





Managing Livestock to Deliver Safe Water to Society



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University of California-Davis



To all our cooperators from across California

be they ranchers, growers, or regulators,
activists, resource managers, and the public

THANK YOU!

From all of us

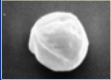


Waterborne zoonotic pathogens of primary concern
North American list

- (1) pathogenic for humans
- (2) shed by an animal
- (3) proven waterborne transmission

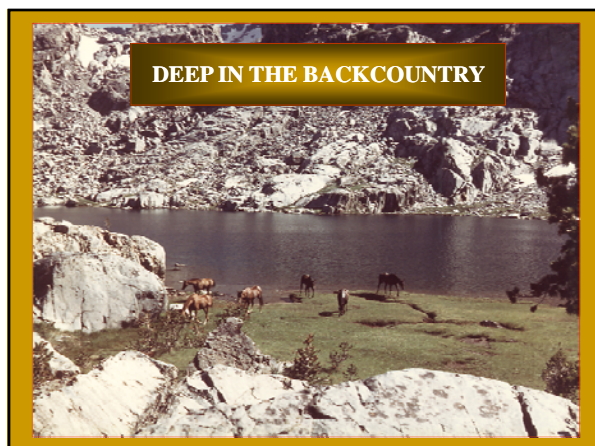

Protozoa:

- ❖ *Cryptosporidium* sp.
- ❖ *Giardia duodenalis*




Bacteria:


- ❖ Enterohemorrhagic *E. coli* (e.g., O157:H7)
- ❖ *Salmonella enterica*
- ❖ *Campylobacter jejuni*



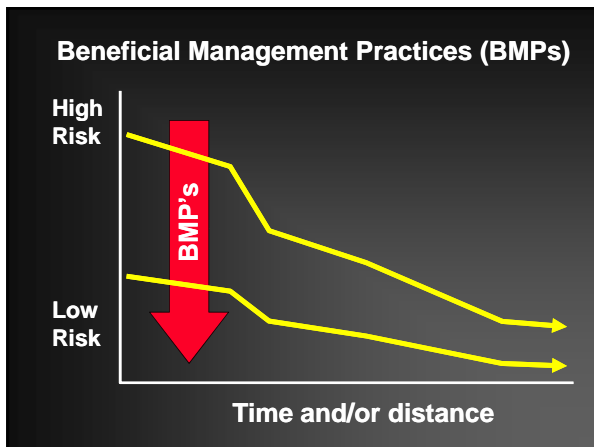
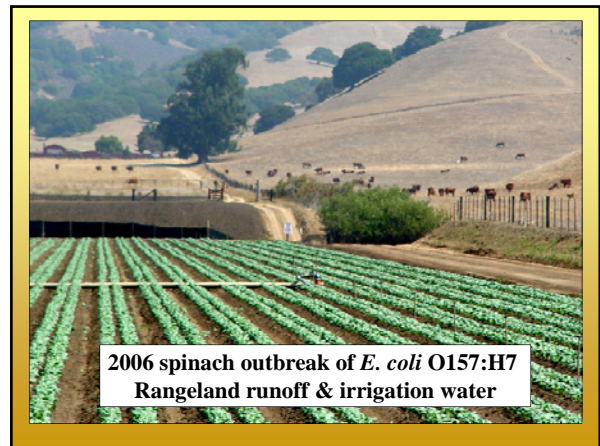
Cow-calf production



Mountain meadows



Foothills



Developing BMPs

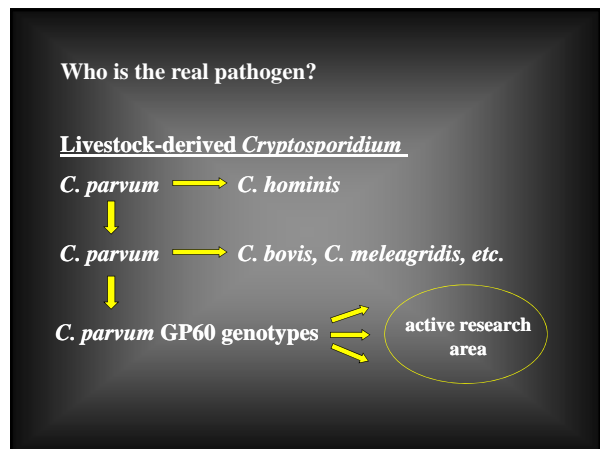
Key processes driving waterborne contamination

