Cryptosporidium Occurrence Variations and MS Recovery

USEPA LT2 Review Presentation

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November 15, 2012

OVERVIEW

- *Focus... Individual Site Data...and ...Concentration vs Numbers*
- *Methods 1622/23 → Data*
  - *LT2 First Round*
  - *Australian Water Utility Data*
  - *Australian PhD Thesis*
- *Analysis--Statistics & Experience*
- *Conclusions...Recommendations*
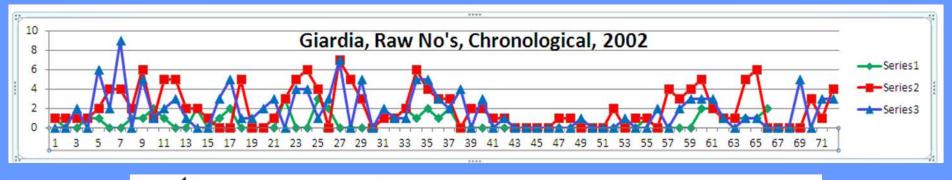
BACKGROUND
(Quoting from LT2)

- "...Purpose...to reduce disease from *Cryptosporidium* ...

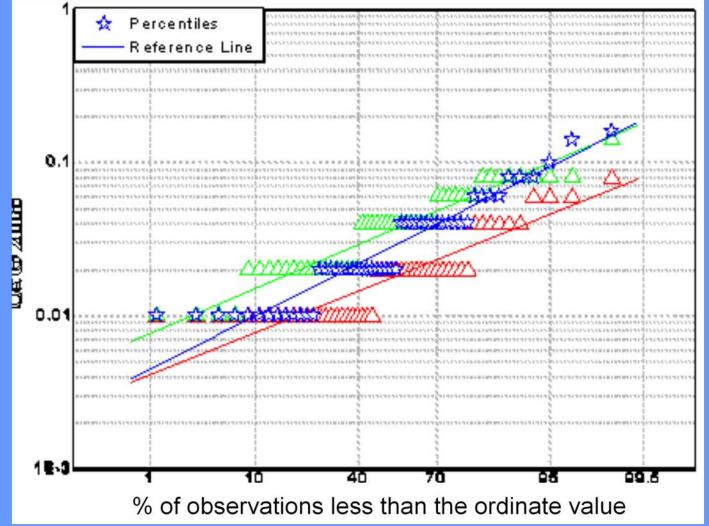- ...By...adding *Cryptosporidium*... control to higher risk systems…"

NO LONGER QUOTING

- Risk...proportional to concentration... what people are exposed to

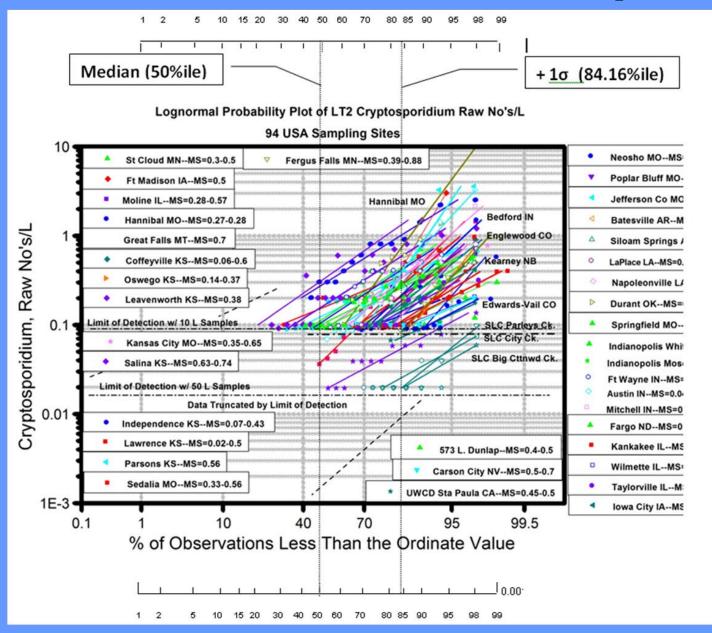- Concentration...requires measuring recovery (Matrix Spike)

