Bacteria Holding Time and Degradation

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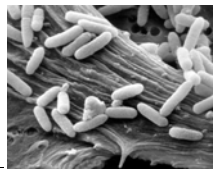
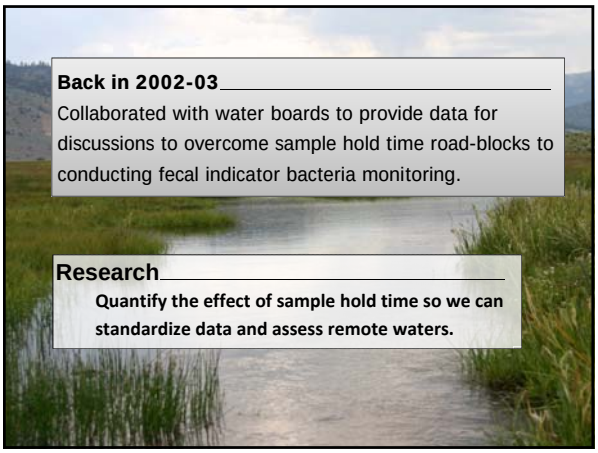


rangelandwatersheds.ucdavis.edu



Back in 2002-03

Collaborated with water boards to provide data for discussions to overcome sample hold time road-blocks to conducting fecal indicator bacteria monitoring.

Research

Quantify the effect of sample hold time so we can standardize data and assess remote waters.

Most of the State's waters are > 6 hr from a laboratory

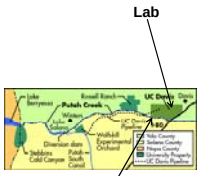
…and unless we can either control the weather or implement the 24 hour work day and outlaw weekends, they can be >24 hours from getting analyzed!

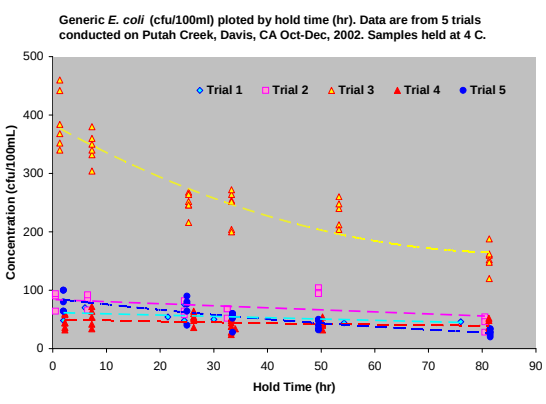
Decay Studies

- **15 streams enrolled**
- **Rangeland to Ag/Urban**
- **Joint with CVRWQCB – 5 streams, DMF & Colilert**
- **Samples analyzed <3 hr: then ~6, 12, 24, 48, 72, 96hr, 4 C**

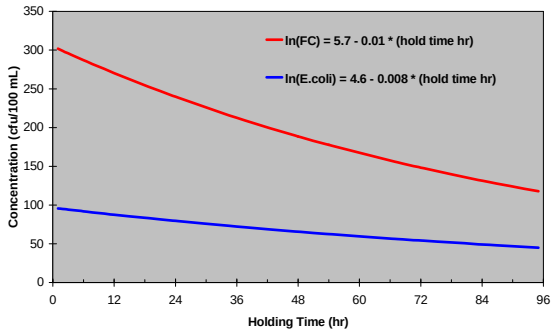
cfu/100mL = a + b * time

Putah Creek – Initial Study

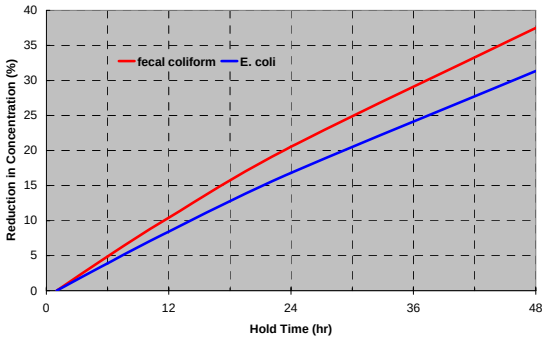




Effect (p<0.0001) of holding time at 4 C on generic *E. coli* and fecal coliform in samples from Putah Creek, Davis, CA. Samples processed within 1 hour of collection and at hold times ~6, 12, 24, 48, 72, 96 hr. Data are from 5 trials, Oct-Dec 2002.



Reduction in generic *E. coli* and fecal coliform due to hold time (hr) at 4 C. Data from 5 trials on Putah Creek, Davis, CA, Oct-Dec 2002



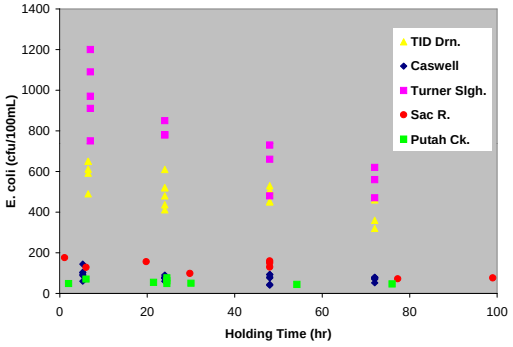
Is Putah just weird?
Other streams?
Other methods?