1. animal loading (who done it)
2. microbial transport (how did it get there)
3. microbial inactivation (is it still alive)

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Giardia duodenalis

Assemblage A: **humans**, primates, **livestock**, companion animals, rodents and other mammals

Assemblage B: **humans**, primates, dogs, **horses**, **cattle**

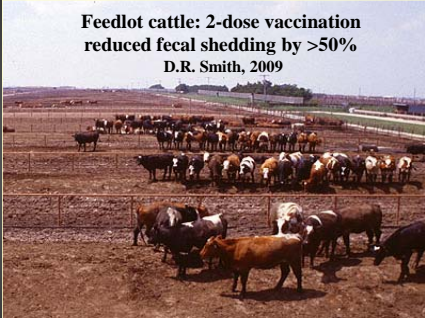
Assemblage C&D: dogs

Assemblage E: **cattle** and some other **livestock**

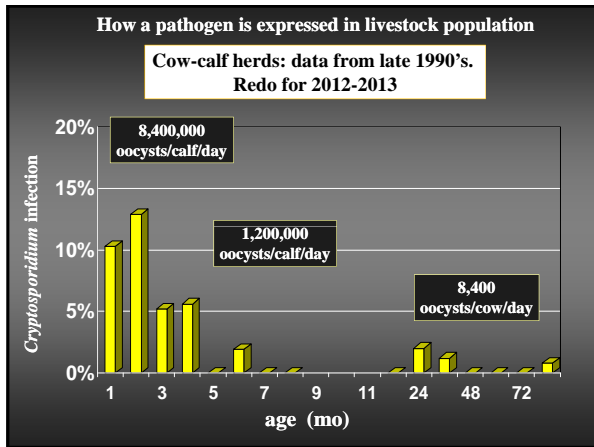
Etc.

Is there a magic bullet that eliminates animal infection?

Feedlot cattle: 2-dose vaccination reduced fecal shedding by >50%
D.R. Smith, 2009



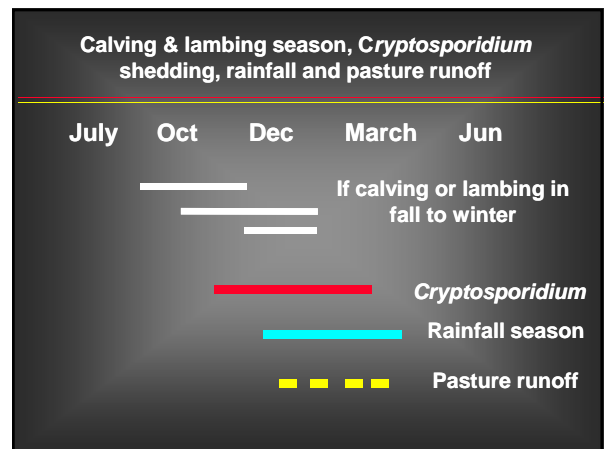
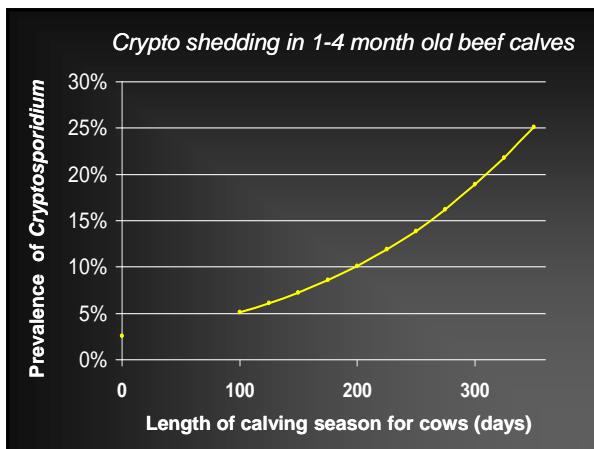
Efficacy of *E. coli* O157:H7 vaccine that targets type III secreted proteins (Bioniche Life Sciences Inc.)



