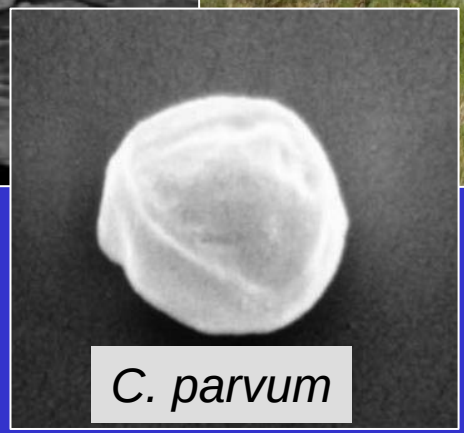
Indicator Bacteria:

Sentinels of Safe Water? or Agents of Angst?

SWRCB-Prop 50 ILRP

E. coli

C. hild



C. parvum

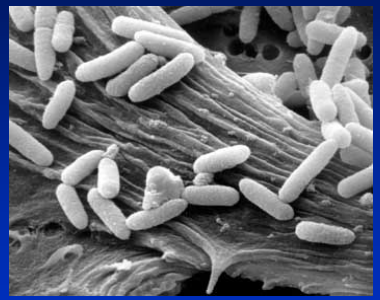
Salmonella

Holly George, K.W. Tate, D.F. Lile, E.R. Atwill, B. Hoar Plus

Many Great Cooperating Ranchers & Support Staff…C.D. Childers

UNIVERSITY of CALIFORNIA
Agriculture & Natural Resources

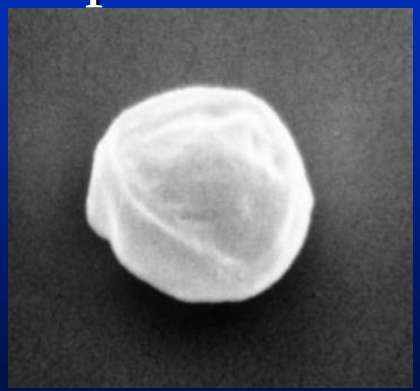
What are indicator bacteria?



total coliforms,
fecal coliforms, *E. coli*

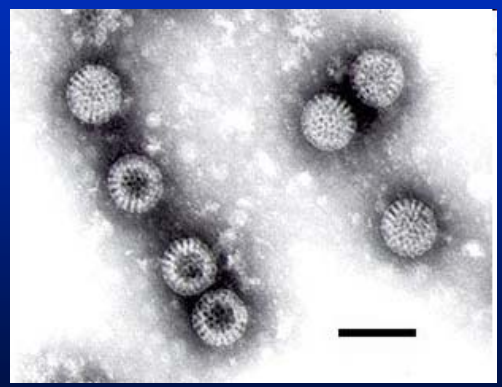
<u>Bacteria</u> that when present in water <u>indicate</u> the presence of fecal material and pathogens.

protozoa



C. parvum

viruses



Rotavirus

bacteria

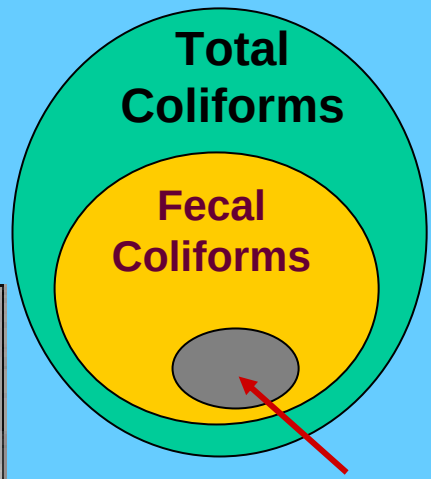
Salmonella

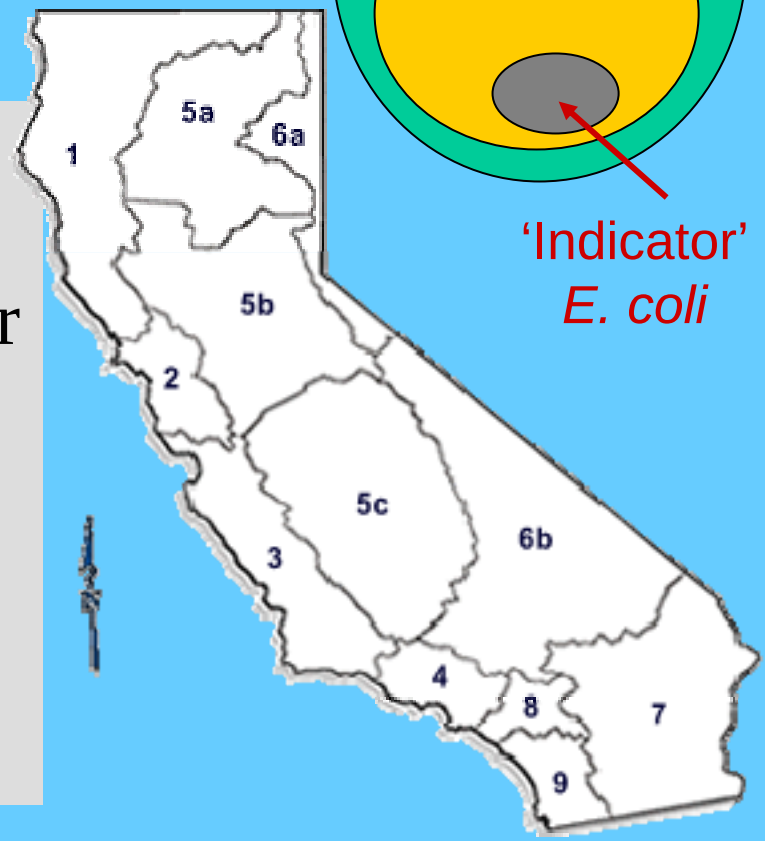
‘Indicator’ Bacteria Standards: Surface Waters