Presentation of LT2 Data

- Use log-probability plots
  - Rank order data…highest to lowest
  - Number 1 to n+1
  - Plotting position is $n_i \div (n+1)$…=> % less than

Giardia, Raw No's, Chronological, 2002

% of observations less than the ordinate value

LT2--94 Site US-wide Composite

Lognormal Probability Plot of LT2 Cryptosporidium Raw No's/L
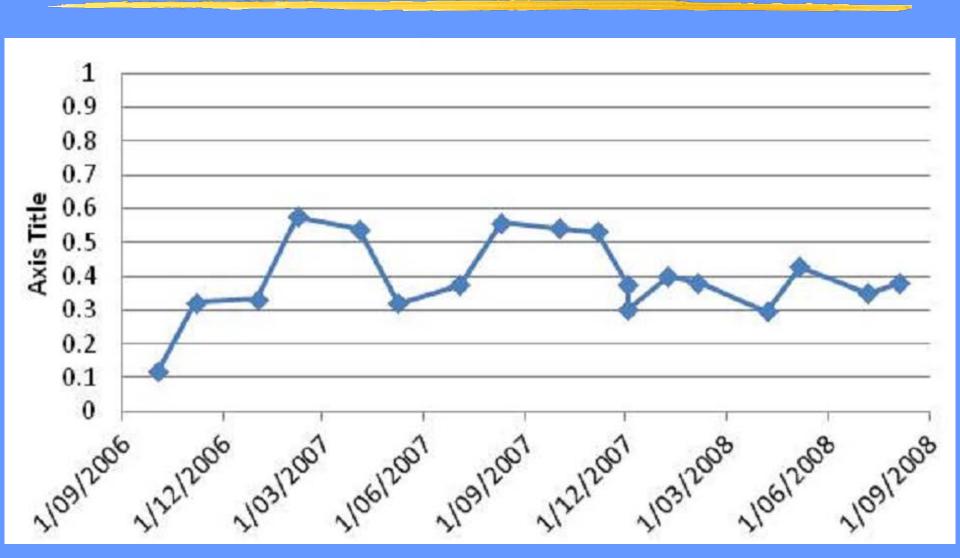
94 USA Sampling Sites

Summary

- Average Occurrence, No/L and variability (coef. of var.) define site conditions
- LT2 data cover range of Crypto occurrence & variability likely on USA surface sources
- $0.002/L <$ Median Raw Crypto/L $< 0.5/L$
- $2. <$ Coef. of Var. $< 15.$
- Occurrence & variability => Risk and differ:
  - With sample site location
  - With sample time at the same location

...CONCENTRATION ? ? ?

⌘ **The best method (1623) cannot recover all oocysts...ca. 20-50%**

⌘ **Numbers / L ≠ Concentration**
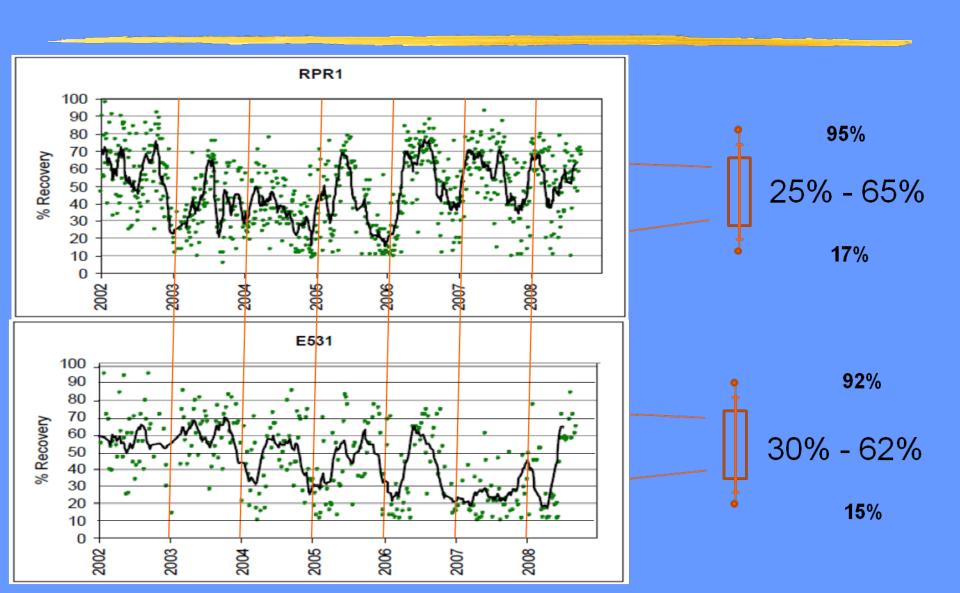
⌘ $$CONCENTRATION = \frac{ORGANISMS\ FOUND}{VOLUME \times RECOVERY\ FR.}$$

