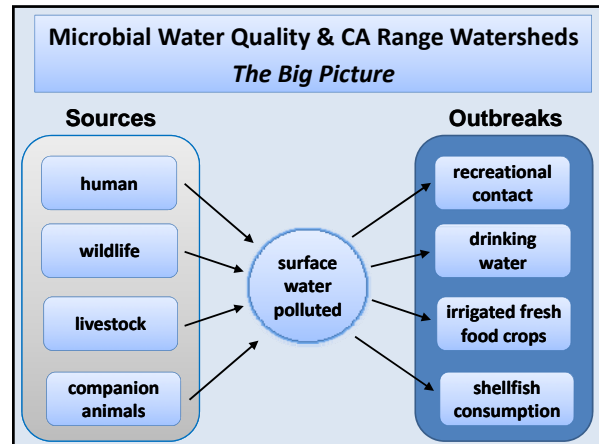


### E. coli as a Water Quality Indicator

Ken Tate, UC Davis

Presented McArthur, CA  
March 17, 2011



### 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.

**Pathogens** are microbes which can create disease/outbreaks and thus pose a real threat to human health.

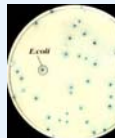
### Indicator bacteria v. pathogens






total coliforms

fecal coliforms

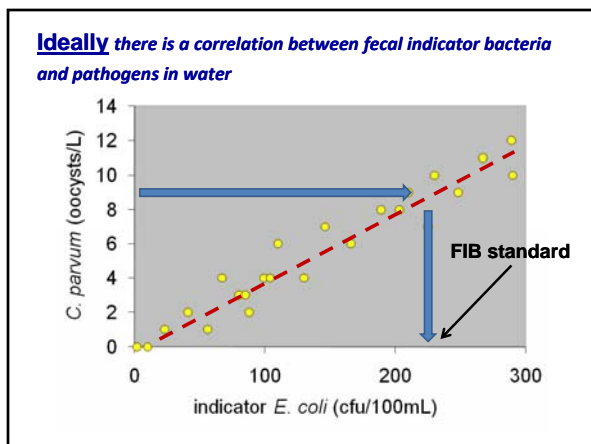
indicator *E. coli*




**Bacteria** that when present in water **indicate** the presence of fecal material and pathogens.

*C. parvum*
*E. Coli* O157:H7
*Salmonella*



### Beef cattle - indicator bacteria



**Fecal coliforms:**

10,000,000+ per gm feces

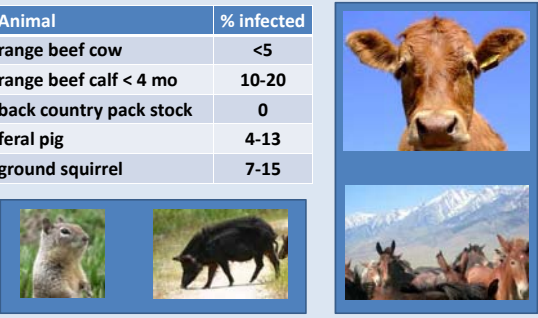
**Indicator *E. coli*:**

1,000,000+ per gm feces

humans, wildlife, cats, dogs as well...

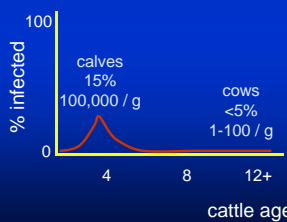
### Cryptosporidium dynamics in wildlife and livestock

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

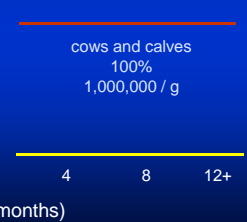


### Pathogens and indicators in range/pasture cattle feces: not correlated at the "end" of the cow.

**C. parvum in CA range cattle**

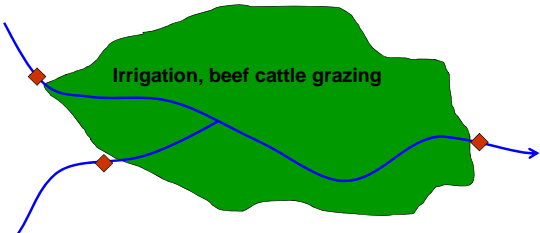


**Indicator E. coli in CA range cattle**



### Irrigated Mountain Meadows

Sampled 16 sites above and below 4 irrigated, intensively grazed meadows. Sampled monthly for indicator *E. coli* and FC, *C. parvum*, *Salmonella*, *E. Coli* O157:H7, *Campylobacter*.