Standards exist for both “indicator”

***E. coli* & fecal coliforms across CA:**

varies by water board



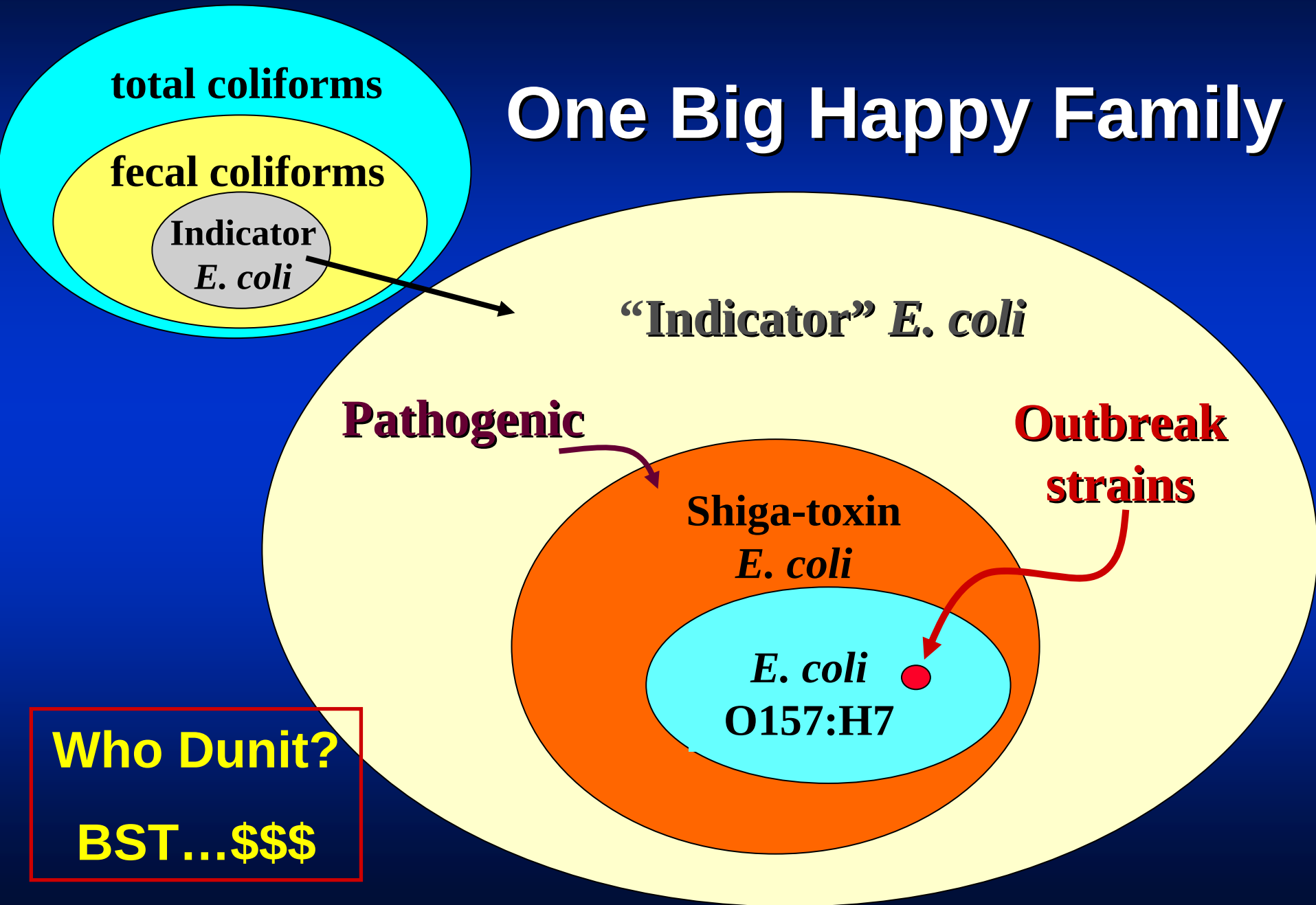


USEPA Recommends *E. coli*

1. geometric mean <126 bacteria per 100 ml from 5+ samples in 30 days

2. single grab samples should not exceed 235 bacteria per 100 ml

‘Indicator’ Bacteria:



Livestock Pathogens of Concern:

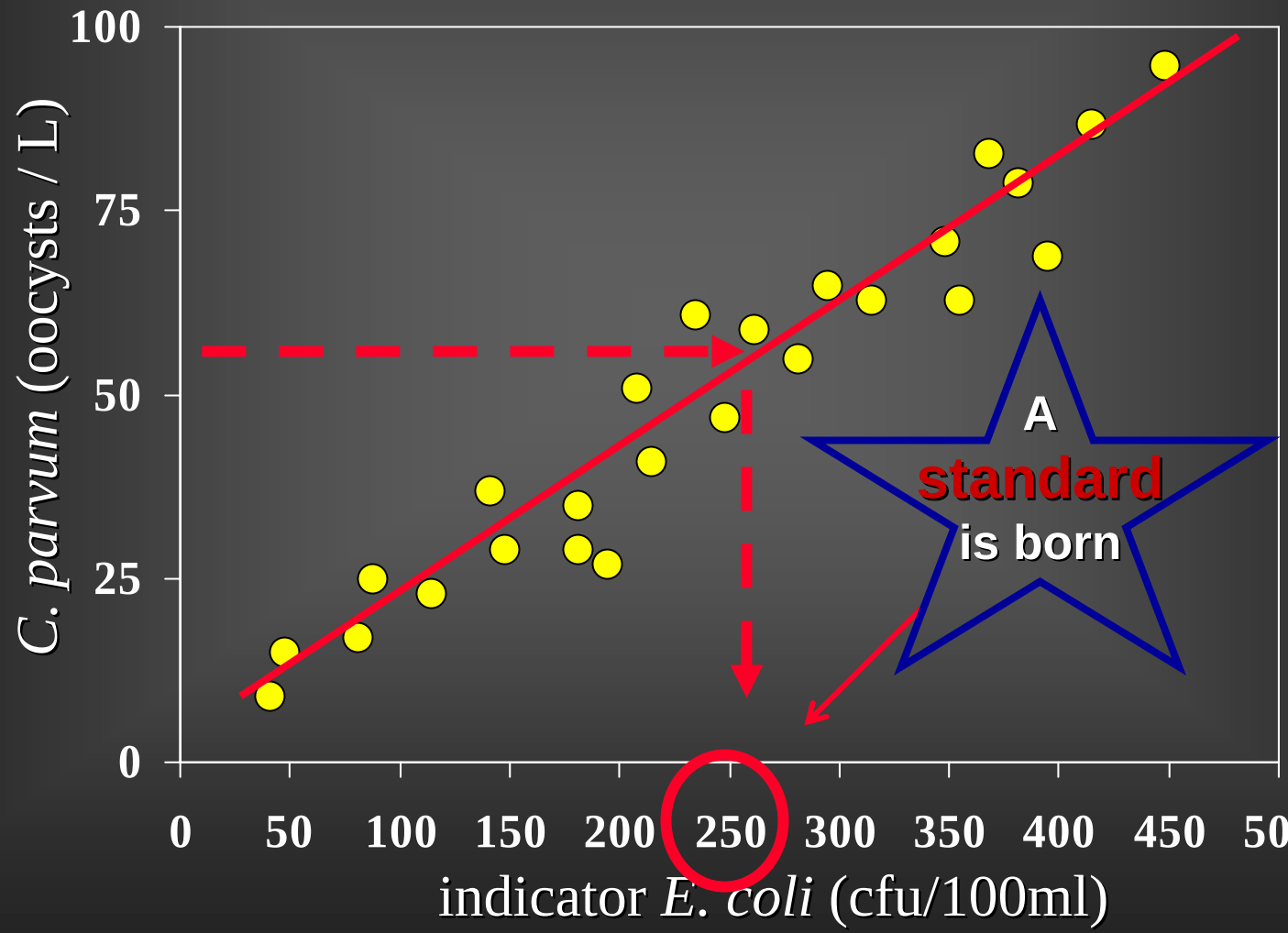
Protozoa: hard to eliminate during water treatment