LT2 MS Data--Louisville, KY 18 MS Fraction Values

Single Site Variations

V. Whiffen, SCA Presentation--WQRA Cryptosporidium Workshop, Melbourne, 8/12/09

MS Reproducibility???

- **Matrix Spiked by Method 1623**

- **Nine sites--3 each on 3 streams**

- **Sites 1-5 miles apart**

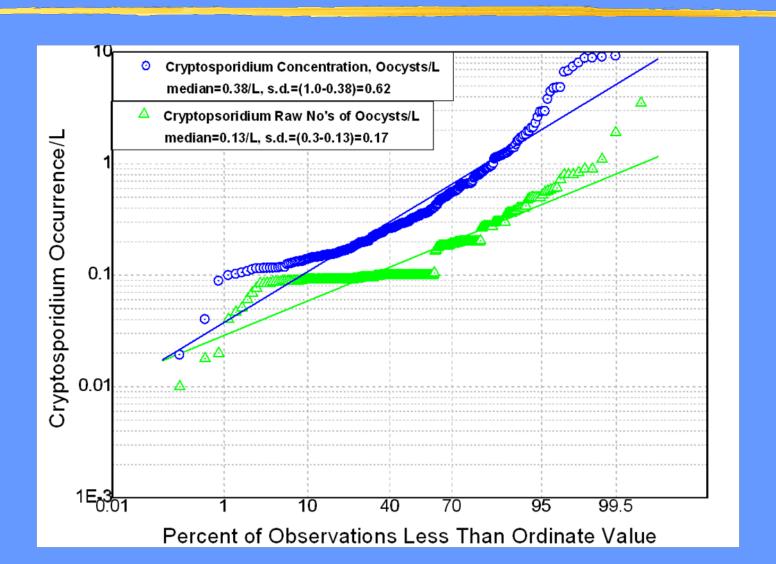- **SE Coastal New South Wales, Australia**

MS Reproducibility

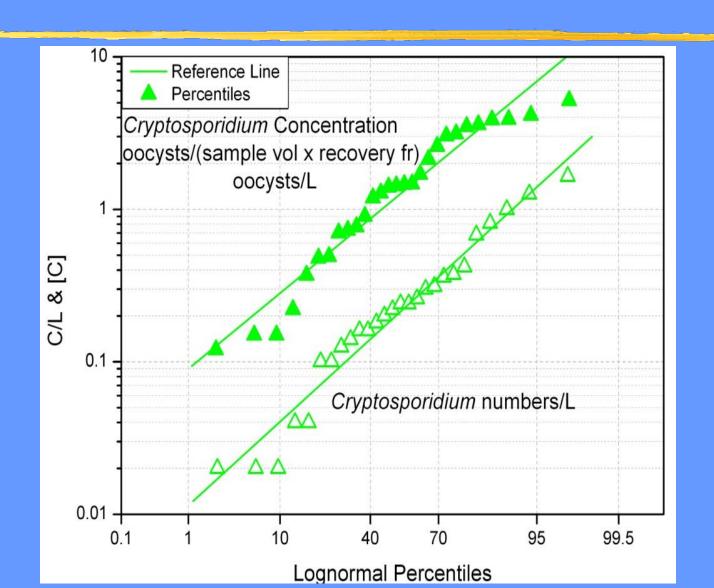| MS x3 Rep's	Cryptosporidium			Giardia		
	Avg %	Std Dev	C.V.	Avg %	Std Dev	C.V.
1	9.2	1	0.11	65.9	11.7	0.18
2	3.3	1.3	0.39	60.8	11.6	0.19
3	5.4	1.5	0.28	47.1	6.8	0.14
4	17.4	2	0.11	51	3.2	0.06
5	32	6.1	0.19	46.6	0.5	0.01
6	7.1	0.7	0.10	70.9	8.3	0.12
7	14	7.7	0.55	8.2	2.9	0.35
8	20.5	4.9	0.24	50.2	17.5	0.35
9	13.4	4.4	0.33	55.3	7.2	0.13
Avg.	13.6		0.26	50.7		0.17
Std Dev	9.2			18.9		

