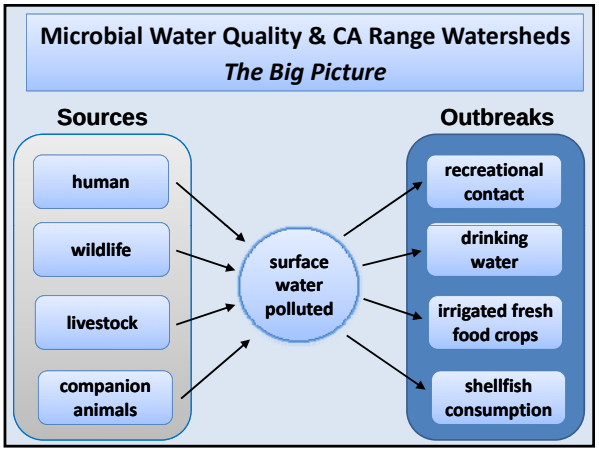
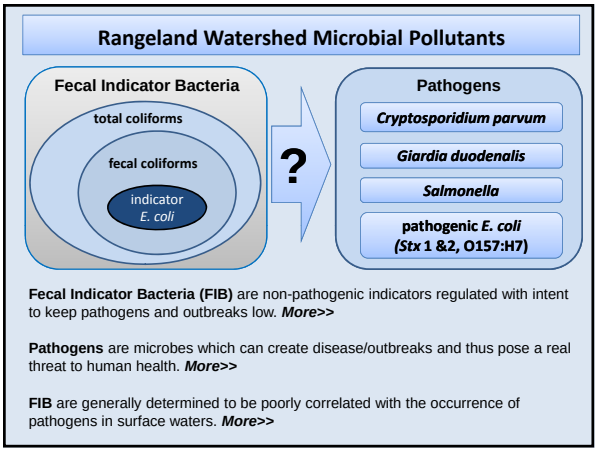
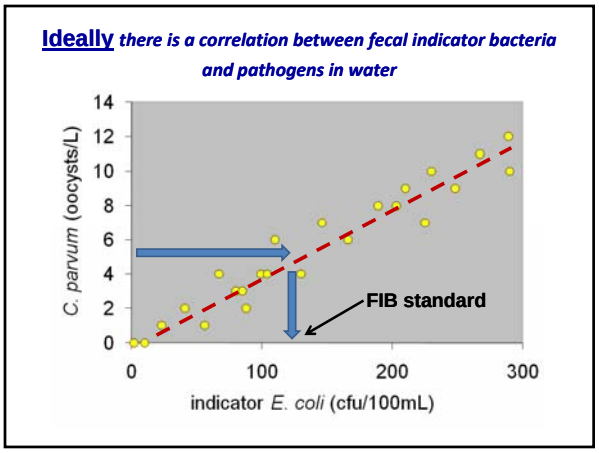
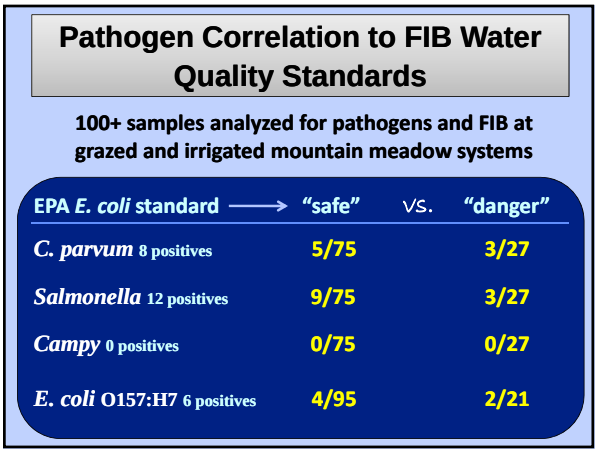

Systems approach for managing ranch water quality
Integrating research into management
Ken Tate, UC Davis


Reality: we manage for many goals, not just one, nor one at a time
Forage and Livestock Production
Weed Control – Diversity
Wildlife and their Habitat
Productive and Healthy Soils
Water Quantity and Quality