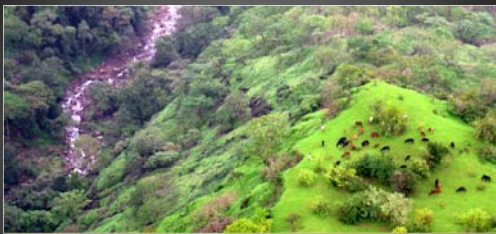
California sheep study, 2009-2010

	<u><i>Cryptosporidium</i></u>	<u><i>Giardia</i></u>
Lamb (n=385)	31%	49%
Yearling (n=41)	12%	39%
Ewe (n=372)	3%	15%

much of the *Giardia* is assemblage E (not infectious for humans)



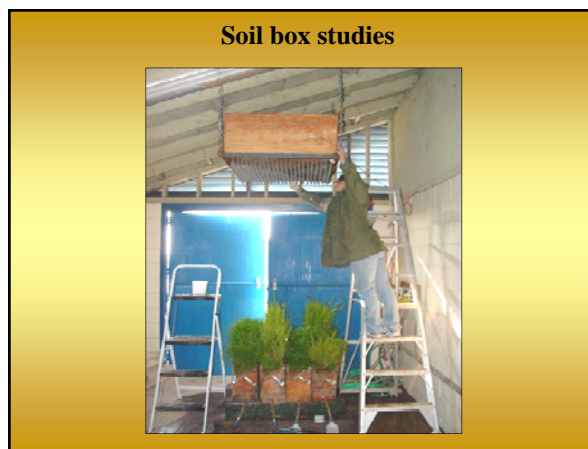
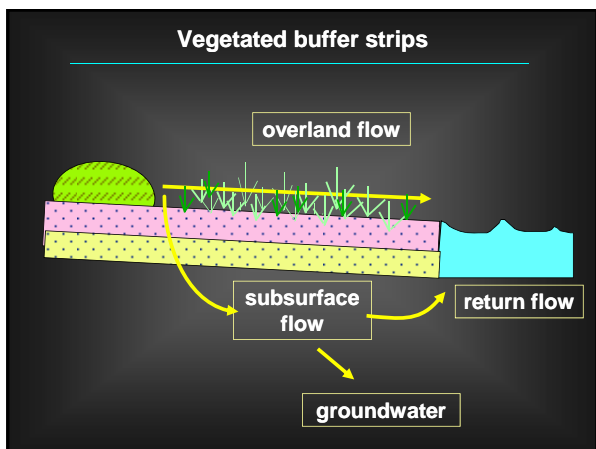
Developing BMPs



Key processes driving waterborne contamination

1. animal loading (who done it)
2. **microbial transport (how did it get there)**
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How do you manipulate cattle distribution so that fecal deposition occurs away from water?