Numbers vs Concentration

LT2 Data:

- ❖ **5234 Samples w/ non-zero findings**

- ❖ **1577 of the 5234 are MS recoveries**

- ❖ **_319_ of MS +'s on dates w/ non-zero field's**

    …called "pairs"

- ❖ **Majority of field data: 0.1/L & 0.2/L (0.1 to 2.0)**

- ❖ **MS range: <0.1 to >0.9, Avg=0.68**

LT2 MS-Data Pairs

NSW Streams--No's vs Conc.

What Do LT2 Data Show?

- **LT2 Site by site data define the range of Cryptosporidium occurrence in the US**
- **Cryptosporidium risk depends on both Magnitude and Variability of occurrence**
- **Recovery of Cryptosporidium by 1623--**
  - **Varies with time at the same site**
  - **Differs between sites...even on same stream**
  - **Numbers & MS recovery vary independently**
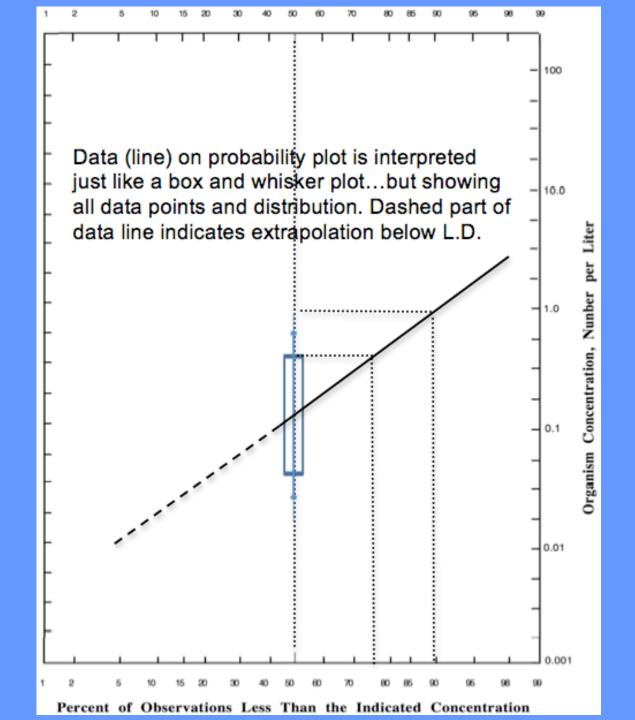- **Recovery measurements are reproducible**