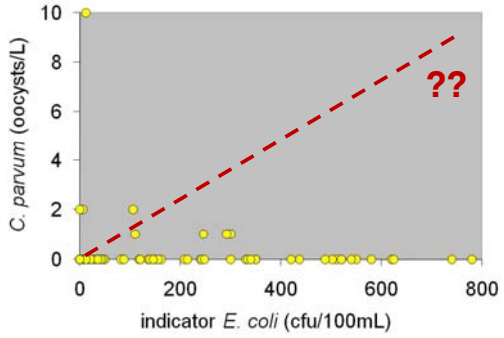

Microbial Water Quality & CA Range Watersheds
The Big Picture
Sources
Outbreaks
human
wildlife
livestock
companion animals
surface water polluted
recreational contact
drinking water
irrigated fresh food crops
shellfish consumption


Rangeland Watershed Microbial Pollutants
Fecal Indicator Bacteria
total coliforms
fecal coliforms
indicator E. coli
?
Pathogens
Cryptosporidium parvum
Giardia duodenalis
Salmonella
pathogenic E. coli (Stx 1 &2, O157:H7)
Fecal Indicator Bacteria (FIB) are non-pathogenic indicators regulated with intent to keep pathogens and outbreaks low. More>>
Pathogens are microbes which can create disease/outbreaks and thus pose a real threat to human health. More>>
FIB are generally determined to be poorly correlated with the occurrence of pathogens in surface waters. More>>

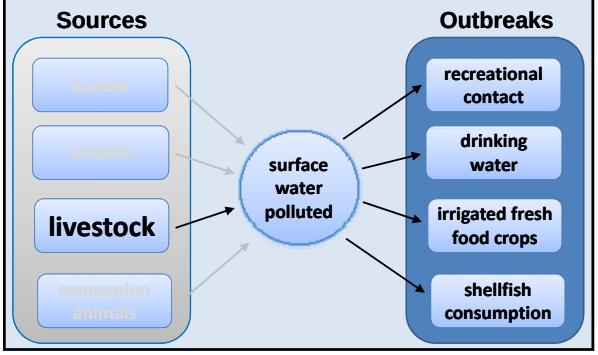

Ideally there is a correlation between fecal indicator bacteria and pathogens in water
C. parvum (oocysts/L)
indicator E. coli (cfu/100mL)
FIB standard
0
2
4
6
8
10
12
14
0
100
200
300


Pathogen Correlation to FIB Water Quality Standards
100+ samples analyzed for pathogens and FIB at grazed and irrigated mountain meadow systems
EPA E. coli standard → "safe" vs. "danger"
C. parvum 8 positives 5/75 3/27
Salmonella 12 positives 9/75 3/27
Campy 0 positives 0/75 0/27
E. coli O157:H7 6 positives 4/95 2/21

Indicator *E. coli* concentrations not well correlated to *Salmonella*, *C. parvum*, etc.

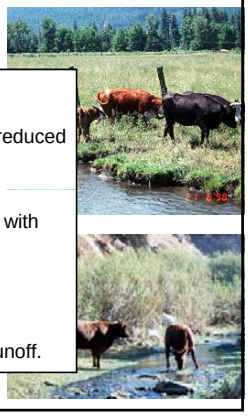


Microbial Water Quality & CA Range Watersheds
The Big Picture



Some Risk Factors

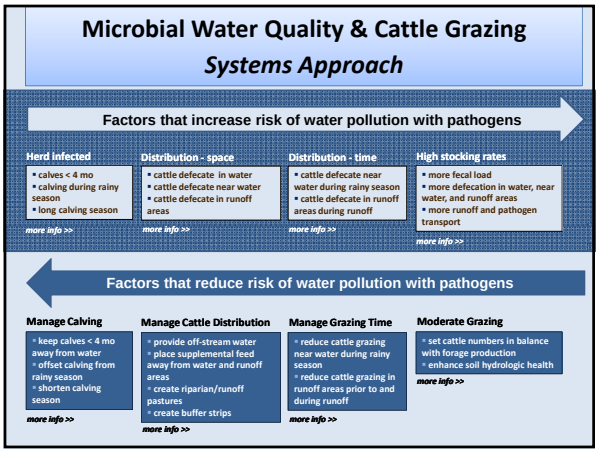
- Heavy grazing - excessive soil compaction, riparian degradation, reduced filtration, heavy fecal loading.
- Livestock allowed frequent contact with surface water.
- Grazing during periods of runoff.
- Fecal deposition in areas of high runoff.



