Pathogens in fecal material can certainly be directly deposited in a water body by an animal, but livestock and wildlife spend more hours grazing and resting on the surrounding watershed than they do drinking or cooling in a creek or stream. The proximity of contaminated fecal material is a key factor in determining whether or not the pathogen will be able to reach water- Our research has demonstrated that, for indicator *E.coli*, more than 90% of the bacteria was retained within a fecal pat or trapped within 1 foot downslope. [More>>](#)

We are starting to find the same thing for hormones and pharmaceuticals....

Overview

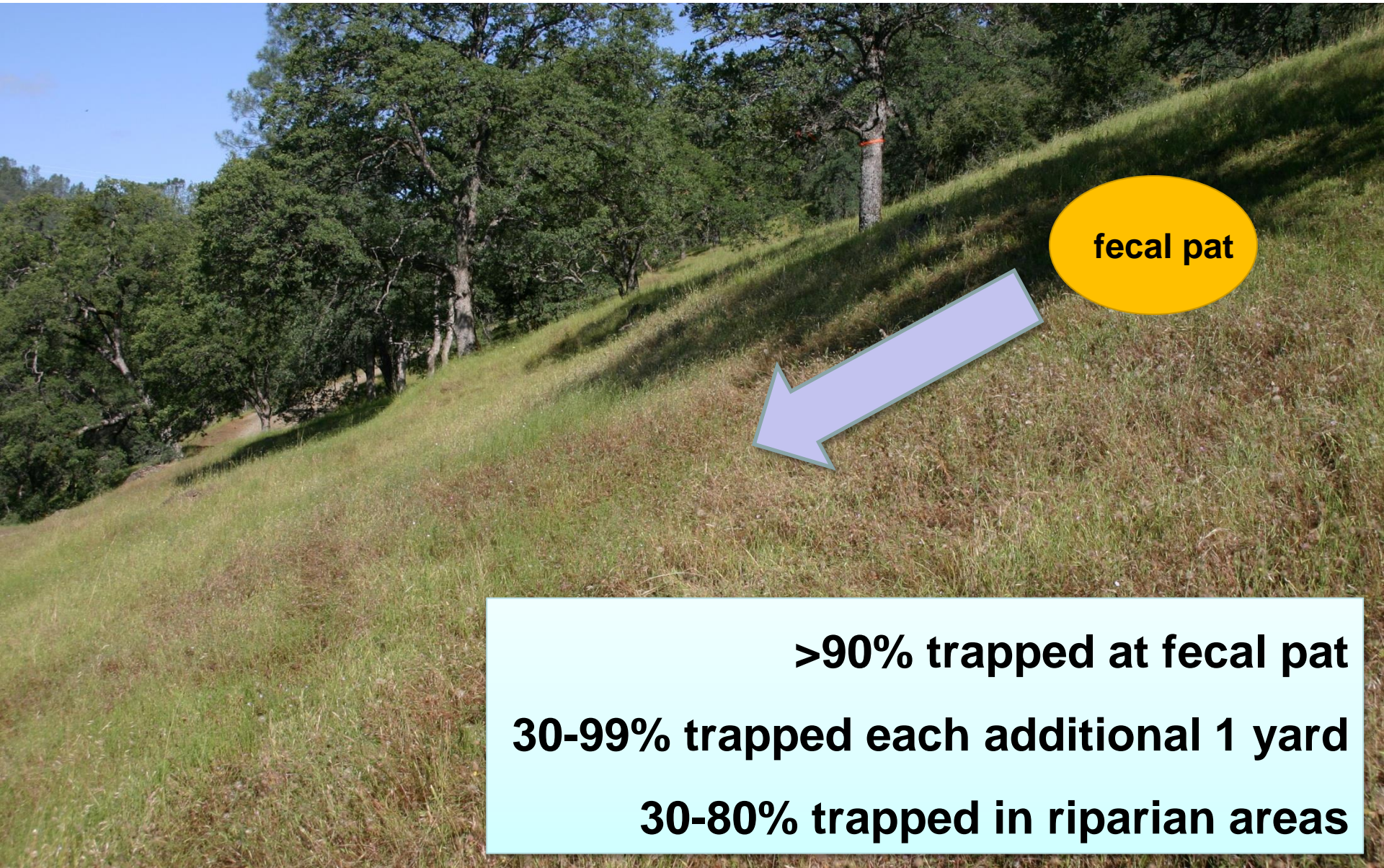
Indicators

Risk Factors

Science

FAQ

Distribute cow pats away from streams and the whole range is a buffer



fecal pat

>90% trapped at fecal pat

30-99% trapped each additional 1 yard

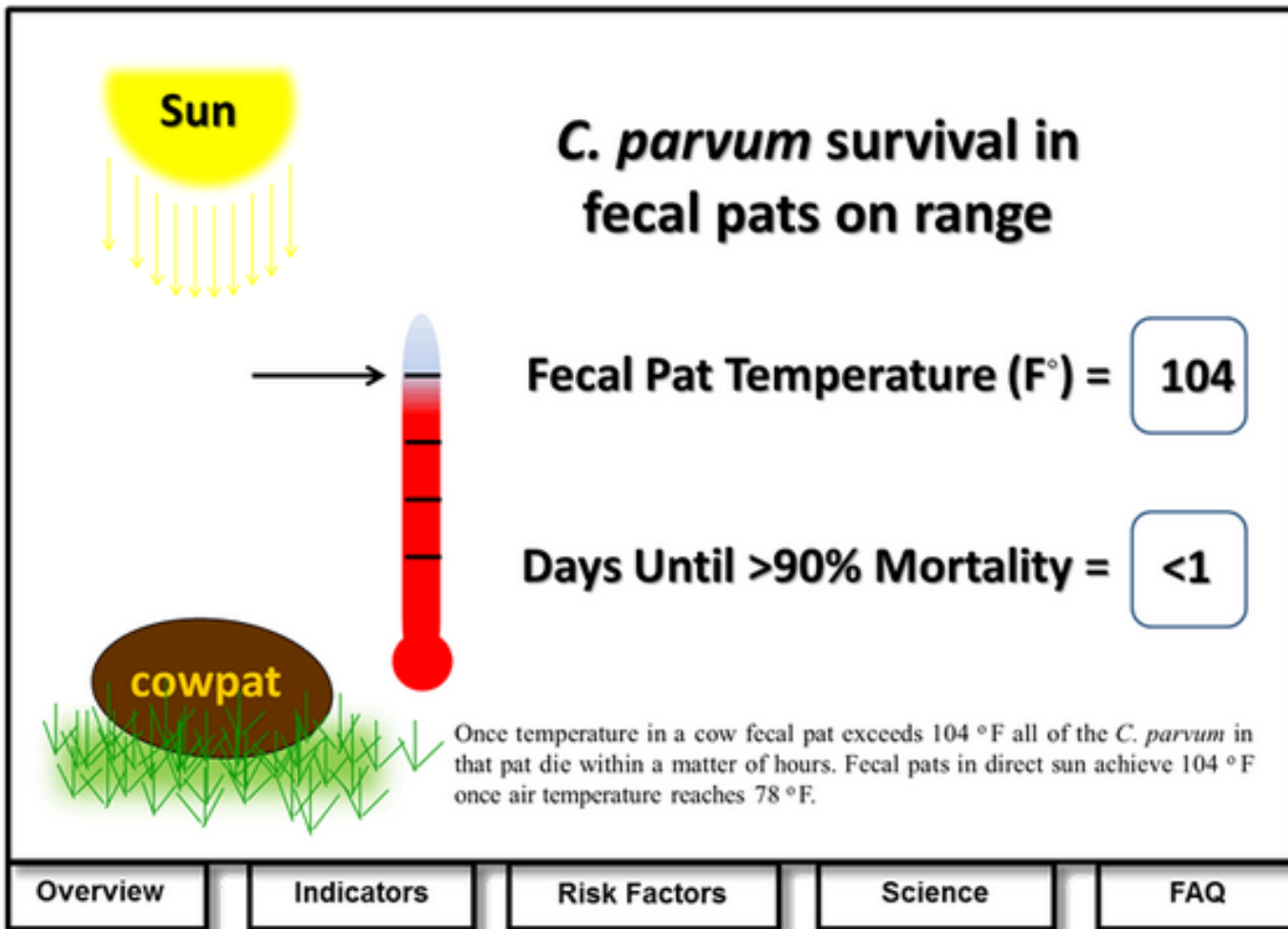
30-80% trapped in riparian areas

Opportunity

A large, dark, moist fecal pat is the central focus of the image, resting on a bed of green grass. The pat is irregular in shape and has a glistening, wet appearance. The surrounding grass is vibrant green and appears to be a mix of different species, including some broad-leafed plants and thin blades. The lighting is bright, suggesting a sunny day, which highlights the texture of the feces and the individual blades of grass.

**Microbial pollutants die fast in
fecal pats during Spring,
Summer, Fall**

Cryptosporidium eggs die in one day of 78 F air temperature in direct sun.