- *Cryptosporidium parvum*
- *Giardia duodenalis*

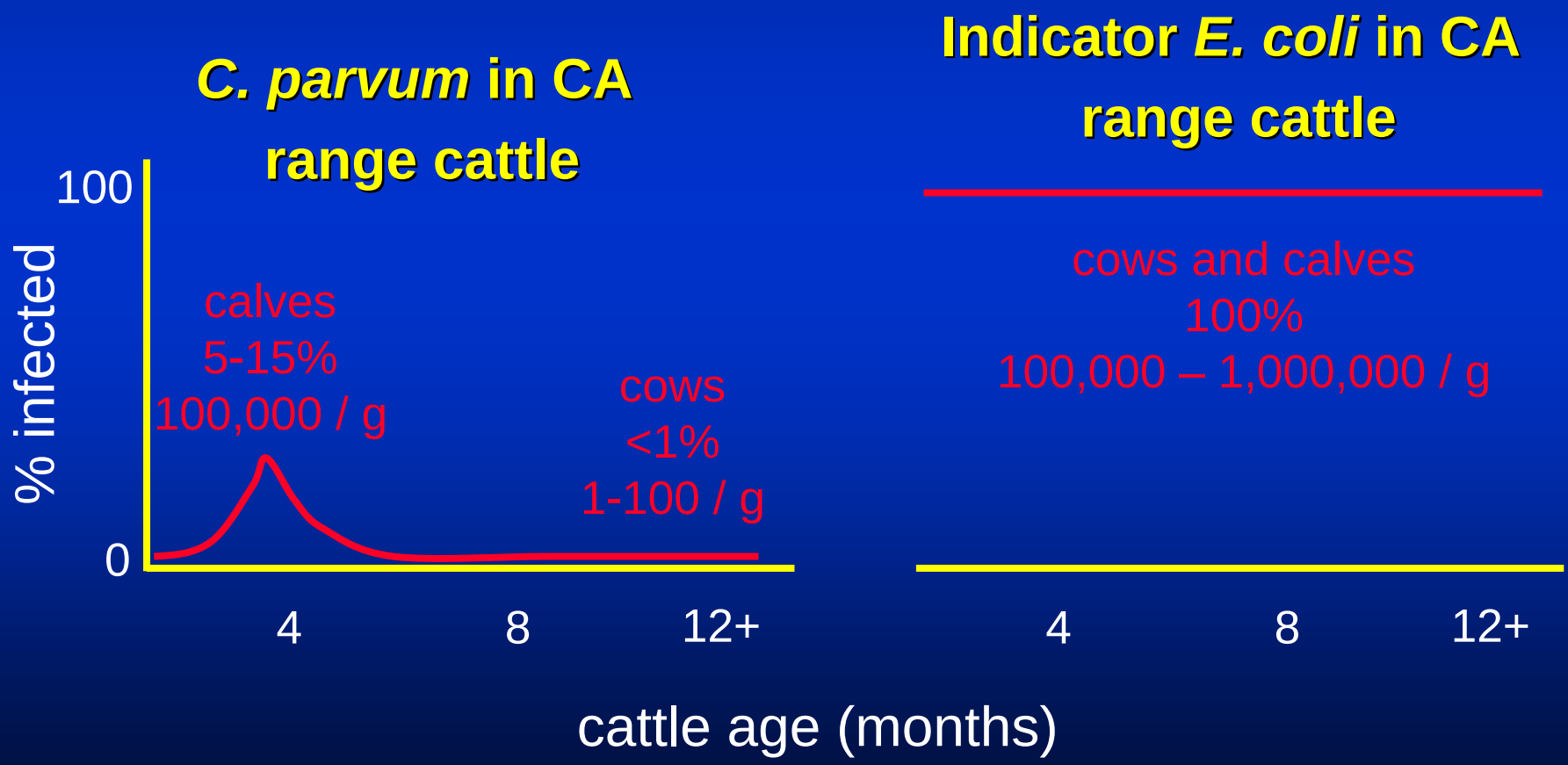
Bacteria: easier to eliminate during water treatment

- *Pathogenic E. coli (Stx 1&2, O157:H7, etc.)*
- *Salmonella*
- *Campylobacter*

IDEAL WORLD: good correlation between indicator bacteria and bovine pathogens in water



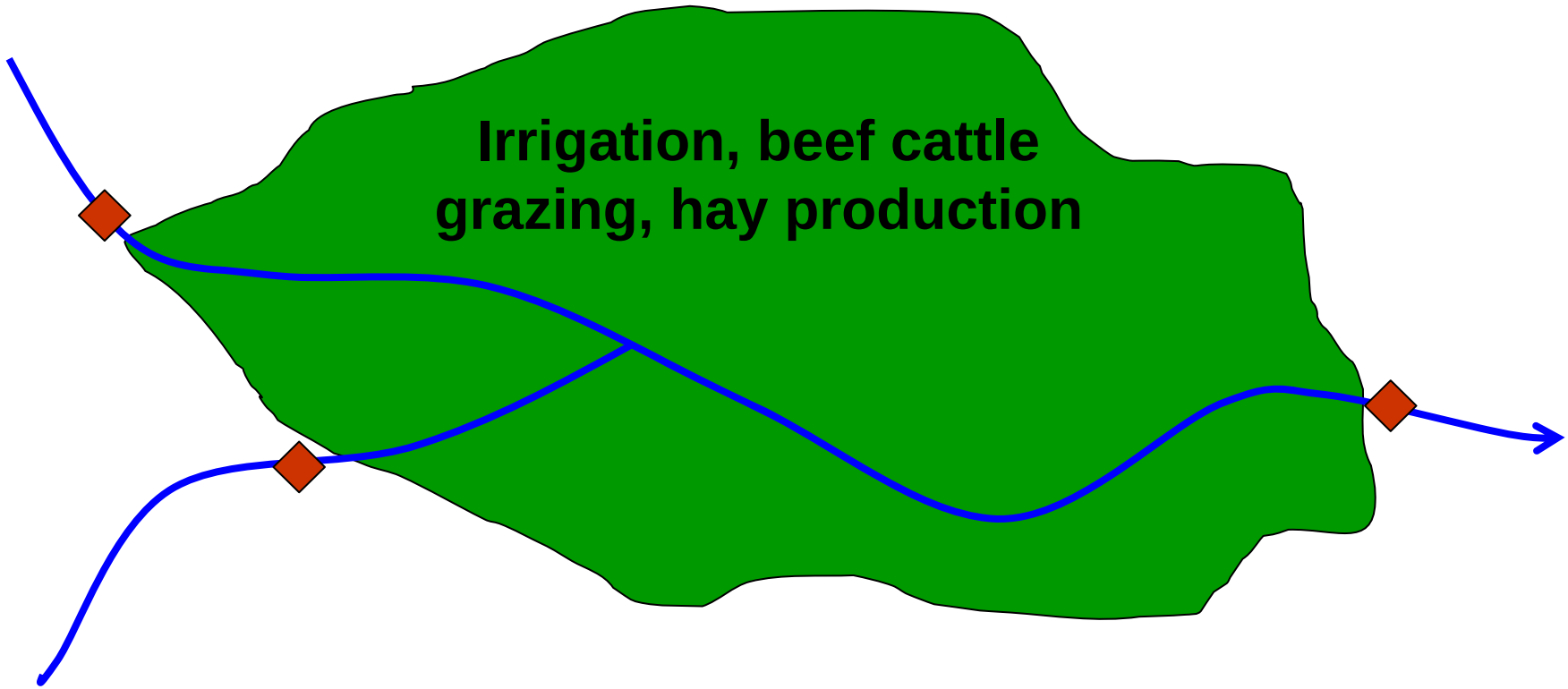
Correlations of indicators with animal-to-human and animal-to-animal pathogens mostly unknown on agricultural watersheds