Some Opportunities

- Pathogen prevalence low in beef cattle, confined to certain classes.
- Rangelands have great capacity to filter pollutants in runoff.
- Pathogens can die quickly in fecal pats during spring-fall.
- Think tool box – not silver bullet.

Microbial Water Quality & Cattle Grazing
Systems Approach



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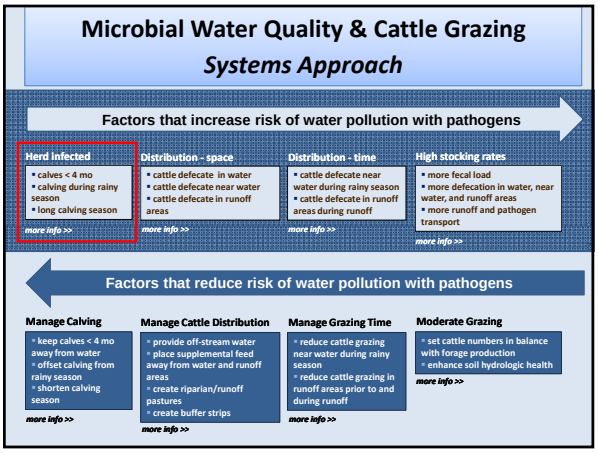
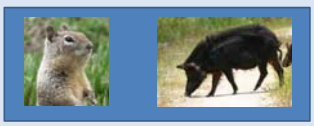
Systems Approach

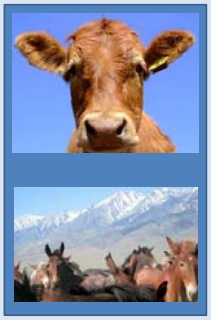


Cryptosporidium dynamics in wildlife and livestock

Animal	% infected
range beef cow	6-8*
range beef calve < 4 mo	10-20*
back country pack stock	0
feral pig	4-13*
ground squirrel	7-15*

**C. parvum* is rare





Microbial Water Quality & Cattle Grazing
Systems Approach

Factors that increase risk of water pollution with pathogens

Herd infected	Distribution - space	Distribution - time	High stocking rates
▪ calves < 4 mo ▪ calving during rainy season ▪ long calving season	▪ cattle defecate in water ▪ cattle defecate near water ▪ cattle defecate in runoff areas	▪ cattle defecate near water during rainy season ▪ cattle defecate in runoff areas during runoff	▪ more fecal load ▪ more defecation in water, near water, and runoff areas ▪ more runoff and pathogen transport

more info >>

Factors that reduce risk of water pollution with pathogens

Manage Calving	Manage Cattle Distribution	Manage Grazing Time	Moderate Grazing
▪ keep calves < 4 mo away from water ▪ offset calving from rainy season ▪ shorten calving season	▪ provide off-stream water ▪ place supplemental feed away from water and runoff areas ▪ create riparian/runoff pastures ▪ create buffer strips	▪ reduce cattle grazing near water during rainy season ▪ reduce cattle grazing in runoff areas prior to and during runoff	▪ set cattle numbers in balance with forage production ▪ enhance soil hydrologic health

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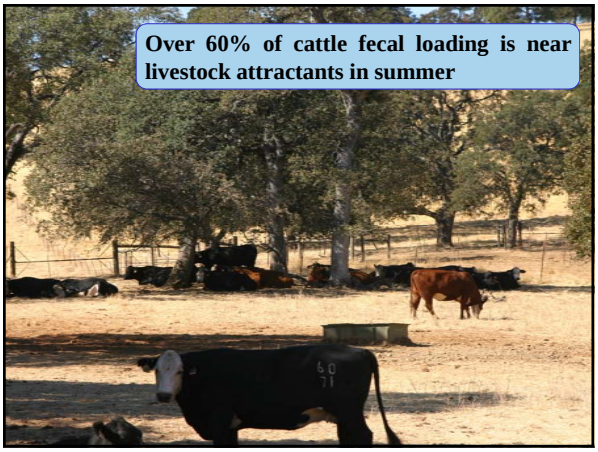

