Coliforms and E. Coli in Big Chico Creek

Chico, California

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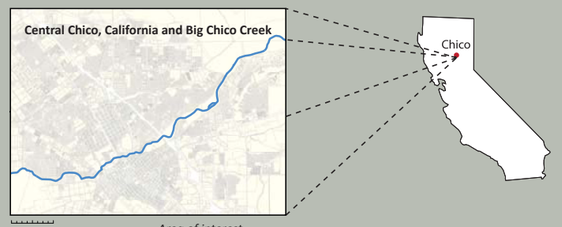
Summary

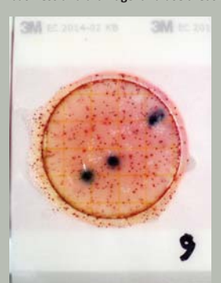
While studies that coliform and Escherichia (E. Coli) counts increase in Chico California's Big Chico Creek as it passes through the city, we were not able to find any studies that are able to explain where the high spikes of fecal coliforms are coming from by the time the creek reaches the western extent of Chico. While it seems possible that the elevated amounts of coliforms and E. coli along Big Chico Creek are caused by either pets, livestock, septic systems, homeless encampments or a combination of each, we suspected the culprit was primarily coming from the 51 city drains within a 600 foot buffer of the creek. Additionally, we wanted to see if land use had any role in elevated levels of bacterial colonies. We believed we would show a correlation between Elevated levels of coliforms and E. Coli and city drains and we thought we might be able to show a correlation between land use and the high levels of bacteria



Area of interest

Data Collection and Methods

Our data was collected using sterile test-tubes while wearing sterile gloves to prevent any cross contamination between the sample and our hands during collection, stoppers were inserted into the test-tubes with gloved hands. Afterwards, a 1 ml drop of the sample was applied to a 3M Petrifilm™ count plate with a sterile pipette. This culture was then allowed to incubate for a period of 48 hours whereupon the colonies were grown and counted. We collected on three different occasions, the first two times using 5 sampling locations. After examination of our sample data, it was determined that we needed a broader sampling set, so we doubled the amount of our sample locations. Although we elected to use 10 point sampling, the 5 point sampling data corresponded, in general, to the coliform counts with the 10 point sampling data. We then began to look at the collected biological data and compared it to city drains, parks, single and multi-family homes, right of ways, agricultural, educational, business and drainage land use areas.

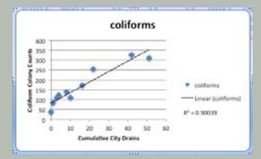


3M Petrifilm count plate (sample 9)

Site	Location	Coliform	E. Coli
1.	North eastern extent of Bidwell golf course.	38	1
2	Centennial Ave., south of the western extent of Bidwell golf course.	83	1
3	Bidwell Park, south of Salishan Ct.	109	2
4	Bidwell Park, north of El Monte Ave.	122	1
5	Bidwell Park, south east of Bryant Ave.	140	1
6	Bidwell Park, One Mile recreational pool.	109	1
7	Bidwell Park, south west of Mangrove and Vallombrosa Ave.	173	3
8	Footbridge south of Bidwell Mansion.	253	2
9	Beneath Hwy. 32 overpass.	328	4
10	Western extent of Bidwell Ave.	310	4

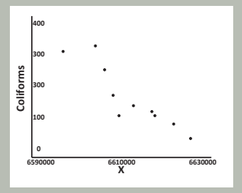
Results and Analysis

For our analysis, we ran a coefficient of determination on our data. The regression, using coliform counts and city drains, when ran in excel returned an R2 value of 0.90, E. Coli returned an R2 of 0.81, which we thought was pretty convincing, we also ran coefficients for the land use data and found a few of them also had strong positive correlations.



Regression graph showing strong positive correlation

The problem with this, we realized, was that all the data becomes skewed spatially as one moves in the direction of the flow of the creek. One could just as easily prove a strong correlation with stop signs in the west end of the city as any thing else. As shown here you can see a strong negative correlation between latitude and coliforms, when no correlation actually exists.



Scatter plot showing longitude and coliforms

So what we did was to strip out the latitude and longitude from the equation in SPSS using a partial regression, using the unstandardized residual points off the regression trend line. This resulted in the determination that there are four land use areas, right of way, parks, drainage and business/commercial that returned an R squared value of .87 and Adjust R Squared of .76, with a high degree of confidence. These areas are shown in the map below.

Conclusion

Our initial hypothesis was that we would find a strong correlation between coliform/E. coli counts and storm drains within a six hundred foot buffer. Our calculations in SPSS showed that not only is there no significant effect of the drains to the high colony counts, but that, rather unexpectedly, it was an issue of land use. Part of this isn't too surprising, as one of the land use areas is parks, where the creek is flowing for most of its tenure through the city of Chico. These area are used heavily by the citizenry, including the homeless, bathers and people who frequent the park with pets. Of particular interest to us is the drainage area (shown in pink). This is the portion of Big Chico Creek where our counts started to dramatically increase, and we are not exactly sure why. Further study of what is going on in these land use areas would need to be completed, perhaps by mapping in detail what exactly is going on in the buffer zone along Big Chico Creek.

Having said this, we cannot say at this time what is causing this issue, all we can say is which areas are likely to be the culprit for elevated levels of fecal bacteria in the creek.

Model	R	R Square	Adjusted R Square	Std. Error of The Estimate
1	.93	.86	.76	20.7

Results of the Partial Regression Method.

Sources

Analysis of coliform and fecal streptococcal bacteria in Butte Creek and Big Chico Creek Williams, Donald Robert. Chico, Calif., 1978 avail. Merriam Library, CSU Chico Thesis

Water quality management plan Big Chico Creek, Butte County, California : a preliminary assessment for urban stormwater runoff and fecal coliform contamination, by Stewart M. Oakley, Matt Lee, Brian Reed, and Mark Winter. 1997 avail. Merriam Library, CSU Chico Special Collections.

http://www.thestreamteam.org/nodes/projects/monitoring_2005_chemistry.htm

http://www.thestreamteam.org/documents/citizen_monitoring_report_2010.pdf