2007 Grazing Season (May – Oct): Sierra, Goodrich, Bridgeport Valleys

Sample monthly: indicator *E. coli* and FC, *C. parvum*, *Salmonella*, shiga-toxin *E. coli*, *Campylobacter*

Sample a total 16 sites: entering and exiting irrigated agriculture areas



1,000 to 20,000 AU

1,500 to 32,000 ac irrigated

2007 Pathogen monitoring

UFRW and Bridgeport Valley

102 water samples taken, May-Oct 2007

	Indicator *E. coli*	
	≤ 235 cfu/100 ml	> 235 cfu/100 ml
	"SAFE"	"RISK"
Crypto 8=Yes	5 of 75 (6%)	3 of 27 (11%)
Salmonella 12=Yes	9 of 75 (12%)	3 of 27 (11%)
Campy 0=Yes	0 of 75 (0%)	0 of 27 (0%)

Four Irrigated Valleys in Eastern Sierra Nevada

Sampled 18 sites monthly:

Entering & Exiting Irrigated Agricultural Areas

Laboratory Analyses: 116 samples

Commensal *E. coli* and Fecal Coliform

Presence *E. coli* O157:H7 (Yes/No)

	Indicator *E. coli*	
	< 235 cfu/100 ml	> 235 cfu/100 ml
O157:H7	"SAFE"	"RISK"
6=Yes	4 of 95 samples (4%)	2 of 21 samples (9%)