Cryptosporidium parvum Survival in the Environment

The survival of pathogens in the environment is highly correlated to weather patterns. In hot weather, feces quickly dry out, killing most pathogens that were contained within them. In cooler weather, fecal pats are a more favorable environment for pathogens as the pats remain moist for a much longer period of time. To evaluate and confirm this phenomenon, we measured the ambient temperature and the temperature within fecal pats in two different environments- sun and shade, for a year. [More>>](#)

The Key New Finding

Most Cryptosporidium in cattle does not appear to be the type infectious to humans.



The Key New Finding

New statewide herd survey of range cattle and calves – 14% had Cryptosporidium.

Cryptosporidium	No. Observations
<i>C. ryanae</i>	61/81 (75%)
<i>C. bovis</i>	19/81 (24%)
<i>C. andersoni</i>	1/81 (1%)
<i>C. parvum</i>	0/81 (0%)

- Species and subtypes identified are minimally infectious for humans.
- Protozoal contamination by cattle may not be the public health threat once thought.

K. Flores *et al.*

WQ Summary

- Water quality on extensively grazed rangelands and forests is high.
- Management can create risk to water quality.
- Rangelands have great capacity to attenuate pollutants from livestock and other ranch activities – work with that potential.
- A large toolbox of tested, feasible practices exists.



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

Google

rangeland watersheds