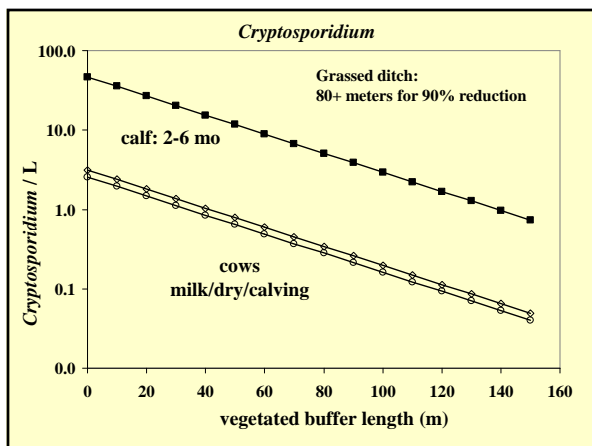
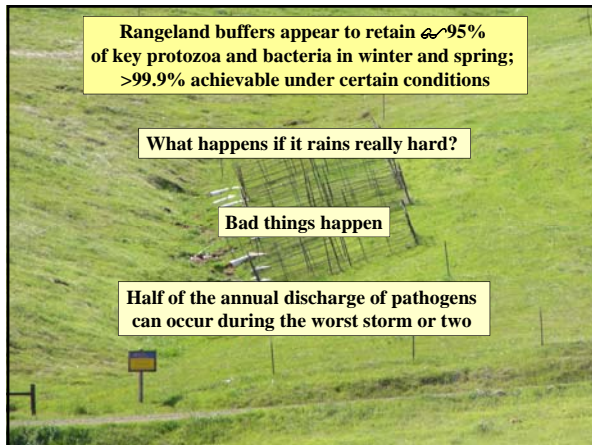
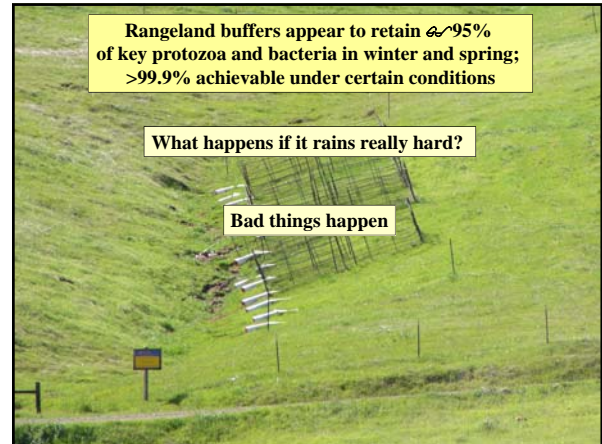
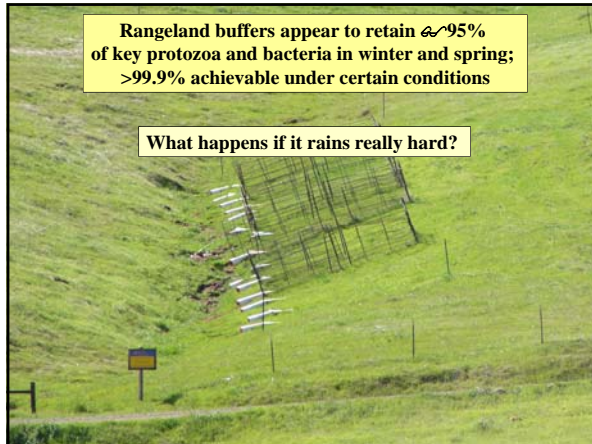
Sierra Foothill
Research &
Extension Center,
University of California