Irrigation, beef cattle grazing

1,000 to 20,000 AU      1,500 to 32,000 ac irrigated

### Above v. Below EPA Guideline

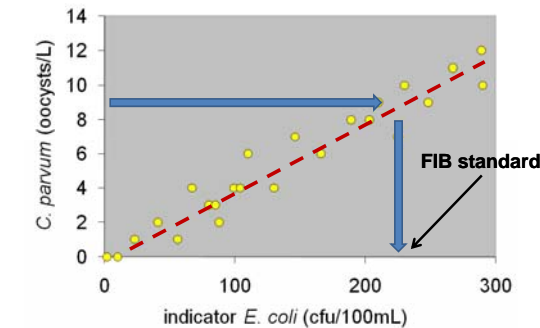
Indicator *E. coli* → <235 cfu/100ml VS. >235 cfu/100ml

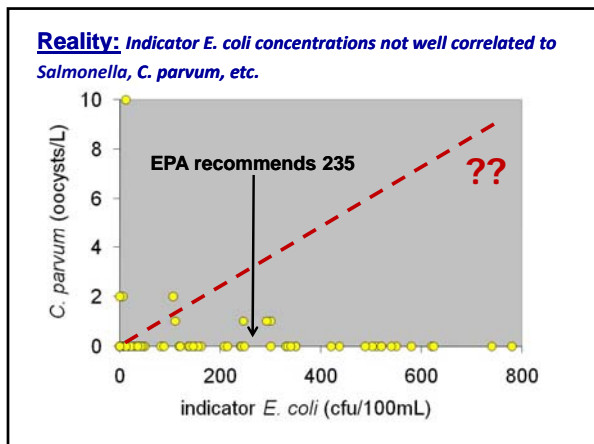
<i>C. parvum</i> 8 positives	5/75	3/27
<i>Salmonella</i> 12 positives	9/75	3/27
<i>Campy</i> 0 positives	0/75	0/27
<i>E. coli</i> O157:H7 6 positives	4/95	2/21

### Above v. Below Meadows

Location	Above	vs.	Below
<i>C. parvum</i> 8 positives	5		3
<i>Salmonella</i> 12 positives	10		2
<i>Campy</i> 0 positives	0		0
<i>E. coli</i> O157:H7 6 positives	0		6

**Ideally** there is a correlation between fecal indicator bacteria and pathogens in water





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Review

**Fecal source tracking, the indicator paradigm, and managing water quality**

Katharine G. Field<sup>a,\*</sup>, Mansour Samadpour<sup>b</sup>

*“E. coli is not well correlated with pathogenic Salmonella spp. (Lemarchand and Lebaron, 2003), Campylobacter spp. (Bonadonna et al., 2002; Horman et al., 2004; Lemarchand and Lebaron, 2003; Lund, 1996), Cryptosporidium and Giardia spp. (Bonadonna et al., 2002; Harwood et al., 2005; Horman et al., 2004; Lemarchand and Lebaron, 2003; Lund, 1996), ...”*

- ### Summary
- We consistently find very low levels of pathogens in these waters,
  - Essentially non-existent correlations between pathogens and indicator bacteria in these waters,
  - FIB (*E. coli*) generally can signal fecal connection to the stream, but not a good indicator of human health risk.

### Grazing for Many Goals at Once

- Forage and Livestock Production
- Weed Control – Diversity
- Wildlife and their Habitat
- Productive and Healthy Soils
- Water Quantity and Quality

**Mail survey to 2000 CA and WY ranchers**

Capture manager knowledge about grazing to achieve both agricultural and ecological goals

Information managers need to manage for goals

Best way to provide information to managers

Mailed from CCA

Confidential

Mar 2011

Please participate

**Rangeland Decision-Making Survey**

Participating in a survey to...  
 • Assess current rangeland conditions and trends  
 • Identify management issues and opportunities  
 • Provide information to help improve rangeland health and productivity  
 • Help inform policy and management decisions

Website: <http://www.cca.com/rangelandquality/index.cfm/projects>

Please respond – fill out and return survey