2008 Grazing Season (May – Oct)

PATHOGEN MONITORING

UFRW and Bridgeport Valley

102 water samples taken, 2007

116 water samples taken, 2008

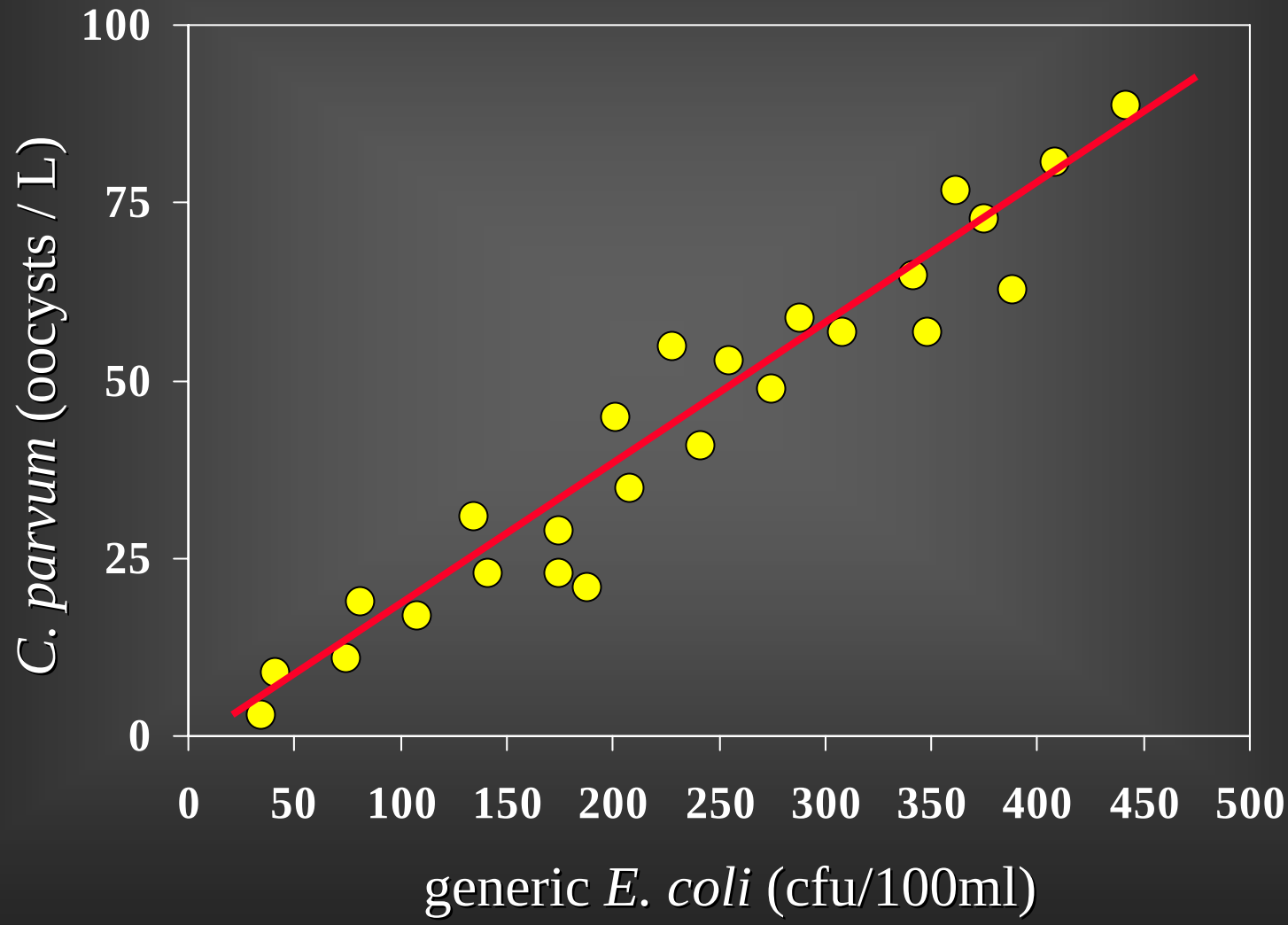
	2007	2008
Stx *E. coli* 3=Yes	<3%	---
E. coli O157:H7 6=Yes	---	5%

UFRW/Bridgeport Valley 2007-08 Pathogen Monitoring

Above and Below Irrigated Agriculture

	Above	Below
Crypto 8=Yes	5	3
Salmonella 12=Yes	10	2
Campy 0=Yes	0	0
O157:H7 6=Yes	0	6

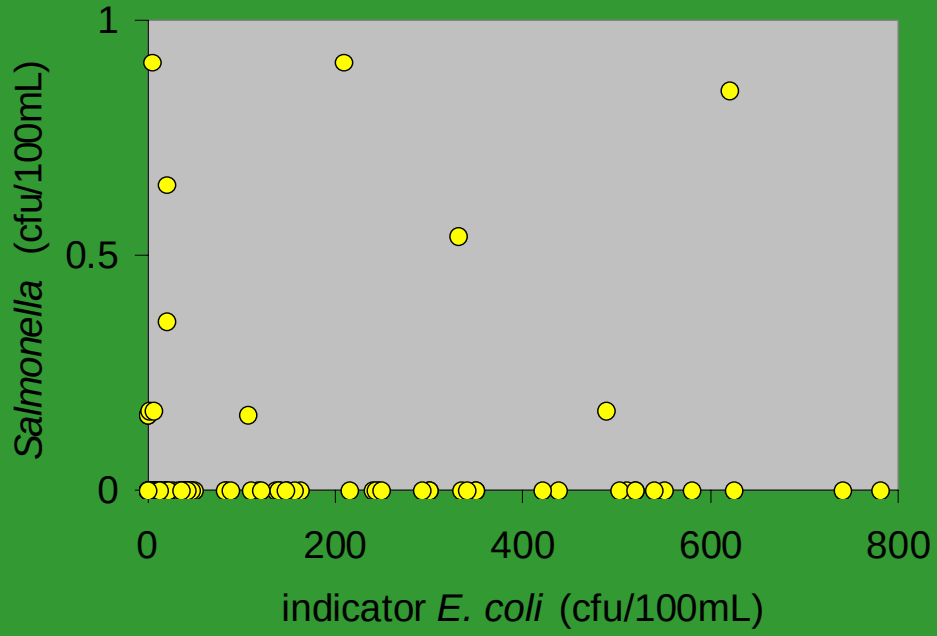
IDEAL WORLD: good correlation between indicator bacteria and bovine pathogens in water