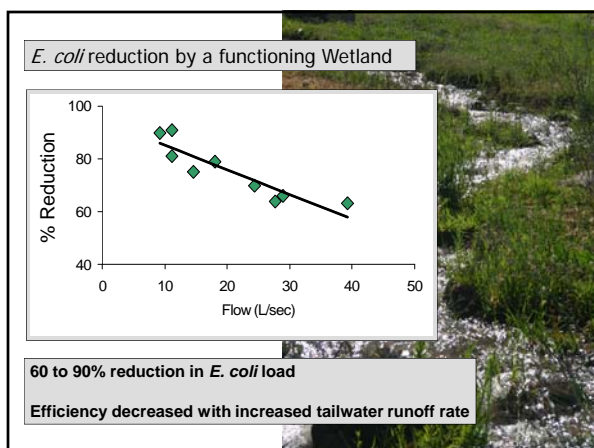
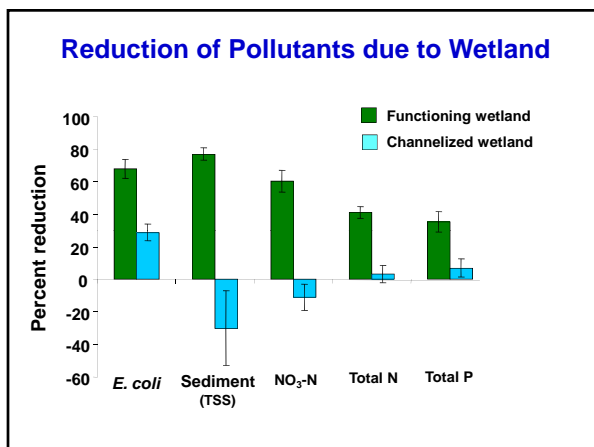
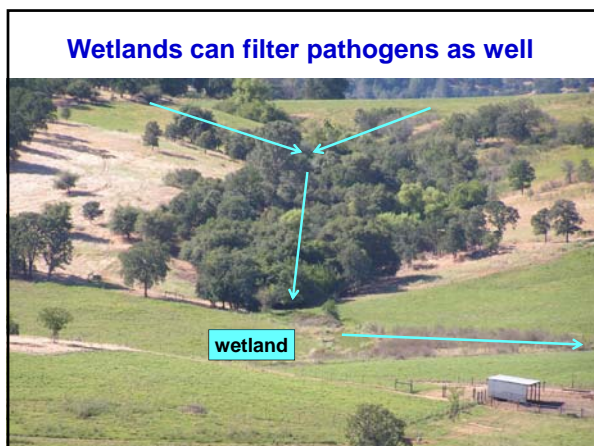
Buffer width (m)
0.1, 1.1, 2.1