CONCLUSIONS

- **Matrix spikes--an essential measure of conditions...not quality control**
- **Variations w/ time & location require consistent MS recovery measurement**
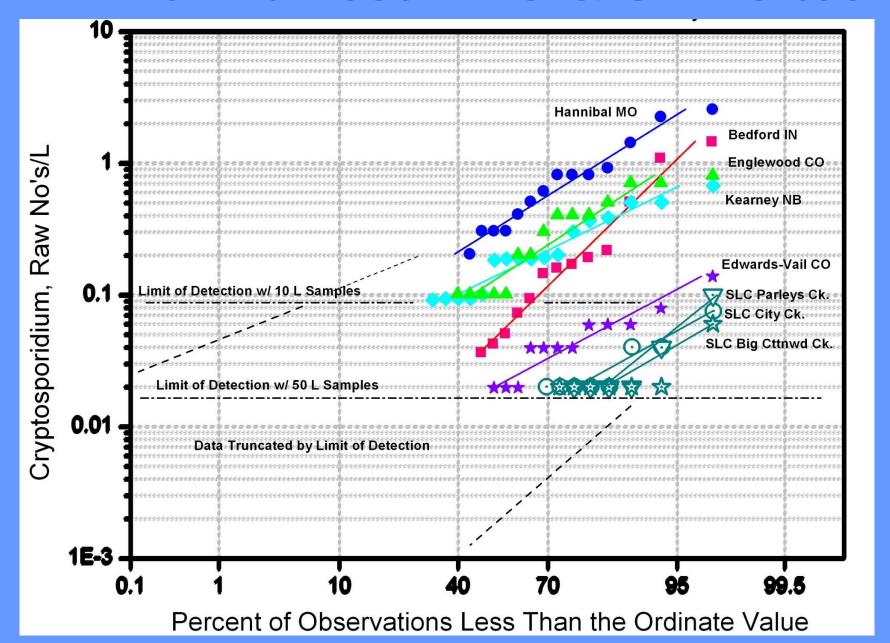
RECOMMEMDATIONS

- **MS measurement by "color-seeding" ...Practical w/o major cost increase**
- **Use larger sample volumes & MSs to give representative Crypto data by site**

QUESTIONS ???

Data (line) on probability plot is interpreted just like a box and whisker plot...but showing all data points and distribution. Dashed part of data line indicates extrapolation below L.D.

Organism Concentration, Number per Liter

Percent of Observations Less Than the Indicated Concentration

LT2--5 Midwest + CO & SLC Sites

Cryptosporidium, Raw No's/L

Percent of Observations Less Than the Ordinate Value

Hannibal MO
Bedford IN
Englewood CO
Kearney NB
Edwards-Vail CO
SLC Parleys Ck.
SLC City Ck.
SLC Big Cttnwd Ck.

Limit of Detection w/ 10 L Samples
Limit of Detection w/ 50 L Samples
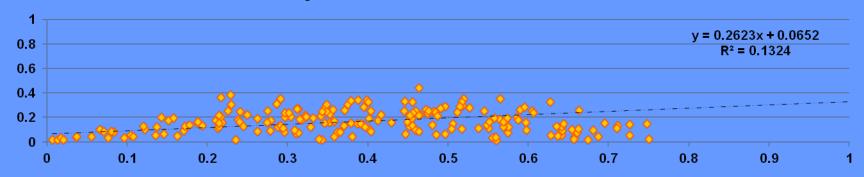Data Truncated by Limit of Detection
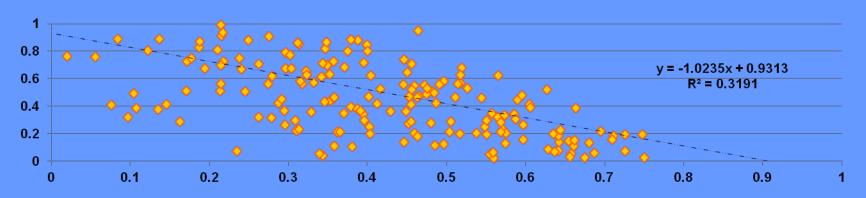
LT2 Matrix Spike Data

- **1831 Sampling Sites**

- **3370 Matrix Spike Samples**
  - ➤ **Avg=0.397 (sd=0.223, cv=56.2%)**

- **201 Sites w/ 3 or more MS's**
  - ➤ **162x3's; 30x4's; 4x5's; 1x6,7,&8; 2x9's**
  - ➤ **Avg=0.396 (sd=0.20, cv=49.2%)**

LT2 Matrix Spike Multiples

LT2 MS Multiples--SDs of Means vs Means, n=201

$y = 0.2623x + 0.0652$
$R^2 = 0.1324$

LT2 MS Multiple--cv's of Means vs Means, n=201

$y = -1.0235x + 0.9313$
$R^2 = 0.3191$

LT2 MS-Data Pairs

LT2 Paired Raw No/L vs MS Fraction (n=319)