Joint project with CVRWQCB

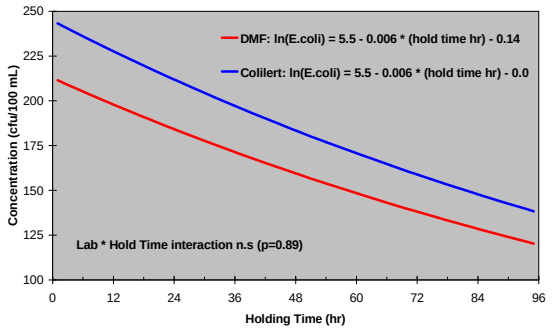
Add 4 more streams
TID, Discovery Park, Turner Slough, Putah, Caswell Park

2 methods
Direct Membrane Filtration, Colilert

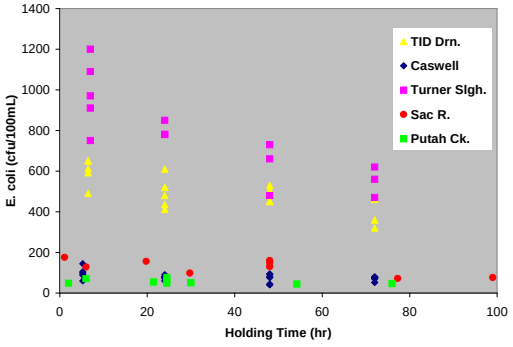
Generic *E. coli* concentration by holding time for samples from 5 streams enrolled in joint decay study between CVRWQCB and Tate Lab. Oct 2002.



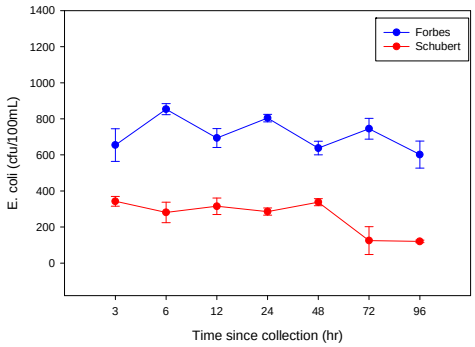
Effect (p<0.0001) of holding time at 4 C and analysis method on generic *E. coli* in samples from 5 creeks. Samples processed within 3 hour of collection and at hold times ~6, 12, 24, 48, 72, 96 hr.



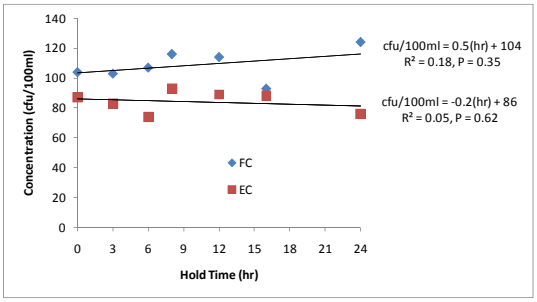
But not all samples experienced decay



Annual Rangeland Stream – no decay out to 24 hours



Stanislaus National Forest



Tate, K.W., E.R. Atwill, J.W. Bartolome, and G.A. Nader. 2006. Significant *E. coli* Attenuation by Vegetative Buffers on Annual Grasslands. J. Environmental Quality. 35:795-805.

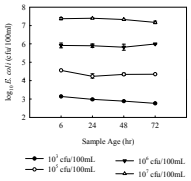
In order to adjust the *E. coli* concentration in each water sample tested *x* hours ($t=x$) after initial time of collection ($t=0$) to a single 24-hour standard ($t=24$), we first assumed the following basic model,

$$\log_{10}(EC_{t=x}) = \log_{10}(EC_{t=0}) + \beta(t=x) \quad [1]$$

whereby $\log_{10}(EC_{t=x})$ was the observed $\log_{10}$ concentration of *E. coli* determined *x* hours ($t=x$) after initial time of collection, $\log_{10}(EC_{t=0})$ was the modeled $\log_{10}$ concentration of *E. coli* at the initial time of collection ($t=0$), and $\beta(t=x)$ was the fitted decay coefficient(s) generated by the linear mixed effects model described above. $\beta(t=x)$ was allowed to be a univariate or polynomial term depending on whether the raw data signified a first or second-order time-dependent decay process for the *E. coli* concentration in our source water. The decay process was for water samples held at approximately 4 °C. Once $\beta(t=x)$ was obtained, equation (2) was used to adjust each sample to a single 24-hour standard ($t=24$),

$$EC_{t=24} = (EC_{t=x})10^{\beta(t=24-x)} \quad [2]$$

whereby $EC_{t=y}$ was the fitted or expected concentration of *E. coli* at a 24-hour standard, $EC_{t=x}$ was the observed concentration of *E. coli* determined *x* hours ($t=x$) after initial time of collection, and $10^{\beta(24-x)}$ was the expected decay coefficient adjustment factor raised to the power of 10 which allowed us to model concentrations of *E. coli* directly instead of $\log_{10}$ values.



Summary

- We can account for the decay of indicator bacteria resulting from hold time.
- Hold times out to 24 hours may have limited decay for many streams/samples.
- Will each waterbody require a unique curve? Looks like at a minimum that unique curves will be required for “types” of streams (i.e. range v. ag v. urban).