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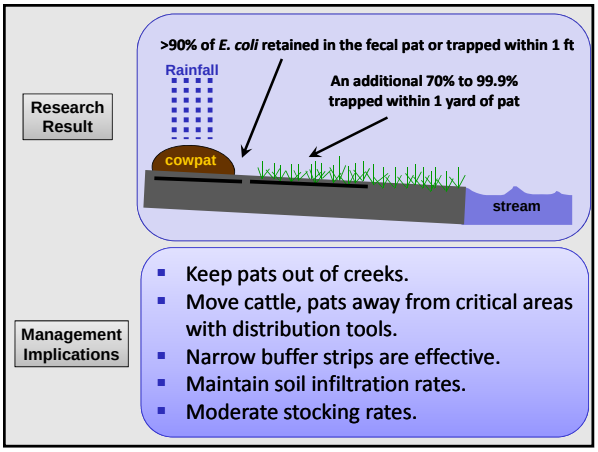
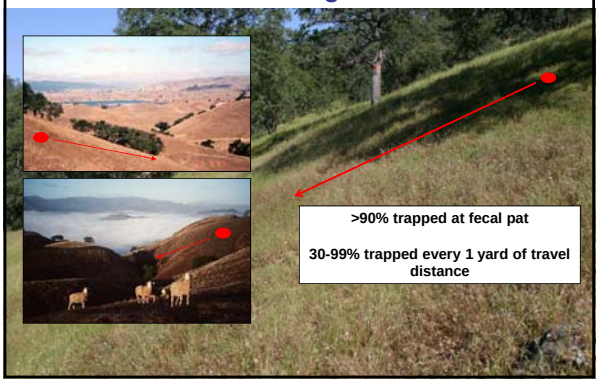
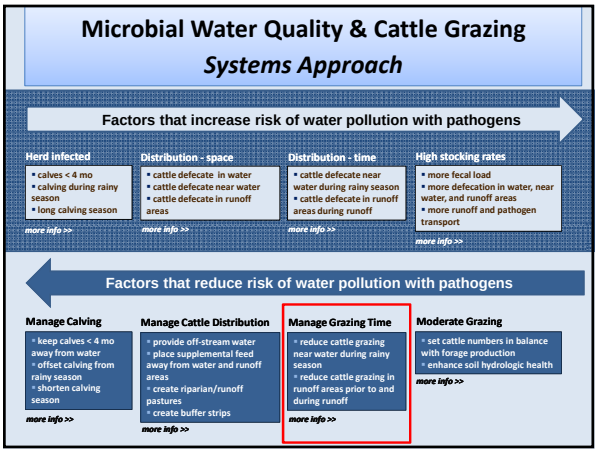
Do you know where your supplement is?

- Move existing supplement and water sites away from streams.
- Evaluate trails leading to and from existing and proposed sites – do they link site to stream during storms?