Land slope (%)
5, 20, 35

RDM (kg/ha)
225, 560, 900, 4500



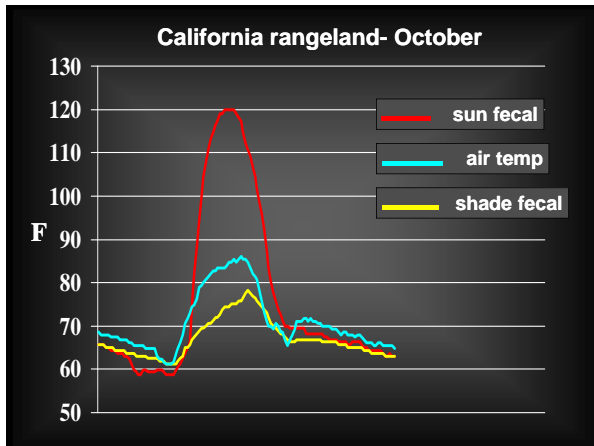





Developing BMPs

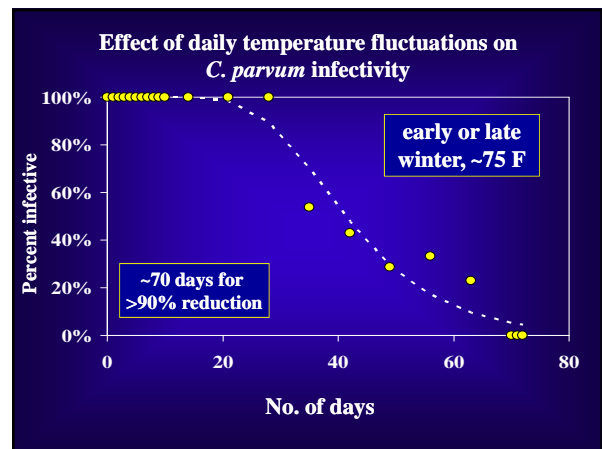
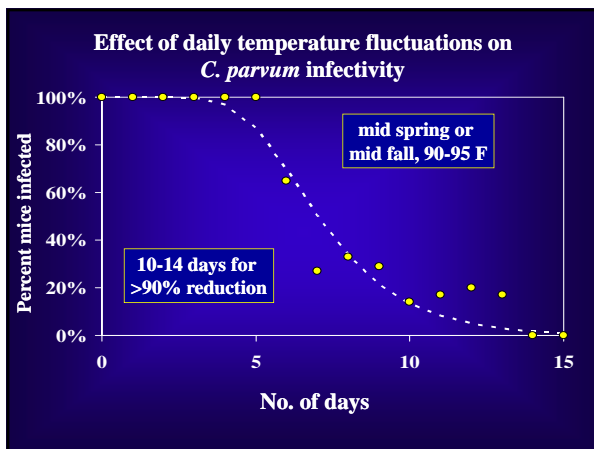
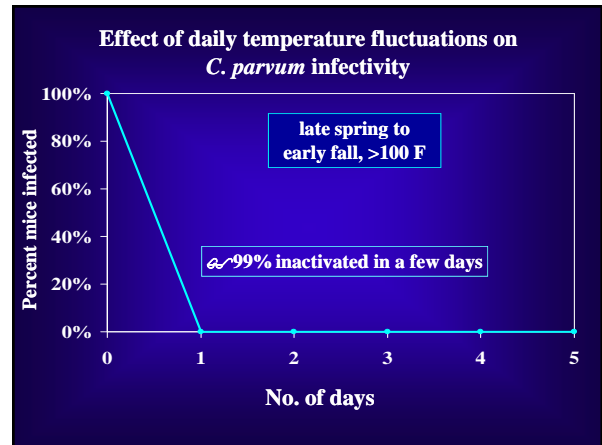
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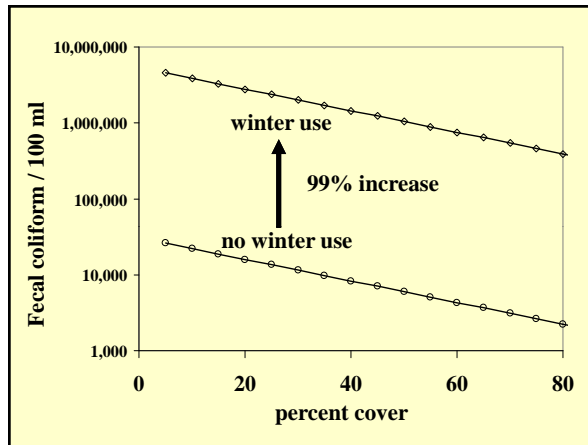
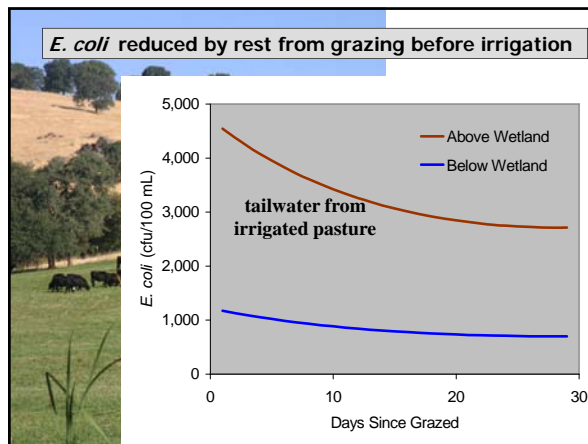
**Spike 5 million oocysts into a fecal pat
Rain 2 hours on fecal pat, 15 mm/hour
Summer in Tulare county, California**

Age of fecal pat (days)	Total oocysts in runoff (T _r)	T _r / 5×10 ⁶ oocysts (%)
0	25,498	0.51
1	334	0.007
2	106	0.002
3	201	0.004
4	631	0.013
8	194	0.004



Rangeland, meadow, irrigated pasture grazing

- Match onset of rainy season to exclusion dates
- Summer riparian grazing
- Rotational grazing timelines

Key to BMP success

Match effectiveness to the pathogen load, fate and transport

“I tried that fix; it don’t work!”