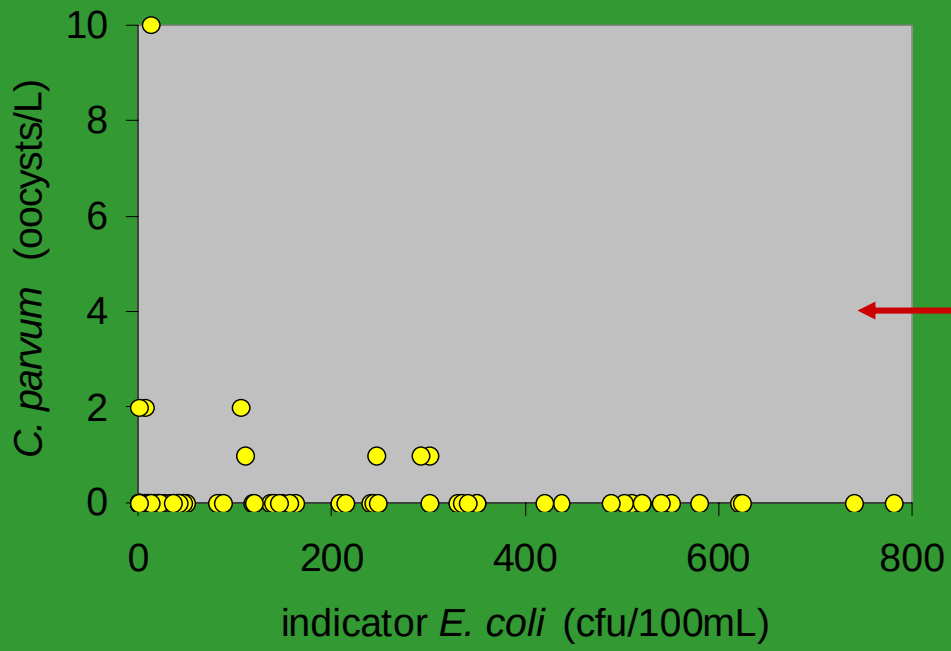


Not so Ideal World:

"Indicator" *E. coli* concentrations

NOT well correlated to *Salmonella*

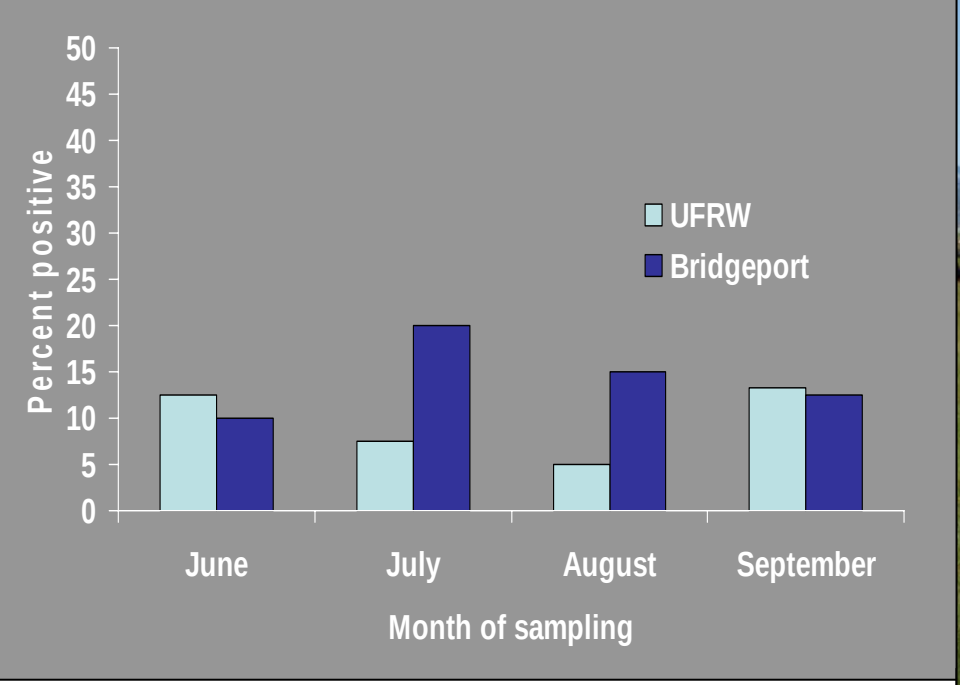


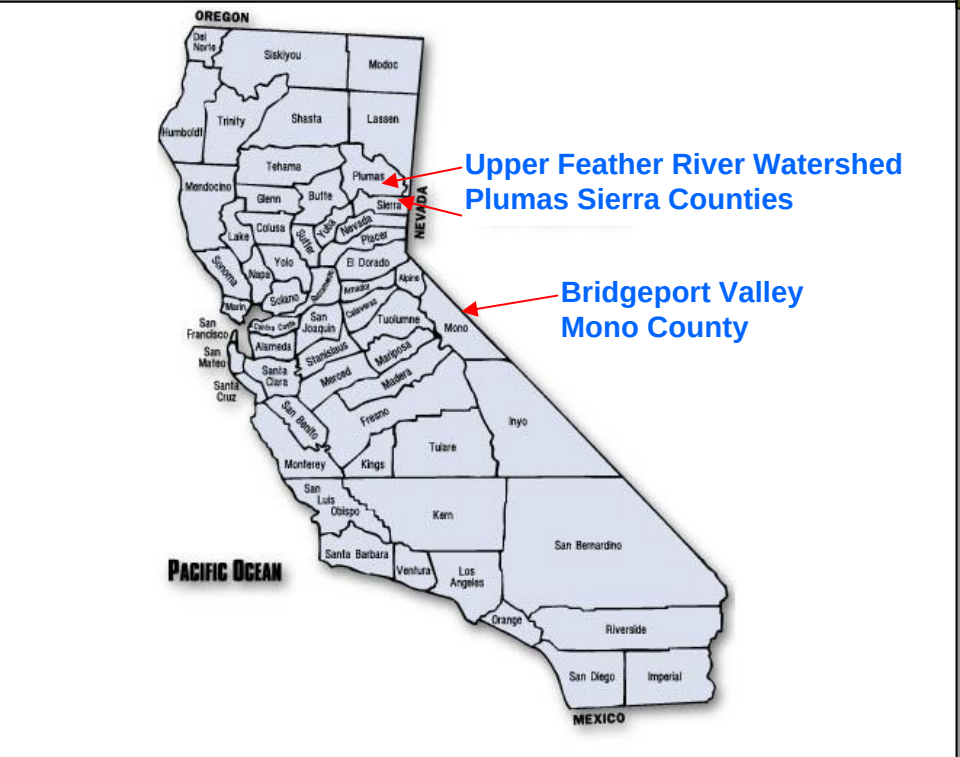


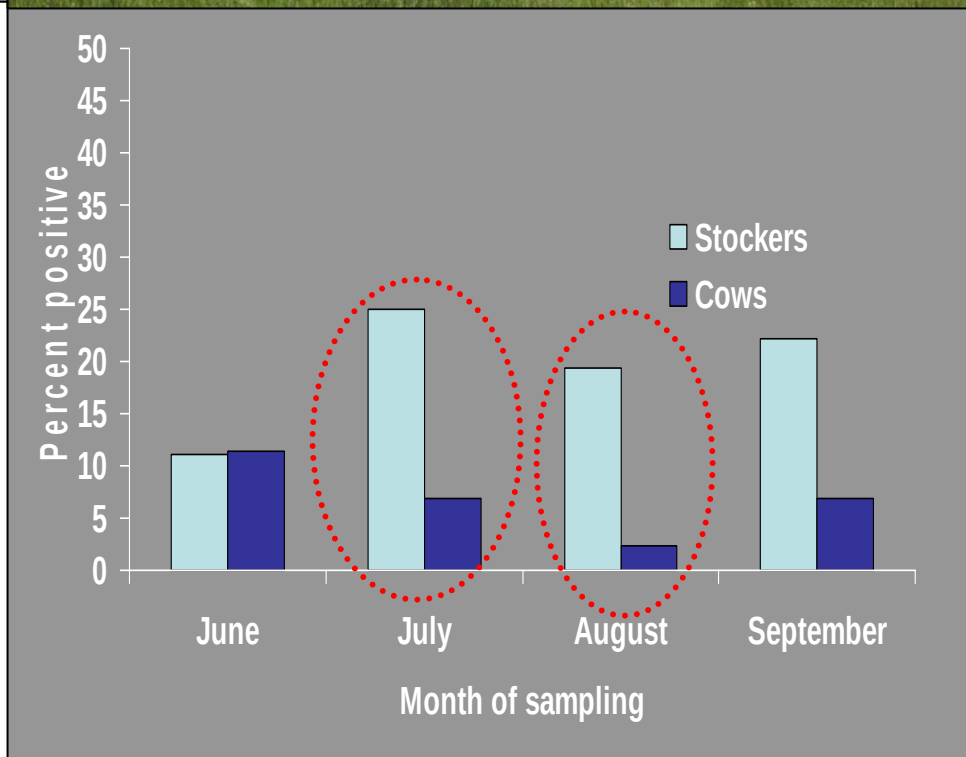
NOT well correlated to *C. parvum*

- **UFRW – 2 cow/calf herds, 2 stocker**
  - 10 fecals per sample, 10 samples per group
- **Bridgeport Valley – 3 cow/calf, 2 stocker**
  - 5 fecals per sample, 8 samples per group
- **Fecal samples collected once/mo for 4 mo**

2008 *E. coli* O157:H7 monitoring UFRW and Bridgeport Valley


Percent positive
50
45
40
35
30
25
20
15
10
5
0
UFRW
Bridgeport
June
July
August
September
Month of sampling


OREGON
NEVADA
MEXICO
PACIFIC OCEAN
Upper Feather River Watershed
Plumas Sierra Counties
Bridgeport Valley
Mono County


Percent positive
50
45
40
35
30
25
20
15
10
5
0
Stockers
Cows
June
July
August
September
Month of sampling

Summary of fecal results

- Positive samples collected every month
- Higher proportion positive in stockers than cows in two of four months
- No significant difference between locations

Overall Summary

- In these watersheds, indicator bacteria DO NOT appear to be a reliable indicator of either safety or risk.
- Need to evaluate the utility of indicator bacteria monitoring and standards.
- In these watersheds, pathogen risk is relatively low – but not zero.
- Risk is in the eye of the beholder….


The End…
Any Questions?