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



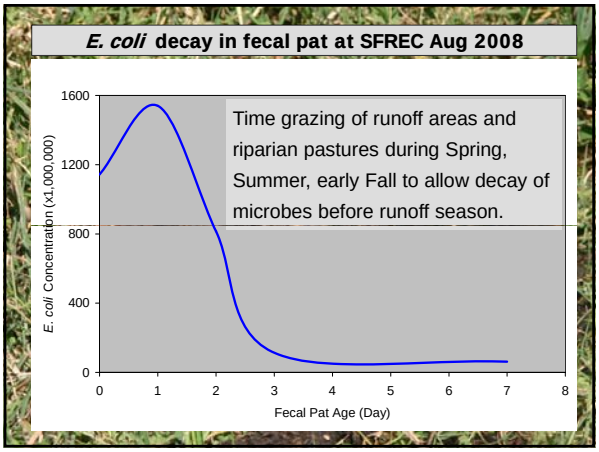


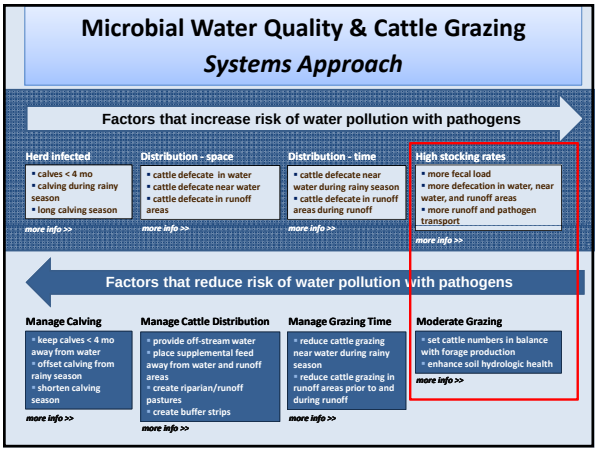
C. parvum survival in cow pats on range

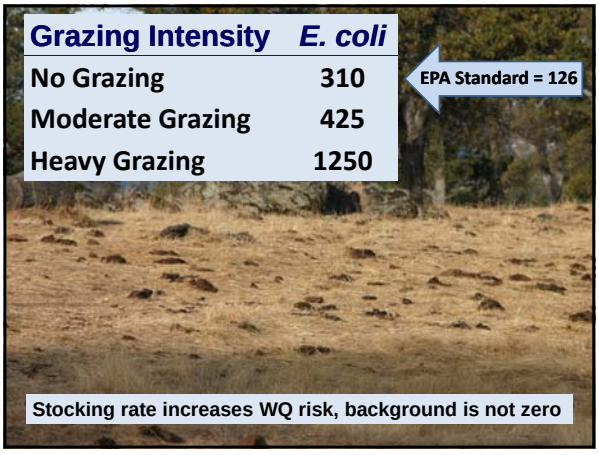
	Days until >90% dead	Fecal Pat Temperature (F)
Research Result	72	50
	29	68
	5	86
	<1	104

Translation: 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.

Management Implication: We can use this fact to time grazing in critical runoff areas so that there are enough days above 78 °F to neutralize any *C. parvum* in cattle fecal pats prior to rainfall and runoff.







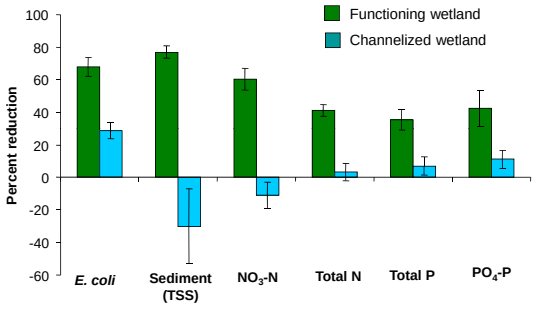
Functioning riparian areas filter pollutants from runoff

We examined filtration of pollutants in pasture runoff by two wetlands

Functioning Wetland

Channelized Wetland

Reduction of Pollutants due to Wetland



Fencing to manage grazing along streams.

- **Exclusionary buffers,** vegetation management for weeds, fuels, N uptake, etc.
- **Riparian pastures,** integrate into rotational grazing program based on timing, intensity, frequency of use.

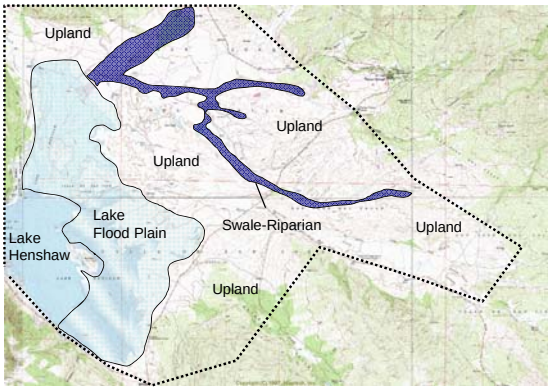
Fencing to manage grazing along streams.

- Reduce time spent in and near water - difficult during dry season without fencing.
- Control time of use near stream.
- Control intensity of use near stream.
- May not be needed.

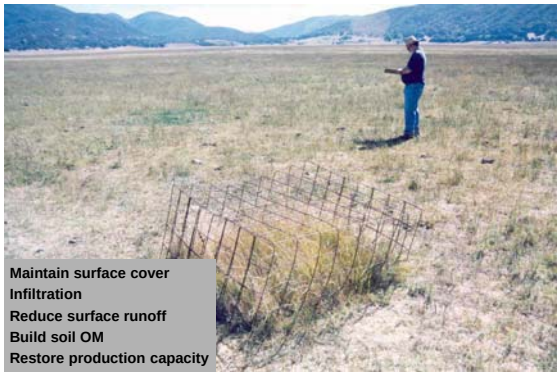
Example – putting the pieces together

- **Warner Ranch**
- **Drinking water for Vista, CA**
- **Owned by Vista Irrigation District**
- **Evaluated grazing plan – leased for dairy replacement heifers.**

Warner Ranch – Lower Lake Henshaw Watershed

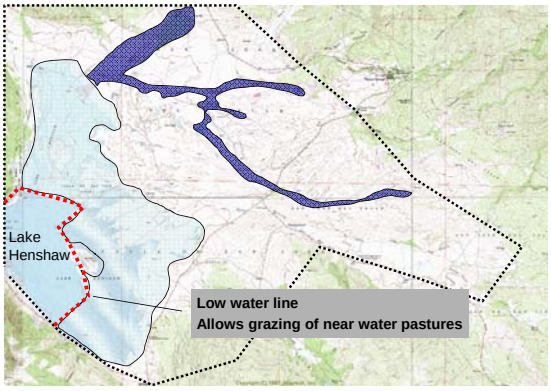


First Step – establish and achieve RDM standards

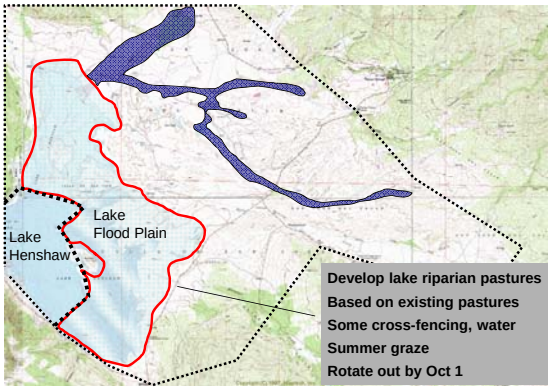


Maintain surface cover
Infiltration
Reduce surface runoff
Build soil OM
Restore production capacity

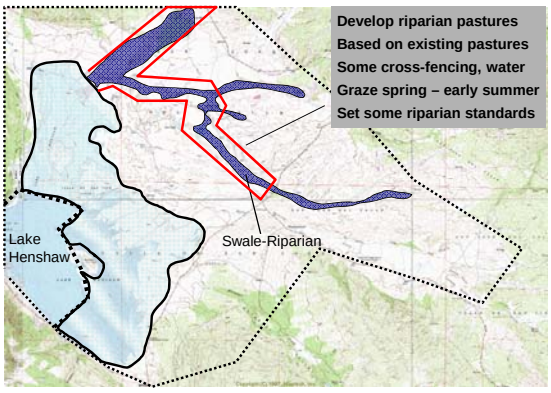
Second Step – Control access to Lake Henshaw



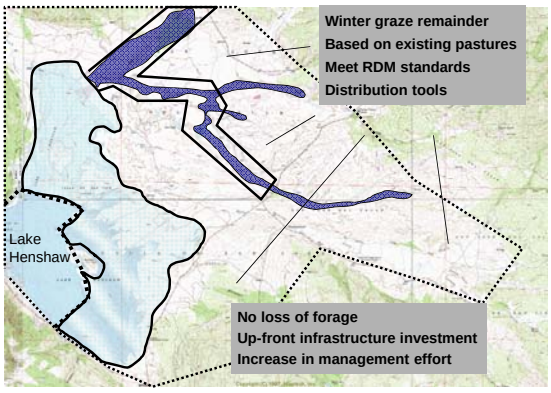
Second Step – Lake riparian pastures



Third Step – swale riparian pastures



Fourth Step – Winter graze uplands




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